CENTRAL AND SOUTHERN FLORIDA PROJECT
MODIFIED WATER DELIVERIES TO EVERGLADES NATIONAL PARK, FLORIDA

8.5 SQUARE MILE AREA

APPENDIX G
FINAL FISH AND WILDLIFE COORDINATION ACT REPORT

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

July 2000

HDR Engineering, Inc.

FINAL FISH AND WILDLIFE COORDINATION ACT REPORT

FOR THE

MODIFIED WATER DELIVERIES TO

EVERGLADES NATIONAL PARK, FLORIDA

THE 8.5 SQUARE MILE AREA

GENERAL REEVALUATION REPORT AND

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Prepared by:

U.S. Fish and Wildlife Service
South Florida Field Office
Vero Beach, Florida

and

National Park Service
Everglades National Park
Homestead, Florida

July 18, 2000

United States Department of the Interior

National Park Service
Everglades National Park
40001 State Road 9336
Homestead, FL 33034

Fish and Wildlife Service
Office of the State Supervisor
P.O. Box 2676
Vero Beach, FL 32961

July 18, 2000

Colonel Joe R. Miller
District Commander, Jacksonville District
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Attention: Planning Division

RE: Final Fish and Wildlife Coordination Act Report for the Supplemental Environmental Impact Statement/General Reevaluation Report for the Modified Water Deliveries to Everglades National Park, 8.5 Square Mile Area, Miami-Dade County, Florida

Dear Colonel Miller:

The Department of the Interior (Department) has prepared the enclosed report for the Corps of Engineers' (Corps) Final Supplemental Environmental Impact Statement/General Reevaluation Report (SEIS/GRR) for the Modified Water Deliveries to Everglades National Park (MWD), 8.5 Square Mile Area, Miami-Dade County, Florida. This will serve as the Final Fish and Wildlife Coordination Act (FWCA) report and Cooperating Agency analysis from the National Park Service (NPS) and the Fish and Wildlife Service (Service). This report replaces previous draft reports dated March 30, April 25, and May 9, 2000, submitted to the Corps, wherein substantial revisions to the design and operation of proposed project alternatives were incorporated. This Final FWCA report includes an evaluation of the Federally Recommended Plan with appropriate modifications.

This Final FWCA report, including the views and recommendations of the Service and the NPS, is submitted for inclusion into the Final SEIS/GRR, and will fulfill the requirements of section 2(b) of the FWCA (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq.*), representing the Secretary of the Interior's report to Congress. Additionally, we are requesting the Florida Fish and Wildlife Conservation Commission review and concur with the recommendations contained in the Final FWCA report.

As discussed at our recent interagency coordination meeting, we would like the Corps to expand the scope of the MWD Project to include provisions for removal of roads and the demolition of all residential dwellings from the east Everglades addition to Everglades National Park (ENP). To date, some of these roads have been used to maintain access to private land and some of the buildings have been used to provide an interim presence in the area for the protection of parkland as it is acquired. Our land acquisition program will soon be completed. While the NPS may need some facilities for visitor protection and providing visitor services, the ENP supports the removal of all structures other than those determined to be essential, because these functions cannot be accomplished in any other way. Unless such an essential need can be demonstrated through a public decision process in the ENP's forthcoming General Management Plan, all roads and structures would be removed. We ask that an inventory of these roads and structures be conducted and an estimated cost for their removal be developed. We request that this work be evaluated and included as an additional project component of the MWD Project.

We believe that the Federally Recommended Plan, which includes the Department's modifications and assurances described in Chapter 10 of the FWCA report, will meet the legislative requirements for the MWD Project. These modifications and assurances are also contained in Section 11.0 (Recommendations) of the General Reevaluation Report (GRR), and will become requirements of the 8.5 SMA project upon finalization of the GRR.

We look forward to reviewing the Final SEIS/GRR and appreciate the Corps' concerted efforts to coordinate the National Environmental Policy Act process for the 8.5 SMA project under such limited time constraints. If you have any questions regarding this report, please contact Jim Boggs at (561) 778-0896, extension 18, or Dave Sikkema at (305) 242-7814.

Sincerely yours,

Richard G. Ring
Superintendent
Everglades National Park
& Dry Tortugas National Park

Stephen W. Forsythe
State Supervisor
Ecological Services
U.S. Fish and Wildlife Service

Enclosure

cc:
Department, Office of Policy, Attention: Shannon Cunniff
Department, Office of the Solicitor, Attention: Donald Jodrey
Service, Assistant Regional Director: Cindy Dohner (Attn: Cherry Green)
Corps of Engineers, Jacksonville District, Attention: Cheryl Ulrich
Corps of Engineers, Jacksonville District, Attention: Martin Gonzalez
Corps of Engineers, Jacksonville District, Attention: Elmar Kurzbach
Florida Fish and Wildlife Conservation Commission, Attention: Mary Ann Poole
South Florida Water Management District, Attention: Dewey Worth
HDR Inc., Attention: Charles Sinclair

FINAL FISH AND WILDLIFE COORDINATION ACT REPORT

FOR THE

MODIFIED WATER DELIVERIES TO

EVERGLADES NATIONAL PARK, FLORIDA

THE 8.5 SQUARE MILE AREA

GENERAL REEVALUATION REPORT AND

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Prepared by:

U.S. Fish and Wildlife Service
South Florida Field Office
Vero Beach, Florida

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National Park Service
Everglades National Park
Homestead, Florida

July 18, 2000

This Final Fish and Wildlife Coordination Act Report (CAR) has been prepared by the Department of the Interior's (DOI) Fish and Wildlife Service (Service) and National Park Service, Everglades National Park (ENP) as Cooperating Agencies for the Supplement to the U.S. Army Corps of Engineers' (Corps) 1992 General Design Memorandum and Final Environmental Impact Statement, Modified Water Deliveries to Everglades National Park (MWD Project.) The purpose of the MWD Project is to improve delivery of water into ENP and, to the extent practicable, restore hydropatterns in Northeast Shark River Slough (NESRS). This CAR summarizes analyses of the proposed alternatives for mitigation of higher water levels in the 8.5 square mile area (8.5 SMA) resulting from the restoration of NESRS through the MWD Project.

The 8.5 SMA is located within the eastern periphery of the historic Everglades flow path. Within the 8.5 SMA, land use is dominated by agriculture, but also includes residences, and wetlands. The land cover within ENP consists of long and short hydroperiod wetlands interspersed with tree islands, which combine to support a diverse assemblage of vegetation and wildlife.

The nine proposed alternatives and two additional variations of Alternatives 6 include both structural water conveyance systems and landowner compensation arrangements and are listed in Table ES–1. The six objectives of the 8.5 SMA component of the MWD Project used by DOI to evaluate the proposed alternatives were divided into objectives authorized in law and other objectives (those desirable to the interested parties).

Legislative Requirements:

- Evaluate effects on hydropatterns in NESRS according to Section 104 of the 1989 Everglades National Park Protection and Expansion Act

- Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project according to Section 104 of the 1989 Everglades National Park Protection and Expansion Act

- Evaluate effects on Federal and State Listed Endangered Species survival in accordance with the Endangered Species Act of 1973

Other Objectives:

- Analyze effects to ecological function

- Measure compatibility with the Corps' Comprehensive Everglades Restoration Plan (CERP) and C–111 Project without adversely impacting the current level of flood protection east of L–31N

- Analyze impacts and costs associated with time delays in implementation of alternatives

For each of the alternatives requiring structural changes, a hydrologic model (MODBRANCH) was used to predict the resulting water levels for both a wet and a dry year. Analysis of these water levels combined with the Wetland Rapid Assessment Procedure provided the data required to evaluate the alternatives with regard to the stated objectives.

