COMMENTS By ROBERT M NORTON

NOTES #1

Robert Norton
4200 US Highway 441 S.E.
Okeechobee, FL 34974

NOTES CULVERTS (NO LONGER USED)
ABENDMENTS
REACH # 5 AREA
C-7
~~TCC~~ TCC Taylor Creek Culvert
C-9 NOTE Also Other Areas
ACTION TAKEN TO
(A) REDUCING RISKS TO TOLERABLE LEVELS
(B) REMOVE STRUCTURE
(C) REPLACE STRUCTURES
(D) REMOVE OR fill IN CULVERTS 4 PROPOSED
SYSTEM-WIDE STRUCTURAL ALTERNATIVES

#1
REMEDIATION of Soil Contamination With AGRICULTURE INDUSTRY CHEMICALS WILL BE REQUIRED
#2 PRIMARY LAND USE IN THE LAKE OKEECHOBEE REGION IS AGRICULTURE RUN-OFF WATER

NOTES #2

#3 FISHEATING CREEK FROM THE HEADWATERS NEAR LAKE JOSEPHINE TO THE CREEK DISCHARGES UNCONTROLLED AND FLOWS SOUTH FOR 32 MILES, THEN EAST FOR 23 MILES TO DISCHARGE INTO LAKE OKEECHOBEE NO WONDER THEY CAN NOT MEET SET TMDL OF 140 NT - 40 PPB. THIS DISCHARGE UNCONTROLLED IS VERY VERY POLLUTED PEOPLE

#4 WETLANDS LAKE OKEECHOBEE AREA THOUGH GREATLY REDUCED IN AREA AND QUALITY THROUGH HUMAN IMPACT BY IMPROVED PASTURES THERE AGRICULTURE..

#5 DID YOU KNOW THAT WATER FLOWS FROM NORTH OF LAKE OKEE TO SOUTH INTO LAKE OKEECHOBEE DUE TO THE FACT WE HAVE A ELEVATION DROP OF 36 FOOT TO LAKE OKEECHOBEE S-65 TO S-65E

NOTES #3

#6 WATER QUALITY IN OKEECHOBEE IS VERY POOR DUE TO AGRICULTURE RANCH RUN-OFF. ALSO IT IS AFFECTED BY OTHER AGRICULTURE OPERATIONS. SUCH AS. CITRUS, DAIRIES, ROW CROPS SOD FARMS., TREE PLANTIONS THAT HAS RUN-OFF WATER TO OUR LAKE OKEECHOBEE.

#7 WE HAVE HORSE FARMS, PIG FARMS, CHICKEN FARMS THAT ALSO IMPACT WATER QUALITY. WE NEED TO PUT IN PLACE SOME-THING BESIDES BMP'S AS THE BMP PROGRAM IS VOLUNTARY SYSTEM, NOT ENFORCED BY LAW.

#8 THE STATES 40E-61 AND 40E-63 IS NOT ENFORCED. AS I CAN SHOW YOU WHERE CATTLE ARE, IN CONTACT WITH FLOWING WATER TO LAKE OKEECHOBEE.

NOTES #4

#9 WE NEED TO PUT MORE INTREST INTO COMPLETEING MORE THAN 50 INDIVIDUAL PROJECTS LAKE LEVELS SHOULD BE SET AT 12.5 TO 15.5 FOR LAKE OKEECHOBEE REGULATION SCHEDULE.

#10 WE NEED TO STOP SEA PLANE'S LAND AND TAKE OFF FROM LAKE OKEECHOBEE. REMEMBER LAKE OKEECHOBEE IS A CLASS #1 DRINKING WATER SUPPLY PEOPLE ONE ACCIDENT AND WE HAVE FUEL IN OUR DRINKING WATER THEY CAN PRACTICE AT SEA OR OTHER LAKES THAT ARE NOT A DRINKING WATER SUPPLY SIR

#11 A VERY GOOD IDEA ON THE INTERNAL DRAINAGE SYSTEM. I LIKE THAT THE SEEPAGE WATER IS COLLECTED, FILTERED AND SAND FILTER SYSTEM PAGE # 2-29 FIG 2-17

NOTES #5

#12 SURFACE WATER USE NEEDS TO BE PERMIT HAS TO MANY LOOP HOLES, NEED TO MORE ACTION TO CONTROL. ALSO THE GROUND WATER NEEDS MORE CONTROLS SET FOR USE AGRICULTURE OVER USE.

#13 BACK PUMPING NEEDS TO STOP AND ONLY FLOOD WATER PUMPED OUT OF LAKE NOT INTO LAKE.

#14 I AGREE WITH THE CUT-OFF WALL SYSTEM VERY GOOD.

#15 WATER QUALITY WILL BE IMPROVED IF WE FILTER AGRICULTURE RUN-OFF WATER TO LAKE OKEECHOBEE. THE STATE WILL NEVER MEET THE SET TMDL 140MT-40PPB TO LAKE OKEECHOBEE BECAUSE OF FISH EATING CREEK BEING A UNCONTROLLED DISCHARGE.

MY POINT OF VIEW YOUR

NOTES #6

BOOK I RECEIVED IS VERY GOOD A LOT OF FINE INFORMATION. AS I TRAVEL AROUND THE LAKE I SEE THE CUT-OFF WALL WORK. I AM SURE IT WILL WORK AND BE A GOOD STRUCTURAL MEASURE I ALSO LIKE FLOOD WALL AND ARMORING TO REPLACE OLD CULVERT REMOVALS. NOT IN USE ANY MORE. ANY TIME I CAN HELP YOU WITH MY PUBLIC COMMENTS PLEASE WRITE ME AS I DO NOT OWN OR OPERATE A COMPUTER AT ALL. SNAIL MAIL ONLY PLEASE.

Robert M. Norton
Veteran
4200 U.S. Hwy. 441 SE
Okeechobee, Florida 34974

Robert M Norton
ECOSYSTEM WATCH
LAKE OKEECHOBEE

Auvenshine, Stacie SAJ

From: Rudy Kronauge <rudy.kronauge@gmail.com>
Sent: Tuesday, February 23, 2016 8:57 PM
To: HHDEnvironment, SAJ
Subject: [EXTERNAL] HHDDSMS Public Comment

To Whom it May Concern,

I am writing to give public comment regarding the Herbert Hoover Dike Dam Safety Modification Study. As a Ft. Myers residence and FGCU Marine Science major, the issue of the current Lake Okeechobee water levels and the subsequent releases down the Caloosahatchee and St. Lucie rivers are of great concern to me. While I understand much of this issue has been misreported and skewed by the media, there are many legitimate concerns being buried in the process. On issue 10 in the study, the consistency statement specifically states that because the proposed project is located inland, it will have "no effect on saltwater resources either directly or indirectly through discharge downstream". This statement is in direct conflict with the common knowledge regarding rates of seagrass loss and oyster die-offs in the Ft. Myers/Sanibel area due to low salinity levels and decreased sunlight penetration due to turbidity resulting from river discharge..

Equally false is the consistency statement in issue 13, which states "this work does not involve the transportation or discharge of pollutants", when in fact it has been shown that the discharge waters do contain excess nitrogen and phosphorous from agricultural activities. Whether or not these elements are in high enough concentrations to account for any known environmental issues we have observed, they are still pollutants and therefore must be addressed.

I appreciate your time regarding this increasingly-important environmental issue in Southwest Florida. I hope that there is a solution that can be reached that benefits all parties involved. Thank you.

Sincerely,
Rudy Kronauge

Auvenshine, Stacie SAJ

From: Stephanie Palmer <sapalmer2349@eagle.fgcu.edu>
Sent: Tuesday, February 23, 2016 11:50 AM
To: HHDEnvironment, SAJ
Subject: [EXTERNAL] HHD Dam Safety Modification Study Concerns

Dear Stacie Auvenshire:

Using the rights given under NEPA, this email is to express some concerns that I have with the draft EIS regarding the Herbert Hoover Dike dam safety modification. Under the table of contents, when looking at the environmental effects, some effects do not state a TSP. Since a TSP is not mentioned for all of them, does that mean that there is no favored alternative? With regards to the dam safety, is it rated to sustain a major hurricane on the Saffir-Simpson scale?

In Appendix D, Chapter 258, State Parks and Aquatic Preserves, how can you be so sure that there will not be any impacts? And, how can you state that the chapter is not applicable, when there is definitely a possibility that there will be indirect impacts? Also, for Chapter 370 Living Saltwater Resources, it states that, “The proposed project is located inland and would have no effect on saltwater resources directly or indirectly through discharge downstream,” but how can that be true when water is shipped down C-43? For Chapter 388 Arthropod Control, what would be done if the zika virus was exposed?

Thank you for your time,

Stephanie Palmer

SEMINOLE TRIBE OF FLORIDA
TRIBAL HISTORIC PRESERVATION OFFICE
AH-TAH-THI-KI MUSEUM

TRIBAL HISTORIC
PRESERVATION OFFICE

SEMINOLE TRIBE OF FLORIDA
AH-TAH-THI-KI MUSEUM

30290 JOSIE BILLIE HWY
PMB 1004
CLEWISTON, FL 33440

PHONE: (863) 983-6549
FAX: (863) 902-1117

February 24, 2016

Colonel Jason A. Kirk, P.E., District Commander
Department of the Army, Jacksonville District Corps of Engineers
701 San Marco Boulevard
Jacksonville, Florida 32207-8175

Subject: Herbert Hoover Dike Dam Safety Modification Study, Draft Environmental Impact Statement
THPO#: 0011642

Dear Colonel Kirk,

Thank you for consulting with the Seminole Tribe of Florida's Tribal Historic Preservation Office (STOF-THPO) regarding the draft Environmental Impact Statement (DEIS) referenced above. Because the project lies within an area that is culturally and historically significant to the Tribe we feel that it is important to offer the following comments about the DEIS.

- In the section of the document entitled Environmental Consequences of the Tentatively Selected Plan (found within the documents Executive Summary) no mention is made of possible adverse effects to cultural resources (including burial resources) or Tribal resources. While we recognize that this is just a brief summary of the documents conclusions we feel that it is important to mention early on that cultural and Tribal resources were taking into consideration.

- It seems to be a standard practice in NEPA documents when describing existing conditions for cultural resources (see Section 3.18 Cultural Resources) to focus on what is currently known, that is, to focus on previously recorded sites and resources. This is reasonable since it does describe current or existing conditions but it also tends to predispose people to assume that if there aren't any known resources in an area it is unlikely that any resources exist there. Clearly this is not the case, and we caution against relying too heavily on utilizing the number of previously recorded sites within an area as predicting whether or not any unrecorded/undiscovered resources are present. We believe that additional cultural resource investigations, possibly involving field surveys, may be warranted as the overall project proceeds.

- The Seminole Tribe believes that its history in Florida predates the time frame stated in the DEIS (see page 3-14). While the federal government's recognition of the Seminole Tribe of Florida is of a relatively recent origin, the Tribe views those indigenous populations who resided in Florida 12,000 (or more) years ago as ancestors.

TRIBAL HISTORIC
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- While the U.S. Army Corps of Engineers (USACE) has consulted with the STOF about the DEIS, consultation under Section 106 of the National Historic Preservation Act has not been initiated. Also, no consultation pursuant to the USACE-STOF Burial Resources Agreement (BRA) has occurred. In order to ensure that the Tribes cultural and historical resources are adequately considered and that possible impacts are fairly assessed, the STOF THPO stands ready to meaningfully engage in Section 106 and Burial Resource consultations with the USACE.

- Related to the preceding comment: At this time the STOF THPO believes that a considerable amount of Section 106 and BRA consultation is required in order to fully assess the possible impacts of whichever Alternative is finally chosen. We note that the preferred alternative involves multiple undertakings (cutoff walls, filter and drainage blankets, armored embankments, floodwalls, etc.). Each of these construction undertakings will require consultation with the THPO and careful assessment of the nature of impacts to cultural and historical resources and how these impacts might be avoided or resolved.

- Based on the Advisory Council on Historic Preservation's position that NEPA documents cannot be finalized (i.e., no Record of Decision rendered for an EIS) before Section 106 compliance has been completed, a Memorandum of Agreement would need to be prepared and executed.

- Lastly, we respectfully request that as part of our anticipated BRA consultation, the USACE and the STOF develop "plan of action" to be implemented in the event of an accidental/unanticipated discovery of human remains.

Thank you again for contacting us. Please continue to consult with us on this project and if you have any questions feel free to contact us at any time.

With Consideration,

Paul N. Backhouse, Ph.D., RPA
Ah-Tah-Thi-Ki Museum Director and Tribal Historic Preservation Officer

cc: Kim Taplin, Tribal Liaison, USACE
Jim Shore, General Counsel, STOF
Danny Tommie, Chairman's Administrator, STOF
Anne Mullins, THPO Assistant Director, STOF

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960
February 23, 2016

Stacie Auvenshine
U.S. Army Corps of Engineers
Jacksonville District
P.O. Box 4970
Jacksonville, FL 32232-0019

SUBJ: EPA Review and Comments on the Draft Environmental Impact Statement (DEIS) Herbert Hoover Dike (HHD) Dam Safety Modification Study (DSMS); Glades, Hendry, Martin, Okeechobee, and Palm Beach Counties, FL; CEQ No.: 20150358

Dear Ms. Auvenshine:

Pursuant to Section 309 of the Clean Air Act (CAA) and Section 102(2)(C) of the National Environmental Policy Act (NEPA), the U.S. Environmental Protection Agency (EPA), Region 4 reviewed the Draft Environmental Impact Statement (DEIS) for the Herbert Hoover Dike (HHD) Dam Safety Modification Study (DSMS). The HDD, surrounding Lake Okeechobee, is currently recognized as requiring urgent repairs to minimize risks to public safety and the surrounding environment. The purpose of this letter is to provide our review and technical comments regarding the proposed project.

Alternative 3 is identified in the DEIS as the Preferred Alternative and tentatively selected plan (TSP), as well as the environmentally-preferred alternative. The TSP includes construction of risk reduction measures around the southern half of the HHD, and to limited areas in the northwest sides of the dam, in order to reduce the potential for breach-related damages to the surrounding areas and to ensure the continued safety of the surrounding communities. The construction of a cutoff wall would significantly decrease the likelihood of failure of the embankment and, therefore, reduce the likelihood of risk to surrounding areas, including economic and environmental damages from a potential breach. The objective stated in the DEIS is to identify and recommend a cost-effective alternative risk management plan (RMP) that supports the efficient reduction of risk from a breach of the HHD.

Based on the EPA's review of the project, the Preferred Alternative will result in reducing the risk of adverse impacts on surrounding communities and the environment by lowering the risk of a potential breach in the embankment. We also note that no air quality permits are required, regardless of the selected alternative, and that no wetlands would be impacted by the Preferred Alternative. The project would not impact the water quality of Lake Okeechobee. Therefore, we rated the DEIS's Preferred Alternative as Lack of Objections (LO). The enclosed Summary of Rating Definitions provides a detailed explanation of the EPA's ratings.

We recommend that updated information be included in the Final EIS (FEIS) regarding threatened and endangered species, environmental justice, and coordination activities regarding historic preservation. In addition, the EPA encourages continued government-to-government consultation with the Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida at all levels of decision-making. The FEIS should include updated information regarding consultation and coordination with the aforementioned tribes. Please see the enclosed detailed comments regarding subjects that EPA requests to be clarified in the FEIS.

We appreciate your coordination with us, and look forward to reviewing the FEIS. If you have any questions, please contact Ramona Klein McConney of my staff at 404-562-9615 or at McConney.Ramona@epa.gov.

Sincerely,

Christopher Militscher, Chief
NEPA Program Office
Resource Conservation and Restoration Division

Enclosures: EPA Review and Comments
Summary of Rating Definitions and Follow-up Action

Enclosure
EPA Review and Comments
Draft Environmental Impact Statement (DEIS)
Herbert Hoover Dike (HHD) Dam Safety Modification Study (DSMS)
Glades, Hendry, Martin, Okeechobee, and Palm Beach Counties, FL
CEQ No.: 20150358

General

The EPA concurs with the need to repair the HDD, and with the objectives of ensuring continued public safety, lowering the probability of experiencing a breach, and avoiding impacts to ecological, cultural, and aesthetic resources and the Everglades ecosystem from a potential breach. We also appreciate your efforts to minimize project impacts during construction.

Climate Change and Greenhouse Gases (GHGs)

Executive Order 13653, Climate Change Considerations (EO 13653), requires Federal agencies to review the effect of climate change on their programs. Tables 5-2–5-4 in the DEIS estimates emissions resulting from the construction of the project alternatives, including the Preferred Alternative. The DEIS also states that climate change is likely to affect water management operations of Lake Okeechobee, which is contained within the Herbert Hoover Dike. In the future, the ability of water managers to keep the lake level within the target parameters is likely to be affected because climate change could increase or decrease the frequency and magnitude of large storm events, alter the frequency and characteristics of rainfall patterns, and influence evapotranspiration from the lake and upstream basins.

The DEIS states that the effectiveness of the dike renovation efforts may be adversely impacted by potential climate change impacts associated with increased frequency and magnitude of large storm events, which could result in more extreme high lake stage events, thereby, potentially placing more stress on the dike. The lake levels are engineered and controlled and, therefore, each alternative for the rehabilitation of the embankment would not be directly affected by sea level rise. However, if storms become stronger, rehabilitation of the embankment would provide more stability for community safety and resource protection. We also note that, depending on the effects of climate change (temperature and rainfall especially), plant community structure within the littoral zone of Lake Okeechobee may change.

Recommendations: We recommend that the FEIS include discussions and analysis of reasonable alternatives and/or practicable mitigation measures to reduce project-related GHG emissions. The FEIS should make clear whether commitments have been made to ensure implementation of design or other measures to reduce Greenhouse Gas (GHG) emissions or to adapt to climate change impacts. The EPA further recommends that the Record of Decision (ROD) commits to implementation of reasonable mitigation measures that would further reduce or eliminate project-related GHG emissions.

Threatened and Endangered Species

The U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) have designated certain species of reptiles, birds, mammals, gastropods, and plants and lichens in

Glades, Hendry, and Palm Beach counties as threatened or endangered, and the DEIS notes that several of these listed species have been observed within the vicinity of the HHD.

The DEIS states that the Preferred Alternative is not likely to adversely affect the threatened and endangered species and their critical habitat in the project area, and that these species would not be directly affected by the construction of a cutoff wall or internal drainage system. However, the DEIS also states that there is a potential for disturbance to the species during construction activities, and page 5-23 describes impacts to protected species as minor and temporary.

Recommendations: The EPA defers to the Federal and the state wildlife agencies on these issues, and recommends that the FEIS provide updated information regarding coordination and consultation with these agencies regarding the protection of threatened and endangered species in the context of the proposed project. Impacts should be avoided to the maximum extent feasible, and unavoidable impacts should be mitigated.

Water Quality

The DEIS states that the Preferred Alternative would not result in impacts to wetlands. However, incidental temporary impacts may occur in association with staging or site access, and the DEIS states that these impacts would total less than half an acre. Therefore, a Section 404(b)(1) evaluation was not prepared as part of the DEIS.

Recommendations: Temporary impacts resulting from construction-related activities, such as staging or site access, should be avoided or minimized to the extent feasible.

National Pollutant Discharge Elimination System (NPDES)

Section 402(b) (2) requires that a NPDES construction activities permit be acquired for construction activities that disturb more than one acre of land. The Florida Department of Environmental Protection (FDEP) issues these permits, which would be acquired prior to initiation of construction of this project. The DEIS states that full compliance with the Clean Water Act (CWA) will be achieved with issuance of a Water Quality Certification under Section 401 from the State of Florida (page 6-1).

Recommendations: Impacts resulting from construction-related activities should be avoided or minimized to the extent feasible. The FEIS should include a listing of permits that are required for this project, and the planned schedule for these permits.

Environmental Justice (EJ)

Pursuant to Executive Order 12898, an assessment of the potential for disproportionately high and adverse health and environmental impacts was included in the DEIS. This assessment concluded that while a significant low-income population resides within the study area, this project is not expected to have disproportionately high and adverse human health or environmental impacts on minority or low income populations.

Communities may experience both benefits and burdens associated with construction. The DEIS identifies potential benefits to minority and low-income populations such as improved safety for community residents in the event of a project failure, but fails to identify potential impacts (page 6-4). In regards to project-related impacts, the EPA notes that a distinction is made between temporary construction impacts and longer-term impacts. However, the DEIS does not specify the construction period. If the construction is likely to be underway for a long period, these impacts may be considered significant for local communities.

According to the DEIS, two public scoping meetings were held in February, 2013 prior to the required public meetings in January 2016 for the proposed rehabilitation of the HHD. It is unclear what specific efforts were made to meaningfully engage minority and low-income populations within the project area throughout the decision-making process.

***Recommendations*:** The EJ analysis should include demographic data, and a summary of impacts on affected minority and low-income populations, including Native American tribes and populations that are dependent on subsistence resources. Issues regarding traffic congestion, socioeconomic impacts, noise, construction impacts and other issues that directly concern the local communities, as well as operational impacts related to these matters, should also be fully clarified in the FEIS. The EPA's EJ and mapping tool, EJSCREEN (www.epa.gov/ejscreen), utilizes standard and nationally consistent data to highlight areas that may have environmental burdens and vulnerable populations, and may assist in determining any project-specific impacts to minority and low-income populations.

The EPA encourages a comprehensive public outreach strategy. This should include, but is not limited to, targeted outreach campaigns to neighbors, informational literature, and updated websites. The FEIS might also include information about the outreach towards, and participation of, minority and low-income populations that may have limited English proficiency. In addition, a summary of any EJ comments or concerns and their resolution should be included in the FEIS. Traffic impacts and emergency preparedness measures are particular topics that should continue to be addressed and coordinated with local communities. The EPA encourages continued coordination with the communities that will be impacted by the construction of the proposed project in an effort to meaningfully involve them throughout the decision-making and construction process.

Tribal Coordination and Consultation

The DEIS states that the Seminole Tribe would probably continue to use the HHD for hunting and fishing (Section 3, Existing Conditions). The DEIS also documents previous communication with tribes regarding the proposed project. The EPA encourages continued government-to-government consultation with the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida at all levels of decision-making. The EPA works closely with both tribes on Everglades-related matters, and is committed to working with other Federal partners to prioritize the tribes' water quality and water management concerns.

Recommendations: The FEIS should include updated information regarding consultation and coordination with the tribes regarding the proposed project. Finalized decision documents should be included, if available.

National Historic Preservation Act (NHPA), Section 106

The Corps of Engineers has determined that there will be no effects to historic properties' area of potential effect (APE) if activities take place within the Federal right-of-way. In 2005, the Corps determined that the cutoff wall for Reach 1, constructed within the Federal right-of-way, would not affect the National Register of Historic Places (NRHP) eligibility of the dike, and the Florida State Historic Preservation Officer (SHPO) concurred. The DEIS provides that the remaining reaches would be expected to attain this determination and subsequent SHPO concurrence. Any actions outside of the Federal right-of-way may have the potential to affect historic properties within the APE, and further consultation with the Florida SHPO and federally-recognized tribes would be conducted in this event. The DEIS notes that consultation is ongoing with the SHPO and federally-recognized tribes (page 6-3).

Recommendations: Compliance with Section 106 of the National Historic Preservation Act (NHPA) should be documented as the project progresses. The FEIS should include an update of coordination activities with the SHPOs and tribes, along with the finalized decision documents pursuant to Section 106 of the NHPA, if available. The EPA defers to the SHPOs and tribes on these issues, and encourages continued government-to-government consultation with the Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida at all levels of decision-making.

SUMMARY OF RATING DEFINITIONS AND FOLLOW UP ACTION*

Environmental Impact of the Action

LO-Lack of Objections
The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC-Environmental Concerns
The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impacts. EPA would like to work with the lead agency to reduce these impacts.

EO-Environmental Objections
The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU-Environmentally Unsatisfactory
The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS sate, this proposal will be recommended for referral to the CEQ.

Adequacy of the Impact Statement

Category 1-Adequate
The EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collecting is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2-Insufficient Information
The draft EIS does not contain sufficient information for the EPA to fully assess the environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

Category 3-Inadequate
EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From EPA Manual 1640 Policy and Procedures for the Review of the Federal Actions Impacting the Environment

Auvenshine, Stacie SAJ

From: William Glassey <waglassey5892@eagle.fgcu.edu>
Sent: Tuesday, February 23, 2016 12:11 AM
To: HHDEnvironment, SAJ
Cc: Gable, Frank
Subject: [EXTERNAL] EIS Draft Comment

William Glassey

Feb. 23, 2012

Draft EIS Comment

I feel that the issue at hand isn't just a public safety issue, but also a water quality issue.

I believe that another option would be to dredge a canal leading to the everglades past the agricultural farmland. If the water has a way to filter out all of the sediments and nutrients through the everglades naturally then not only will there be a way to move water out of the Lake faster and keep the water levels at a more sustainable level during rainy months like Jan.2016, but one would also be able to avoid the slew of problems caused by the discharging of water through the Saint Lucy and Caloosahatchee rivers.

1. Increase Dykes and Dams to withstand Category 5 hurricanes.
    a. During the process add a system to send water south efficiently.
        i. Water moving through the everglades gives more options for water control
        ii. Won't cause algae blooms as much
        iii. Will improve relations with Naples and Port Saint Lucy areas.

As a final comment what was the Herbert Hoover Dyke and Dam system originally designed to withstand in terms of a hurricane. The levee system in Katrina was rated for Category 3 storms. I feel that Florida's should be rated for the worst storms that can be thrown at it.

Thanks for the chance to comment.