Table ES–1 Summary 8.5 SMA Alternative Evaluation

	Legislative Requirements					Other Objectives		
Alternative	NESS Restoration (acre-ft reduction in restored water in NESRS)	Structural Mitigation Provided (acres mitigated)	Non-structural mitigation required (acres)	Endangered Species Protection (rank[1]) Sk: snail kite Ws: wood stork[2])	Wetland Function (Increase in Functional Units)	Compatibility with future restoration	Time to Implementation	Flood Protection (% not protected) (acres protected / inhabited area)
1 — GDM Plan (No action)	Poor (6,979)	6,215	694	Sk: 3 Ws: 2	Poor (-2,765)	Poor	< 3 years	Not provided (91.5%) (586/6,909)[3]
2B — Modified GDM	Poor (9,912)	6,538	371	Sk: 1 Ws: 4	Poor (-2,765)	Poor	< 3 years	Not provided (89.8%) (704/6,909)[3]
3 — Deep Seepage Barrier	Good (0)	1,891	5,018	Sk: 11 Ws: 1	Poor (-1,775)	Poor	< 3 years	Poor (91.5%) (586/6,909)
4 — Residents' Choice Land Acquisition	Good (0)	0	6,909	Sk: 10 Ws: 11	Good (2,448)	Good	< 3 years	Good (0%) (6,909/6,909)[3]
5 — Total Buyout	Good (0)	0	6,909	Sk: 10 Ws: 11	Best (2,448)	Best	< 3 years	Good (0%) (6,909/6,909)[3]
6B — Buffer Plan	Fair (868)	2,250	4,659	Sk: 5 Ws: 9	Fair (1,606)	Fair	< 3 years	Good (11.5%) (1,992/2,250)
6C — Modified Buffer Plan	Poor (6,711)	4,656	1,658	Sk: 4 Ws: 5	Poor (-1,805)	Poor	< 3 years	Poor (61.4%) (1,799/4,656)[3]
6D — Modified Buffer Plan	Fair (889)	2,834	4,075	Sk: 6 Ws: 9	Fair (1,322)	Fair	< 3 years	Poor (39.6%) (2,276/3,768)[3]
7 — Raise all public roads	Good (0)	774	6,135	Sk: 10 Ws: 6	Fair (1,290)	Good	< 3 years	Not provided (91.5%) (586/6,909)[3]
8A — Western Flow-way	Good (117)	2,652	4,257	Sk: 7 Ws: 7	Good (2,240)	Good	< 3 years	Not provided (89.3%) (737/6,909)[3]
9 — Adaptive Refinement of GDM	Poor (9,912)	6,538	371	Sk: 1 Ws: 4	Poor (-2,765)	Poor	< 3 years	Not provided (89.8%) (704/6,909)[3]

[1]Rank from 1 (Lowest) to 11 (Highest) (nine alternatives and 2 variations)

[2]Other species to be evaluated include Cape Sable seaside sparrow, Eastern indigo snake and Florida panther

[3]For Alternatives not designated as flood protection alternatives, the reported % is the part not provided flood protection and the reported acreage represents the area provided incidental 1 in 10 year flood protection out of the total inhabited acreage.

The DOI screened the alternatives by requiring that they satisfy all three of the legislative requirements. To receive the highest rating, alternatives were required to: 1) provide at least 95 percent of the predicted potential increase in water storage in NESRS from implementation of the MWD Project, 2) mitigate for adverse hydrologic impacts to the presently developed portions of the 8.5 SMA resulting from implementation of the MWD Project, and 3) provide conditions favorable to Federal and State Listed Endangered Species survival.

It is the opinion of DOI that Alternative 5 is the environmentally preferred alternative (Figure ES–1) because it provides the greatest increase in wetland function, allows for complete restoration of NESRS consistent with the objectives of the MWD Project, and provides full flood mitigation and flood protection. Alternative 4 is less compatible with future restoration, such as the CERP, because continued residential use could constrain future restoration and wetland function is only moderately increased. Alternative 6B was evaluated as fair because it provides only moderate increases in wetland function in NESRS and could require retrofitting for future restoration project features. Alternatives 6D and 8 met the restoration criteria, but did not meet the full flood mitigation criteria.

It is the intent of the COE to select a Federally Recommended Plan based on Alternative 6D with modifications to address certain deficiencies. These modifications will be incorporated to address the recommendations of DOI as well as the local sponsor, the South Florida Water Management District (SFWMD). It is the opinion of DOI that upon incorporation of these modifications, the Federally Recommended Plan will meet the performance criteria evaluated in the CAR.

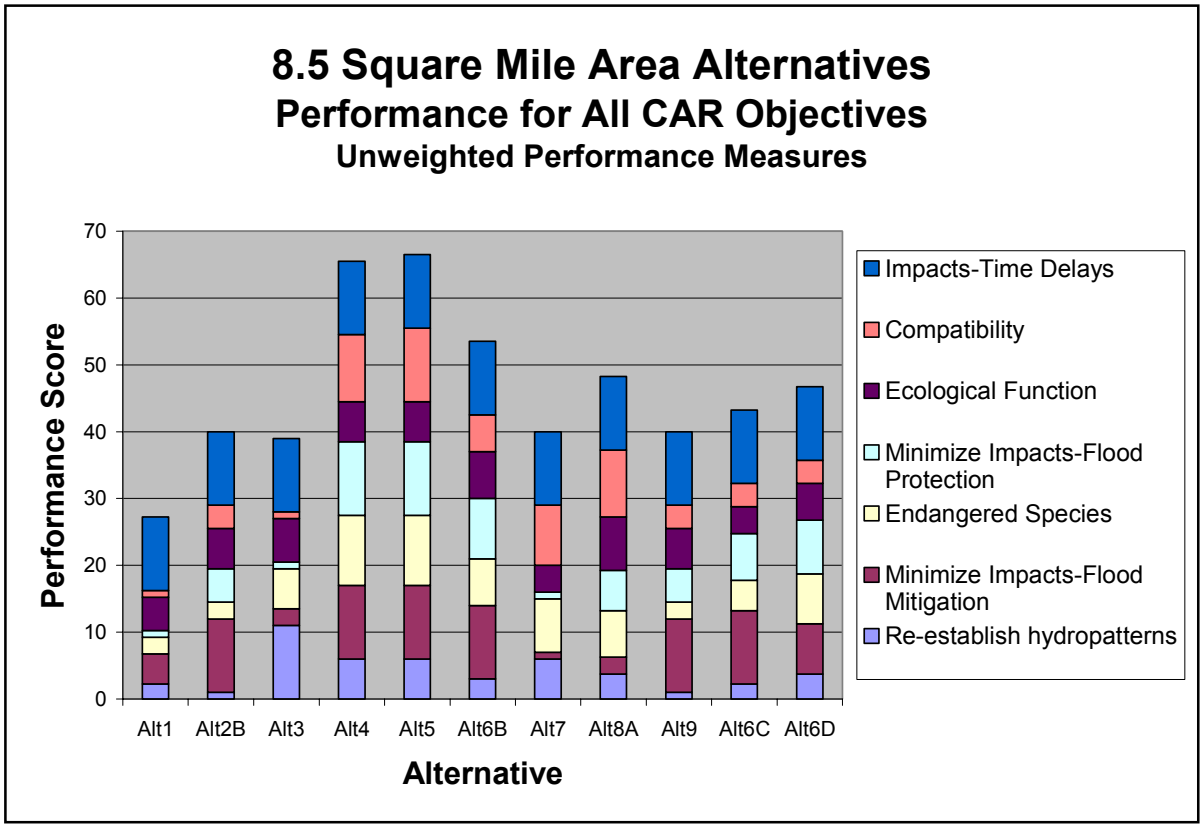

Figure ES–1 8.5 SMA Performance Scores for Objectives Analyzed in the CAR (unweighted)

It is the opinion of DOI that the remaining alternatives (1, 2, 3, 7, 6C, and 9) do not meet multiple legislative requirements, as well as the other project objectives.

Review of the Federally Recommended Plan

DOI has reviewed the Federally Recommended Plan, and has developed a list of assurances for the final design, construction and operation of this alternative consistent with the recommendations of the Governing Board of the South Florida Water Management District and the concerns expressed by DOI (see Chapter 11). DOI recommends that these assurances be integrated into the design, construction and operation of the Federally Recommended Plan for the 8.5 Square Mile Area Project, and be included in the Corps of Engineers' Record of Decision in the Final GRR/SEIS. Recent interagency coordination between the DOI and the Corps of Engineers resulted in an agreed-upon list of assurances that will be included in the Final GRR/SEIS, as reflected in Chapter 11.

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Chapter 1 — Project Purpose, Scope, and Authority

The Fish and Wildlife Service (Service) and the Everglades National Park (ENP) have prepared this Final Fish and Wildlife Coordination Act Report (CAR) as cooperating agencies for the U.S. Army Corps of Engineers' (Corps) General Reevaluation Report (GRR) and Supplemental Environmental Impact Statement (SEIS). This GRR and SEIS supplement the Corps' 1992 General Design Memorandum (GDM) and Final Environmental Impact Statement, Modified Water Deliveries to Everglades National Park (MWD Project), Miami-Dade County, Florida. The GRR and SEIS analyze and evaluate several alternatives to facilitate the restoration of ecologic function and hydrologic conditions in Northeast Shark River Slough (NESRS) and the Rocky Glades, as well as provide a flood mitigation system to address impacts to the Eight and One-half Square Mile Area (8.5 SMA) resulting from the implementation of the MWD Project. The South Florida Water Management District (SFWMD) is the local sponsor for this project. This CAR is provided in accordance the Fish and Wildlife Coordination Act (48 Stat. 401, as amended: 16 U.S.C. 661 et seq.). DOI is requesting the Florida Fish and Wildlife Commission (FWC) review and concur with the recommendations contained in the Final FWCA report.

This CAR provides the Department of the Interior's (DOI's) analyses and recommendations pertaining to alternatives proposed for implementation of the 8.5 SMA component of the MWD Project (as the two Department of the Interior agencies involved with this document, ENP and Service are collectively referred to as DOI in this document). Chapter 1 describes the purpose, scope, and authority for the 8.5 SMA component of the MWD Project. Contained within this chapter is an explanation of the authority for the MWD Project, a general description of the original 1992 design, as well as the responsibilities and decisions for each of the agencies having a role in the implementation of the Project. This chapter also details the objectives of the 8.5 SMA project component and the performance measures that were used in the evaluation sections of the report. The DOI completed an analysis of the 8.5 SMA alternatives based on these performance criteria under the legislative authorities discussed.

Chapters 2, 3, and 4 describe the project's location and the natural resources of particular concern to the Service and ENP. Chapters 2 and 3 contain an explanation of the without project, existing conditions and future without project conditions. Chapter 4 provides an explanation of the alternatives being considered for implementation.

Chapters 5, 6, and 7 include all technical evaluations conducted by DOI. These evaluations focus on the hydrologic analyses, wetland function assessments, and endangered species evaluations associated with each of the proposed alternatives. All of these analyses focused on the performance measures specified in Chapter 1.

Chapters 8 through 10 include evaluations of the alternatives, DOI's position, DOI's recommendations for the Federally Recommended Plan, and supporting material. Contained within this portion of the document are numerous matrices that served as the evaluation tool used by DOI in comparing the alternatives. DOI's position is based on the set of performance measures assessed by DOI, including most of the Corps' performance measures, using the legislative authorities provided DOI as outlined in Chapter 1

Modified Water Deliveries Project

On 13 December 1989, the Everglades National Park Protection and Expansion Act became law (P. L. 101–229). This Act added the NESRS and the East Everglades to ENP. It also authorized the Secretary of the Army, in consultation with the Secretary of the Interior, to design and construct modifications to the Central and Southern Florida Flood Control Project (C&SF Project). The purpose of these modifications was to improve delivery of water into ENP and, to the extent practicable, restore the natural hydrologic conditions within ENP. The Secretary of the Army was to base the modifications upon the findings of the Secretary of the Army's experimental program for delivering water to ENP, which Congress originally had authorized in 1983 (P. L. 98–181). This Act directed the Secretary of the Army to set forth the proposed modifications to the C&SF Project in a General Design Memorandum entitled "Modified Water Deliveries to Everglades National Park."

In addition to addressing expansion of ENP's boundary and modifications to improve delivery of water into ENP, the Act recognized that restoration of flows to ENP might adversely affect adjacent agricultural lands and a residential area within the East Everglades (8.5 SMA). Regarding the 8.5 SMA, the 1989 Act authorizes and directs the Secretary Army to "construct a flood protection system for that portion of presently developed land within such area" to mitigate against any *increase* in flooding over existing water levels in the area that might result from implementation of the MWD Project.

1992 GDM Design and Requests for Design Modifications

In 1992, the Corps released the GDM and Environmental Impact Statement (EIS) addressing the modifications to the C&SF Project necessary to construct the MWD Project. As specified in the 1992 GDM, the MWD Project consists of three general components: (1) conveyance and seepage control features, (2) Tamiami Trail features, and (3) the 8.5 SMA flood mitigation features. Although the focus of this report is on the 8.5 SMA features, considerable redesign work also is occurring with the project's other two components. For this reason, all evaluation of the 8.5 SMA component must be conducted in a manner to ensure compatibility with the MWD Project's other components.

The conveyance components proposed in the GDM were designed to redirect water from Water Conservation Areas (WCA) No. 3A and 3B into NESRS under

normal conditions of flow. However, the Corps also determined the proposed modifications may raise levels of ground water and increase the spatial extent and frequency of flooding in the 8.5 SMA. Consequently, the Corps recommended a flood mitigation system as a component of the overall MWD Project. This system is only intended to prevent increased levels and frequency of flooding in the 8.5 SMA resulting from the increase in water levels associated with restoration of hydropatterns in the NESRS associated with the implementation of the MWD Project. It is not intended to provide the area with any level of guaranteed flood protection. As such, the flood mitigation design was only intended to prevent conditions within the 8.5 SMA from getting worse because of the implementation of the MWD Project. The 1992 mitigation plan was never intended to improve the conditions within the flood-prone area.

Since the project was authorized in 1989 and the design approved in 1992, various concerns about the flood mitigation system for the 8.5 SMA component have arisen. These concerns were a direct result of the new information that became available since the completion of the 1992 GDM such as significant improvements to hydrologic modeling capabilities and an enhanced the understanding of the restoration requirements of the ecosystem. The C–111 Project has also been designed and partially implemented, underscoring the need for better project integration. Lastly, it is the DOI position that the new information has indicated that flood mitigation may not be a sustainable solution for the 8.5 SMA component of the project. The SFWMD, ENP, and others suggested other potential engineering designs that would meet the needs of the 8.5 SMA's residents while ensuring environmental restoration to NESRS. In addition, significant progress has been made in the collection and analysis of hydrologic and biological data from Everglades research resulting in more effective scientific modeling analysis. New information regarding shifts in vegetational composition and dominance, hydropatterns, and transportation and assimilation of nutrients in south Florida ecosystems has been discovered. Consequently, the SFWMD, ENP, and others have suggested the flood mitigation system approved by the Corps in 1992 may no longer represent the best alternative for attaining full restoration of NESRS while simultaneously meeting the need for a "flood protection system" in the 8.5 SMA.

In response to these concerns, the Corps has agreed to consider and evaluate alternatives to the 8.5 SMA component of the MWD Project. These alternatives and the analysis of their effects (adverse and beneficial) will be presented in a SEIS.

8.5 Square Mile Area Project Component

The 8.5 SMA is in the East Everglades about 20 miles southwest of Miami, Florida and 10 miles north of Homestead, Florida (Figure 1). ENP and L–31N bound the 8.5 SMA on the west and east, respectively. Richmond Drive (SW 168th Street) and SW 104th Street bound the 8.5 SMA on the south and north, respectively. U.S. Highway 31 lies about 6.6 miles to the north. In general, residential and agricultural areas occupy the eastern half of the 8.5 SMA whereas vacant land and wetlands characterize the western half.