William Glassey

Auvenshine, Stacie SAJ

From: Zoe Spanbroek <zrspanbroek7129@eagle.fgcu.edu>
Sent: Sunday, February 21, 2016 8:10 PM
To: HHDEnvironment, SAJ
Cc: Gable, Frank
Subject: [EXTERNAL] public comment

US Army Corps of Engineers,

Hello, my name is Zoë Spanbroek, a student at Florida Gulf Coast University. I have recently been made aware of your draft Environmental Impact Statement for the Herbert Hoover Dike Dam Safety Modification Study. After overlooking the document, I have compiled an official public comment, which is as follows:

"While this draft EIS document is very thorough in explaining all immediate effects of the proposed HHD repairs, I would like to know more about their longevity. More specifically, what is the expected lifespan of each proposed alternative? Are these reparation plans meant to last a while or will they require constant future upkeep? Given that these repairs are being made in the interest of public safety, wouldn't it benefit the citizens being protected by the HHD if its repairs lasted a long time? (Also, doesn't the tediousness of the EIS process give further cause to create strong, long-lasting repairs that don't require constant upkeep and thus constant involvement in the EIS process?) Put succinctly, I think it might be a good idea to indicate how long you anticipate the proposed repairs are likely to last before the HHD needs to be repaired again."

Thank you for your time,

-Zoë

February 21, 2016

Stacie Auvenshine
U.S. Army Corps of Engineers Jacksonville District
P.O. Box 4970
Jacksonville, FL 32232-0019

RE: U.S. Army Corp of Engineers – Herbert Hoover Dike Draft Dam Safety Modification Study Report (DSMS) – SAI # FL201601047515C

Dear Ms. Auvenshine:

The Florida Fruit & Vegetable Association (FFVA), a non-profit, agricultural trade organization whose mission is to enhance the competitive and business environment for producing and marketing fruits, vegetables and other crops, greatly appreciates the tremendous effort and diligence put forth by the United States Army Corp of Engineers (USACE) regarding the rehabilitation of the aging Herbert Hoover Dike (HHD). As an organization that represents a myriad number of producer members that operate both around and south of Lake Okeechobee and whose livelihoods are intrinsically linked to surface water provided by the lake, we greatly appreciate the opportunity to comment on the Draft Environmental Impact Statement (EIS) for the Herbert Hoover Dike Dam Safety Modification Study (DSMS).

As stated in the report, the primary objective of the DSMS is to identify and recommend an economic solution to mitigate and reduce risk of the dam breaching. With Alternative 3 as the tentatively selected plan, I think the Corp is on the right path to accomplishing this task. What is glaringly absent, however, is any discussion pertaining to how future operations and management of Lake Okeechobee water levels could be affected by the identified and anticipated dike repairs. The current Lake Okeechobee Regulation Schedule (LORS) 2008 is innately tethered to the state and integrity of HHD. We are currently in the midst of an unprecedented wet "dry" season where every option regarding water storage is being thoroughly examined in hopes that additional lake water won't have to be discharged east and west to the St. Lucie and Caloosahatchee estuaries. Ironically, we will inevitably again face drought conditions in the near future where the lake's water will be concurrently and desperately sought after for public supply, agriculture and environmental benefit for the estuaries, the storm water treatment and water conservation areas, the Everglades and for the lake itself. It is imperative that we at least begin the discussion of how the recommendations proposed within the DSMS might translate to potential modifications of LORS 2008. To expedite this process without being hindered by another evaluation study, the DSMS needs to broach the subject and identify a range of lake levels that might be realistic with the completion of the proposed dike remediation projects.

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Again, FFVA supports the USACE's efforts in addressing the integrity of HHD to mitigate risk of a breach. While ensuring public health and safety is, rightly, the focus of this study, it is also paramount that we move forward prudently and simultaneously consider how the LORS 2008 could be beneficially modified as a result of the proposed remediation of HHD. With Lake Okeechobee, we find ourselves in the constant struggle between balancing public safety, water supply and environmental benefit. At the very least, the inclusion of a discussion in the DSMS offering guidance on how the dike repairs could possibly impact revised lake stages certainly seems salient. This will help expedite the process for the much needed review and reevaluation of the LORS without being burdened and mired by another prolonged study. If you have any comments or concerns, please don't hesitate to contact me.

Sincerely,

Florida Fruit & Vegetable Association

Kerry B. Kates, P.E.
Director of Water and Natural Resources

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To Whom It May Concern:

The purpose of this letter is to post public comment on the Herbert Hoover Dike rehabilitation project. As a concerned citizen, student and after going over the draft EIS, I've come to raise a few issues regarding the HHD rehabilitation project. I agree that the one of the primary purposes of the project should be to ensure public safety, as we don't want a reoccurrence of what has happened in the past. Although one issue I find to be pressing is to what standard the levee and HHD will be built to withstand on the Saffir-Simpson hurricane scale. Louisiana was decimated years ago because of a failed levee systems, and at that time theirs was only built to withstand a level 3 Hurricane, which proved devastating. In regards to public safety, to what degree on the Saffir-Simpson scale will the revitalized HHD and levees be built to withstand. With hurricane intensity on the rise and frequency staying roughly the same, it's important if infrastructure revitalization is taking place that we must take all available precautions to prepare for fiercer storms by building to higher standards.

Another issue with the HHD project is one of water quality. As a resident of Southwest Florida I find it to be of pivotal importance to alleviate the amount of water leaving Lake Okeechobee to the east and west, which are creating havoc on both the environment as well as economy because of polluted waters. Although the primary purpose of the remediation of the HHD is to ensure public safety, it is also their objective to reduce ecological impacts and aesthetic impacts, which both impact tourism and the economy. I believe that the HHD rehabilitation project should take into consideration an alternative route south through the EAA that may also play a role in the Everglades Restoration project. By facilitating more water south from Lake Okeechobee and into the Everglades, restoring sheet water flow as a means to filter out pollutants before reaching Everglades National Park is also a critical issue that needs to be addressed and an action that needs to be taken to ensure the health and wellbeing of our estuaries, and overall water quality of Southwest Florida.

Concerned Citizen and Student,

Logan M. Crawford

DEAR STACIE

ON THE FOLLOWING MATERIAL OF PAGES YOU WILL FIND. MY PUBLIC IN-PUT OR MY PUBLIC-COMMENT OR MY POINT OF VIEWS. I SEND YOU THE PAGES, FROM THIS REPORT, THAT I WAS INTRESTED IN. I HAVE BEEN ACTIVE ON ALL OF OUR WATER PROBLEMS WE FACE.

SOME OF THE MANY PEOPLE I HAVE MADE CONTACT ARE. EPA - FDEP - FDACS - SFWMD - SWIM - USACE -. EVER SINCE YEAR 1989 I HAVE BEEN ACTIVE WITH SFWMD. TO IMPROVE WATER QUALITY AND TO STOP AGRICULTURE RUN-OFF WATER. BUT THIS POINT IN TIME SOME 27 YEARS LATER I STILL DO NOT SEE WATER QUALITY IMPROVEMET.

THE STATE SET A TMDL OF 140-40 PPB TO LAKE OKEECHOBEE, IT WAS TO BE IN COMPLIANCE BY JUNE 2001 YEAR 2015. THEY DID NOT MAKE COMPLIANCE. 2015. THEY DO NOT ENFORCE 40E-61 OR 40E-63. THE STATE DOES NOT SEEM TO CARE AT ALL, WHAT A WASTE OF TAX DOLLARS ON PEOPLE WHO DO NOT DO THEIR JOBS.

BMP'S AND BMAP PEOPLE DO NOT SEEM TO WANT TO ENFORCE ACTION TO CLEAN-UP WATER. BMP'S MUST NOT BE VOLUNTARY SYSTEMS BUT NEED TO BE ENFORCED, COWBOYS DO NOT VOLUNTEER FOR

ANY THING EVEN I KNOW THIS. EVEN AT TODAYS DATE, I SEE CATTLE IN CONTACT WITH FLOWING WATER TO LAKE OKEECHOBEE. ALL ALONG THE RIM CANALS, I SEE PASTURE RUN-OFF WATER GOING INTO RIM CANALS ALL ALONG 441 AND STATE ROADS 78, 70E-61 AND 70E-63 VIOLATIONS.

SO MUCH FOR ME AND YOUR PROBLEMS MAYBE AT SOME POINT WE WILL SEE SOMEONE WAKE-UP.

NOTE SOME OF THE REAL PEOPLE

Robert M Norton
ECOSYSTEM WATCH
LAKE OKEECHOBEE

Robert M. Norton
Veteran
4200 U.S. Hwy. 441 SE
Okeechobee, Florida 34974

GREEN BERET FOUNDATION

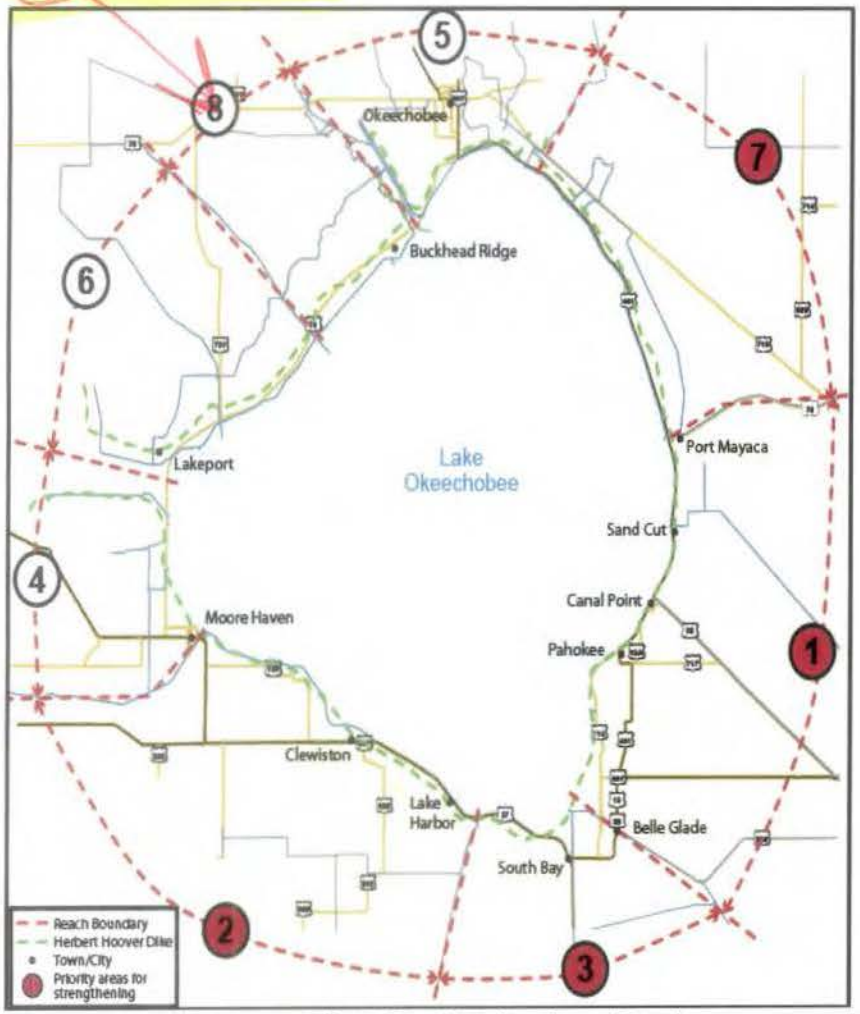

Figure 1-2. Herbert Hoover Dike Original Designation of Reaches

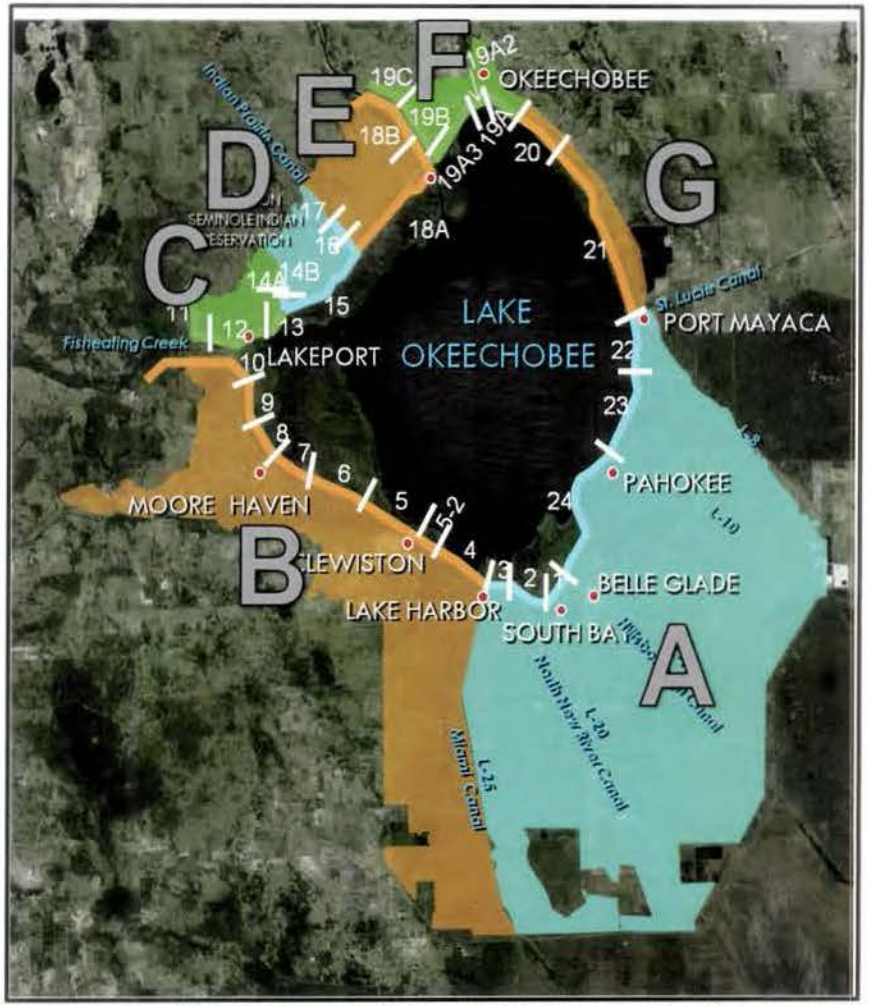

Figure 1-3. Common Inundation Zones with Segments for HHD

(X) PROBLEM AREA = TO FAR NORTH OF TO CAUSE ANY PROBLEMS.
NOTE - REMEMBER ALL WATER FLOWS TO THE SOUTH & 36 FT ELEVACTION DROP TO LAKE OKEECHOBEE THRU S-65 LOCKS.

1.2 PROJECT NEED AND OPPORTUNITY

Since the early 1980s, the Corps and independent technical reviewers have studied and documented the potential for catastrophic failure of the HHD during high water stages, particularly in CIZ A. The primary causes for concern are seepage and piping. Seepage occurs when water travels from the lake through the foundation and embankment of the dike. The seepage can carry material (mostly sands) with it, eventually eroding a water flow path through the HHD embankment and foundation. This causes a damaging mechanism of internal erosion or piping through the embankment or foundation. Underground seepage and internal erosion are made possible by the permeable nature of the materials of which the dike is constructed, including sand, gravel, shell, and limestone, and by the variable geology comprising the foundation of the dike system.

There are three phases of the piping erosion process: initiation, continuation and progression. Piping typically initiates at the toe or in the ditch at the toe of the HHD embankment (also referred to as the toe ditch) and is the point at which the seepage flows first become sufficient to erode the surface soils at the toe. In the continuation phase, the seepage flows are sufficientto continue erosion up-gradient toward the water source where erodible materials in the embankment or foundation are continuous and not interrupted by less erodible layers. In the erosion progression phase of piping, the seepage volumes and erosion increase, and layers within the embankment or foundation acts like a roof that allows the pipe to progress toward the lake. The final stage of the piping process results in an open conduit ("pipe") between the lake and landside toe that can rapidly cause a breach of the embankment (**Figure 1-4**).

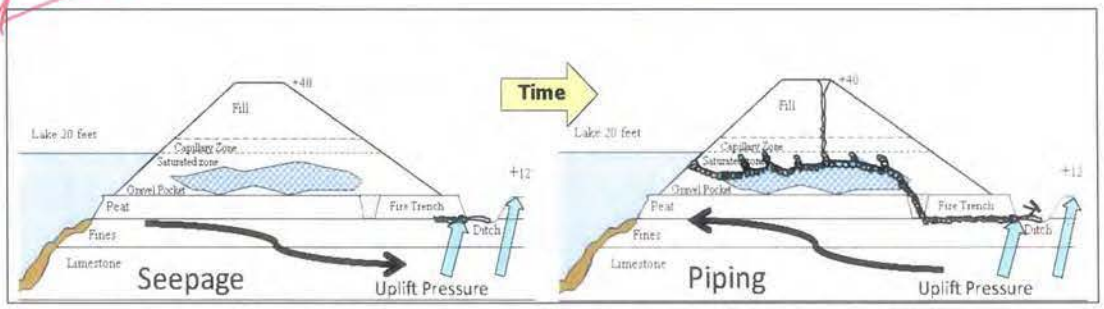

Figure 1-4. Dike Failure Cross-Section Depicting Seepage and Piping.

Symptoms of serious seepage and piping include sand boils--concentrated vertical discharge of water mixed with sand on the landside of the dike, and/or horizontal discharge of seepage with deltas of sand being deposited around the discharge location. Piping can create tunnels and cavities, causing instability and sinkholes on the dike. Seepage and piping are the failure modes of greatest concern due to the high potential for their occurrence and evidence of this failure mode was observedduring past high water events (sinkholes, sand boils, and deltas of sand deposited in the landside toe ditch observed during high water events are evidence that the piping process has initiated or could initiate at slightly higher lake levels in some areas).

Water managers are unable to maintain safe water levels following sustained high rainfall events or water patterns because the outlet capacity to release lake water is limited. The outlet capacity (released via the St. Lucie and Caloosahatchee canals) is about one-sixth of the potential inflow capacity (USACE 2007b).

b. Effect of existing and proposed outlets on lake levels during the floods of record, 100-year flood, and standard project flood.
c. Height of levees required to protect developed areas from wind tides, waves, and wave run up which could be expected if a major hurricane should occur.

The plan of improvement included construction of levees on the northwest and northeast shores of Lake Okeechobee and raising of existing levees. It was recommended that the design of project works be based on the following hydraulic conditions: probable maximum hurricane on a 17.5-ft pool, standard project hurricane on a 21.6-ft pool (the 30-day average 100-year flood stage at that time), and moderate hurricane on a 23.5-ft pool (the 30-day average Standard Project Flood stage at that time). All elevations are in the National Geodetic Vertical Datum 29 (NGVD 29) throughout this report unless otherwise noted.

1.6 LAKE OKEECHOBEE REGULATION SCHEDULES

NOTE - A VERY GOOD LEVEL HERE

Regulation of Lake Okeechobee from the early 1900s up through the authorization of the Central and Southern Florida Project (C&SF) in 1948 attempted to maintain the lake at water levels between elevation 12.56 to 15.56 ft., NGVD29 (11.26 to 14.26 ft., NAVD88). The 1948 C&SF project authorization did not specify what lake regulation schedule should be adopted. As agricultural development south of the lake and population growth along Florida's southeast coast burgeoned in the 1950s and 1960s, an increased reliance and draw on the lake for water supply encouraged water managers and decision makers to attempt to store more water in the lake by raising the lake regulation schedule. Incorporating additional hurricane studies and the effects of wind setup/wave run-up, design, and construction of the full-height HHD in the 1960s also influenced the decision to increase the water levels in Lake Okeechobee with a revised lake regulation schedule. In 1974, the regulation schedule was increased with operating ranges between 14.5 to 16 ft., NGVD29 (13.2 to 14.7 ft., NAVD88) and then again in 1978, with operating ranges between 15.5 to 17.5 ft., NGVD29 (14.2 to 16.2 ft., NAVD88). The RUN25 and Water Supply and Environmental (WSE) lake regulation schedules were implemented in 1994 and 2000, respectively, with the WSE formally incorporating forecast information such as tributary inflows and climate outlooks into the lake management process. The top of the flood storage pool varied between 17 ft., NGVD29 (15.7 ft., NAVD88) up to 18.5 ft., NGVD29 (17.2 ft., NAVD88) for both the RUN25 and WSE lake regulation schedules.

The current regulation schedule implemented in April, 2008 is called the Lake Okeechobee Regulation Schedule (LORS). Lake regulation schedules influence the stage-duration on the lake which has the most effect on antecedent lake stages prior to episodic flood events. One purpose of LORS implementation was as an interim HHD risk-reduction measure by attempting to maintain lower lake levels. LORS attempts to limit maximum stages on Lake Okeechobee to elevation 17.25 ft., NGVD29 (15.95 ft., NAVD88) as opposed to previous schedules which limited maximum stages to 18.5 ft., NGVD29 (17.2 ft., NAVD88). ANY THING ABOVE 15.5 MUST BE LOOKED AT HAZARD 15.5 TO 16.5 PROBLEM

A variety of lake regulation schedules have been utilized on Lake Okeechobee since authorization of the C&SF project in 1948. These regulation schedules have been summarized within Appendix B.

1.7 HHD ENVIRONMENTAL AND RELATED DOCUMENTS

Since 1999, numerous engineering designs and interim risk reduction measures have been proposed for rehabilitating the dike in Reaches 1, 2, and 3. Each one has been accompanied by

an Environmental Assessment (EA) or an EIS. **Table 1-1** provides a summary of all NEPA documents that have been prepared for the HHD project. Each of the actions described in the NEPA documents have independent utility.

Table 1-1. Previous NEPA Documents for HHD Rehabilitation.

Type	Project	Title	Recommended Action	Decision
Draft EIS	Reach 1	Draft EIS for the Major Rehabilitation Report, HHD, Reach 1 (USACE, 2000)	Installation of a seepage berm with relief trench along the landward toe of the embankment.	Approved in 2000 contingent on economic revisions
Final EIS	Reach 1	Final EIS for the HHD Major Rehabilitation Report, Reach 1 (USACE, 2005)	Installation of a seepage cutoff wall on the landward side of the dike slope and a relief trench and relief berm at the toe of the dike, all within the current right of way.	Record of Decision signed on September 23, 2005
Draft EIS	Reaches 2 and 3	Draft EIS for the Major Rehabilitation Report, Phase 1, HHD Reaches 2 and 3 (USACE, 2006)	Installation of a partial cutoff wall at crest of dike and construction of a seepage berm within existing right of way	Cancelled by Notice in Federal Register (78 FR 8119) February 5, 2013
EA	Reaches 1, 2, and 3	EA of Modified Design in Reach 1 and Priority Toe Ditch Repairs in Reaches 1, 2, and 3 (USACE, 2007c)	(1) Installation of a cutoff wall at crest of dike, a partial seepage berm within existing right of way, and a drainage swale at toe of berm. (2) Backfill toe ditch for immediate repairs in the most critical areas. This document only assessed impacts within the existing right of way. A future NEPA document would assess impacts of the full seepage berm, which would extend outside of the existing right of way.	Finding of No Significant Impact, January 12, 2007
EA	Reach 1 and Sub-reach 1A	EA of Reach 1 Seepage Berm and Reach 1A Test Cutoff Wall (USACE, 2007e)	Installation of a demonstration cutoff wall at the crest of the dike in Reach 1A and a partial seepage berm within the existing right of way. A future NEPA document would assess impacts of the full seepage berm.	Finding of No Significant Impact, May 3, 2007
EA	Reach 1 and Sub-reaches 1B, C, and D	EA of Reach 1 Cutoff Wall with Addendum (Quarry) (USACE, 2008a)	Installation of a cutoff wall at crest of dike in Reach 1B, C, & D.	Finding of No Significant Impact, February 11, 2008

Type	Project	Title	Recommended Action	Decision
EA	Reaches 1 and 2	EA for Partial Reach 1 and 2 Ditch Backfill and Culvert 14 Removal (USACE, 2008b)	In Reach 1, assesses the impacts of removing Culvert 14 and filling the toe ditch in Focus Areas 1 and 6. In Reach 2, assesses impacts of filling in 9.5 acres of toe ditch.	Finding of No Significant Impact, August 28, 2008
Draft Supple-mental EIS	Reach 1A	Draft Supplemental EIS for the Major Rehabilitation Project, HHD Reach 1A (USACE, 2010)	Installation of a seepage berm, drainage swale, and relief wells outside of the existing right of way. Removal of Culvert 11 and replacement of Culvert 16.	Cancelled by Notice in Federal Register (78 FR 8118) February 5, 2013
EA	HHD Federal Culverts	EA for HHD Culvert Replacement and Removal	Replacement of 28 Federal culverts and removal of 4 Federal culverts.	Finding of No Significant Impact, May 13, 2011
EA	HHD Pilot Test	EA for HHD Alternative Rehabilitation Plan Pilot Test	To perform a pilot test to determine constructability and efficacy of alternative seepage collection systems and comparison to cutoff wall currently installed in Reach 1.	Finding of No Significant Impact, February 7, 2012
EA	Reach 3	EA for HHD Supplemental Major Rehabilitation Report	To perform maintenance on an existing Federal project and construction would occur within the Federal right of way.	Finding of No Significant Impact, June 15, 2015

NOTE - REMOVE ALL UNUSED CULVERTS

1.8 RELATED PROJECTS

Comprehensive Everglades Restoration Plan (CERP), April 1999

The $10.9 billion CERP takes a watershed approach that builds upon and works with other state and Federal efforts to revitalize the wetlands, lakes, bays, and estuaries of south Florida. Considered the largest environmental restoration program in history, CERP is largely based upon a series of projects that would address four major characteristics of freshwater flow: quantity, quality, timing, and distribution.