The 8.5 SMA is prone to frequent flooding because it lies in the historical Everglades, a large, slow moving watercourse of wetlands in South Florida. Because this area is west of the protective levee system of the C&SF Project, no authorized level of flood protection is provided. Additionally, much of the area's development occurred during the 1970s, a decade of generally below average rainfall with no major storms. Since that decade, floods from heavy rains and periodic high ground water have caused damage to property and loss of crops.

Assuming the MWD Project is implemented as authorized, the net increase in water introduced to NESRS would potentially raise elevations of ground water in the adjacent 8.5 SMA. As a result, the volume of storage of ground water available to retain runoff from rainfall would be reduced. This would raise the potential for increases in flooding. Consequently, the Everglades National Park Protection and Expansion Act (and the 1992 GDM) provided for a system designed to address the increases in the levels of ground water in order to maintain the current hydrologic conditions within the 8.5 SMA.

The design proposed by the GDM consists of a double levee, canal between the two levees for collection of seepage, and a pump station. The double levee would surround the 8.5 SMA on the north and west sides and tie into existing Levee 31N, which borders the 8.5 SMA's east side. The inner levee is included to prevent sheet flow from the 8.5 SMA from entering the seepage collection canal.

The canal's depth would range from 12 feet in the north to about 6.5 feet in the south. Seepage water from ENP would be collected and conveyed to the L–31N canal through construction of pump station S–357 on the northeast terminus of the collection canal. Subsequently, these waters would be conveyed north in L–31N and discharged into the NESRS via the L–29 canal through the S–356 pump station. In effect, this original design allows for the continuous return of NESRS seepage back to the slough.

8.5 Square Mile Area Project Component Objectives

The overall goal for the 8.5 SMA component of the MWD Project is to identify a sustainable technical solution for the 8.5 SMA that is compatible with the restoration requirements of the 1989 ENP Protection and Expansion Act. It is also desirable to ensure compatibility with ongoing restoration projects, such as the C–111 Project and future components of the Comprehensive Everglades Restoration Plan. Recognizing this overall goal, several objectives have been identified for the 8.5 SMA component of the MWD Project.

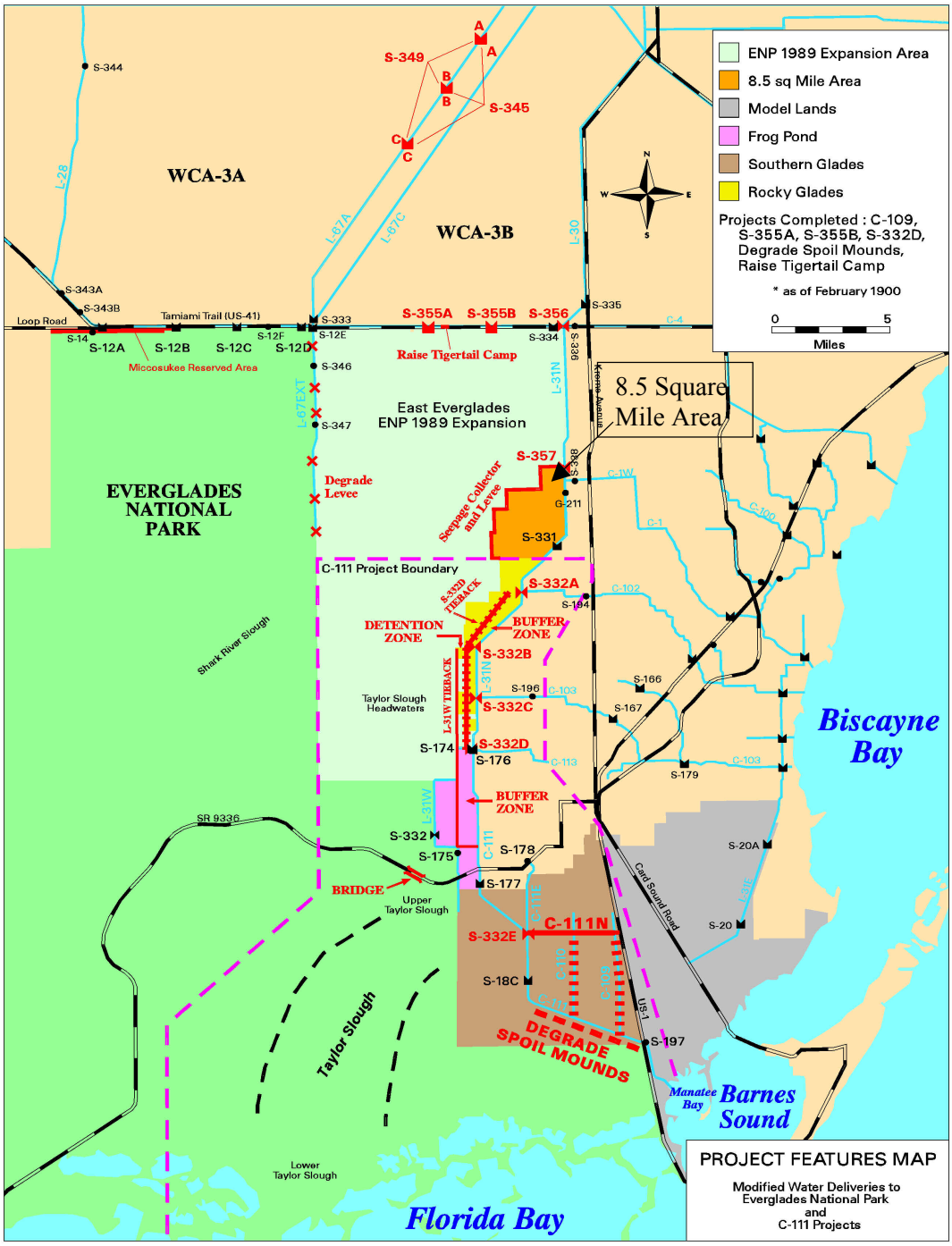

Figure 1 Location of the 8.5 Square Mile Area

DOI has developed objectives for the 8.5 SMA project based on the objectives provided by the Corps in its final Performance Measures Report, February 15, 2000 (Appendix A). DOI subdivided them into two categories: legislative requirements and other objectives. The requirements have their basis in the project's authorization. These three objectives measure performance relative to the project's requirements (see Appendix A for the specific project requirements). The other objectives are evaluated to meet requirements of NEPA, but specific performance is not viewed as a requirement of the project.

Legislative Requirements (Must provide sufficient level of performance to meet project requirements)

1. Evaluate effects on hydropatterns in the NESRS according to Section 104 of the 1989 Everglades National Park Protection and Expansion Act.

2. Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project according to Section 104 of the 1989 Everglades National Park Protection and Expansion Act.

3. Evaluate effects on Federal and State Listed Endangered Species survival, in accordance with the Endangered Species Act of 1973.

Other Objectives (Desirable outcomes from project implementation)

4. Analyze cost effectiveness.

5. Analyze effects to ecological function.

6. Measure compatibility with Comprehensive Everglades Restoration Plan and C–111 Projects without adversely impacting the current level of flood protection east of L–31N.

7. Analyze impacts and costs associated with time delays in implementation of alternatives.

8.5 Square Mile Area Project Component Performance Measures

For purposes of the CAR, the following objectives and associated performance measures were examined:

Legislative Requirement 1 — Evaluate hydropatterns in NESRS according to Section 104 of the 1989 Everglades National Park Protection and Expansion Act

a) Increase in hydroperiod in NESRS during the 1995 wet year (number of acres in NESRS with increase in hydroperiod compared to the restored condition).

b) Decrease in hydroperiod in NESRS during the 1995 wet year (number of acres in NESRS with a decrease in hydroperiod compared to the restored condition).

c) Increase in water depth in NESRS during the 1995 wet year (number of acres in NESRS with an increase in water depth compared to the restored condition).

d) Decrease in water depth in NESRS during the 1995 wet year (number of acres in NESRS with a decrease in water depth compared to the restored condition).

Note: For each of the above performance measures, the 1989 dry year performance will be evaluated when model output is made available to DOI.

Legislative Requirement 2 — Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project according to Section 104 of the 1989 Everglades National Park Protection and Expansion Act

a) Acres of 8.5 SMA damaged by increases in hydroperiod during the 1995 wet year (number of acres when the number of days of flooding exceeded the existing condition).

b) Acres of 8.5 SMA damaged by increases in surface water depth during the 1995 wet year (number of acres where the average water depth exceeded the base condition).

c) Flood Protection was also examined for the 1995 wet year (number of acres within the area designated for protection where the water table did not exceed the ground surface).

Legislative Requirement 3 — Evaluate effects on Federal and State Listed Endangered Species survival, in accordance with the Endangered Species Act of 1973

a) Cape Sable Seaside Sparrow:

- Nesting opportunity changes (number of consecutive days from March 1 through July 15 with water levels below the ground surface)

- Nesting habitat suitability (change in indicator cell hydroperiod of less than 6 month duration)

Note: For each of the above performance measures, the performance could not be evaluated with the model output provided to DOI (See Chapter 7, Cape Sable Seaside Sparrow)

b) Snail Kite:

- Kite habitat suitability (number of acres with water depths between 0.2 and 0.13 meters for greater than 360 days)

c) Wood Stork:

- Stork habitat suitability (stork habitat was defined as the number of acres with a water depth between 0.1 and 0.25 meters, but each alternative was evaluated by an examination of the stage hydrographs for any abrupt changes in water levels within the habitat area)

Other Objective 5 — Evaluate effects to ecological functions

a) Spatial distribution of functional short hydroperiod wetlands

Short hydroperiod wetlands for this study were defined as having the following characteristics:

- dry year water levels below 1.5 feet of ground surface for no more than 30 days, and
- average hydroperiod for both wet and dry year between 30 and 180 days, and
- maximum wet year water depths less than 2 feet

b) Wetland Rapid Assessment Procedure or WRAP (number of wetland FUs for each proposed alternative when compared to the existing condition)

Other Objective 6 — Measure Compatibility with Comprehensive Everglades Restoration Plan and C–111 Projects without adversely impacting the current level of flood protection east of L–31N

a) Potential for retrofitting of project features (qualitative rank of alternatives based on potential need to rehabilitate or remove structural components)

b) Potential to re-establish historical flow regimes (qualitative rank of potential of alternatives to restore more historic flow conditions)

Other Objective 7 — Analyze impacts and costs associated with time delays in implementation of alternatives

a) Potential to delay implementation of the overall MWD project objectives

The performance measures stated above were used to evaluate and compare alternative performance for each of the objectives reviewed by DOI. For the hydrological analysis DOI compared all alternatives, including the No Action Alternative (Alternative 1), to the conditions expected upon full restoration capability of the MWD project in order to demonstrate the relative contributions of each alternative to the restoration goal of the project. This comparison was

also done for the listed species analyses. The wetland function impact comparisons were made to the existing condition as well as to the No Action Alternative.

The Corps of Engineers' SEIS includes comparisons of all performance measures to the No Action Alternative (Alternative 1). Together, the information contained in this CAR and the information in the SEIS serve to sharply define the issues.

Local Sponsor's Responsibilities and Decisions for Identification of Alternative Design

The SFWMD is the project's local sponsor and represents local interest. As the project's local sponsor, SFWMD has specific duties and obligations. These include:

- Contributing a minimum of 25 percent of total costs needed to operate and maintain, repair, replace, and rehabilitate the project works involved to mitigate the increased risk of flooding in the 8.5 SMA, including the levee and canal system, pumping stations, and structural works and modifications in the WCA No. 3 and adjacent canals.

- Hold and save the United States free from damages due to the construction or subsequent operation and maintenance of the project, except any damages due to the fault or negligence of the United States or its contractors.

- Prevent encroachment on the flood-carrying capacity of the project, including the culvert system under the U.S. 41 road.

- Maintain and operate the works after completion in accordance with regulations prescribed by the Secretary of the Army, except for the water control structures and outlets in WCA No. 3, which will be maintained and operated by the Corps.

Based on a request by the SFWMD's Governing Board in April 1999, the Corps provided an analysis of the proposed alternatives in April 2000. The analysis was in the form of a Draft SEIS. The SEIS will be used as the decision document by the Corps.

Corps of Engineers' Responsibilities and Decisions for Identification of Alternative Design

As described above, the Everglades National Park Protection and Expansion Act authorized and directed the Corps (through the Secretary of the Army) to design and construct modifications to the C&SF Project. The purpose of modifications is to improve the delivery of water into ENP and, to the extent practicable, take

steps to restore ENP's natural hydrological conditions. As stated above, the Act also directs the Corps to set forth the proposed modifications in a GDM.

Before the Corps can implement any proposed modifications to the C&SF Project, those modifications must be evaluated and disclosed under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.). Due to its responsibilities for designing and constructing modifications to the C&SF Project, the Corps has assumed the lead agency's role for the analysis of proposed modifications to the 8.5 SMA component of the MWD Project under the National Environmental Policy Act (NEPA). In the role as lead agency, the Corps determined the proposed modifications potentially would have a significant effect on the human environment and the NEPA analysis would have to be documented in a SEIS.

As the lead agency, the Corps has the ultimate responsibility for the content of the SEIS. However, the SEIS is supposed to use the environmental analysis and recommendations of cooperating agencies with jurisdiction by law or special expertise to the maximum extent possible, consistent with the Corps' own responsibilities as lead agency (Section 1501.6(a)(2)). If the lead agency leaves out a significant issue or ignores the advice and expertise of a cooperating agency, the EIS may be found later to be inadequate (CEQ 1981). This CAR contains the results of the Service and ENP's primary environmental analyses and recommendations regarding hydrological and ecological effects of the alternatives on ENP and fish and wildlife resources in the study area.

As discussed previously, the Corps released a GDM, Final EIS, and ROD on the MWD Project in 1992. Since the project was authorized in 1989 and the design approved in 1992, various concerns about the flood mitigation system for the 8.5 SMA component have arisen necessitating reconsideration of the 8.5 SMA component of the MWD Project. In response to new information as well as the sponsors request that the Corps review all alternatives to facilitate a decision on a locally preferred alternative, the Corps is conducting a supplemental NEPA analysis, which it is documenting in a SEIS.

Upon completion of this supplemental NEPA analysis, the Corps will issue a ROD after full consideration of all viewpoints. The ROD will identify the alternative selected by the Corps for implementation.

Department of the Interior's Responsibilities and Decisions for Identification of Alternative Design

Authority for the involvement of the ENP and Service in the SEIS originates from various laws, agreements, and regulations. Each of these laws, agreements, and regulations are described below.

1989 Everglades National Park Protection and Expansion Act (Including the 1994 Amendment and Interagency Agreement)

The Everglades National Park Protection and Expansion Act authorizes the Secretary of the Army, in consultation with the Secretary of the Interior, to design and construct modifications to the C&SF Project. Consultation with the Secretary of Interior is needed because the specific purpose of the MWD Project is to benefit ENP's ecological values (including federally listed threatened and endangered species) and hydrologic conditions.

In recognition of the unique role of ENP in the project, the Department of the Army (acting through the Corps) and National Park Service (representing the Department of the Interior) entered into an interagency agreement to facilitate implementation of the Everglades National Park Protection and Expansion Act. This 1991 agreement defined each party's responsibilities. It also identified procedures for accomplishing and funding the work needed to implement the Act. In particular, this agreement states that the Corps shall:

- Cooperate with the National Park Service (NPS) to ensure effective implementation of the Act.
- Cooperate with the NPS in the development of a long-term monitoring program designed to assess the impacts and success of the Corps and NPS' activities undertaken pursuant to the Act.
- Cooperate with the NPS in the modification, refinement, and improvement of the computer-based hydrologic model for South Florida that will be used to develop new schedules for delivery of water to ENP and assess the impacts of activities within the basin that could affect ENP.