The complex, multi-year undertaking has two distinct levels of activity:

- Program-level coordination fosters productive working relationships and understanding among the various Federal, state, local, tribal, and stakeholder partners involved in CERP implementation. In addition, other key activities that span the life of CERP include ongoing efforts such as data collection, computer modeling, studying the response of the natural environment to CERP activities, addressing recreational opportunities, and science, outreach, and economic issues.
- Project-level activities are the land acquisition, planning, designing, and constructing of more than 50 individual projects.

GO FORWARD

Once fully implemented, CERP would allow water deliveries and overland flow to follow patterns that are more natural throughout the south Florida ecosystem. The CERP reservoirs would store excess water from Lake Okeechobee, receive flood control releases that would otherwise go to the estuaries, and collect stormwater runoff from developed areas. The stored water would then improve high and low water levels in Lake Okeechobee; help meet environmental targets in the estuaries, Everglades, and other natural areas; and supplement urban and agricultural water supply. The integrity of the HHD could affect future lake levels and Lake Okeechobee's ability to store water for Everglades restoration.

Final Supplemental EIS on Lake Okeechobee Regulation Schedule (LORS), Lake Okeechobee, Florida, 2008

The LORS was approved by the Corps on April 28, 2008. This regulation schedule represents the best balance of project goals, including improving the environmental health of certain major ecosystems while providing for public health and safety. High lake stages approved under the previous schedule, called the Water Supply and Environment schedule, threatened the integrity of the HHD in its current condition. To avoid stressing the HHD when lake stages are high, large volumes of lake water have been released to Lake Okeechobee's two major outlets, the St. Lucie and Caloosahatchee estuaries, contributing to adverse effects in these ecosystems. Extended periods of high water levels in Lake Okeechobee have also resulted in significant losses of valuable habitat in Lake Okeechobee's littoral zone and marsh communities, including habitat for the endangered Everglade snail kite (*Rostrhamus sociabilis*). The LORS allows for quick response and operational flexibility to changing lake conditions and tributary inflows. The schedule improves the rates of flow to the coastal estuaries by allowing low rates of flow to begin earlier as the lake rises, which in turn helps reduce the need for higher flows later in the year. The LORS also improves the environmental health of Lake Okeechobee by reducing the frequency and duration of high lake elevations that affect Lake Okeechobee's shore zones and HHD stability.

South Florida Water Management District (SFWMD) Restoration Strategies Project

The SFWMD is required to meet a numeric discharge limit, referred to as the WQBEL, which is contained in the National Pollutant Discharge Elimination System (NPDES) permit for discharges from the stormwater treatment areas (STAs) into the ENP. The WQBEL was developed to assure that such discharges do not cause or contribute to exceedances of the 10 parts per billion (ppb) total phosphorus (TP) criterion (expressed as a long-term geometric mean [LTGM]) established under 62-302.540, Florida Administrative Code (F.A.C.). The TP criterion is measured at a network of stations across the ENP marsh and is intended to prevent imbalances of aquatic flora and fauna. The WQBEL is measured at the discharge points from each STA and requires that the total phosphorus concentration in STA discharges shall not exceed: 1) 13 ppb as an annual flow weighted mean in more than three out of five water years on a rolling basis; and 2) 19 ppb as an annual flow-weighted mean in any water year. Excess phosphorus discharged into the ENP has caused ecological impacts within the Everglades.

To address water quality concerns associated with existing flows to the ENP, the SFWMD, FDEP, and USEPA engaged in technical discussions starting in 2010. The primary objectives were to establish a WQBEL that would achieve compliance with the State of Florida's numeric phosphorus criterion in the ENP and to identify a suite of additional water quality projects to work in conjunction with the existing Everglades STAs to meet the WQBEL. Based on this collaborative effort, a suite of projects has been identified that would achieve the WQBEL. The Restoration Strategies Regional Water Quality Final Plan (SFWMD 2012) describes those resulting projects and

Table 2-1. Common Inundation Zones (Zone) and Segments with HHD Reaches.

Zone	Segment	Reach
A	22, 23, 24, 1, 2, 3	1, 3
B	4, 5, 5-2, 6, 7,8, 9, 10	2, 4
C	11, 12, 13, 14A	6
D	14B, 15, 16	6
E	17, 18A, 18A-2, 18B	8
F	19A, 19A2, 19A3, 19B, 19C	5
G	20, 21	7

2.3 ALTERNATIVES

An initial array of alternatives was established by combining retained management measures with the intent of meeting three overarching concepts established for plan formulation:

I. System-wide structural solutions to reduce loading on the dike
II. System-wide solutions that are non-structural in nature
III. Structural and non-structural solutions at the segment level

The initial array of alternatives includes the five required alternatives specified in Engineering Regulation (ER) 1110-2-1156. Additional plans were developed to ensure that economically, socially, and environmentally justified alternatives were identified. The required alternatives include the following:

- No Action
- Reducing risks to tolerable levels and meeting applicable essential USACE guidelines (To meet USACE essential guidelines means to correct for all deficiencies from current state of the practice design guidance in the areas recommended for remediation.)
- Reducing risks to tolerable levels
- Remove Structures
- Replace Structures

NOTE - REMOVE ANY STRUCTURE OR CULVERT NOT USED ANY MORE

Figure 2-3 displays the initial suite of alternatives considered for remediating HHD. The alternatives shaded in green represent the five required plans and the alternatives shaded in white were additional alternatives identified.

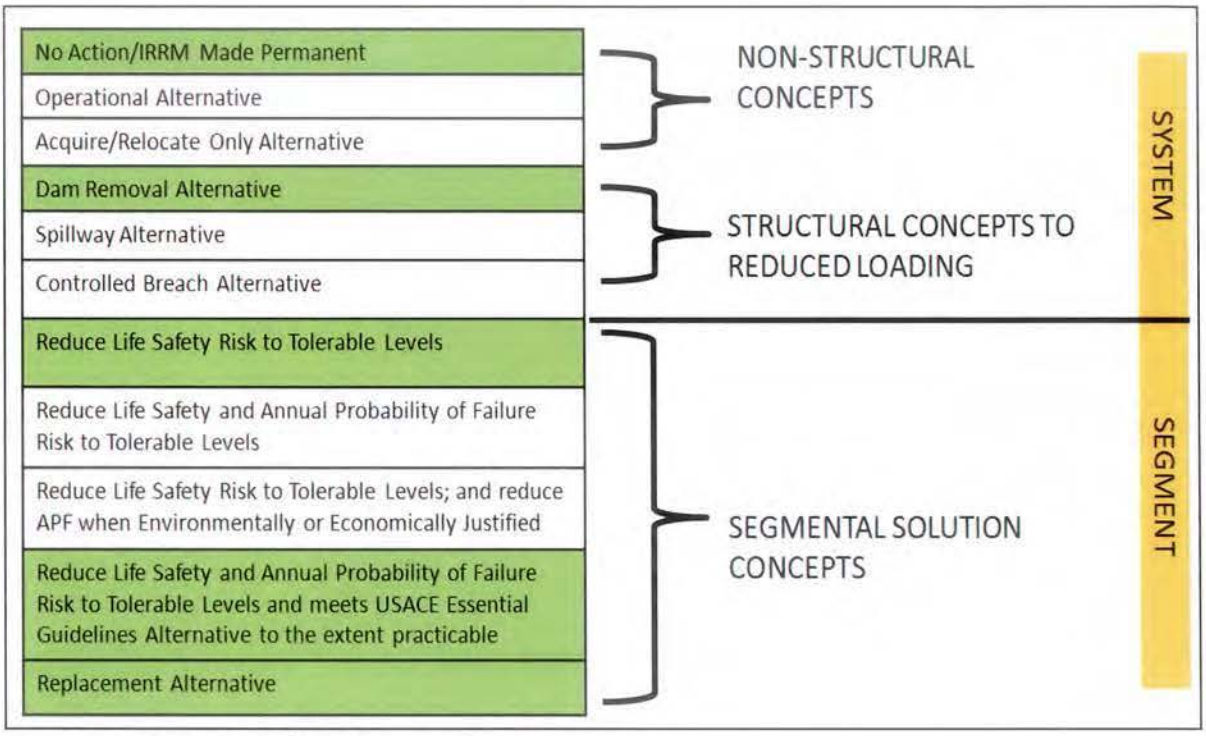

Figure 2-3. Overview of Initial Array of Alternatives

2.3.1 No Action Alternative

Evaluation of the No Action Alternative, also known as the future without project condition, is a requirement of NEPA regulations. The No Action Alternative is defined as not taking actions to improve the existing system. This alternative assumes the lake is operated according to the current regulation schedule (Lake Okeechobee Regulation Schedule, LORS 2008). The schedule is intended to contain the lake stage within a band that best satisfies the C&SF Project flood damage reduction, water supply, navigation, and environmental objectives, while reducing the likelihood of a lake stage that could cause dam failure. The baseline risk assessment demonstrated that, even with the loading restrictions imposed by the current regulation schedule, the existing risk is still well above tolerable risk guidelines. This plan offers no opportunity to restore authorized project benefits or reduce risk to tolerable levels.

Without improvements to the HHD embankment, the safety of the surrounding human and natural environment may be severely impacted with subsequent effects upon the local and regional economies. The No Action Alternative does not provide a long-term solution to the potential for internal erosion throughout the system. Under this alternative, the continued occurrence of seepage and piping would increase the likelihood of a dike failure. The term "dike failure" implies a catastrophic breaching of some portion of the HHD system. This would result in widespread flooding as waters from Lake Okeechobee pass through the breach and onto adjacent lands. A failure could be initiated by the continuous uncontrolled seepage of water from one side of the dike to the other. If seepage increases to a rate that displaces material from the dike or its foundation, piping could eventually create large voids through the dike embankment or foundation. If the voids become large enough, the dike would weaken, and sections of the embankment could collapse. Such a collapse would reduce the embankment crest elevation in

the immediate area to a point where lake water would overtop the dike. At that point, lake water flowing through the breach would be uncontrollable, levee erosion would continue, and adjacent areas would flood. In the event of a total breach, significant impacts to human life, wildlife, agriculture, property, vegetation, and water resources would result. The No Action Alternative would not provide an acceptable level of flood risk management for nearby communities. Additional expectations in the future without project condition include: limited changes in land use and structure inventories, enhanced warning systems as a local responsibility, greater public awareness and education, and more effective evacuation planning. The No Action alternative is retained for further analysis in this DSMS and used as a baseline of comparison among the other alternatives.

THAT IS THE PROBLEM NO ACTION TO MEET TMDL TO LAKE OKEE

2.3.2 System-Wide Structural Alternatives

Three of the following system-wide structural alternatives focus on reducing the loading on the dike. The fourth system-wide alternative does not change the loading, but includes a complete replacement of the entire dam that would meet current USACE standards for embankment dams.

2.3.2.1 Dam Removal Alternative

This alternative includes removal of some portion(s) of the dike, or water control structures, such that the dike no longer retains a permanently impounded pool. Because the dike and its associated water control structures are integral components of the C&SF Project, this plan would require deauthorization of major portions of the C&SF Project. Without the dike, major portions of the C&SF Project cannot function as intended. According to the FY14 Corps Annual Civil Works Budget, the C&SF project produces over $225M in annual flood risk management benefits. The majority of that benefit is derived from lake stages above the 100-year storm event stage. As little as 20% of these benefits would still accrue, primarily from C&SF project components north of the lake, in the absence of the dike.

Based on analysis performed to route inflow volume that would result in a lake stage of 24.5 feet (the maximum inflow volume that would need to be passed to reduce both annual probability of failure and societal risk estimates to tolerable levels), the dam removal alternative includes the degradation of a 1.0 mile portion of the dam in Segment 2 to a crest elevation of 9.50 ft. NAVD88. The resulting peak lake stage during this inflow event was 12.29 ft. NAVD88, which would meet risk reduction objectives. The downstream area required to: 1) sufficiently capture discharges from this inflow volume, and 2) meet the desired downstream pool depth (depth of 6ft or less to allow emergent vegetation to dampen wind effects) resulted in use of lands between the North New River Canal and Miami Canal, as well as land east of the North New River Canal. This plan includes levee modifications to the Miami Canal, North New River Canal, L-5 Canal, L-6 Canal, L-15 Canal, and the L-16 Canal. Additionally, reconstruction of a portion of US Hwy 27, including a 1.0 mile bridge along HHD to allow water through the roadway corridor; relocation of a railroad that traverses the retention area; demolition of an existing industrial complex; and remediation of soil contaminated with agriculture industry chemicals will be required. Acquisition of real estate, relocation of public infrastructure, construction of additional levees, installation of pump stations, and water quality treatment would all be required for this alternative. The estimated real estate cost would be similar to the real estate costs for the controlled breach and the spillway/retention area alternatives, $1.6 to $1.9 billion. Construction costs would be additional.

AGRICULTURE IS OUR PROBLEM PEOPLE

The Dam Removal Alternative (**Figure 2-4**) is not pursued further because of the high cost, time to implement, and the significant adverse impacts to the benefits provided by Lake Okeechobee and the entire C&SF Project.

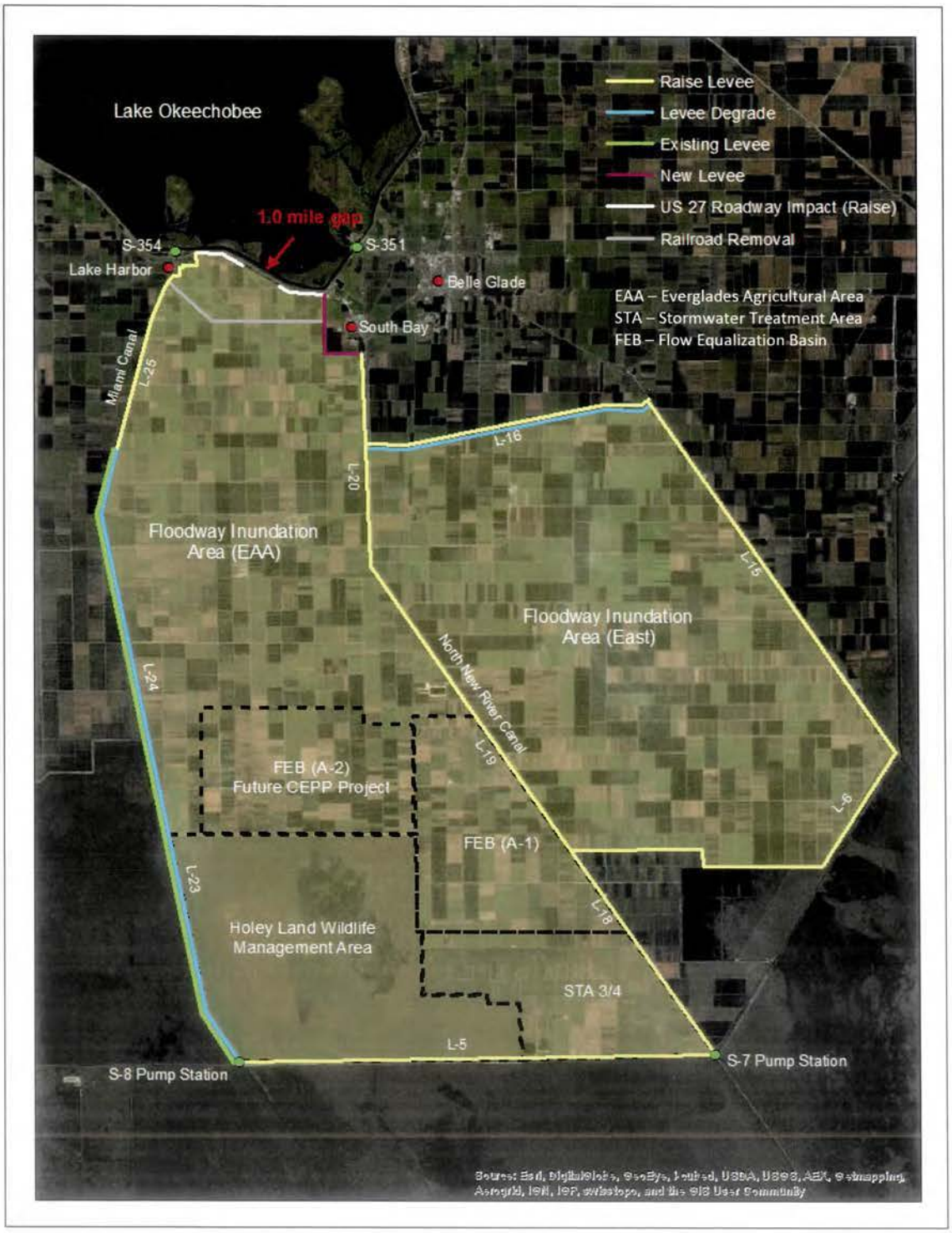

Figure 2-4. Conceptual Dam Removal Alternative

2.3.2.2 Gated Spillway and Retention Area Alternative

This plan includes the construction of a multi-bay bottom-hinge gated spillway (crest elevation 14.0 ft. with gate closed (in "up" position) and 10.5 ft. with gate open (in "down" position)) and an 89,000 acre downstream water retention area (**Figure 2-5**). The Lake Okeechobee pool stage requirement is the same for the spillway option as described in the Dam Removal - the maximum stage was established as 15.50 ft. NAVD88. Such a pool restriction is expected to reduce risk to tolerable levels, while preserving C&SF water supply and navigation benefits, and having only minimal adverse effects on the existing lake ecology. This plan would require reauthorization of major portions of the C&SF Project. The spillway configuration reduced the Lake Okeechobee stage to 15.94 ft. NAVD88 during the modeled inflow event.

The retention area would be formed by levee modifications adjacent to the Miami Canal, the North New River Canal, and Holey Land, and new levee construction near the town of South Bay, and partial levee degrading along the Miami Canal north of Holey Land. This plan also includes reconstruction of a portion of US Hwy 27, including a new 1,000 ft. bridge to allow water through the roadway corridor; relocation of a railroad that traverses the retention area; demolition of an existing industrial complex; and remediation of soil contaminated with agriculture industry chemicals. This plan is intended to preserve the function of the State's existing Stormwater Treatment Area 3/4 and future A-1 Flow Equalization Basin, although the infrastructure modifications required to do so have not been investigated. The estimated real estate cost would be similar to the real estate costs for the dam removal and controlled breach alternatives, $1.6 to $1.9 billion. Construction costs would be additional.

The gated spillway alternative is not pursued further in this DSMS because of the high cost and time to implement, and the significant adverse impacts to portions of the C&SF Project south of the retention area.

I AGREE HERE ON GATED SPILLWAYS, ALSO ANY CONNECTING CANALS AND CULVERTS SHOULD BE REMOVED. TO STOP AGRICULTURE RUN-OFF WATERS. WE MUST HAVE ENFORCEMENT OF BMP'S AND BMAP, WE CAN NO LONGER HAVE A VOLUNTARY SYSTEM FOR AGRICULTURE OPERATIONS

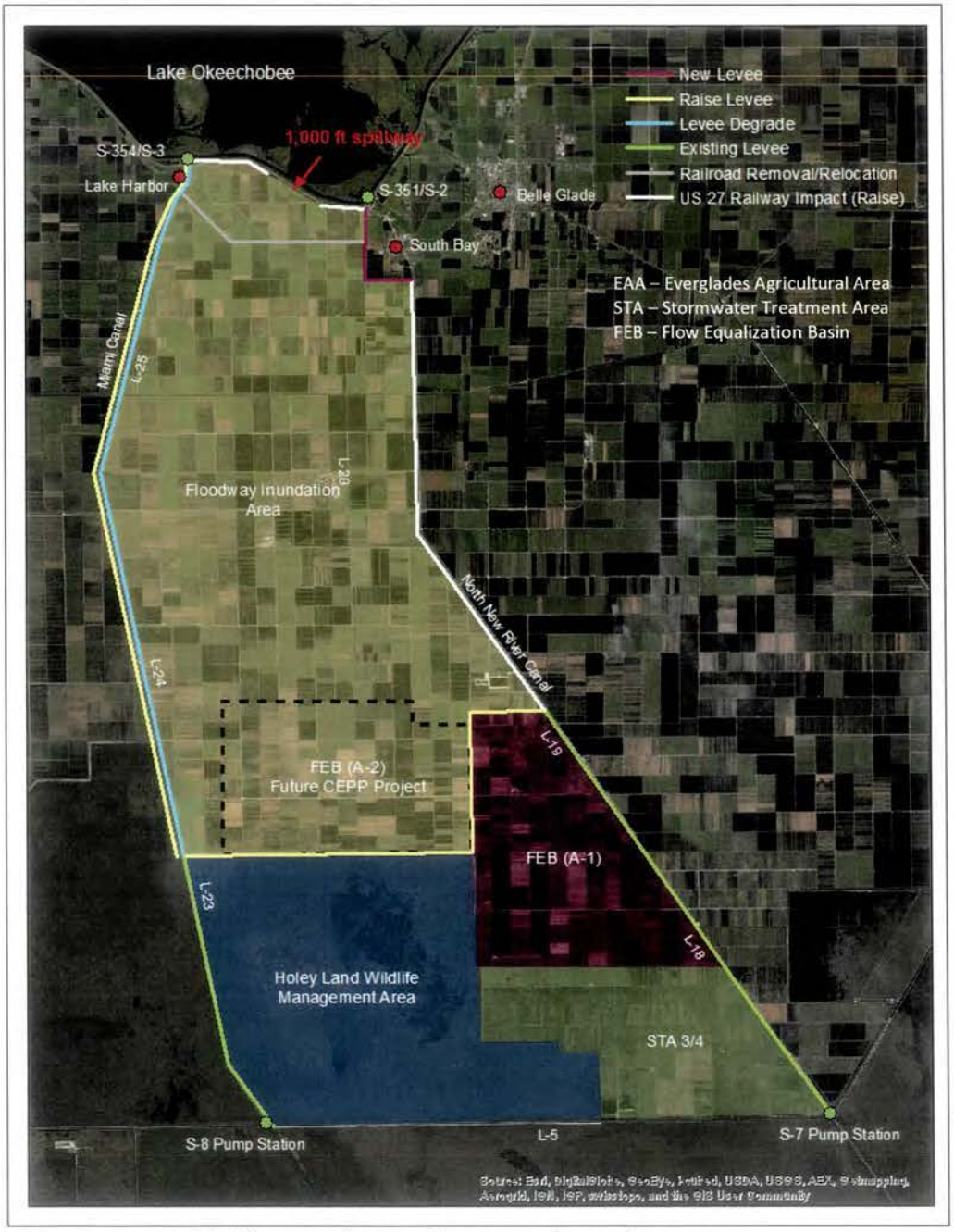

Figure 2-5. Conceptual Spillway and Retention Area Alternative

2.3.2.3 Controlled Breach and Retention Area Alternative

This plan includes deliberately breaching the dam at a predetermined location that would result in no/low potential for life loss and low economic damages to preclude a breach in a location that would result in a much higher consequences. This plan differs from the Dam Removal Alternative in that the this plan is based on a scenario in which an internal erosion failure has progressed, intervention has failed, and a breach would occur within 24 to 36 hours absent a rapid drop in lake stage. This plan requires that within a short notice period (2-3 hours), local law enforcement clear the Population At Risk (PAR) from the predetermined impacted/inundation area and re-

route all traffic accordingly. The proposed controlled breach location is the same as the new service spillway, to take advantage of a low-lying downstream agricultural area that would serve as a breach flood getaway and temporary retention area, assuming required flowage easements are secured. The breach width necessary to lower the reservoir from 25 ft to 18 ft NAVD 88 within 24 hours is estimated to be 3.75 miles.

Although this plan offers an opportunity to reduce risks, it does not reduce risk associated with a wind-driven wave overwash failure. For internal erosion failure modes, this plan may not reduce individual risk to within tolerable guidelines, meaning that, despite the efforts of local law enforcement, transient PAR would likely remain in the inundation area. This alternative also assumes that the control breach would undoubtedly prevent an additional uncontrolled breach at the progressing failure mode location. It is likely that by the time the breach was determined to be imminent at a progressing failure mode location, a controlled breach of the dam at a different location would not progress and reduce reservoir loading quickly enough to stop the progressing failure.

STOP UP STREAM PROBLEMS

Downstream property damages are not well defined and would likely include damages to US Hwy 27 (emergency and interior hurricane evacuation route for south Florida region), a railroad, an existing industrial complex, and others. In addition to infrastructure damage, indirect damages include economics of the region with loss of crops and flooded quarries for an extended period of time (e.g. months to a year), as well as catastrophic environmental damages to a sensitive and unique ecosystem currently holding hundreds of millions of dollars in sunken Federal and state capital investments. Potentially, flood damages may occur elsewhere within the C&SF system as the main floodwater storage components of the system (Lake, Water Conservation Areas, future reservoirs) would be strained with dewatering of the flooded EAA area for up to a year (e.g. lack of pumped water storage, excess seepage from the conservation areas over long duration, canal storage, etc.).

Based on a screening level evaluation, this plan was eliminated from further consideration. Although major consequences have been noted here, there are various other consequences that would further justify the final decision to eliminate breaching the dike in a deliberate manner.

2.3.2.4 Dam Replacement Alternative

This alternative includes replacing the existing dam with a new dam, built in increments, along the same alignment. Existing embankment material would be reused to the extent practical. This plan would require reauthorization of major portions of the C&SF Project. Dam replacement may require multiple decades to complete, with an estimated construction cost of $15B.

REPAIR AND MODE ION

The Dam Replacement Alternative is not pursued further because of the high cost and time to implement.

2.3.3 System-Wide Non-Structural Risk Management Plans

System-wide alternatives were formulated to determine if solutions other than rehabilitation of the dike existed to satisfy the risk reduction objectives.

2.3.3.1 New Lake Okeechobee Regulation Schedule Alternative

Several Lake Okeechobee regulation schedules were considered to determine if a change in the lake regulation schedule could significantly reduce the loading on the dam, and therefore the necessary rehabilitation. **Figure 2-6** depicts Lake Okeechobee Regulation Schedule 2008, developed to satisfy flood control, water supply, environmental requirements, and dam safety concerns.

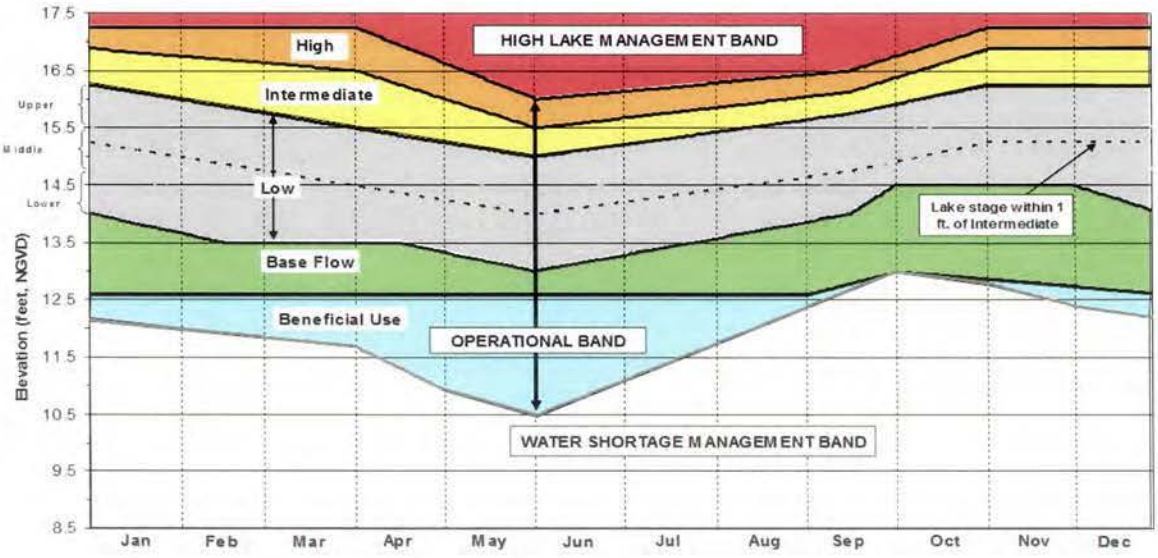

Figure 2-6. Lake Okeechobee Regulation Schedule 2008

As part of the HHD Major Rehabilitation Report 2000, a stage-frequency analysis was conducted that demonstrates that, even with an initial lake stage of 9.1 ft. (NAVD88), the Standard Project Flood (SPF) event results in a peak lake stage of 23.7 ft. (NAVD88). This situation is caused by a large volume of water that flows into the lake during an SPF event combined with a limited lake discharge capacity. Therefore, implementing a modified operational schedule would not significantly reduce lake stages during large storm events, and this alternative was screened from further consideration from the DSMS.

More recent hydrologic modeling using the MCRAM methodology also demonstrates that the LORS has limited ability to reduce the peak SPF on the lake versus prior regulation schedules. **Figure 2-7** and **Figure 2-8** show a peak SPF stage of el. 22.8 ft., NGVD29 (el. 21.5 ft., NAVD88) and el. 23.7 ft., NGVD29 (el. 22.4 ft., NAVD88) for the current LORS (2008-present) and RUN25 (1994-2000) lake regulation schedules, respectively.

Step 1: The risk assessment of each segment for both existing and future without federal action conditions (FWAC)/No Action was examined to identify where formulation of risk reduction measures is needed.

The first criterion in identifying minimally acceptable alternatives pertains to remediating areas of the dike where the risks of public safety and loss of life is intolerable. Since societal life loss is paramount to the Dam Safety program, a conservative approach was taken to account for uncertainty and formulate any segment without considering the potential for human intervention to detect and stop progression of a failure mode prior to breach. At a minimum, all alternatives in the final array would reduce risks to greater than an order of magnitude below societal life safety Tolerable Risk Guidelines (TRGs).

Segments 5-2, 8, 12, and 13 all present societal life safety risks that were determined to be intolerable.

The second criterion examined the probability of a dike breach occurring in any given Segment on an annual basis. Contrary to the formulation of segments for societal life loss and public safety, a less conservative approach was taken when formulating solutions based on the annual probability of a dike failure and consideration for possible intervention was included. Intervention would occur if a failure mode were detected and active flood fighting took place to prevent breach (as has occurred historically at HHD and at similar facilities).

Segments 4 through 9, 12, and 13 are all considered to have an annual probability of failure from internal erosion failure modes that causes concern and are included in the formulation of alternatives.

Structures S-71, S-72, and the SR 78 Harney Pond Canal Bridge crossing also cause concern for an overtopping driven failure due to low dike elevations at these points. The remediation of these structures (articulated concrete block armor and/or floodwall) is included in all of the alternatives as the cost of remediation is low when compared to the economic, social, and environmental damages that would occur from a breach at these locations.

WHAT-IF WHAT-IF PROBLEMS

Step 2: In addition to formulating solutions at the segment level, alternative formulation then focused on identifying combinations of segmental measures within CIZs in order to reduce the probability of a breach, and the resulting economic, social, and environmental risks to tolerable levels for the entire zone. As previously described, common economic, social, and environmental impacts would occur due to overlapping inundation patterns that occur for a breach in any segment within a CIZ. The annual probability of a breach and the breach-related economic and environmental risks for a given zone are not tolerable unless each segment in that zone is tolerable. Leaving a "weak link" or intolerable segment in any of the zones would render the entire zone intolerable.

WHAT IF PROBLEMS

Step 3: After solutions were formulated per segment, they were categorized into alternative concepts. The resulting measures identified at the segment were simply combined to form four alternatives at the CIZ. Respective alternatives per CIZ were then combined to provide four complete alternatives based on segmental solutions. The four alternatives are as follows:

NOTE WE NEED FACTS NOT (WHAT IF) AND PLEASE NO MORE (ASSUME) IS A WEAK LINK PEOPLE

Alternative 1: Alternative 1 reduces societal life safety risk to tolerable levels for every segment using the most cost-effective approach. As societal life safety is of paramount concern to the nation, the segments included in this minimal alternative are also included in Alternatives 2-4.

Alternative 2: Alternative 2 includes the risk management plans identified in Alternative 1 to reduce societal life safety risk and includes segments where the risk to individuals and the probability of a dike breach are intolerable. This alternative includes remediation of segments or CIZs having an intolerable probability of failure, regardless of the economic, environmental or social consequences.

Alternative 3: Alternative 3 reduces risks for all segments in which either societal or individual life safety risks were determined to be intolerable. However, this alternative only includes risk reduction for segments where the probability of a dike breach is intolerable and there are significant economic, social or environmental risks.

Alternative 4: Alternative 4, similar to Alternative 2, also reduces individual and societal risk for every segment, and brings the probability of failure to tolerable levels for every segment regardless of the economic, environmental or social consequences. However, this alternative is formulated to achieve a complete remediation of the individual failure modes being addressed to support the ultimate goal of having an adequately safe dam that meets essential USACE guidelines and the total residual risk for the dam is considered tolerable (DSAC V).

Each of the alternatives was analyzed to determine if there was a faster means of satisfying the primary objectives and considerations were applied to each alternative to identify if there was a refinement that could further reduce risk in a cost effective manner.

2.3.4.1 Segmental Risk Management Measures Considered

This section discusses the structural risk reduction measures that were carried forward for further evaluation. The measures for segmental designs are probabilistic, meaning no minimum service reservoir level and factors of safety were selected for design as would be done for a typical deterministic engineering solution. Rather, the robustness of the designs was tailored to annual probability of reservoir loadings and resulting downstream consequences. These plans will reduce risk and probability of failure.

2.3.4.1.1 Internal Erosion

Structural risk reduction measures for internal erosion can be generalized into two categories; cutoff walls and internal drainage systems. Three general variations of cutoff wall and three general variations of internal drainage systems were evaluated. For cutoff walls, these variations include different depth governing criteria based on the location specific geology and the cross sectional details of the embankment in each segment. Two different alignments of the cutoff wall were also considered (i.e. in the upstream face of embankment or along the centerline). Variations in the internal drainage system included depth or presence of a foundation trench to intercept through foundation seepage, presence of a chimney drain in the embankment to intercept through embankment seepage, and the materials and stages within the drain.

2.3.4.1.2 Cutoff Walls

Cutoff walls were evaluated as a risk reduction measure around the dam. Cutoff wall depth varied by segment based on local geologic conditions (permeability of the strata penetrated by the wall, erodeability of the foundation strata, reduction in estimated seepage exit gradients, etc.). The proposed wall depths were also influenced by the cross sectional characteristics of the embankment that could influence the depth of an internal erosion failure path; such as ground surface elevations at the toe and ditch or canal invert elevations. The proposed cutoff wall would be constructed of a Soil-Cement-Bentonite mixture, constructed by mixing a cement bentonite clay slurry with in-situ HHD soils. This would result in a low permeability barrier with strength characteristics similar to weak concrete.

Generally, the proposed cutoff walls can be separated into three categories; 1) traditional cutoff walls that tie into a confining layer, 2) partly penetrating (hanging) cutoff walls or walls that do not tie into any specific confining unit, and 3) cutoff walls that tie into a less erodible limestone layer. The magnitude of risk reduction is significantly different for the various wall types and therefore the depth requirements of the wall are variable around the dam.

GOOD IDEA HERE

Traditional fully penetrating cutoff walls that tie into a confining layer provide the largest magnitude of risk reduction. These walls cut off most seepage, reduce downstream pore water and exit gradients, cut off horizontal failure paths and force a failure path to advance through less erodible soils. This type of cutoff wall could be implemented in Segments 12/13 and in Segments 5 and 6 and throughout portions of other segments where clay or clayey soils are present in the foundation. **Figure 2-9** presents a generalized section of this variation of cutoff wall.

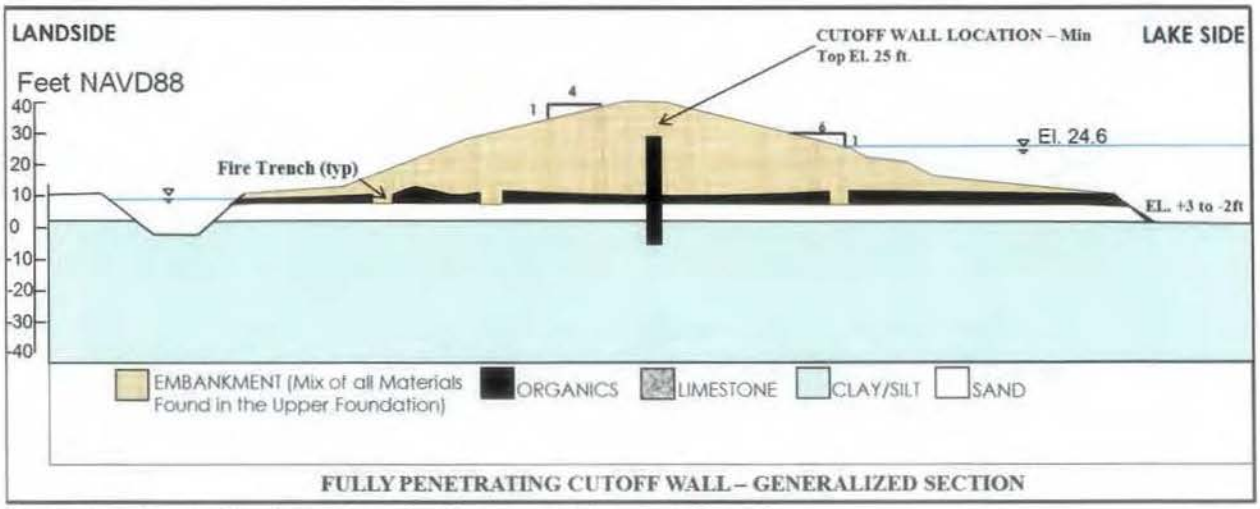

Figure 2-9. Generalized Section of Fully Penetrating Cutoff Wall

Partly penetrating cutoff walls achieve risk reduction by increasing the seepage path length, interrupting the horizontal failure path through the embankment and shallow foundation, add a vertical component to the failure mode progression, and significantly increase the reservoir levels that could initiate and progress an internal erosion failure mode to failure. For this variation of cutoff wall, the minimum wall depth that was established extends the cutoff wall to at least 20 feet below the adjacent canal/ditch invert elevation. This cutoff wall is proposed for a few isolated

areas in the south of HHD. **Figure 2-10** presents a generalized section of this variation of cutoff wall.

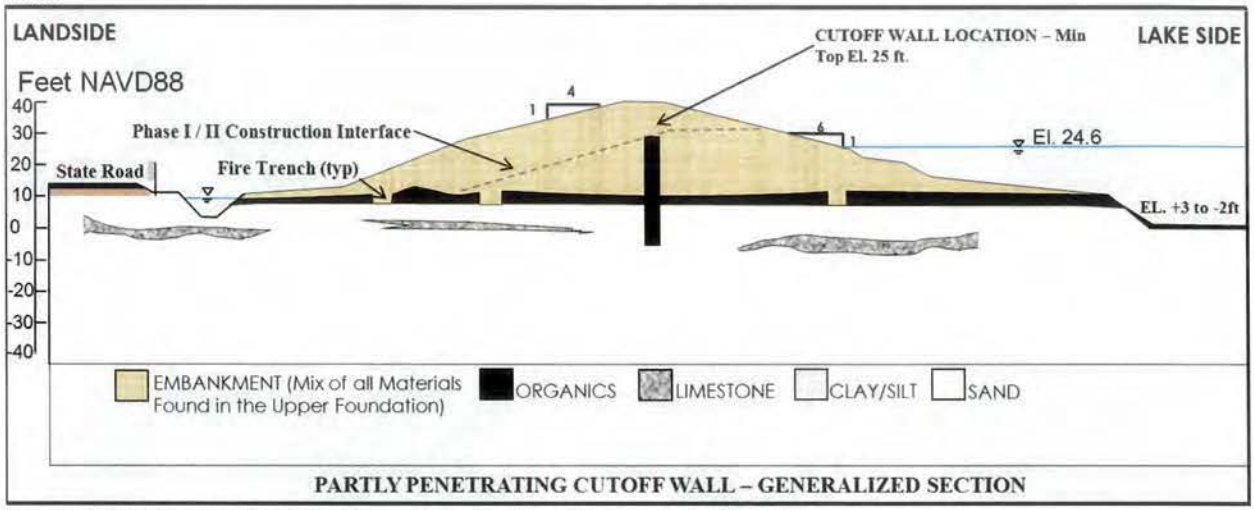

Figure 2-10. Generalized Section of Partly Penetrating Cutoff Wall

Partly penetrating cutoff walls that penetrate limestone are similar to that discussed above but with the additional benefit of forcing seepage flows and the failure path through un-erodible limestone or through a more tortuous path that must progress through defects in the limestone. This type of cutoff wall could be implemented throughout most of the southern segments of HHD.

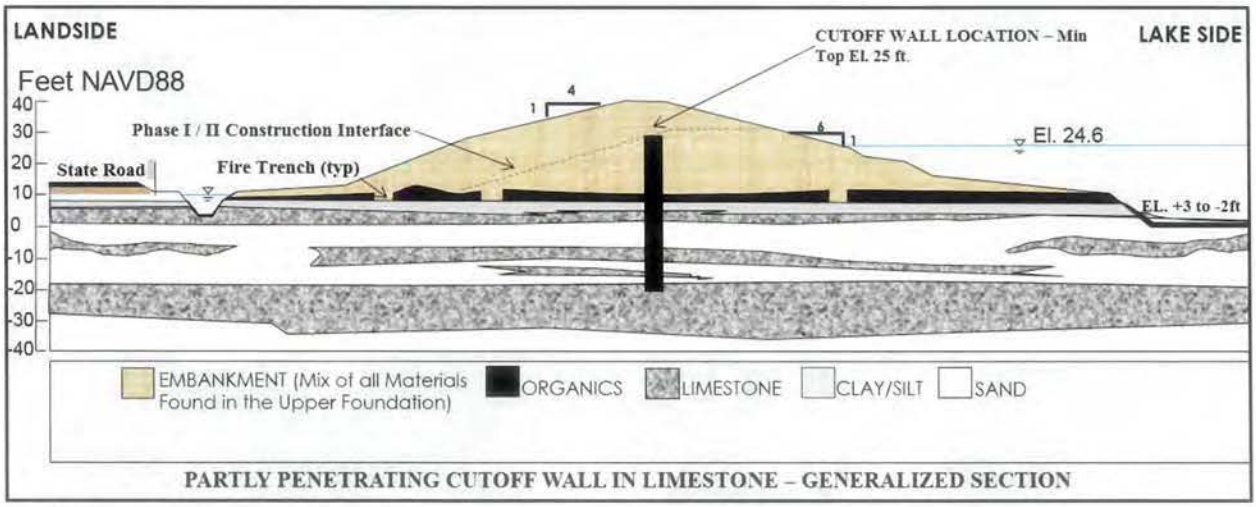

Figure 2-11. Generalized Section of Partly Penetrating Cutoff Wall Tipped In Limestone

The partly penetrating cutoff walls meet the risk reduction objectives; however, it should be understood that unfiltered seepage would likely still discharge in the toe ditch during high reservoirs.

2.3.4.1.3 Internal Drainage Systems

Internal drainage systems of varying designs and configurations were evaluated around the full length of the dam. The design and effectiveness of an internal drainage system varied around the dam considering local geologic conditions, actionable failure modes, and adjacent features such

Short duration, shallow overtopping could occur under certain elevated lake levels in combination with tropical cyclone storm surge on the lake.

2.3.4.2.1 Articulated Concrete Block (ACB)

Articulated Concrete Block (ACB) is a crest and landside slope protection measure that was evaluated as a risk reduction measure for the overwash/overtopping failure mode. ACB consists of inter-connected concrete blocks that form a hard armor to protect against surface erosion. These blocks can be open cell and infilled with topsoil and vegetated, or can be closed cell concrete surface treatments (depending on the severity of the erosive forces being resisted). ACB is proposed to armor the crest and landside of the embankment for several hundred feet surrounding the Harney Pond Bridge. Construction of an ACB erosion protection system around the SR78 Harney Pond Bridge meets risk reduction objectives in this area. This structural measure would reinforce the embankment such that short duration overtopping during a storm would not fail the embankment; however, some flooding could still occur in the areas surrounding the bridge as a result of the overtopping. The combinations of loading events that would result in overtopping this area have a low probability of occurrence; therefore, this interim risk reduction measure is considered practical. The recommendation will be made to Florida Department of Transportation to raise the bridge to match surrounding embankment crest elevations upon normal service life replacement.

2.3.5 Formulation of Segmental Risk Management Plans

Plans were developed to remediate both the internal erosion and overwash and overtopping failure modes. The primary consideration is ensuring risks are reduced to tolerable levels with cost-effective considerations, and every alternative considered would, at a minimum, reduce risks to tolerable levels for life safety. Additionally, as a secondary metric, an assessment of the economic, environmental, and societal benefits and impacts determined if there was justification to take action in areas exhibiting intolerable probabilities of failure, but the risk to life safety was above guidelines. Plans were also examined based on implementation speed, robustness, resiliency, and redundancy.

Upon identification of the required depth of cutoff wall to reduce risks to tolerable levels, and the internal drainage system that most practicably meets Essential USACE guidelines, formulation of alternatives focused on which segments these solutions would be applied. Alternative 1, focused specifically on the most economical means to reduce life safety risks. Alternative 2 focused on the most economical means to reduce probability of failure for all segments that were identified as intolerable. Alternative 3 focused on the most economical means to reduce risks below TRGs, but also relied upon the significance of the economic, environmental, and social impacts that would result in the aftermath of a breach. Alternative 4 is similar to Alternative 2, but includes the most practicable means to meet essential USACE guidelines while reducing risks.

Table 2-2 presents the results for all four of the segmental alternatives arranged by common environmental and economic zone. Each of these alternatives were determined to be cost effective solutions to providing at a minimum life safety, and to varying degrees reduce risks in order to lower the likelihood of expected annual economic and environmental damages. **Table 2-3** presents the results of the overwash and overtopping alternatives arranged by common environmental and economic zone.

Table 2-2. Segmental Alternatives Description for Internal Erosion Failure Modes

Segment	Intolerable Probability of a Breach (Yes/No?)	Intolerable Societal Life Loss (Yes/No?)	Alternative 1	Alternative 2	Alternative 3	Alternative 4
ZONE A						
22, 23, 24	NO	NO	No action included in the DSMS: Cutoff-wall constructed as part of the 2000 MRR			
1	YES	YES	No action included in the DSMS: To be completed as part of the 2015 MRR Supplement			
2 and 3	YES	NO				
ZONE B						
4, 5, 6 and 7	YES	NO	No Action Recommended	Cutoff Wall	Cutoff Wall	Internal Drainage System
5-2 and 8	YES	YES	Filter at the Raw Water Intake	Cutoff Wall and Filter at Raw Water Intake	Cutoff Wall and Filter at Raw Water Intake	Internal Drainage System and Filter at Raw Water Intake
8	YES	YES	Cutoff Wall	Cutoff Wall	Cutoff Wall	Internal Drainage System
9	YES	NO	No Action Recommended	Cutoff Wall (Full Segment)	Cutoff Wall to C-5A	Internal Drainage System (Complete Segment)
Segment 10: No action is recommended. Risk is considerable tolerable.						
ZONE C						
Segments 11 and 14A: No action is recommended. Risk is considered tolerable.						
12	YES	YES	Cutoff wall from the interceptor levee east to segment end	Cutoff wall (Full Segment)	Cutoff wall from the interceptor levee east to segment end	Internal Drainage System (Complete Segment)
13	NO	YES (Adjacent to Segment 12)	Cutoff Wall- segment start to Sta. 4665	Cutoff Wall- segment start to Sta. 4665	Cutoff Wall - segment start to Sta. 4665	Internal Drainage System - segment start to Sta. 4665
Zone E						
Segments 17, 18A, 18A-2 and 18B: No action is recommended. Risk is considered tolerable.						
Zone F						
Segments 19A, 19A-2, 19A-3, 19B and 19C: No action is recommended. Risk is considered tolerable.						
Zone G						
Segments 20 and 21: No action is recommended. Risk is considered tolerable.						

boulders can be found within the embankment. These coarse pockets vary in length and thickness, and can have voids between the cobbles or be filled with a matrix of sand and gravel. These pockets are highly permeable.

Foundation

Organic Horizon: The organic horizon is 0 to 10 feet thick and has low permeability. The color of this horizon is typically black or brown, and it may vary from fibrous to intensely decomposed. The organic horizon is also composed of organic silt. The organic horizon is about eight feet thick at Belle Glade and gradually thins out both to the northeast and west. It is continuous in Reach 3 but thins and grades to organic stained sands in Reach 2. This horizon sometimes appears to be thicker, thinner, or out of sequence compared to the natural geologic sequence. This is usually the result of local excavations, fill placement, or spoil disposals. Any material overlying the organics is usually fill used to construct the dike.

Fines Horizon: The fines horizon has low permeability and alternating marine and freshwater limestone and/or marls. This horizon is typically tan, calcareous silts and clays formed from decomposed limestone. The fines horizon is not continuous, and pinches out in the eastern half of Reach 2 and ranges from one to five feet thick. Where the fines horizon is absent, the rock or sand horizons underlie the organic horizon.

Rock Horizon: The rock horizon is usually 0 to 30 feet thick. The rock horizon occurs throughout Reach 3 but thins in Reach 2 and is no longer continuous. This horizon is composed of interbedded limestone or sandstone and sand layers. The limestone within the rock horizon varies from dense crystalline limestone to sandy and shelly limestone. Some of the limestone is essentially impermeable, while the remainder varies to highly permeable, containing fractures, voids and solutioning features. In some areas, the rock horizon is essentially all limestone. In other areas, the limestone grades into sand deposits. The sands are usually clayey and silty, calcareous sands. Fine deposits such as silt and clay are interbedded within the rock horizon, formed from decomposing limestone.

Sand Horizon: The sand horizon is usually 30 to 110 feet thick. The sand horizon is typically fine to medium grained quartz sand and quartz silty sand. It sometimes has a significant shell component, and occasionally shell layers are present. Limestone beds are common.

Reach 4 (CIZ B)

Embankment

The HHD embankment was constructed using dredged material from Lake Okeechobee and is a heterogeneous mixture of loose to medium density, fine grained, silty, clayey, quartz sand with high percentages of silt and clay (average 30%), and varying amounts of shell. Other materials encountered in the fill at minor percentages are organic soils and peat, limestone and sandstone gravel, and cobbles, with occasional layers of sandy clay and silt. Along the Fisheating Creek tieback, the amount of fines decreases significantly. The fill is approximately 22 feet thick along the main stem of the crest and pinches out at the west end of the Fisheating Creek tieback.

Foundation

Organic Horizon: The organic horizon is 0 to 2 feet thick and has moderate permeability. The color of this horizon is typically black or brown and consists primarily of fine, organic stained, silty quartz sand and occasional layers of sandy organic silt and peat. These organic materials may become thicker in lower lying areas.