The agreement also states that the NPS shall:

- Cooperate with the Corps to ensure effective implementation of the Act.
- Make available to the Corps such funds as are appropriated for the Corps' activities authorized pursuant to Section 104 of the 1989 Act.

The Endangered Species Act

The Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) specifically requires consultation and coordination between the Corps and the Service. The Endangered Species Act (ESA) requires federal agencies to consult with the Service and National Marine Fisheries Service (NMFS) regarding any effects that a federal action may have on federally listed threatened or endangered species or those proposed for listing as threatened or endangered. Section 7(a)(2) states that each Federal agency shall, in consultation with the Secretary of the Interior, ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a federally listed species or result in the destruction or adverse modification of designated critical habitat. In fulfilling these require-

ments, each agency is to use the best scientific and commercial data available (Service 1998). This section of the ESA sets out the consultation process, which is further implemented by regulation (50 CFR §402).

The Service has determined several species listed as threatened or endangered occur or potentially occur in the study area. They include the snail kite (*Rostrhamus sociabilis*), wood stork (*Mycteria americana*), Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), Florida panther (*Felis concolor coryi*), and eastern Indigo snake (*Drymarchon corais couperi*).

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) mandates coordination with the Corps regarding fish and wildlife resources. Both NPS and Service have collaborated to provide this CAR because many of the fish and wildlife resources associated with the project are within ENP. The purpose of the FWCA is to recognize the contribution of these resources to the nation, the increasing public interest and significance thereof due to expansion of our national economy and other factors, and to provide that the conservation of fish and wildlife receives equal consideration and be coordinated with other features of water-resources development programs. The Secretary of the Interior, through the Service is authorized to assist and cooperate with federal, state and public or private agencies and organizations in the conservation and rehabilitation of fish and wildlife resources. The FWCA provides that whenever the waters of any stream or other body of water are proposed to be impounded, diverted, the channel deepened or otherwise controlled or modified, the Corps shall consult with the Service and the agency administering the fish and wildlife resources of the state (Corps 1998). The consultation shall consider conservation of wildlife resources with the view of preventing loss of and damages to such resources as well as providing for development and improvement in connection with such water resources development (Corps 1998).

Any reports and recommendations of these fish and wildlife agencies shall be included in authorization documents for construction or for modification of projects. The Corps shall give full consideration to the reports and recommendations of these fish and wildlife agencies and include such justifiable means and measures for wildlife mitigation or enhancement as the Corps finds should be adopted to obtain maximum overall project benefits (Corps 1998).

The National Environmental Policy Act

To facilitate the required consultation and coordination with ENP and the Service, the Corps has included both agencies as cooperating agencies for the SEIS under the authority of NEPA. In addition to the responsibilities described above, the Council on Environmental Quality's (CEQ) regulations and guidelines for implementing NEPA confer specific rights and responsibilities to agencies functioning as cooperating agencies in the NEPA process. A cooperating agency is any agency, other than a lead agency (Corps in this case), that has jurisdiction by law or special expertise with respect to any environmental impact involved in

a proposal (or a reasonable alternative) for legislation or other major federal action that might significantly affect the quality of the human environment. Where cooperating agencies have their own decisions to make and they intend to adopt the EIS and base their decisions on it, one document should include all of the information necessary for the decisions by the cooperating agencies (CEQ 1981). The Secretary of the Interior, through ENP and the Service, intends to make a recommendation to the Corps on the project and alternatives analyzed in the SEIS.

Executive Orders

Executive Orders (EOs) 11988 (Floodplain Management) and 11990 (Protection of Wetlands) require federal agencies to evaluate the likely impacts of actions to floodplains and wetlands. The objectives of the EOs are to avoid, to the extent possible, the long-term and short-term adverse impacts associated with occupancy, modification, or destruction of floodplains and wetlands and to avoid indirect support of development and new construction in such areas wherever there is a practicable alternative.

To document its evaluation for these EOs, the NPS prepares a Statement of Findings (SOF) that presents the purpose of the proposed project and documents the anticipated effects on wetlands and floodplains. ENP is preparing an SOF for the new alternatives for 8.5 SMA component of the MWD Project currently being evaluated and documented in the SEIS.

Additional Potential Department of the Interior Participation

The SFWMD Governing Board has included the implementation of a state-sponsored willing seller program to acquire lands in the 8.5 SMA in their recommendations submitted to the Corps on June 15, 2000. The willing seller program will address concerns related to secondary and cumulative impacts due to potential increased development in the 8.5 SMA from implementation of the Recommended Plan. The DOI has identified four sources of funding that may be used to provide additional federal funds to the SFWMD to assist in its willing seller program. These sources include the Fiscal Year 2000 Land and Water Conservation Fund appropriations, the ESA, the Farm Bill, and funds provided under the MWD Project's authorization. All four sources are described below.

Land and Water Conservation Fund

The Department of the Interior and Related Agencies Appropriations Act for Fiscal Year 2000 (FY 2000 Appropriations Act), P. L. 106–113, contains $45 million in the NPS's Land Acquisition and State Assistance Appropriation that is available to the Secretary of the Interior to provide financial assistance to the State of Florida for land acquisition within the "Everglades watershed." The FY 2000 Appropriations Act defines the "Everglades watershed" as "lands and waters within the boundaries of the South Florida Water Management District,

Florida Bay and the Florida Keys, including the areas known as the Frog Pond, the Rocky Glades and the Eight and One-Half Square Mile Area." Any funds provided to the State for the purchase of lands within the authorized areas must be equally matched by the State and are subject to an agreement that the lands acquired will be managed in perpetuity for the restoration of the Everglades. This authority and funding is available to allow the DOI to provide funds to the State of Florida for acquisitions within the 8.5 SMA, subject to the statutory requirements associated with the expenditure of these funds and subject to the completion of the appropriate environmental compliance, including compliance under NEPA. To the extent the SFWMD continues or expands its on-going willing seller program for 8.5 SMA to areas east of the existing "Save Our Rivers" boundary in the 8.5 SMA, consistent with the SFWMD Governing Board recommendations adopted on June 15, 2000, these funds could be used, subject to statutory requirements above, to provide up to 50 percent of the SFWMD's acquisition costs.

Endangered Species Act

Section 5(a) of the ESA authorizes the Secretary of the Interior to acquire lands to conserve fish, wildlife, and plants that are federally listed as threatened or endangered. For this purpose, the Secretary shall utilize the land acquisition and other authority under the Fish and Wildlife Act of 1956, as amended, the FWCA, as amended, and the Migratory Bird Conservation Act, as appropriate. The Secretary is authorized to acquire by purchase, donation, or otherwise, lands, waters, or interest therein, when implementing this conservation program. Immediate attention is given to those resident fish and wildlife that are determined by the Secretary and the Florida Fish and Wildlife Commission as threatened or endangered and most urgently in need of conservation.

Farm Bill 390

Farm Bill 390 provides two distinct programs for funding the acquisition of land in support of the Everglades' restoration. The first program provided $200 million to the Secretary of the Interior to conduct restoration activities in the Everglades ecosystem in South Florida, including acquisition of real property and interests in real property and resource protection and resource maintenance activities. The funds in this account have been used or are already allocated for use in acquiring lands through cost-sharing agreements with the SFWMD.

The second program provides for a special account (known as the Everglades Restoration Account). This account receives funds from the sale of surplus real property located in the State of Florida. A variety of lands throughout Florida has been identified tentatively as potential surplus federal properties for possible use in generating funds for this account. The funds deposited in the account, the total of which cannot exceed $100 million, must be used in conjunction with matching funds provided by the State of Florida.