Sand Horizon: Below the organic horizon, over 100 foot thick sand is encountered. The sand horizon is composed of two distinct sand units. A bowl of high fines content sand and clays are found in the middle of the reach and are surrounded and underlain by cleaner sands with occasional rock layers. The sand within the bowl is found to be up to 70 feet thick and is composed of greenish gray, silty, clayey, and fine to very fine quartz sand with shell. The sands have a high fines content that averages over 30 percent, and is found to transition into layers of sandy silts and clays. The clay layers can run for several thousand feet, interbedded with silty/clayey sand and can be over 5 feet thick. The sand that surrounds and underlies the dirty sand is a homogeneous fine, partially cemented, light greenish gray, slightly silty to clean quartz sand with trace shell. These sands are dense, partial cemented, with occasional layers of sandstone and sandstone nodules.

Reach 5 (CIZ F) my AREA North of LAKE

Embankment

The HHD embankment was constructed using dredged material from Lake Okeechobee and is a semi-homogeneous mixture of loose to dense, fine to medium grained, clean to slightly silty quartz sand with shell. Other materials encountered in the fill at minor percentages are organic soils, and limestone and sandstone gravel, cobbles, with possible boulders. The thickness of the fill averages 25 feet.

Foundation

Organic Horizon: The organic horizon is 0 to 1 foot thick, semi-continuous, and has moderate permeability. The color of this horizon is typically black and consists of primarily of loose fine to medium grained clean to silty organic stained quartz sand with varying amounts of silt and occasional pockets of organic sandy silt, and peat. These organic materials may become thicker in lower lying areas.

Sand Horizon: This sand horizon is found to be over 100 feet thick and consists of semi-homogeneous light greenish gray, clean to slightly silty fine quartz sand with shell. Also found widely scattered throughout this unit are layers of silty to clayey fine quartz sand and layers of clay and silt. At various locations within this sand unit, the sand is composed of wholly fine to coarse sand sized broken shell with lesser amounts of quartz sand and fines; which account for less than 5% of the whole unit. This sand unit is generally of loose to medium consistency with dense areas generally caused by higher degrees of cementation, consolidation or thin layers of sandstone. Multiple thin layers of discontinuous soft to moderately hard sandstone can be found widely scattered throughout this sand unit.

Reach 6 (Includes Harney Pond Canal and Indian Prairie Canal; CIZ C, D)

Embankment

The HHD embankment was constructed using dredged material from Lake Okeechobee and is a heterogeneous mixture of loose to medium consistency, fine to medium grained, clean to silty quartz sand with shell. Minor percentages of organic materials and organic stained sands would also be present. At several locations within the main stem, the sand becomes considerably finer consisting of mostly, loose, very silty and clayey, fine quartz sand with significant interbedded layers of soft, sandy clay and silt up to 5 feet thick. In addition, from the middle of the reach towards the east, the shell content increases as does the appearance of limestone gravel, cobbles, and an occasional boulder. The fill is approximately 25 feet thick along the main stem of the crest and pinches out at the west end of the Fisheating Creek tieback.

Foundation

Organic Horizon: The organic horizon is 0 to 1 foot thick, semi-continuous, and has moderate permeability. The color of this horizon is typically black and consists primarily of loose fine to medium

The Soils of the Flatwoods group are level to gently sloping flat areas and poorly drained. These soils are acid to loamy sands and are low in fertility. Flatwood soils occur in areas where the water table rises to within five to 20 inches of the soil surface at least once during a growing season. The Soils of Sloughs and Freshwater Marshes are nearly level and poorly drained. These soils are found in areas with longer hydroperiods (typically nine to twelve months) and greater maximum depths of flooding. The soils of the Everglades group are nearly level and very poorly drained. This group of soils has a surface layer of muck underlain by limestone. These are primarily moderately permeable soils with a water table within three feet of the ground surface.

NEED ACTION SOON

3.3 LAND USE AGRICULTURE IS OUR PROBLEM NO ENFORCEMENT DONE

The primary land use in the Lake Okeechobee region is agriculture. Major agricultural activities in the area include sugarcane plantations, ornamental plant nurseries, and citrus groves.

The Farmland Protection Policy Act of 1981 was enacted to minimize the extent that Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses. The U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) is responsible for designating prime or unique farmland protected by the Act. In early 2010, the NRCS designated certain high-value crops in Florida, such as sugarcane, ornamental plant nurseries, and citrus groves, as "unique," thereby protecting these farmlands under the Act. Unique farmland protected by the Act exists in close proximity to the HHD in Reaches 2 and 3.

3.4 HYDROLOGY & HYDRAULICS

Surface Water

Inflow to Lake Okeechobee for drainage purposes and outflow for agricultural water supply and other purposes, such as releases made under LORS 2008, are made through a series of Federal, state, and local drainage district culverts that penetrate the HHD. The majority of inflow enters Lake Okeechobee through several major canals and control structures. In general, excess runoff from the drainage basins are gravity fed to the canals and structures on the north, east, and west shores of Lake Okeechobee, as well as pumped to the canals and structures on the south shore of Lake Okeechobee. The Lake Okeechobee drainage area, including Lake Okeechobee, is approximately 5,600 square miles. The Standard Project Flood (SPF) was selected as the inflow design flood (IDF) for the HHD Project. The SPF is equivalent to a stage of 24.7 feet NAVD88.

Inflow enters from the north, east, and west of Lake Okeechobee through the following watersheds: Kissimmee River, Taylor Creek-Nubbin Slough, Fisheating Creek, Nicodemus Slough, and Lake Istokpoga. Inflow enters from the south of Lake Okeechobee through mostly state and local water control districts in the watershed designated as the 'South Shore'. These basin discharges are generally pumped back into Lake Okeechobee through the HHD culverts, with the exception of Culverts S-2 and S-3, which pump directly into Lake Okeechobee. In general, the HHD culverts along the south shore have surface water management permits for drainage to Lake Okeechobee and water supply from Lake Okeechobee for agricultural irritation purposes.

The largest outlets of Lake Okeechobee include the St. Lucie (C-44) and the Caloosahatchee Rivers (C-43). Four major agricultural canals (West Palm Beach, Hillsboro, North New River, and Miami) drain to the south into Stormwater Treatment Areas (STAs), and then sequentially through the three Water Conservation Areas (WCAs). **Figure 3-2** shows the major Lake Okeechobee hydrologic features including

the contributing watersheds to the north, east, and west, and the local water control districts along the south shore of Lake Okeechobee. Please see **Figure 3-4** for a map of structure locations.

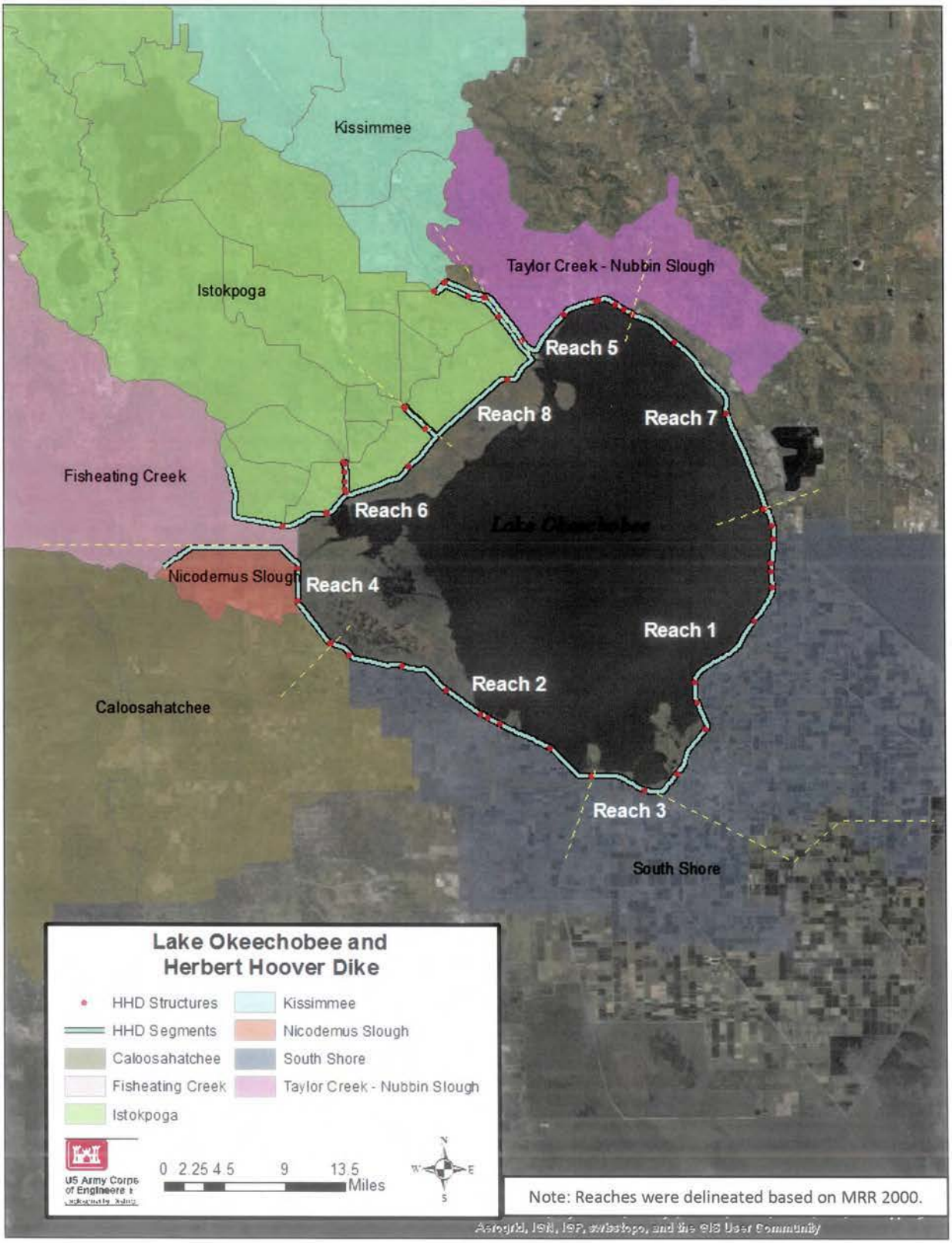

Figure 3-2. Basin Location Map

Kissimmee River

The Kissimmee River drainage basin encompasses about 2,260 square miles and extends from Orlando southward to Lake Okeechobee at the mouth of the Kissimmee River (C-38). The basin is the largest source of surface water flow to Lake Okeechobee with the inflow from C-38 controlled at SFWMD structure S-65E. There are two culverts that discharge into C-38 south of S-65E: KI-1 and KI-2.

Taylor Creek – Nubbin Slough REACH #1 5 AREA'S

The Taylor Creek – Nubbin Slough drainage area bordering the north and northeast shores of Lake Okeechobee encompasses about 309 square miles and extends from the Kissimmee River (C-38) to the St. Lucie River (C-44). All inflow from this watershed is controlled. There are five HHD culverts in the basin: C-6, C-7 (abandoned), C-8, C-9 (abandoned), and Taylor Creek Culvert (TCC; abandoned). The C-7, C-9 and TCC culverts are not in use and considered abandoned in place.

NOTE-NO ENFORCEMENT OF 40E-61 OR 40E-63 PEOPLE

Fisheating Creek

Fisheating Creek is located principally in the western portions of Highlands and Glades counties, with the western boundary extending into the easterly edges of Hardee, DeSoto, and Charlotte counties. The drainage area is adjacent to the Peace Creek Basin on the west and northwest, the Lake Istokpoga-Indian Prairie and Harney Pond Canal areas on the north and northeast, and Nicodemus Slough on the south. Fisheating Creek drains an L-shaped area of about 550 square miles. From the headwaters near Lake Josephine, the creek discharges uncontrolled and flows south for 32 miles, then east for 23 miles to discharge into Lake Okeechobee. UNCONTROLLED FLOWS ARE A PROBLEM DUE TO NO ENFORCEMENT OF 40E-61 AND 40E-63 AGRICULTURE RUN-OFF WATER

Nicodemus Slough

The Nicodemus Slough drainage basin borders the southwest shore of Lake Okeechobee extending from Fisheating Creek to Culvert 5A just north of the Caloosahatchee River watershed. The area encompasses about 39 square miles and normally drains to Lake Okeechobee. When lake levels are abnormally high, it is necessary to drain some of Nicodemus Slough south to the Caloosahatchee River through structures C-5 and C-5A. There are two HHD culverts in the basin: C-5 and C-5A. THIS IS NOT A VERY GOOD IDEA DUE TO DRINKING WATER BECOMES POLLUTED

Istokpoga

The Istokpoga drainage basin borders the northwest shore of Lake Okeechobee from Kissimmee River (C-38) to Fisheating Creek and encompasses about 1,070 square miles. Levees isolate the two main canals, Indian Prairie Canal (C-40) and Harney Pond Canal (C-41) from the watershed. There are three culverts that discharge into Indian Prairie Canal: IP-1, IP-2, and IP-3, as well as the S-72 gated spillway; and six culverts discharge into Harney Pond Canal: HP-1, HP-2, HP-3, HP-5, HP-6, and HP-7, as well as the S-71 gated spillway. The FC-1 culvert discharges into the L-50 borrow (Refer to **Figure 3-4** for a structure location map).

South Shore

The South Shore of Lake Okeechobee extends from Moore Haven at the Caloosahatchee River to Port Mayaca at the St. Lucie River. There are 13 HHD culverts in the basin: 1, 1A, 2, 3, 4A, 10, 10A, 11, 12, 12A, 13, 14 (to be removed), and 16. The drainage areas associated with these 13 culverts are local water control districts mostly contained within the Everglades Agricultural Area (EAA), but also include U.S. Sugar, Trucane, Lake Point and Five Smooth Stones. The EAA is divided into seven drainage basins and is comprised of a network of canals, structures, and levees that divide the area to provide for the removal of excess water to Lake Okeechobee and the WCAs to the south. The local drainage districts, also referred to as '298 Districts', have private pump stations that discharge to Lake Okeechobee or the EAA canals. **Figure 3-3** provides a map of the 298 Districts. WE MUST STOP BACK PUMPING

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NOTE - HERE WE SEE NO ENFORCEMENT ACTION TO IMPROVE AREA'S

Surface Water Use

The SFWMD manages the water use permitting process within its boundaries under authority of Chapter 373, State Statutes, 40E-20 Florida Administration Code (F.A.C.). A water use permit allows a user to withdraw a specified amount of water, from the ground, a canal, a lake, or a river. The water can be used for public water supply, for industrial processes, or for irrigation.

There are 298 Water Control Districts (originated through Florida State Statute 298), which maintain and operate a secondary canal systems in the EAA (**Pickett et al., 2013**; **Figure 3-3**). The water use in the EAA is assured by maintaining water levels in these canals. The Water Control Districts maintain water levels approximately 1 to 2 feet below ground surface for most of the year. During the planting and harvesting seasons, water levels are lowered further to facilitate operations. During dry periods, increased water use and high evapotranspiration can result in undesirably low water levels in Lake Okeechobee. To reduce adverse ecological effects from low lake levels, the SFWMD has developed a water supply management plan that requires various actions to be taken according to the severity of the dry conditions. The basis of this plan is an allocation scheme that parcels out lake water based on estimated water use for the remainder of the dry season.

Groundwater

The groundwater resources in the Lake Okeechobee area include the surficial unconfined aquifer system (SAS) and the Floridan Aquifer System (FAS) separated by the Intermediate Confining Units (**Radin et al. 2005**). Artesian freshwater conditions exist in the Upper Floridan Aquifer in the areas along HHD Reaches 4, 5, 6, and 8. Groundwater recharge in the area occurs primarily from precipitation. Pumping of the surficial aquifer for agricultural and potable water needs occurs around the entire perimeter of the lake though it is most predominant in the northern reaches of the lake. In the northern reaches (Reaches 4, 5, 6, 7, and 8) of the HHD, surficial aquifer groundwater tends to move from the landside to the lakeside since adjacent land elevations and groundwater levels are generally higher than the lake levels. Through the southern reaches (Reaches 1, 2 and 3) of the HHD, surficial aquifer groundwater tends to move from the lakeside to the landside (**England et al. 2013**) since adjacent land elevations and groundwater levels are generally lower than the lake levels. THIS IS A PROBLEM THAT CAN CAUSE SALT-WATER INTRUSSION TO ACCURE.

The typical depth to the surficial groundwater table in the Lake Okeechobee area is about three feet below ground surface. In Palm Beach, Glades, and Hendry counties, the SAS may extend to 200 feet below ground surface in HHD Reaches 2 and 3. The surficial groundwater aquifer in the vicinity of the eastern and southern portions of the HHD extends from the land surface (8.7 feet NAVD88) to a depth of -180 feet. The upper portion of this aquifer is potable to a depth of approximately -50 feet below land elevation. Residents and agricultural operations adjacent to the eastern and southern portions of Lake Okeechobee use shallow wells as a source of drinking and irrigation water. The groundwater below elevation -50 feet is not considered potable due to the high salinity of the underlying trapped connate water (i.e., ancient saline water). IRRIGATION USE CAN CAUSE SINK HOLES TO ACCURE ??

Lithologies that include the SAS consist of undifferentiated fill, peat/silt, inter-bedded zones, highly permeable limestone layers, sand, and semi-confining units (**Pickett et al. 2013**). Pumping tests and other aquifer performance tests have been conducted along the HHD alignment to estimate values of key hydrologicparameters that characterize the transmissivity and storativity of groundwater within the SAS. These tests show that the transmissivity of groundwater in the SAS generally increases moving from north to south, with the overall hydraulic conductivity

estimated at 14 ft/day for the HHD Reaches 4, 5, 6, 7 and 8 and from 1 to 2 orders of magnitude higher along the HHD Reaches 1, 2, and 3.

Groundwater levels surrounding the HHD are rarely static and often fluctuate with changes in lake levels, recent rain events, agricultural pumping and operation of water control structures and canals. Typically, toe ditch water levels adjacent to the HHD are reflective of the local groundwater levels. In contrast, the water levels in the C&SF Project canals are managed by the SFWMD and water levels in those canals do not necessarily represent local groundwater levels. Within the EAA, due to land subsidence and the presence of levees bounding the C&SF Project canals, water levels in these canals can often be several feet higher than the groundwater levels being managed in the adjoining EAA farms.

Compared to the pre-historic condition, the groundwater hydrologic system in the area (particularly along the southern portions of Reaches 1 and 2 and all of Reach 3) has been changed due to the construction of the HHD, the construction/operation of public and private drainage systems and agricultural practices. The completion of the HHD and the primary drainage canal system of the C&SF Project allowed agricultural operations to flourish in the peat-deposited lands downstream of Reaches 1, 2, and 3, to the point that this region became known as the EAA. Water levels in the 298 Water Control Districts with the EAA are artificially maintained approximately 1 to 2 feet below the ground surface during the majority of the year and further lowered during the planting and harvesting seasons to facilitate operations. Other entities (lessees) of the EAA have similar practices. These systems operate under surface water and groundwater use permits issued by the SFWMD. Ultimately, the altered distribution of flows, peat loss, land subsidence, and decline of groundwater tables has caused an increase in the groundwater gradients across the HHD (**England et al. 2013**).

Groundwater Use

Lake Okeechobee provides potable water and recharges the surficial aquifer. The unconfined SAS is the principal source of groundwater for the basin's potable, agricultural, and industrial uses. The confined FAS aquifer has higher levels of dissolved solids such as sodium, thus it is not suitable for potable water except in some areas of Okeechobee and Glades Counties with the higher quality FAS water. Only eight water supply wells are known to tap into the Upper Floridan aquifer in the basin. AGRICULTURE WATER USE IS NOT CONTROLLED IN THESE AREAS AT ALL

There are approximately 300 surficial aquifer system groundwater pumping wells permitted within the general vicinity of the south, southwest, and southeastern portions of Lake Okeechobee. These wells, in addition to unpermitted wells in the area, are used for household, agricultural, industrial consumption, and de-watering activities. Some of these wells are located within 2,500 ft. of the HHD. The majority of the wells have pump capacities below 1 million gallons per day. In the area south of the HHD, groundwater is used primarily for irrigation, livestock, and landscaping. In addition, there are several groundwater wells that are used for industrial and public water supply. For instance, the city of Moorehaven uses a surficial aquifer wellfield located within one mile of the HHD for its potable water supply.

PROBLEM AREA PEOPLE

Water control Structures

Culverts

The HHD has numerous culvert structures that provide flood protection to residents of Palm Beach, Okeechobee, Highlands, Broward, Hendry, Glades, and Martin counties. Lake Okeechobee and the HHD are integral components of both the C&SF Project and the CERP which aim to provide flood protection, navigation, agricultural and municipal water supply, prevention of saltwater intrusion, recreation, enhancement of environmental resources, and ecosystem restoration.

The current HHD system is composed of 28 operational culvert structures, designated as either 'primary' or 'secondary' culverts (**Figure 3-4**). Primary culverts were mainly constructed along the southern and eastern portions of Lake Okeechobee with a few located near the City of Okeechobee on the northern end of Lake Okeechobee. Secondary culverts, located along the northern side of Lake Okeechobee, were constructed as feeder canals and rivers flowing into Lake Okeechobee. **Table 3-1** summarizes details of each culvert structure.

- 15 primary culverts (adjacent to Lake Okeechobee): Culverts 1, 1A, 2, 3, 4A, 5, 5A, 8, 10, 10A, 11, 12, 12A, 13, and 16
- 13 secondary culverts: Culverts 6, FC-1, HP-1, HP-2, HP-3, HP-5, HP-6, HP-7, IP-1, IP-2, IP-3, KI-1, and KI-2

Four additional primary culverts (C-7, C-9, C-15 and TCC) have been buried and/or scheduled to be removed from service. Additionally, the SFWMD and other private entities operate separate additional culverts into and out of Lake Okeechobee. **Table 3-2** summarizes details of these additional culverts.

NOTE
ON FOLLOWING PAGES
WE TAKE UP CULVERTS AND THERE
LOCATIONS - (X) MARKES THE AREAS
I CALL PROBLEM AREAS

Figure 3-4. Structure Location Map

Table 3-1. HHD Culvert Summary

Culvert Name	New Structure Name	Barrels	Size (ft.)	Pipe Length (ft.)	Barrel Type	Reach	Basin
C-11	S-269	1	10	95	CMP	1	South Shore
C-16	S-270	1	10	96	CMP		
C-10A	S-271	5	10	76	CMP		
C-13	S-272	1	10	95	CMP		
C-10	S-273	2	10	111	CMP		
C-12A	S-275	1	7	86	Concrete		
C-12	S-274	3	10	91	CMP		
C-4A	S-276	1	10	177	CMP	3	
C-3	S-277	2	10	105	CMP	2	
C-2	S-278	6	10	105	CMP		
C-1A	S-279	3	7	172	CMP		
C-1	S-280	2	10	115	CMP		
C-5A	S-281	3	10	160	CMP	4	Nicodemus Slough
C-5	S-282	3	10	160	CMP		
FC-1	S-283	2	9	118	CMP	6	Istokpoga
HP-1	S-288	1	2.5	94	CMP		
HP-2	S-287	1	7	94	CMP		
HP-3	S-286	1	9	94	CMP		
HP-5	S-284	2	9	96	CMP		
HP-6	S-285	2	7	94	CMP		
HP-7	S-289	1	5	94	CMP		
IP-1	S-292	1	5	94	CMP		
IP-2	S-290	2	7	80	CMP		
IP-3	S-291	2	6	80	CMP	8	Kissimmee
KI-1	S-266	3	6	145	Concrete		
KI-2	S-265	1	6	145	Concrete		
C-6	S-267	1	10	151	CMP	5	Taylor Creek/ Nubbin Slough
C-8	S-268	3	10	151	CMP		

(8) REACH AREA PROBLEM AREAS DUE TO NO ENFORCEMENT ACTION TO IMPROVE RUN-OFF FROM AGRICULTURE - BMP'S ARE VOLUNTARY AND SELDOM ENFORCED AT ALL BY FDEP PEOPLE. COMES TO MY MIND IS THAT FDEP IS RUN BY AGRICULTURE PEOPLE.

Table 3-2. Additional HHD Culverts Summary

Culvert Name	Entity	Barrels	Size (ft.)	Pipe Length (ft.)	Barrel Type	Reach	Basin
S-169	SFWMD	3	7	60	CMP	2	South Shore
S-235	SFWMD	2	6	70	RCP	4	Caloosahatchee
S-47B	SFWMD	2	8	38	CMP	4	Nicodemus Slough
S-129	SFWMD	1	8	119	CMP	6	Istokpoga
S-131	SFWMD	1	8	217	CMP	6	
S-127	SFWMD	1	8	131	CMP	8	
S-154	SFWMD	2	8x10	117	CBC	5	Taylor Creek-Nubbin Slough
S-154C	SFWMD	1	6	136	RCP	5	
S-192	SFWMD	1	4	112	RCP	5	
S-135	SFWMD	2	8	161	CMP	7	S-135 Basin*
IPPC-1	Private	1	3	N/A	CMP	N/A	N/A
IPPC-2	Private	1	3	N/A	CMP	N/A	N/A

* Basin description not included because inflow provides negligible impact on Lake Okeechobee stages

AGRICULTURE DROP POINTS TO LAKE OKEECHOBEE

Lock Structures

The Corps, the SFWMD, and other private entities operate and maintain several other water control structures around Lake Okeechobee for navigation, such as locks. **Table 3-3** summarizes lock structures around Lake Okeechobee. See **Figure 3-4** for a structure location map.

Table 3-3. Lock Summary

Lock	Owner	Name	Reach	Basin
S-308B	Corps	Port Mayaca	1/7	South Shore
S-310	Corps	Clewiston	2	
S-77	Corps	Moore Haven	4	Caloosahatchee
S-131	SFWMD	Lakeport	6	Istokpoga
S-127	SFWMD	Buckhead Ridge	8	
S-65E	SFWMD	Kissimmee River		Kissimmee
S-193	SFWMD	Taylor Creek	5	Taylor Creek-Nubbin Slough
S-135	SFWMD	N/A	7	S-135 Basin*
G-36	Private	Henry Creek		S-135 Basin*

* Basin description not included because inflow provides negligible impact on Lake Okeechobee stages.

AGRICULTURE RUN-OFF TO LAKE OKEE

Pump Stations and Spillways

Several pump stations and spillways are operated along Lake Okeechobee to provide flood relief, irrigation water, and water supply to downstream property owners and municipalities. Many pump stations are adjacent to and operated in conjunction with spillways, locks, and culverts. All pump stations are operated by the SFWMD and have the ability to pump nearly 12,000 cfs at maximum operating capacity.

Additionally, there are several spillways on the tributary systems which assist in flood control, water supply, and irrigation needs. These spillways are owned and operated by the Corps and/or the SFWMD in accordance with the LORS 2008. All of the spillways operate with vertical lift gates that allow flow to spill over the crest. Locations of all pump stations and spillways can be found on **Figure 3-4**. **Table 3-4** summarizes pump station information; **Table 3-5** summarizes spillway information.

Table 3-4. Pump Station Summary

Pump Station Number	No. of units	Max cfs	Reach	Basin
S-2	4	3600	1/3	South Shore
S-3	3	2670	2/3	
S-4	3	2805	2	
S-236	3	255		
S-131	2	250	6	Istokpoga
S-129	3	375		
G-207	1	135		
S-208	1	135	8	
S-127	5	625		
S-133	5	625	5	Taylor Creek - Nubbin Slough
S-135	4	500	7	S-135 Basin*

* Basin description not included because inflow provides negligible impact on Lake Okeechobee stages.

Table 3-5. Spillway Summary

Spillway No.	No. of gates	Max cfs	Reach	Basin
S-47D	1	1195	4	Caloosahatchee
S-77	4	9300	2/4	
S-71	3	6800	6	Istokpoga
S-72	2	3800	6/8	
S-84	2	9000	8	
S-65E	6	26000	8	Kissimmee
S-135	2	500	7	S-135 Basin*
S-191	3	7440	5/7	
S-153	2	4400	1/7	S-308C Basin*
S-308	4	17000	1/7	L-8 Basin*
S-351	3	2400	1	South Shore
S-352	2	1250	1	
S-354	2	2000	2/3	

* Basin description not included because inflow provides negligible impact on Lake Okeechobee stages.

Existing Canals

Major outflow canals from Lake Okeechobee include the Caloosahatchee River (C-43), St. Lucie River (C-44), Miami Canal, North New River Canal, Hillsboro Canal, and the West Palm Beach Canal. The Caloosahatchee River and the St. Lucie River are the primary outlets for release of floodwater when the lake is above regulation stages. Releases are controlled by a regulatory schedule and zones (USACE 2008).

The Caloosahatchee River (C-43), extending 52.8 miles from Lake Okeechobee, provides drainage for an area of about 1,230 square miles. The canal provides water control for the area adjacent to C-43 to prevent excessive depletion of groundwater during normal or dry periods. It also provides regulatory discharge capacity for Lake Okeechobee; serves as a navigation channel as part of the Okeechobee Water Way (OWW); and prevents saltwater intrusion and maintains freshwater supplies in the lower reaches of the Caloosahatchee River. Structure S-77, S-78, and S-79 in the Caloosahatchee River maintain normal pool elevations in the canal to prevent excessive velocities.

The St. Lucie River begins at Port Mayaca (S-308) and extends 23.9 miles east. The canal provides drainage for a 245-square mile area and for regulatory discharges for Lake Okeechobee. The canal also serves as a navigation channel as part of the OWW and prevents saltwater intrusion. Structure S-80 maintains normal regulated pool elevations in the canal.

Smaller outlet sources include the Miami, North New River, Hillsboro, and West Palm Beach Canals. The Miami Canal extends from Lake Okeechobee at pump station S-3 southeast to Miami-Dade County, by way of the S-8 pump station and through Water Conservation Area 3A. The Miami Canal is the primary drainage component of the S-3 and S-8 basins, the South 298 Drainage Districts and C-139 basin. The North New River Canal extends from Lake Okeechobee at pump station S-2 to pump station S-7, bordering Water Conservation Areas 2A and 3A, and on eastward to Ft. Lauderdale. The North New River Canal is the primary drainage feature of the S-2 and S-7 basins in the EAA. The Hillsboro Canal extends from Lake Okeechobee at the S-351 structure eastward to tide near Boca Raton. The West Palm Beach Canal extends from Lake Okeechobee at S-352 eastward to tide south of West Palm Beach.

Embankments

The existing HHD totals about 143 miles in length with crest elevations ranging from 30 to 45 feet NAVD88. Adjacent land elevations typically range from 8 to 19 feet NAVD88. Lakeside levee slopes vary from one foot vertical to three feet horizontal (1V:3H) to 1V:10H and landside slopes range from 1V:2H to 1V:5H. In addition to the main levees, there are several tie back levees on the Kissimmee River, Indian Prairie Canal, Harney Pond Canal, and Fisheating Creek. These tieback levees are considered part of the HHD system. The HHD is used for water storage and water control structures follow an operational schedule, whereas a dike does not have such characteristics (USACE 2008).

3.5 WATER QUALITY

Surface Water

Lake Okeechobee is a multipurpose reservoir providing drinking water for urban areas, irrigation water for agricultural lands, recharge for aquifers, freshwater for the Everglades, habitat for fish

Drinking Water for All of South Fla.

and waterfowl, flood control, navigation, and many recreational opportunities. Lake Okeechobee has been designated by the FDEP as a Class I water body (drinking water supply). The surface water in the HHD toe ditch and nearby canals meets most Class III water quality standards (recreation and maintenance of healthy fish and wildlife populations). However, the water in Lake Okeechobee and canals has elevated concentrations of nutrients (primarily phosphorus and nitrogen). The Clean Water Act requires states to classify their surface waters according to designated uses and to develop water quality standards. If water bodies are not meeting the standards, states are required to develop Total Maximum Daily loads (TMDLs). The TMDLs establish the maximum amount of a pollutant that a water body can assimilate without causing an exceedance of water quality standards. Nutrient loads within the Lake Okeechobee Basin are regulated under the LOPA. State agencies developed the Lake Okeechobee Protection Plan (LOPP) to outline strategies to reduce phosphorus loading to the lake and to meet the total phosphorus TMDL of 140 metric tons by 2015. The LOPP specifies the implementation of Best Management Practices, Basin Management Action Plans (BMAPs), which allocate discharge reductions to the various stakeholders within the watershed or river basin, and construction of large regional facilities to capture phosphorus. The plans contain a schedule for subsequent phases of phosphorus load reduction consistent with the TMDLs. The FDEP has a five-year cycle for setting and updating TMDLs and BMAPs. A reduction in Lake Okeechobee phosphorus is desired, in part, to reduce the occurrence of blue-green algal blooms in the lake, and to reduce the adverse effects of phosphorus on downstream systems, including the Caloosahatchee River Basin and the St. Lucie River Basin. During high lake stages conditions, large volumes of water are released from Lake Okeechobee and sent to the Caloosahatchee and St. Lucie Estuaries. These large flow events are undesirable because they contribute to harm in the downstream estuaries (USACE 2007d).

NOTE-STATE FAILED TO MEET 2015 DATE SO WHERE DO WE GO FROM HERE PEOPLE

Groundwater LAKE OKEECHOBEE CLASS #1 DRINKING WATER SUPPLY

Groundwater quality varies throughout the five counties surrounding Lake Okeechobee, depending on geographic location and the subsurface aquifer characteristics. Two aquifer systems are present within Okeechobee County. These are the SAS and the FAS, which are separated from one another by a thick and impermeable Hawthorn Group sediments. Water quality within the SAS in most areas of Okeechobee County is considered suitable for drinking water supply.

Similarly, in Glades County, two aquifer systems are present beneath the entire county, the SAS and the FAS. The Intermediate Aquifer System is present in the western third of the county. The SAS yields low to moderate quantities of potable water in most areas of Glades County, except for the area near Lake Okeechobee, and in the western area of the county near the border with Charlotte County. The Intermediate Aquifer System is present in the western portion of Glades County but yields only small to moderate quantities of relatively good quality water. The FAS is utilized primarily for irrigation. Throughout most of the county it is highly mineralized and would require expensive treatment to meet public drinking water standards. However, in the northwestern corner of the county the FAS water quality generally meets drinking water standards. WHAT ARE YOU ABOUT THIS GENERALLY STUFF IT DOES OR DOES NOT MEET FAS QUALITY

In Hendry County, the SAS is the primary source of groundwater throughout the county and is composed of two aquifers, the Water Table Aquifer and the Lower Tamiami Aquifer. Water quality within the SAS is considered poor in the Everglades area in the northeastern corner of the county where incomplete flushing of connate seawater, or FAS irrigation water, has left high

chloride and total dissolved solids concentrations (SFWMD 1989). The FAS in this area is highly mineralized and for this reason it is not used as a source of potable water.

NOTE - WE MUST MEET SAS QUALITY BEFORE SOME ON GETS SICK

Two aquifer systems are present in Martin County that provide drinking water and irrigation water. These are the SAS and the FAS, which are separated from one another by the thick and impermeable Hawthorn Group sediments. The SAS is the primary source of drinking water throughout the county. The FAS is an alternate source of agriculture and potable water supplies.

The surficial groundwater aquifer surrounding Palm Beach County, the vicinity of the eastern and southern portions of the HHD extends from the land surface (8.7 feet NAVD88) to a depth of -180 feet. In the vicinity of HHD, the upper portion of this aquifer is potable to a depth of approximately -50 feet elevation. Rural houses and agricultural operations adjacent to the eastern and southern portions of Lake Okeechobee use shallow wells as a source of drinking and irrigation water. The groundwater below elevation -50 feet is not considered potable due to its high salt content.

The quality of the groundwater in the lower portion of the SAS is compromised by the presence of remnant seawater (Reese and Wacker, 2009), which has a high salt content and renders much of this water unsuitable for most potable and agricultural uses. The cities of Belle Glade, Pahokee, and South Bay historically drew their potable water supply from Lake Okeechobee because of the poor quality of the SAS and the underlying FAS in this part of Florida. Agricultural water demand in this area is generally met by water delivered through an extensive surface water canal network. Despite the poor water quality of the surficial aquifer, there are water supply wells that are primarily use the water for irrigation, though some of the shallower wells may be used as a source of potable water.

The USACE and the U.S. Geological Survey have been monitoring groundwater quality in the vicinity of the HHD Levee in Reaches 1, 2, and 3 since 2011 (Prinos and Valderrama, 2015). Groundwater quality is characterized using geophysical induction logging methods, in which the relative tendency of saturated sediments to conduct an induced electric charge is measured. Saline water has a greater tendency to conduct an electric charge, so saline water shows higher values of bulk conductivity. Most of the logging was conducted in Palm Beach County (CIZ A), where the saltwater interface is clearly defined in the SAS. Some of this monitoring occurred prior to the cutoff wall installation in Reach 1 which was completed in 2013. **Figure 3-5** shows a monitoring well at Segment 22 (PB-1815). The cutoff wall at this location is placed to a depth that is 30 or more feet above the elevation of the interface between fresh groundwater and saline groundwater. Induction logs at this monitoring well show that the cutoff wall has not had a significant effect on groundwater quality, as shown by a repeated pattern with depth over a four-year period. This is likely because the cutoff wall does not restrict all of the fresh groundwater that flows from the lake side of the levee landward. In contrast, **Figure 3-6** shows induction logs from a monitor well (PB-1819) in which the observed change in the saltwater interface became shallower subsequent to the installation of the cutoff wall in Segment 24. Based on the data available to date, it appears that the cutoff wall has caused the saltwater interface depth to decrease by about 10 feet. Given that each successive measurement shows a smaller change in the zone of interest in comparison to the prior measurement event, it is likely that the elevation of the saltwater interface is equilibrating. As long as the saltwater interface is substantially below the bottom of drainage and water supply ditches, the impact of the reduced depth of saline water is likely to be limited to those water supply wells located within the zone of influence of the cutoff wall and are screened at the depth of the cutoff wall tip. There are no monitoring wells placed in

the 500 to 1,000 foot downstream range from the levee so at present the USACE cannot determine the maximum distance from the levee that changes to groundwater saline interface depth occur; however, density dependent groundwater modeling simulation results indicate that this distance is likely less than 1,500 ft. In the vicinity ofSegment 23, there is some recent evidence of increased chloride concentrations in surface water drainage/supply canals that are located within 500 or so feet of the HHD levee. This area in the vicinity of Sand Cut has at least two active rock mines that may be possible sources of the elevated concentrations in the surface water. It is possible, though not proven, that installation of the cutoff wall in this location may contribute to the observed increase in surface water chloride concentrations. The Corps and USGS continue to conduct groundwater monitoring in Reaches 1, 2, and 3 to further understand the impact of the cutoff wall on groundwater and surface water quality. GOOD IDEA PEOPLE

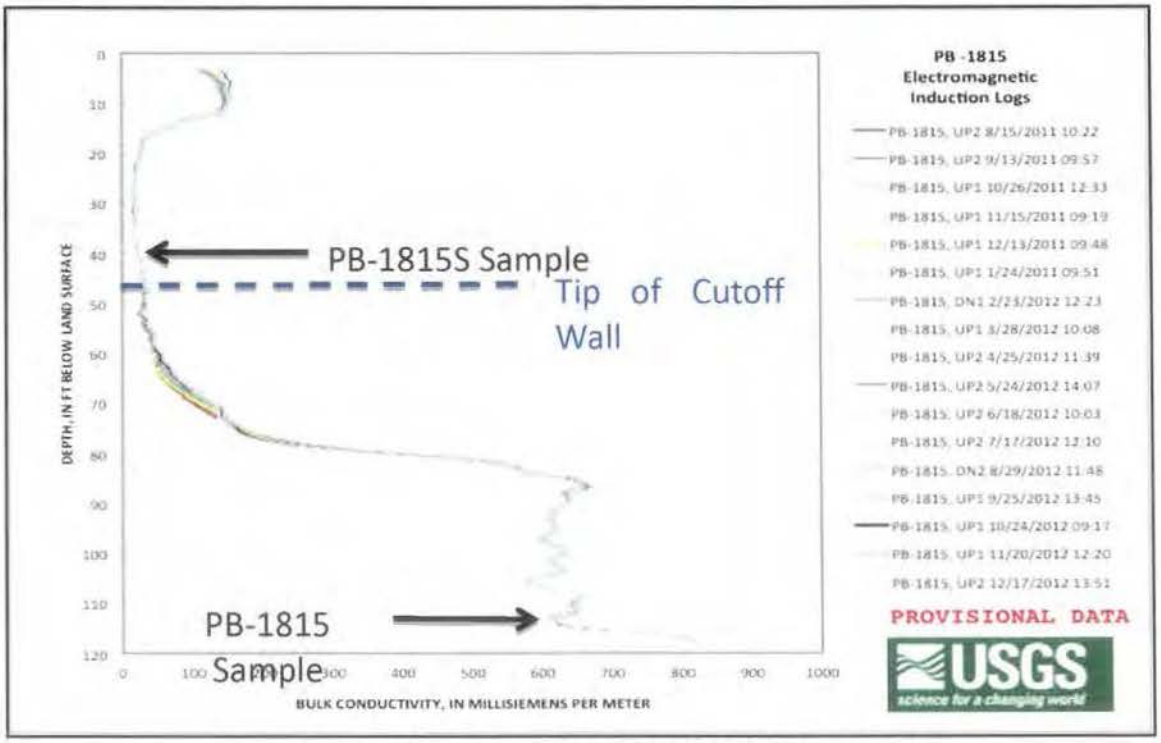

Figure 3-5. Bulk Conductivity at PB-1815 Well (Segment 22)

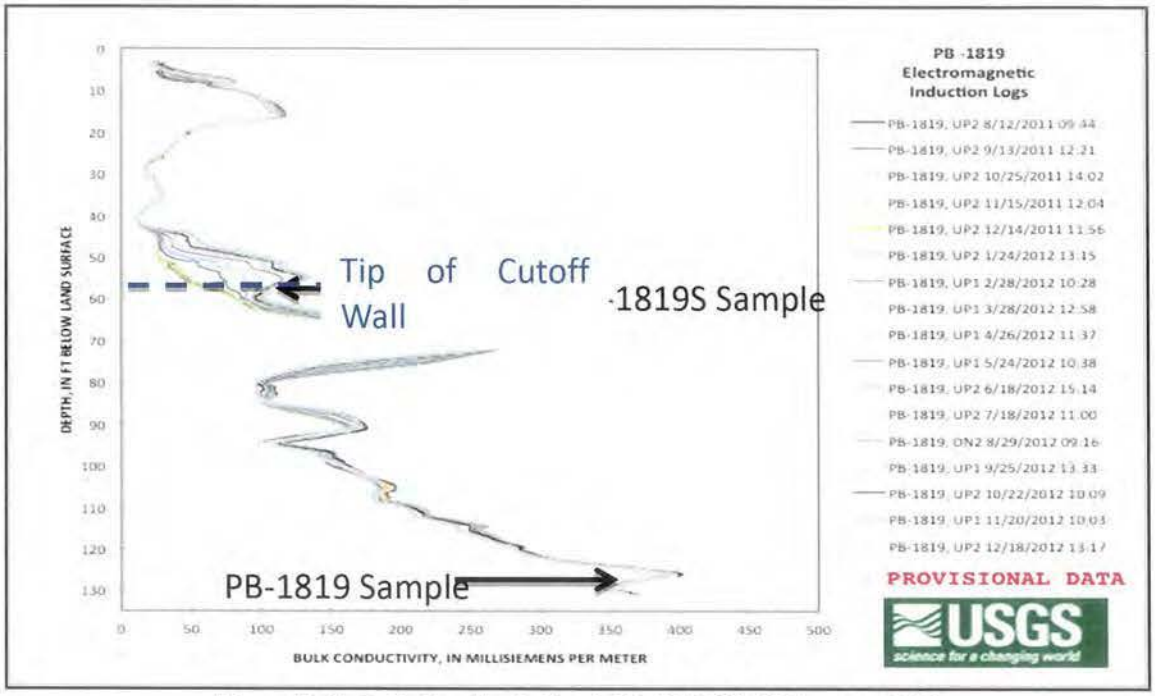

Figure 3-6. Bulk Conductivity at PB-1819 Well (Segment 24)

Saltwater Interface Characteristics in CIZ B (area of the TSP)

Additional monitor well clusters were constructed in the area during 2015 to supplement two existing monitor wells locations. Groundwater quality sampling and induction logs were obtained from all new well clusters. The depth and salinity of the saltwater interface in CIZ B wells differ from those in CIZ A. The saltwater interface occurs at greater depth, and the contrast in chloride concentration between overlying fresh groundwater and saltwater is not as great in CIZ B wells. **Figure 3-7** shows the induction log, chloride concentrations, and the proposed range of cutoff water termination depths for Segment 6 near Moore Haven.

Bulk conductivity values are significantly lower, indicating lower salinity in well G-333 at depth along CIZ B (100 to 200 mS/m at -60 to -80 ft NAVD88; **Figure 3-7**). For comparison, bulk conductivity values range between 100 and 600 mS/m at depths of -40 to -100 ft NAVD88) ft in Palm Beach County wells (CIZ A, **Figures 3-5** and **3-6**).

Chloride concentrations are considered elevated when they exceed the drinking water standard of 250 mg/L. Along CIZ B, chloride concentrations that exceed 250 mg/L (along with bulk conductivity values that exceed 100 mS/m) are found at elevations greater than approximately -50 ft NAVD88. The maximum cutoff wall elevation proposed for CIZ B is -30 ft NAVD88. The proposed cutoff wall will not intrude directly on the deeper, less saline saltwater interface in that area. Changing hydrologic flowpaths could cause some displacement of the saltwater interface at depth in CIZ B. However, groundwater quality changes are unlikely in this area due to the deeper occurrence and more dilute nature of the saltwater interface. "UNLIKELY", IS THAT THE SAME AS ASS/U/ME PEOPLE

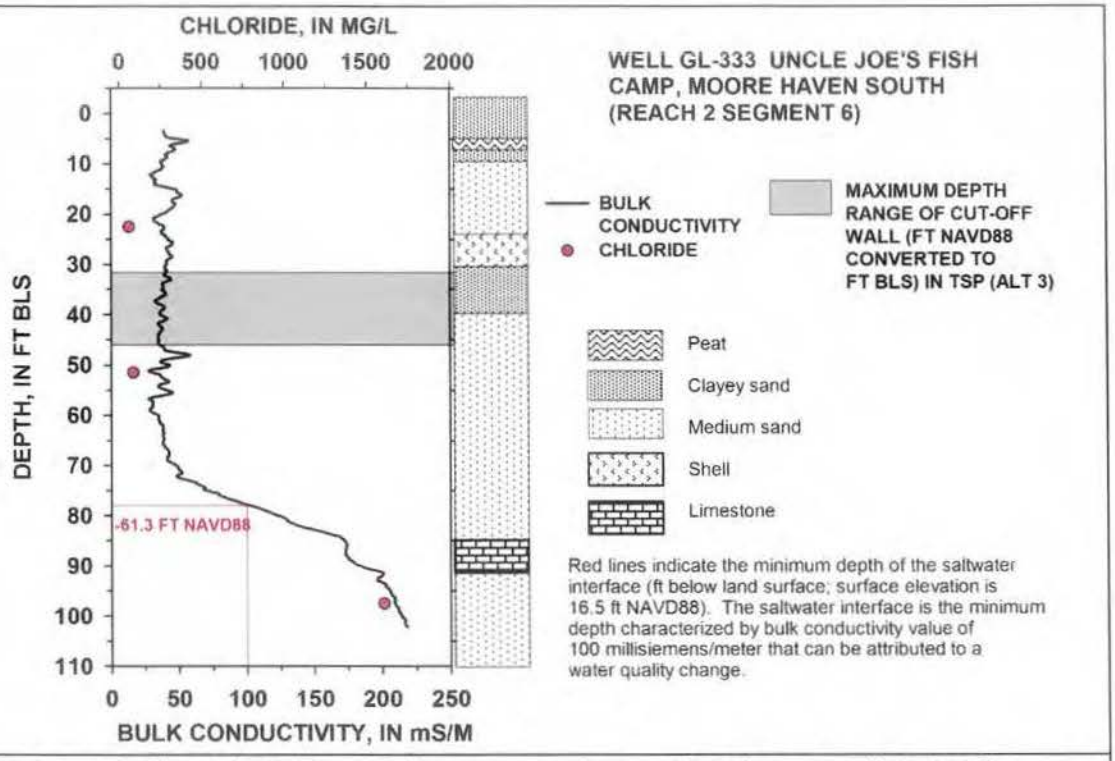

Figure 3-7. Bulk conductivity, chloride concentration, and lithology at well GL-333 (Segment 6)

3.6 VEGETATION

The vegetation within the Lake Okeechobee region has 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. WE MUST STOP RUN-OFF WATERS FROM AGRICULTURE OPERATIONS. WE NEED WETLANDS.

Landward of the HHD, sugarcane plantations, improved pasture, row crops, and urban lands now prevail. The HHD itself is covered with mixed grasses and some shrubs and trees that are mowed on a regular basis. The exotic invasive plants melaleuca (*Melaleuca quinquenervia*), Australian pine (*Casuarina* sp.), and Brazilian pepper (*Schinus terebinthifolius)* are found throughout the area. Wetland vegetation can be found in the toe ditch of the HHD though this vegetation is mowed during regular maintenance activities to allow inspection of the toe of the HHD embankment. GOOD IDEA In the toe ditch and the network of canals, exotic and 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.).

The major cover types lakeward of the HHD include openwater and freshwater marshes. A 98,000-acre (154-square-mile) littoral zone is found along Lake Okeechobee'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. Emergent vegetation within the littoral zone is dominated by cattail, spike rush (*Eleocharis* sp.), and the nuisance exotic torpedo grass (*Panicum repens*). AGRICULTURE RUN-OFF WATER FULL OF FETERLIZER,

Submerged vegetation, such as tape grass (*Vallisneria americana*), is abundant within the photic zone of Lake Okeechobee.

3.7 WETLANDS

REDUCED WETLANDS DUE TO IMPROVED PASTURES

Wetlands in the Lake Okeechobee area, though greatly reduced in area and quality through human impact, still exist as valuable ecosystems both landward and lakeward of the HHD. Lake Okeechobee hydraulically feeds wetlands beyond the dike, providing freshwater for the Florida Everglades to the south and for the Water Conservation Areas in Palm Beach and Broward Counties. Low quality wetlands also occur in the toe ditches around the HHD. Typical vegetation in the toe ditch wetlands includes baby bluestem (*Andropogon* spp.), rush fuirena (*Fuirena scirpoidea*), bald cypress (*Taxodium distichum*), begger's tick (*Torilis arvensis*), matchhead (*Phyla* sp.), alligator weed (*Alternanthera philoxeroides*), Brazilian pepper, common reed (*Phragmities austalis*), common hackberry (*Celtis occidentalis*), elderberry (*Sambucus nigra* subsp. *canadensis*), smartweed (*Polygonum* sp.), southern willow (*Salix caroliniana*), cabbage palm (*Sabal palmetto*), sweetscent (*Pluchea odorata*), day flower (*Commelina* sp.), pennywort (*Hydrocotyle* sp.), Australian pine, water hyacinth, cattails, and water lettuce. Although wetlands present on the landward side of the HHD (toe ditch) may not be considered high quality ecosystems, they host small fishes and invertebrates and provide usable foraging habitat for wading birds, alligators, and turtles. High quality wetland habitat can be found in the extensive littoral zone covering the western side of Lake Okeechobee. This habitat (littoral zone) is outside of the proposed project footprint.