1994 Amendment to the Everglades National Park Protection and Expansion Act

In 1994, Congress enacted Public Law 103–219 thereby amending the 1989 Everglades National Park Protection and Expansion Act by adding a new subsection to provide grant-making authority to the Secretary for the acquisition of lands under the 1989 Act in the event the State of Florida contributes 75 percent of the total acquisition cost of lands acquired. Under the amended project authorization, The Secretary of the Interior may, using funding appropriated for the purpose of implementing this Act, provide up to 25 percent of the total cost of specific lands acquired for the restoration of natural flows to ENP or Florida Bay using funds appropriated to the NPS under the 1989 Act. Lands specifically identified in the amendment include those known as the Frog Pond, Rocky Glades Agricultural Area, and the 8.5 SMA.

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Chapter 2 — Area Setting

Project Location

The 8.5 SMA lies within the Rocky Glades area of the Eastern Everglades biogeographical subregion. The area is roughly bounded by the L–31N canal on the east, ENP on the west, SW 104th Street on the north, and SW 168th Street on the south. A portion of the study area lies within ENP lands immediately adjacent to the north and west boundaries of the 8.5 SMA. NESRS is located just a few miles west of the study area, proceeding northeast to southwest, within ENP.

Description of Study Area

The study area, historically a mosaic of graminoid and herbaceous short-hydroperiod wet prairies located along the eastern extremity of NESRS, is now a patchwork of residential and rural development, which is most concentrated in the eastern one-third of the area adjacent to the L–31N canal. Less dense residential and agricultural development with scattered vacant lots and wetlands comprise the central portion while the western one-fourth of the area is dominated by a mixture of graminoid wet prairies and shrubby wet prairies with limited rural development. ENP lands within the study area are mostly natural areas existing as a mosaic of long and short hydroperiod graminoid wetlands abundantly interspersed with willowheads, bayheads, and hardwood hammocks. Elevation decreases from east to west, generally presenting a flat topography with drier upland habitats adjacent to L–31N (7.0 to 8.5 feet NGVD) grading to a landscape of wet prairies to the west (5.0 to 6.5 feet NGVD).

Shaw (1998) described the 8.5 SMA as dominated by agricultural land uses with the remaining lands dedicated to rural residential, wetlands, and disturbed vacant acreage; of which, only a very small portion (588 acres) is publicly-owned. More recent land use surveys reported by Miami-Dade County Department of Environmental and Resource Management (DERM) indicate that within the 8.5 SMA 1,838 acres are in agricultural land uses, 245 acres are in rural residential, and 970 acres are in residential with agriculture (DERM 1999a). Much of the agriculture is commercial nursery, livestock, and citrus/tropical fruit farming. Residential holdings are typically single-family dwellings on small acreages. Generally, vacant lands and wetlands within the study area are infested with exotic vegetation such as Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casuarina* spp.), *Melaleuca quinquenervia*, common reed (*Phragmites australis*), and Napier grass (*Pennisetum purpureum*). Additionally, many residential holdings are not legitimately permitted by Miami-Dade County's regulatory authorities. Illegal dumping and unpermitted construction activities (e.g., transient commercial operations, junkyards, and residential structures) are abundant in the study area.

Hydrological Description

NESRS and the 8.5 SMA are part of a single hydrological unit, despite their differing land uses. No levee or canal divides the surface water systems of the NESRS from the 8.5 SMA, nor is there a groundwater divide, either man-made or geologic, to separate their groundwater systems. These adjoining tracts are bounded by canals and levees: L–67 ext. to the west, L–29 to the north, and L–31N to the east and southeast (Figure 1).

Surface elevations range from 5.5 to 6.5 feet NGVD within NESRS and from 6.5 to 8.0 feet NGVD within the 8.5 SMA. The canal and levee system that provides flood control to areas east of L–31N drains water from the NESRS resulting in lower water levels and flow rates in NESRS, thereby detrimentally affecting the southern Everglades. Because the entire study area is part of the remnant flow system of the NESRS, seasonal increases in water levels in the restored NESRS will be accompanied by water level increases in the 8.5 SMA.

The Biscayne Aquifer is the surficial aquifer underlying the NESRS and the 8.5 SMA. The western extent of the aquifer in the vicinity of the study area is roughly beneath the L–67 ext. The thickness of the aquifer increases to the east and is roughly 35 to 45 feet thick beneath the 8.5 SMA and reaches a thickness in excess of 100 feet along the east coast. The limestone formations that make up the Biscayne Aquifer have hydraulic conductivities that range from 25,000 to 50,000 feet/day (USGS 1996). High intensity rainfall, porous subsurface geology, and the location of the 8.5 SMA on the wet side of L–31N result in frequent episodes of prolonged flooding in the 8.5 SMA.

Ecological Description

Prior to settlement and development, lands within this part of the eastern Everglades were a mosaic of wet prairies, varying in surface elevation, hydroperiod, and vegetation composition. Short hydroperiod conditions in the eastern Everglades typically favor muhly grass (*Muhlenbergia* spp.) vegetative communities whereas the wetter prairies (long hydroperiod) tend to be dominated by sawgrass (*Cladium jamaicense*). On the Rocky Glades area, vegetative dominance and hydroperiod characteristics tend to be most dependent upon a combination of the surface elevation of limestone bedrock (oolite) and subsurface permeability. Less-disturbed wetlands along the western extremity of the 8.5 SMA appear to be consistent with this relationship between physical and biological aspects of the environment as the muhly grass vegetative community tends to dominate the landscape at higher surface elevations and sawgrass dominates in the lower, wetter elevations. Frequently, these vegetative communities in minimally disturbed landscapes tend to co-dominate within a mosaic of interspersed short and long hydroperiod wetlands. Additionally, as this mosaic is subjected to increasing human disturbance, establishment of exotic vegetation demonstrates a profound positive correlation, increasing in abundance and density upon disturbed soils. Within the more developed and disturbed areas of the 8.5 SMA, exotic species invasion and land management preclude natural trends in plant dominance, favoring a landscape dominated by more opportunistic and/or economically important species.

Fish and Wildlife Resources

Federally listed and State listed species

A variety of species listed as threatened, endangered, or special concern occur or potentially occur in the study area. Federally-listed species that could occur in the action area or be affected by construction and operation of the proposed action include the snail kite, wood stork, Cape Sable seaside sparrow, Florida panther, and eastern Indigo snake. Species listed by the State of Florida as threatened, endangered, or species of special concern are found in Table 1.

Table 1 Species Listed by Florida Game and Freshwater Fish Commission as Threatened, Endangered, and Species of Special Concern, Excluding Federally-listed Species

Common Name	Scientific Name	Designated Status
Reptiles		
Miami black headed snake	*Tantilla oolitica*	Threatened
American alligator	*Alligator mississipiensis*	Special Concern
Birds		
Roseate spoonbill	*Ajaia ajaja*	Special Concern
Limpkin	*Aramus guarauna*	Special Concern
Little blue heron	*Egretta caerulea*	Special Concern
Tricolored heron	*Egretta tricolor*	Special Concern
Snowy egret	*Egretta thula*	Special Concern
White ibis	*Eudocimus alba*	Special Concern
Fish		
Mangrove rivulus	*Rivulus marmoratus*	Special Concern
Mammals		
Everglades mink	*Mustela vison evergladensis*	Threatened
Molusks		
Florida tree snail	*Liguus fasciatus*	Special Concern

Source: Florida Fish and Wildlife Conservation Commission 1997.

It is likely that Florida panthers and eastern Indigo snakes inhabit or frequently utilize the 8.5 SMA. A deceased panther was recovered in ENP just south of SW 168th Street in January 2000 (Orin Bass, personal communication). Smith and Bass (1994) documented that this radio-collared panther included the 8.5 SMA in its core activity area, well within it home range. Eastern Indigo snakes could find necessary resources in and around the higher elevations in the eastern portion of the area. However, there is no known record of eastern Indigo snakes in the 8.5 SMA.

Other Fish and Wildlife Resources

Vegetation

Historically, most lands within the study area were herbaceous wet prairies dominated by sawgrass, muhly grass, and beardgrass (*Andropogon glomeratus*).