DUCK HUNTERS CALL THIS AREA THE SWAMPS, OR LAND IN THIS AREA IS GREAT FOR DUCKS

3.8 THREATENED AND ENDANGERED SPECIES

The U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and State of Florida have designated certain species of reptiles, birds, mammals, gastropods, and plants and lichens in Glades, Hendry, and Palm Beach counties as threatened or endangered (**Table 3-6**). Several of these listed species have been observed within the vicinity of the HHD. Additional detail can also be found in the USFWS draft Fish and Wildlife Coordination Act Report (CAR) included in Appendix E.

Table 3-6. Federal and State Listed Plant and Animal Species Occurring in Glades, Hendry, Martin, Okeechobee, and Palm Beach Counties, Florida

Scientific Name	Common Name	Federal Status	State Status
Amphibians			
Rana capito	Gopher frog	Not listed	S*
Reptiles			
Caretta caretta	Loggerhead sea turtle	Threatened	Threatened
Chelonia mydas	Green sea turtle	Endangered	Endangered
Crocodylus acutus	American crocodile	Threatened	Endangered
Drymarchon couperi	Eastern indigo snake	Threatened	Threatened
Eumeces egregius lividus	Bluetail mole skink	Threatened	Threatened
Gopherus polyphemus	Gopher tortoise	Candidate	Threatened
Pituophis melanoleucus mugitus	Florida pine snake	Not listed	S
Birds			

blading, air boating and hiking. Recreation facilities associated with Lake Okeechobee include: 37 picnic sites, 309 individual camp sites, 4 playgrounds, 1 public swimming area, 1 marina with 41 boat slips, 29 boat ramps, 12 general recreation areas, and hundreds of acres open to hunting. Annual visitation based on a five-year average (2006-2010), amounts to 5,616,000 recreation visits per year. Data for specific recreation activities in these years were obtained from the Institute for Water Resources (IWR) "Lakes Gateway" website. According to the IWR 2010 *Lake Level Report*, it is estimated that visitors to Lake Okeechobee spend approximately $172 million per year, directly supporting more than 1,800 local jobs.

Additionally, Lake Okeechobee supports an active commercial and recreational fishing industry. This includes several different types of commercial fishing operations and landside support activities, such as marinas and wholesale and retail distribution facilities. There are commercial fisheries on Lake Okeechobee that harvest the American alligator. Alligators are harvested from the lake population to supplement the stock in alligator farming operations. Recreational fishing tournaments are held on the lake multiple times a year.

The depth of Lake Okeechobee also makes commercial navigation on the lake possible. There are two navigation routes in Lake Okeechobee, including Route 1 through the center of the lake and Route 2 along the south shore of the lake. Only Route 1 is fully maintained at its authorized depth for commercial navigation. 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 from Pahokee during the tourist season. As stated in Section 3.11 above, the OWW allows passage of boats between the Atlantic Ocean and the Gulf of Mexico through Lake Okeechobee.

Other than agriculture, recreation, tourism, commercial fishing, and navigation, secondary economic activities include: services (banking, insurance, etc.) healthcare, education, and government activities. Examples of the above include: the Lakeside Medical Center, the Belle Glade Elementary School, Lake Shore Middle School, Glades Central High School, and the West Palm Beach County Technical Education Center. Also, the Town of Moore Haven is the seat of government for Glades County, so there are several public buildings in the town.

3.12.2 Demographics

The majority of the study area is rural and agricultural. However, there are a number of towns and cities located in close proximity to the HHD (see **Figure 3-13** and **Table 3-7**). In most of these communities, homes, business and public buildings can be found within 100 feet of the dike. The largest of the communities is Belle Glade, located near the Hillsboro Canal with a population of more than 17,000 people. The study area also includes the Brighton Seminole Indian Reservation in Glades County, which is home to approximately 600 people.

THESE AREAS ARE ALL SMALL TOWN AREAS IN POOR HOMES AND SMALL BUSINESSES. MOST ARE HIGH CRIME AREAS IN THE POPULATED AREAS. DUE TO VERY SMALL TO NO LAW ENFORCEMENT.

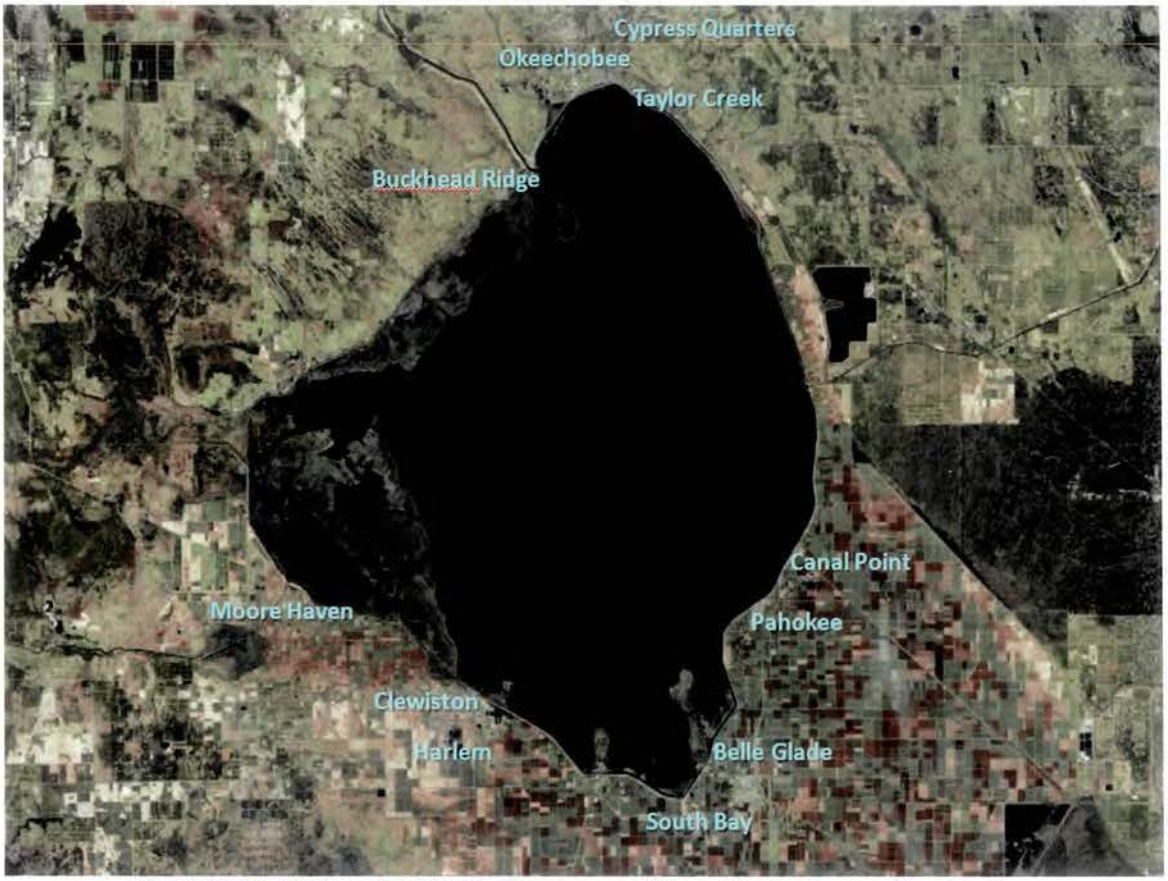

Figure 3-13. Major cities in study area considered in demographics study.

Table 3-7. Major Population Centers Subject to Flooding*

City / Town	County	2010 Population
Pahokee	Palm Beach	5,649
Belle Glade	Palm Beach	17,467
South Bay	Palm Beach	4,876
Clewiston	Hendry	7,155
Harlem	Hendry	2,658
Moore Haven	Glades	1,680
Buckhead Ridge	Glades	1,450
Okeechobee	Okeechobee	5,621
Taylor Creek	Okeechobee	4,348
Cypress Quarters	Okeechobee	1,215

*Please note: Population estimates in this table do not include very small towns (Canal Point, Lake Harbor, Bryant, Lakeport, etc.) in the inundation zones or population at risk in unincorporated areas of Palm Beach, Martin, Hendry, Glades, and Okeechobee counties. The table also does not include population associated with the Brighton Indian Reservation in Glades County.

In general, these are diverse, relatively low income communities. Hendry, Glades, and Okeechobee counties all have median household incomes that are less than the state average. They also have a relatively high proportion of households below the poverty line (**Table 3-8**). Palm

POOR PEOPLE RELATE TO HIGH CRIME AREAS

Beach County has an above average median income, but the communities in the county near the HHD (Pahokee, Belle Glade, and South Bay) have socioeconomic characteristics much more similar to Hendry and Glades counties.

Table 3-8. Economic characteristics of counties adjacent to Lake Okeechobee

	Median Household Income	Persons below poverty line
State of Florida	$47,827,000	14.70%
Hendry County	$37,989,000	26.00%
Glades County	$39,611,000	19.50%
Okeechobee County	$36,929,000	23.70%
Palm Beach County	$52,951,000	13.30%

The primary economic activity throughout the study area is agriculture. The Everglades Agricultural Area (EAA), located directly south of Lake Okeechobee consists of more than 700,000 acres of productive agricultural land, the vast majority of which is under active sugarcane cultivation. In addition to sugarcane, crops grown near the lake include citrus and winter vegetables. Some pasture lands for livestock are also located near the lake. AGRICULTURE RUN-OFF IS OUR MAJOR PROBLEM FOR LAKE OKEECHOBEE

3.13 PUBLIC SAFETY

The HHD system is paramount to public safety. With six times more inflow capacity to the lake versus outflow capacity, the dike provides flood risk management not only to towns immediately adjacent to the dike, but to a vast area south of the lake. Due to signs of dike instability during high water stages in the lake after 2004 and 2005 hurricanes in South Florida, the SFWMD contracted for an expert review panel of the stability and safety of the HHD. Particular emphasis was placed on the structural stability of the dike with regard to seepage and water pressures within the embankment and erosion and potential overtopping concerns during large storm events. The technical review concluded that the current condition of the HHD poses imminent risk to the people and the environment of South Florida (BCI 2006). Throughout the life of HHD and the recent Dam Safety Modification Study, the Corps has also conducted many modeling studies to determine the risk to the public if a breach were to occur.

The term "dike failure" implies a catastrophic breaching of some portion of the HHD system. This situation would result in widespread flooding, as waters from Lake Okeechobee pass through the breach and onto adjacent lands. NOTE - ALL BREACHED WATER WILL RUN TO THE SOUTH AWAY FROM AREA TO THE EVERGLADES AREAS

3.14 REAL ESTATE

The geographic area for the project is located in southern Florida encircling Lake Okeechobee. The lands encircling Lake Okeechobee known as the HHD are approximately 143 miles of real estate that cross several counties in the State of Florida. The Federal Government has approximately 7,802 acres of interests in real estate to support construction and the operation and maintenance (including staging areas, borrow, or disposal sites) for the HHD. These lands are on the north side near Okeechobee in CIZ E, Segments 18A and 18B, and CIZ F, Segments 19A, 19A-2, 19A-3, 19B, and 19C and on the south side near CIZ A, Segments 22, 23, 24, 1, 2, and 3 and CIZ B, Segments 4, 5-2, 5, 6, 7, 8, 9, and 10. The SFWMD has approximately 2,413 acres of interests in real estate that have been certified to the Federal Government to support construction, operation and maintenance (including staging areas, borrow, or disposal sites) for the HHD. These

lands are in CIZ C, Segments 11, 12, 13 and 14A, CIZ D, Segments 14B, 15, and 16, and CIZ E, Segments 17 and 18A-2. Currently, there are a number of public roads providing access to the HHD.

3.15 HAZARDOUS, TOXIC AND RADIOACTIVE WASTES

Hazardous, toxic, and radioactive waste (HTRW) surveys have been conducted as part of EAs and EISs prepared as part of the prior HHD rehabilitation efforts. In December 2007, a HTRW survey of the HHD was conducted using aerial imagery and a contaminated site and petroleum storage site database compiled by the FDEP. A visual survey was conducted to verify the findings of the desktop survey. The survey was updated in August 2009 for the Reach 1A Supplemental EIS (USACE 2010) and in February 2010 for L-D1 and L-D2 and January 2014 for additional levees and remaining Federal right-of-way. The purpose of the additional surveys was to preliminarily identify potential contamination sites within 500 feet of the HHD in remaining reach areas. The results of these surveys show that agricultural and rural residential development has resulted in the HTRW contamination in areas adjacent to the HHD. A subsequent survey conducted as part of this EIS found 27 locations where petroleum has been stored or released within 100 ft of the levee right-of-way. **Table 3-9** is a list of these sites by location, ownership, and status. Five of these sites have been closed and the storage tank or release has been removed. Twelve of the petroleum storage sites are operational and require ongoing monitoring for releases. Seven sites have been closed and required no clean up action. Two sites require clean up actions. The S-12A and S-127 structures have contamination present such that cleanup is required. As of August 2014, there is no plan to remediate the S-127 site. At the S-12A structure in Reach 1, the FDEP spill database shows that a release of approximately 4,000 gallons of diesel occurred in 1991. The Corps and FDEP are coordinating remediation actions to minimize disruption of construction during the replacement of the S-12A structure which will began in early 2015.

Table 3-9. List of Petroleum Storage Facilities within 100 ft. of HHD Right-of-Way (Listed in clockwise order from Port Mayaca)

Site Name	Reach	Operator	Status
S-308 (Port Mayaca Lock)	1	Corps	Ongoing Monitoring
Pahokee Camp Ground	1	City of Pahokee	Ongoing Monitoring
S-12	1	East Shore W. Control District	Cleanup Completed
S-12A	1	New Hope Sugar Company	Cleanup Underway
Torry Island	1	SFWMD	Cleanup not required
S-2 Pump Station	1	SFWMD	Cleanup Completed
Maintenance Shop	3	South Bay	Cleanup not required
South Shore Pump Station	3	South Shore Drainage District	Ongoing Monitoring
Spill Site	2	Hialeah Transport Inc.	Cleanup Completed
S-3 Pump Station	2	SFWMD	Ongoing Monitoring
S-236 Pump Station	2	SFWMD	Ongoing Monitoring
S-310 Pump Station	2	SFWMD	Cleanup not required
S-169 Structure	2	SFWMD	Cleanup not required
S-4 Pump Station	2	SFWMD	Cleanup not required
Diston Island Pump #1	2	Diston Island	Ongoing Monitoring
Diston Island Pump #2	2	Diston Island	Ongoing Monitoring

Site Name	Reach	Operator	Status
S-78 (Moorehaven Lock)	4	Corps	Ongoing Monitoring
Road Dept. Maintenance Facility	4	Glades County	Ongoing Monitoring
Pierce Property Pump	4	SFWMD	Ongoing Monitoring
S-131 Structure	6	SFWMD	Cleanup completed
S-129 Structure	6	SFWMD	Ongoing Monitoring
S-127 Structure	8	SFWMD	Cleanup Required
S-133 Structure	5	SFWMD	Ongoing Monitoring
S-193 Structure	5	SFWMD	Cleanup completed
S-191 Structure	5	SFWMD	Cleanup not required
G-36 Structure	5	SFWMD	Cleanup not required

3.16 RECREATIONAL RESOURCES

A general discussion of recreational resources is described in Section 3.12.1.

Lake Okeechobee Scenic Trail (LOST)

The 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. This is a mostly double-track trail that offers recreation opportunities for hiking, biking, horseback riding, roller-blading and fishing around the lake. Many portions of the trail are paved. Pedestrians and mountain bikers are able to access the trail from many locations in towns adjacent to the HHD. Informational signs along the roadways direct recreational users to the LOST access points as well as wildlife viewing locations. Equestrians are able to access the trail from various locations in the project area as well.

Fishing and Boating

Lake Okeechobee offers a wide-range of fishing opportunities. There are more than 60 species of fish in the lake, the most sought-after game fish being largemouth bass, catfish, and black crappie. Fishing tournaments are regularly held throughout the year. Boats can access the lake through navigation locks and boat ramps. Public boat ramps are available for use at the Moore Haven Lock and Dam, Alvin Ward Park, Lake Observation Point (Bare Beach), the Clewiston Recreation Area, and the South Bay Boat Ramp. Another fishing and boating resource in the area includes Uncle Joe's Fish Camp at Liberty Point, which dates back to the 1940s. FROM OCT THRU APRIL WE SEE A LARGE LAKE USE AND POPULATION TRIPPLE IN SIZE

3.17 AESTHETIC RESOURCES

There are many public access points to view Lake Okeechobee from the elevated vantage point of the length of the HHD crest. In addition, the LOST runs atop the HHD around the entire lake, totaling approximately 110 miles.

The HHD crest affords panoramic views of the flat agricultural (mostly sugarcane) fields and rim canal to the south, southwest, and southeast. The extensive littoral zone on the west side of the lake's perimeter can be viewed from the dike in Reach 2. The littoral zone plant community is composed of a mosaic of emergent and submerged plant species. Emergent vegetation within the littoral zone is dominated by cattail, spike rush, and torpedo grass.

NOTE - OUR WINTER GUEST ARRIVE ON NOV of ONE YEAR AND STAY UNTIL APRIL OF THE NEXT YEAR

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 pond, picnic areas, restrooms, a large grassy field, an outdoor basketball court and a boat ramp. There are several parks adjacent to the HHD, and along the northern area. These parks include resources such as ponds, bird viewing areas, picnic areas, restrooms, grassy fields, boat ramps, and other amenities.

3.18 CULTURAL RESOURCES

The earliest widely accepted date of occupation by aboriginal inhabitants 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 near the HHD. During the Archaic period (ca. 7500 B.C. - ca. 500 B.C.), a wider range of resources was exploited and may have led to a more sedentary existence. Few Archaic period archeological sites are recorded in south Florida. Known sites are clustered along the Atlantic and Gulf coasts and inland waterways. No Archaic period sites are located near the dike, as recorded in the Florida Master Site File (FMSF). In the Okeechobee Basin, the Belle Glades culture sequence (ca. 500 B.C. - A.D. 1500) follows the Archaic. 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, a native tribe, inhabited southern Florida. Their population was decimated by European-introduced diseases, warfare, enslavement, and migration out of Florida. 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. 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. By 1921, there were 16 settlements on or near Lake Okeechobee, with a total estimated population of 2,000. By the 1940's, a number of homes had been built in this area forming historic districts potentially eligible for listing on the National Register of Historic Places.

NOTE- THIS IS WHERE OUR WATER PROBLEM BEGAN ALSO →

A review of the FMSF lists both prehistoric and historic archeological sites located in the near vicinity of the HHD. Prehistoric Native American sites consist of middens, mounds and earthworks. Historic sites include buildings, shipwrecks, canoes, cemeteries, and an early 19th century Fort McRae. An historic dugout canoe and artifacts associated with early military exploration of the Everglades was discovered in the lake near the entrance of the St. Lucie River. Early 20th century homes and historic districts have been recorded along the shoreline of Lake Okeechobee. The HHD, including various locks, dams, buildings and hurricane gates associated with it, is eligible for listing on the National Register and is recorded by the FMSF in each county

Figure 4-1. Florida Land Use (2005 and Projected 2060)

One major constraint to future development in the future with the No Action Alternative is the Federal Emergency Management Agency (FEMA) flood insurance program. Currently, this Federal program offers flood insurance in the communities near Lake Okeechobee. However, without rehabilitation of the HHD, flood insurance rates are expected to increase significantly in the future. Development and population growth pressures in South Florida would be offset by the increased cost of developing and maintaining property in the areas near the HHD.

For all of the above reasons, major changes in land use are not expected in the future without project condition. The area is primarily rural and agricultural. It is expected to remain rural and agricultural in the foreseeable future. AGRICULTURE RUN-OFF WATER TO LAKE OKEECHOBEE IS WHERE WE GET POLLUTED WATER FROM.
It should be noted though that there is tremendous uncertainty with regard to population changes and land use changes over such a long planning horizon, it is impossible to predict all potential changes over a 100-year period. The assumptions presented here represent conservative assumptions based on best available information, therefore, there would be a minor, long term effect on land use due to the No Action Alternative.

4.4 HYDROLOGY & HYDRAULICS

NOTE - WE HAVE A 36FT DROP IN ELEVATION FROM NORTH TO SOUTH INTO OUR LAKE

Surface Water General

The hydrology and hydraulics of the Lake Okeechobee watershed as described in Section 3 of the report would remain essentially unchanged. However, there are a few notable exceptions regarding population growth that are described above in Section 4.3 Land Use.

Increased development can often lead to increased surface water runoff due to natural pervious areas being converted to impervious areas (i.e., parking lots, roadways, roofs). However, increased regulation of stormwater by permitting agencies has tempered the potential for increased surface water runoff by requiring new developments and infrastructure projects to both

WE KNOW THAT 80% OF RUN-OFF IS FROM AGRICULTURE SO WE CAN SAY AGRICULTURE IS THE MAIN POLLUTER

detain a certain volume of runoff on their property and to ensure that post-project peak discharge rates do not exceed pre-project discharge rates. THERE IS NO ENFORCEMENT ACTION TAKEN HERE AT ALL "NONE"

In the future, Lake Okeechobee would remain the hydrologic hub of the Greater Everglades System. Presently, there are large competing demands for the water stored in Lake Okeechobee: urban water supply for the Florida Lower East Coast, agricultural water supply, environmental releases to the estuaries and water for the downstream natural systems. The competition for this water is intense since it represents the most available and economical source of freshwater. Even though there would be environmental consequences for lake ecology if Lake Okeechobee were to store more water, without rehabilitation of the HHD and under continuance of the Future Without condition, the lack of the internal storage option for Lake Okeechobee would by necessity drive water managers to seek and develop alternate freshwater sources for the Greater Everglades System. The most practical of these storage options is to divert Lake Okeechobee watershed runoff into storage reservoirs that would be developed. Also, the freshwater needs of the Florida Lower East Coast, particularly in the face of sea level rise and expanding saltwater intrusion, would need to consider desalinization of brackish waters pumped from deeper aquifers and perhaps some reliance on desalinization of seawater.

ASS/ASSUME ASS OUT OF YOU AND ME.

Key assumptions for the Future Without Condition that can affect hydrology within Lake Okeechobee, within the Lake Okeechobee watershed, and on related projects and downstream areas are presented below:

LORS 2008 in-place

Prior to the LORS 2008, Lake Okeechobee operated under the WSE. The 2006-2008 LORS study was initiated because of adverse environmental impacts that the WSE had on the lake and estuary ecology. Dam safety was later added as a performance criterion since lowering of the lake, as the LORS study was pursuing, is one of the basic Interim Risk Reduction Measures implemented for deficient dams until appropriate remediation is effectuated. The WSE held Lake Okeechobee stages approximately 1.0 – 1.5 ft. higher than the 2008 LORS under wet conditions. Studies for the remediation of the HHD are based on the 2008 LORS.

When it was approved in April 2008, the LORS was identified as an interim schedule. The Corps expects to operate under the LORS 2008 until there is a need for revisions due to the earlier of either of the following actions: (1) system-wide operating plan updates to accommodate CERP Band 1 Projects, or (2) completion of sufficient HHD remediation for all reaches and associated culvert improvements as determined necessary to lower the DSAC rating from Level 1.

CERP Band 1 Projects In-Place

The 1999 CERP, which was approved as a framework for restoring the south Florida ecosystem while providing for other water-related needs of the region in the 2000 WRDA, also recognized the need to modify the Lake Okeechobee Regulation Schedule. Modifications are necessary to reduce the extreme high and extreme low lake levels that adversely impact lake ecology, while improving the management of intermediate water levels and maintaining the capability to manage the lake to balance the requirements of the C&SF Project purposes, including water supply storage. The CERP proposed modifications to the Lake Okeechobee Regulation Schedule (Run 25 at the time of the CERP, prior to Water Supply and Environmental Regulation Schedule [WSE] implementation in 2000) were dependent on additional regional water storage capability north of Lake Okeechobee and new Lake Okeechobee regional aquifer storage and recovery (ASR).

CERP also included water storage components within the C-43 Basin (west of Lake Okeechobee) and the C-44 Basin (east of Lake Okeechobee) to improve the timing, quantity, and quality of freshwater flows to the Caloosahatchee River and Estuary and the Saint Lucie Estuary. South of Lake Okeechobee, CERP proposed an additional water storage component to capture a portion of the high volume freshwater discharges sent from Lake Okeechobee to the Caloosahatchee and St. Lucie Estuaries, to increase the quantity and improve the timing of freshwater flows sent south to the Everglades system, and to provide increased water supply storage within the EAA Basin.

Construction has begun on the first generation of CERP projects already authorized by Congress. These include the Indian River Lagoon Project, the Picayune Strand Restoration Project, and the Site 1 Impoundment Project. The second generation of CERP projects, authorized in WRRDA 2014, include the Biscayne Bay Coastal Wetlands Project, Broward County Water Preserve Areas Project, the Caloosahatchee River West Basin Storage Reservoir, and the C-111 Spreader Canal Western Project. The first generation and second generation of authorized CERP projects listed here were previously referenced as the CERP "Band 1" Projects in the 2005 CERP Master Implementation Sequencing Plan, with the "Band 1" list also originally included the Acme Basin B, Loxahatchee River Watershed, and the EAA Storage Reservoir (Part 1) CERP projects.

CERP Central Everglades Planning Project (CEPP) – In Place

The Corps and the SFWMD initiated the Central Everglades Planning Project (CEPP) as the next proposed increment of the CERP Program in November 2011. The purpose of the CEPP is to improve the quantity, quality, timing and distribution of water flows to the Northern Estuaries, central Everglades (Water Conservation Area 3 (WCA 3) and Everglades National Park (ENP), and Florida Bay while increasing water supply for municipal, industrial and agricultural users. The CEPP draft Project Implementation Report (PIR) was released for public and agency review in August 2013, and the Record of Decision (ROD) was signed August 31, 2015. The recommended plan would achieve these benefits by reducing the large pulses of regulatory flood control releases sent from Lake Okeechobee by redirecting approximately 210,000 acre-feet of water on an annual basis to the historical southerly flow path.

WATER MUST GO SOUTH FROM A WAY IN A LAKE IN A SHEET FLOW TO THE EVERGLADES

CEPP benefits gained from sending new water south from Lake Okeechobee are derived in part from operational refinements that can take place within the existing, inherent flexibility of the LORS 2008, and in part with refinements that are beyond the schedule's current flexibility. Modifications to LORS 2008 would be required to optimally utilize the added storage capacity of the A-2 Flow Equalization Basin (FEB) to send the full 210,000 acre-feet per year of new water available in CEPP south to the Everglades, while maintaining compliance with requirements for water supply and flood control performance levels. The CEPP "new" water accounts for the additional volume of regulatory releases able to be made from Lake Okeechobee to the southerly WCAs, releases that are not currently assumed to be delivered under the pre-CEPP conditions with the 2008 LORS and the State of Florida's Restoration Strategies Project due to water quality constraints.

Most of the LORS 2008 refinements applied in the CEPP modeling lie within the bounds of the operational limits and flexibility available in the current LORS 2008, with the exception of the adjustments made to the class limits for the Lake Okeechobee inflow and climate forecasts. Under some hydrologic conditions, the class limit adjustments made to the Lake Okeechobee inflow and climate forecasts reduced the magnitude of allowable discharges from the Lake, thereby resulting in storage of additional water in the Lake in order to optimize system-wide performance and

ensure compliance with Savings Clause requirements. However, these class limit changes represent a change in the flow chart guidance that extends beyond the inherent flexibility in the current LORS 2008.

Independent of CEPP implementation, the CEPP PIR assumes that revisions to the LORS 2008 would be needed following the implementation of other CERP projects and the HHD infrastructure remediation. When the HHD remediation is completed and the HHD DSAC Level 1 rating is lowered, higher maximum lake stages and increased frequency and duration of high lake stages may be possible to provide the additional storage capacity assumed with the recommended plan. The future LORS which may be developed in response to actions (1) and/or (2) is unknown at this time. It is anticipated that the need for modifications to the 2008 LORS would be initially triggered by non-CEPP actions and that these actions would occur earlier than implementation of CEPP.

Kissimmee River Restoration (KRR) Project Complete

Completion of the KRR Project construction features is scheduled for 2019. Currently, outstanding construction features include Reaches 2 and 3 backfill, the S-69 U-Shaped Weir at the downstream terminus of Reach 3 backfill, removal of the S-65C spillway and tieback levees and completion of the additional spillway capacity at S-65E. However, completion of the KRR project also includes implementation of operational changes in the Upper (i.e., Headwaters Revitalization) and Lower Basins that would provide for restoration as well as maintain existing levels of flood protection. In order to maintain existing levels of flood protection within the Kissimmee River Upper Basin, the KRR Project included canal improvements within the Chain of Lakes and additional spillway capacity at S-65 (the outlet from Lake Kissimmee), increasing the design discharge from 11,000 cfs up to 18,000 cfs. Spillway additions as part of the KRR Project also increased the design discharge of S-65D from 21,300 cfs up to 31,000 cfs and the design discharge of S-65E from 24,000 cfs up to 34,000 cfs. Additional discharge capacity beyond existing levels at some of these spillways is expected for events larger than the 50-yr and the full additional discharge would likely only be required for a basin-wide SPF event. Ongoing studies as part of the Kissimmee Basin Modified Water Control Plan continue to develop flood operations for the anticipated future state of the KRR Project.

With LORS 2008 in-place as an interim risk reduction measure for the HHD Future Without Project condition, there would not be the option to store additional water within Lake Okeechobee (for purposes such as water supply or in order to buffer large releases to the coastal estuaries) because of continued concerns with the structural integrity of the HHD. Since the Kissimmee River basin comprises between 40 to 60 percent of the inflows to Lake Okeechobee, there is instead impetus to intercept and store these excess flows (i.e., during floods) before they reach Lake Okeechobee.

GOOD IDEA THIS WILL STOP AGRICULTURE POLLUTED WATER GETTING TO LAKE OKEECHOBEE.

SFWMD Northern Everglades and Estuaries Protection Program

The SFWMD, the Corps cost-share sponsor for the C&SF Project, continues to study storage options as part of the Northern Everglades and Estuaries Protection Program, established in 2007 to strengthen protection for the Northern Everglades by expanding the LOPA. One particularly relevant plan component is "The Lake Okeechobee Watershed Construction Project, Phase II Technical Plan". The Plan identifies projects and urban and agricultural best management practices needed to achieve water quality targets for Lake Okeechobee. In addition, it includes projects for increasing water storage north of Lake Okeechobee to achieve healthier lake levels and reduce harmful discharges to the Caloosahatchee and St. Lucie Rivers and Estuaries.

SFWMD Dispersed Water Management Program

Since 2005, the SFWMD has been working with a coalition of agencies, environmental organizations, ranchers and researchers to enhance opportunities for storing excess surface water on public and private lands. Over the years, these partnerships have made thousands of acre-feet of water retention and storage available throughout the greater Everglades system, including the Northern Everglades. In addition to utilizing regional public projects, the SFWMD's Dispersed Water Management Program encourages private property owners to retain water on their land rather than drain it and/or accept and detain regional runoff for storage. Landowners typically become involved in the program through cost-share cooperative projects, easements or payment for environmental services. BMPS ARE A VOLUNTARY SYSTEM AND ARE NOT ENFORCED AND COWBOY RANCHERS "DO NOT VOLUNTEER"

Managing water on these lands is one means of reducing the amount of water delivered into Lake Okeechobee during the wet season. With Lake Okeechobee's water levels high from months of above-average rainfall during the 2013 rainy season, the SFWMD utilized this storage while taking further actions to capture and store water throughout the regional water management system. Holding water on these lands helped reduce the amount of water flowing into Lake Okeechobee and/or discharged to the Caloosahatchee and St. Lucie Estuaries during the high water conditions throughout south Florida.

Water control Structures, Culverts, Lock Structures, Pump Stations & Spillways, Canals, Embankments

The structures, as described in Section 3 (Existing Conditions), are not expected to change from what is currently in place. Further, it is expected the structures, canals, and embankments would be operated in much the same manner, except as noted for related projects discussed above. As mentioned previously, the 28 Federal culverts are currently being replaced as discussed in the 2010 HHD Culvert Removal and Replacement EA. The culverts are being replaced in kind, and therefore would not be expected to change the future function of water flows. Construction of the replacement culverts is expected to be completed in 2020. NOTE- CULVERTS THAT NOW CONNECT AGRICULTURE LAND WATER-RUN-OFF TO E/OWING WATER MUST BE STOPPED AND RECYCLED.

4.5 WATER QUALITY

Surface Water

POLLUTED AGRICULTURE RUN-OFF WATER MUST STOP SOON 40E-61 40E-63 ENFORCED

Regardless of the condition of the dike, the highly eutrophic condition of Lake Okeechobee is expected to persist for the foreseeable future due to past and future nutrient loading. Increased population may result in some change to surface water quality; however, the most significant source of surface water pollution will continue to be agricultural operations in the area. If a breach in the dike were to occur, mud sediments from Lake Okeechobee would be transported to nearby waterways, resulting in localized elevated total suspended solids and phosphorus concentrations that might be higher than typical depending upon the affected water body. It is possible that a breach might result in the entrainment of HTRW contaminants into flood waters; however, dispersion and dilution would likely result in few limited areas where water quality standards would be exceeded. No significant effects outside the immediate area of the breach would be expected. Without dike rehabilitation, the lake would be operated at lower stages, which may improve water quality conditions somewhat in the littoral zone of the lake. However, because of the dike's current lack of structural integrity, high-volume freshwater releases are required during flood events to avoid the possibility of a breach in the dike. These releases affect the lake's two primary outlets: the St. Lucie and Caloosahatchee Rivers. Water released from the lake contains elevated nutrient concentrations that contribute to degradation of water quality in

the St. Lucie and Caloosahatchee Rivers and Estuaries. None of the projects or assumptions discussed in the Section 4.4 Hydrology & Hydraulics will result in significant changes to water quality in the project area. Since Florida Water Quality Standards were recently revised, it is not likely that the State will develop stronger more effective regulations in the foreseeable future. A Total Maximum Daily Limit for Phosphorus, the limiting nutrient in Lake Okeechobee, was established for the Lake in 2002. Efforts to attain the TMDL limit through the implementation of Basin Management Plans are likely to continue. STOP VOLUNTARY BMPs AND ENFORCE TMDL REQUIREMENTS 40E-61-40E-63 ADMIT-40 APPS TO LAKE OKEECHOBEE

Groundwater

Increased population in the vicinity of the HHD is likely to result in greater use of the Floridan Aquifer as a source of potable water where its quality supports such use. The FAS groundwater quality conditions are not expected to change in the vicinity of the HHD in the foreseeable future with or without rehabilitation. Along the perimeter of the lake from Port Mayaca southwest to Moorehaven, the quality of the shallow surficial aquifer groundwater is expected to become more saline due to overdraining of the EAA lands which results in the continued upward flow of relatively deep saline connate groundwater into the upper freshwater portion of the surficial aquifer. Preliminary measurements in Reach 1 (Port Mayaca to Belle Glades) indicate the possibility that this upward flow of connate groundwater has accelerated in some areas directly adjacent to the cutoff wall installed between Port Mayaca and Belle Glade. The upward movement of connate groundwater in Reaches 2 and 3 are not expected to impact surface water quality.

From Port Mayaca northwest towards Okeechobee City and Lake Port, the groundwater is not likely to change significantly in the absence of a rehabilitated HHD. This area is expected to experience increased population over the next 50 years which is likely to be the largest driver of changes to surficial groundwater quality conditions as this aquifer is likely to be used as a source for landscape irrigation. STOP UNPERMITTED USE AND ENFORCE ACTION TO CONTROL LANDSCAPE IRRIGATION

4.6 VEGETATION

The No Action Alternative is expected to continue to provide conditions for which the same vegetation, as described in **Section 3** (Existing Conditions), would occur. The HHD itself would continue to be covered with mixed grasses and mowed on a regular basis. Wetland vegetation would likely continue to be found in the toe ditch between operation and maintenance mowing activities.

Open water and freshwater marsh habitats are expected to continue lakeward of the HHD within Lake Okeechobee. It is expected the littoral zone, as described in **Section 3**, would continue on the lake's western edge and on the islands in its southern shore (Kraemer Island, Torry Island, and Ritta Island). The littoral zone would support emergent, submerged, and floating-leaf plants. Depending on the effects of climate change (temperature and rainfall especially), plant community structure within the littoral zone of Lake Okeechobee may change. Further, changes in special extent and distribution of the Lake Okeechobee littoral zone are anticipated as the regulation schedule for Lake Okeechobee may need to be revised as a result of implementation of the CEPP (USACE 2013). In addition, it is anticipated that species composition and abundance within submerged, emergent and floating-leaf communities would likely be altered as a result of changes in lake stage or regulation.

4.7 WETLANDS

The No Action Alternative is expected to continue to provide conditions for which the same wetlands, as described in **Section 3** (Existing Conditions), would occur. Low quality wetlands would continue to occur in the toe ditches around HHD, providing foraging opportunities for wildlife. High quality wetland habitat would be expected to continue in the littoral zone currently on the western side of Lake Okeechobee with the same lake stages as are provided for by the LORS 2008. Lake Okeechobee would continue to hydraulically feed wetlands beyond the HHD, providing freshwater for the Florida Everglades to the south and for the WCAs in Palm Beach and Broward Counties. STOP IMPROVED PASTURES FROM DESTORING WETLANDS AND ORANGE CROP OPERATIONS

If a breach of the HHD were to occur in the southern reaches, it is expected the EAA, the STAs, the WCAs, and ENP could be negatively impacted as a result of the flow of water from Lake Okeechobee. In addition to flooding and destroying the crops within the agricultural areas, water would more than likely overwhelm the STAs and WCAs and continue to move south towards ENP.

4.8 THREATENED AND ENDANGERED SPECIES

The habitat surrounding the HHD is expected to remain similar to that described in **Section 3** (Existing Conditions) and the same species are expected to remain in the area. The No Action Alternative, with continued current conditions, would not have adverse effects on protected species. However, if the dike were to fail, species and habitats directly on the dike and within the path of the water would be negatively impacted, and snail kite critical habitat could be negatively impacted due to lower lake levels.

Further, if a breach were to occur along the southern portions of the HHD, flooding would occur within the EAA and further south, through the WCAs, and eventually to Everglades National Park. There are many state and federally protected species within south Florida that would be negatively impacted due to a loss of habitat from flooding resulting from a breach of the HHD.

4.8.1 Federally Listed Species Expected to Occur Within the Study Area

4.8.1.1 Audubon's Crested Caracara

The No Action Alternative is not expected to affect the caracara. Caracara typically nest in open fields and ranch lands. If the dike were to breach, ranch lands could be flooded and negative impacts to nesting trees could occur. Changes in land use are expected to have a greater impact to the caracara than a potential breach in the HHD.

4.8.1.2 Eastern Indigo Snake

The Eastern indigo snake is expected to continue to have the potential to be found on the HHD embankment with the No Action Alternative. If the dike were to breach, snakes within the breach zone could be swept away due to the loss of water from Lake Okeechobee.

4.8.1.3 Everglade Snail Kite

The snail kite is expected to continue to be present within the littoral zone of Lake Okeechobee with the No Action Alternative. If the dike were to breach, negative effects to the littoral zone could occur due to loss of water within Lake Okeechobee. The littoral zone in Lake Okeechobee is designated as critical habitat for the Everglade snail kite and loss of this habitat would have a

negative effect on the snail kite. Further, it is safe to assume the LORS would be updated during the planning horizon. Changes to the LORS could have the potential to affect the snail kite, however, these effects would be analyzed in a separate NEPA document for an updated regulation schedule for Lake Okeechobee.

4.8.1.4 Okeechobee Gourd

The Okeechobee gourd is expected to be found along or adjacent to the HHD with the No Action Alternative. If the dike were to breach, plants along and within the breach zone would be swept away due with the flow of water from Lake Okeechobee.

4.8.1.5 West Indian Manatee

The manatee is expected to continue to inhabit Lake Okeechobee and the canals adjacent to the HHD with the No Action Alternative. If the dike were to breach and a manatee was in the water near the breach zone, it could be caught up in the water flow and potentially be stranded on dry land.

4.8.1.6 Wood Stork

The wood stork is expected to continue to nest adjacent to the HHD and forage within Lake Okeechobee with the No Action Alternative. If the dike were to beach, temporary impacts to foraging due to loss of water within the littoral zone are expected.

4.8.1.7 Florida Panther

The Florida panther is expected to inhabit the lands surrounding the HHD with the No Action Alternative. The Florida panther continues to extend its territory northward from the southwest Florida region as its population grows. A breach of the HHD could negatively impact the panther if it is caught in the flood waters resulting from a breach.

4.8.1.8 Florida Bonneted Bat

The bonneted bat is expected to continue to inhabit lands north and west of Lake Okeechobee with the No Action Alternative. A breach of the dike could negatively impact foraging habitat of the bat within Lake Okeechobee or adjacent wetlands depending on the location of the breach and flow path of the water.

4.8.2 State Listed Species Expected to Occur Within the Study Area

With the No Action Alternative, the gopher tortoise, burrowing owl, and many wading birds are likely to continue to use the HHD for foraging and nesting. The wading bird species that could potentially occur in the project area are listed in Table 3-6 and would have similar effects as listed for the wood stork.

4.8.2.1 Gopher Tortoise

The gopher tortoise is expected to continue to be found on the HHD embankment with the No Action Alternative. If the dike were to breach, tortoises within the breach zone could be swept away due to the loss of water from Lake Okeechobee.

4.8.2.2 Burrowing Owl

The burrowing owl is expected to continue to be found on the HHD embankment with the No Action Alternative. If the dike were to breach, owls within the breach zone could be swept away due to the loss of water from Lake Okeechobee.

4.9 NOISE

Noise sources and levels are not expected to change significantly from that described in Section 3 (Existing Conditions) with the No Action Alternative. Vehicular traffic on local roadways is expected to increase along with increased population; however, noise conditions are not expected to significantly change. The project area is expected to remain predominantly rural with pockets of low-density residential.

4.10 AIR QUALITY

The No Action Alternative would not affect air quality. Relative to the existing condition, it is expected that traffic and other practices affecting air quality would increase marginally in most areas of the study area due to moderate population growth.

4.11 TRANSPORTATION AND UTILITIES

Transportation and utilities are not expected to be impacted due to the No Action Alternative. If a breach were to occur, impacts to highways and the railroad would be extensive. Structures nearest the breach could be destroyed. Further, travelers or freight on the roads or railroad could be endangered. Even moderate flooding from a low velocity breach would likely cause road closures and traffic delays. The utility infrastructure located on lands adjacent to HHD could be destroyed, resulting in communication and power outages.

4.12 SOCIOECONOMICS

4.12.1 Socioeconomic Characteristics of the Study Area

As described in **Section 3.0** (Existing Conditions, Socioeconomics), the areas surrounding Lake Okeechobee are largely rural with some small towns and cities dispersed throughout agricultural areas. The primary economic activity is agriculture; secondary activities include: recreation, commercial fishing, commercial navigation, services (banking, insurance, etc.) healthcare, education, and government activities.

The general economic characteristics of the study area are not expected to change significantly in the foreseeable future. The economic engine of the region is agriculture and to a lesser extent tourism associated with Lake Okeechobee. This is unlikely to change much over time. If a breach were to occur, thousands of acres of productive farmland (almost entirely sugarcane) would be inundated and likely out of production for several growing seasons. In addition, Zone A (Reaches 2 and 3, see **Figure 2-2**) has the greatest potential for economic damage, which could be significant with a breach. Relative to the other zones, urban damages are highest in Zone A. Agricultural damages are also the largest for Zones A and B due to the close proximity to the EAA.

4.12.2 Demographic Changes Over Time

In most of the communities surrounding Lake Okeechobee, population growth has been slow in recent decades (less than 1% per year). It is reasonable to assume that slow population growth

would continue into the foreseeable future. The State of Florida's Office of Population and Demographic Research provides projections for all Florida Counties through 2040. The projections are summarized in **Table 4-1**. The table also shows percent increase in the total population from 2010 to 2040.

Table 4-1. Projected population growth by county from 2010 to 2040

	2010	2015	2020	2025	2030	2035	2040	% Increase
Palm Beach	1,320,134	1,377,239	1,465,309	1,545,998	1,616,867	1,678,101	1,733,331	**31.30%**
Hendry	39,140	38,463	39,750	40,847	41,700	42,468	42,861	**9.51%**
Glades	12,884	13,035	13,744	14,389	14,950	15,519	15,860	**23.10%**
Okeechobee	39,996	40,530	42,105	43,461	44,574	45,464	46,186	**15.48%**
Martin	146,318	151,983	160,964	169,130	176,238	182,322	187,765	**28.33%**

Source: State of Florida Office of Population and Demographic Research. *Florida Population by County: 1977 through 2040*

It should be noted that Palm Beach County and Martin County are projected to grow much more quickly than the other counties. This is primarily due to expected growth in the coastal areas in each county. The communities near the HHD in Palm Beach County (South Bay, Belle Glade, and Pahokee) are not likely to grow as quickly as coastal cities such as West Palm Beach, Jupiter, and Boca Raton. Therefore, the growth rate for Palm Beach County (31.3% over 30 years) is probably overly aggressive for the communities near the HHD. Instead, the growth rate for Hendry County (9.5% over 30 years) is more realistic projection. Hendry County is adjacent to Palm Beach County, and its demographic characteristics are much more similar to Belle Glade and Pahokee than those cities are to West Palm Beach. For Martin County, the growth rate for Okeechobee County (15.5% years) is more realistic for unincorporated areas near the HHD. In this case, Okeechobee is also an adjacent county with similar demographic and socioeconomic characteristics.

4.13 PUBLIC SAFETY

It is expected the inflow capacity versus outflow capacity of Lake Okeechobee would be as described in the existing conditions. The HHD would continue to provide flood risk management not only to towns immediately adjacent to the dike, but to a vast area south of the lake in the future.

Though major demographic and land-use changes are not expected, the No Action Alternative assumes that reasonable risk management measures would be taken by state and local authorities regardless of Federal action. This is an important assumption, because it ensures that the Federal government would not be making large investments based on poor local planning and preparedness. In other words, risk reduction should be shared responsibility, not an exclusively Federal objective.

In the case of the HHD, several specific local planning changes are assumed in the future condition.

- Improved public warning systems (Reverse 911 and warning sirens)
- Improved Public Awareness and education (more effective pre-breach evacuation warnings)
- Improved evacuation planning (more efficient evacuation plans during breach scenarios)

All of the above changes result in more effective public evacuation in the case of a dike breach. If all of the above actions are taken, life loss associated with a breach is expected to decrease over time (i.e. No Action Alternative), however, it would not decrease below tolerable risk guidelines. The earliest year in which these measures could realistically be implemented by local authorities is 2020, which is a key assumption of the consequences analysis.

4.14 REAL ESTATE

A breach in the HHD would result in widespread flooding of lands and the structures located on them as waters from Lake Okeechobee pass through the breach and onto adjacent lands. The risk to lands and structures located within the vicinity of the HHD is substantial. Inundation mapping and flood stage hydrographs indicate that flooding would be severe. Agricultural lands would also suffer damage, possibly for several growing seasons.

4.15 HAZARDOUS, TOXIC AND RADIOACTIVE WASTES

The No Action Alternative is not expected to result in any HTRW concerns. However, if there is a breach in the dike, some lands adjacent to the dike breach may potentially be subject to HTRW contamination as a result of the dispersion of otherwise contained pollutants on private lands.

4.16 RECREATIONAL RESOURCES

It is expected that Lake Okeechobee and the HHD would continue to host a variety of recreational activities year-round as described in **Section 3** (Existing Conditions). The OWW should continue to allow transit between the Gulf of Mexico and the Atlantic Ocean using the Caloosahatchee River (west coast) through Lake Okeechobee and reaching the Atlantic Ocean through the St. Lucie River. Recreational resources in the project area include the LOST, fishing and boating opportunities, campgrounds, hunting, and park areas. Additional opportunities for recreation could be developed by local entities as population numbers increase in the future.

4.17 AESTHETIC RESOURCES

With the No Action Alternative, the HHD crest would continue to provide panoramic views of the flat agricultural (mostly sugarcane) fields and rim canal to the south, southwest, and southeast of Reaches 2 and 3. The extensive littoral zone on the west side of the lake's perimeter can be viewed from the dike in Reach 2, as well as Reaches 4, 6, and 8. The littoral zone plant community is composed of a mosaic of emergent and submerged 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. There are several parks adjacent to the HHD. These parks include resources such as ponds, picnic areas, restrooms, grassy fields, boat ramps, and other amenities.

As stated above in the Socioeconomics Section, the general economic characteristics of the study area are not expected to change significantly in the foreseeable future. Therefore, land use is expected to remain the same with a large amount of agricultural practices continuing in the future and excessive development is not expected. Depending on the effects of climate change (temperature and rainfall especially), plant community structure within the littoral zone of Lake Okeechobee may change.

4.18 CULTURAL RESOURCES

Compared to the existing conditions in **Section 3.18**, the No Action Alternative would not have any expected impacts to cultural resources. In the event of a breach failure in the HHD, there would be a potential for adverse effects to both recorded and unrecorded historic properties, including the HHD itself which is eligible for listing on the National Register of Historic Places. Depending on the location and severity of the breach, impacts from flooding, erosion, and standing water could cause varying adverse effects to historic properties within the vicinity of the HHD. DUE TO THE FACT AGRICULTURE "Rules"

4.19 TRIBAL RESOURCES

The Seminole Brighton Reservation on the northwest side of Lake Okeechobee would still exist under the No Action Alternative. It is expected the Seminole Tribe would continue to use the HHD for hunting and fishing as discussed in Section 3 (Existing Conditions). If a breach were to occur, lands within the Seminole Brighton Reservation would be inundated, potentially causing adverse effects to hundreds of recorded and as yet, unrecorded historic properties depending upon the severity of the breach.

TRIBE IS NORTH OF LAKE OKEECHOBEE SO POINT OF VIEW, POLLUCTION WILL GO INTO LAKE OKEECHOBEE. NOTE = ELEVATION DROP TO LAKE OKEECHOBEE IS NORTH TO SOUTH. AT 16" WATER SEEKS LOWEST POINT AT A 36 FOOT DROP PEOPLE