Other common native species found on these wet prairies include, but are not limited to arrowhead *(Sagittaria lancifolia)*, spider lily (*Hymenocallis latifolia*), swamp lily (*Crinum americanum*), beakrush *(Rhyncospora* spp.), spikerush (*Eleocharis atropurpurea*), maidencane (*Panicum hemitomum*), Ludwigia (*Ludwigia repens*), and primrose willow (*L. Peruviana*). Information recorded from surveys conducted during December 1999 identified sawgrass, arrowhead, beakrush (*R. tracyi*), spikerush, various bladderworts (*Utricularia* sp.), panic grass (*Panicum tenerium*), saltmarsh aster (*Aster tenuifolia*), bluestem (*Schizachrium* sp.), goldenrod (*Solidago* sp.), and pickerel weed (*Pontederia* sp.) in long hydroperiod graminoid wet prairies. Muhly grass, bluestem, umbrella grass (*Fuirena* sp.), Elliot lovegrass (*Eragrostis ellioti*), lobelia (*Lobelia glandulosa*), goldenrod, string lily (*Crinum* sp.), sneezeweed (*Helenium* sp.), climbing hempweed (*Mikania scandens*), India joint-vetch (*Aeshynomene* sp.) and water hyssops (*Bacopa* sp.) were identified in short hydroperiod wet prairies.

Less than one-percent of lands within the 8.5 SMA were forested wetlands prior to human development in the area (DERM 1999b). This continues to be true as very few forested wetlands occur within the 8.5 SMA, primarily limited to the lower elevations of the western extremity. Historically, these wetlands consisted of bayheads and willowheads. Species typical of bayheads in the Rocky Glades area include: red bay (*Persea palustris*), swamp bay (*Magnolia virginiana*), myrsine (*Myrsine guianensis*), wax myrtle (*Myrica cerifera*), dahoon holly (*Ilex cassine*), pond apple (*Annona glabra*), poisonwood (*Metopium toxiferum*), buttonbush (*Cephalanthus Occidentalis*), and willow (*Salix caroliniana*). Willowheads are typically monotypic, with willow being the most abundant and dominant woody plant (Gunderson 1994).

Conversely, forested wetlands are abundant within adjacent lands in ENP immediately west of the 8.5 SMA. In the ENP portion of the study area, several of these forested wetlands exist as complexes of hardwood hammocks, bayheads, and willowheads. Tropical hardwood species, such as strangler fig *(Ficus aurea*), stopper (*Eugenia* sp.) and cocoplum (*Chrysobalanus icaca*), have established on the higher elevations. Species indicative of bayheads and willowheads have established in the lower elevations and around the margins of the tree islands. Exotics found in these habitats include Australian pine and Brazilian pepper.

Approximately 40 percent of the 8.5 SMA has been significantly disturbed by human activity, exhibiting land uses that have converted native wetlands to agricultural and urban lands. Much of these lands has been rock plowed, filled, scraped, or any combination of these (DERM 1999b), allowing invasion by opportunistic non-native species, such as Australian pine, Napier grass, Melaleuca, and Brazilian pepper.

Avifauna

Avian diversity in this region of South Florida is high. Waterfowl, wading birds, and other bird species that depend upon wetlands for critical resources dominate avian communities here. DERM identified 142 species of birds in the study area (DERM 1999b). Common aquatic species include the spotted sandpiper (*Actitis macularia*), semipalmated sandpiper (*Calidris pusilla*), lesser yellowlegs (*Tringa flavipes*), greater yellowlegs (*T. melanoleuca*), double-crested cormorant

(*Phalacrocorax auritus*), mottled duck (*Anas fulvigula*), anhinga (*Anhinga anhinga*), limpkin (*Aramus guarauna*), great blue heron (*Ardea herodias*), cattle egret (*Bubulcus ibis*), green heron (*Butorides striatus*), little blue heron, black-crowned night heron (*Nycticorax nycticorax*), snowy egret, great egret *(E. alba*), white ibis, and glossy ibis (*Plegadis falcinellus*). Common blackbirds found here include the red-winged blackbird (*Agelaius phoeniceus*), eastern meadowlark *(Sturnella magna*), common grackle (*Quiscalus quiscula*), boat-tailed grackle (*Q. major*), and brown-headed cowbird (*Molothrus ater*). Raptors found in the study area include the red-shouldered hawk (*Buteo lineatus*), red-tailed hawk (*B. jamaicensis*), marsh hawk (*Circus cyaneus*), black-shouldered kite (*Elanus caeruleus*), swallow-tailed kite (*Elanus forficatus*), turkey vulture (*Cathartes aura*), and black vulture (*Coragyps atratus*). Other common birds found in the 8.5 SMA include the northern cardinal (*Cardinalis cardinalis*), cedar waxwing (*Bombycilla cedrorum*), yellow-billed cuckoo (*Coccyzus americanus*), black-throated warbler (*Dendroica caerulescens*), yellow-rumped warbler (*D. coronata*), prairie warbler (*D. discolor*), palm warbler (*D. pamarun*), mocking-bird (*Mimus polyglottos*), house sparrow (*Passer domesticus*), rufous-sided towhee (*Pipilio erythrophthalmus*), American robin *(Turdus migratorius*), Carolina wren (*Thryothorus ludovicianus*), house wren (*Troglodytes aedon*), western kingbird (*Tyrannus verticalis*), white-eyed vireo (*Vireo griseus*), and the non-native european starling (*Sturnus vulgaris*).

Mammals

According to DERM (1999b), 21 species of mammals have been recorded in the 8.5 SMA. Of these, 11 were observed by DERM's staff in 1997 and 1999. Species observed by DERM's staff included the domestic dog (*Canis domesticus*), opossum (*Didelphis marsupialis*), striped skunk (*Mephitis mephitis*), house mouse (*Mus musculus*), cotton mouse (*Peromyscus gossypinus*), raccoon (*Procyon lotor*), black rat *(Rattus rattus*), hispid cotton rat (*Sigmodon hispidus*), eastern cottontail (*Sylvilagus floridanus*), marsh rabbit (*S. palustris*), and grey fox (*Urocyon cinereoargenteus*). Other mammals recorded in the DERM report for the area include the nine-banded armadillo (*Dasypus novemcinctus*), Florida panther, eastern yellow bat (*Lasiurus intermedius*), bobcat (*Lynx rufus*), evening bat (*Nycticeius humeralis*), whitetail deer (*Odocoileus virginianus*), rice rat (*Oryzomys palustris*), eastern mole (*Scalopus aquaticus*), spotted skunk (*Spilogale putorius*), and freetail bat (*Tadarida brasiliensis*).

Fish, amphibians and other aquatic animals

During surveys conducted in December 1999 and January 2000, some small fish were recovered: least killifish (*Fundulus chrysotus*.), sailfin mollie (*Poecilia latipinna*), pygmy sunfish (*Lepomis* spp.), and mosquito fish (*Gambusia* sp.). Only mosquito fish were found in abundance. One species of frog (*Hyla* spp.) was observed frequently throughout surveys within long and short hydroperiod wetlands, whereas leopard frogs (*Rana* spp.) were observed less frequently. Aquatic invertebrates were abundant and representative of Everglades wetland complexes. Common invertebrates identified included the gyrinid water beetle (*Gyrinus* spp.), giant water bug (*Belastoma* sp.), water strider (Family Gerridae), mayfly (Order Ephemeroptera), water tiger (Order Coleoptera: Dyticidae), aquatic spiders (*Dolomedes* spp.), backswimmers (Order Hemiptera: Corixidae).

Fish and Wildlife Resources Without the Project

Existing Conditions

General

Elevations in the study area range from 5.5 to 8.0 feet NGVD and no positive drainage outlet exists, creating ideal conditions for marsh and wet prairie habitats. Significant rainfall typical of this region of South Florida (50 inches or more), often results in groundwater levels rising to and above the surface of the land. The result is extensive flooding that persists for relatively long periods of time (Shaw 1998).

A large portion of the 8.5 SMA (primarily the eastern half) is dedicated to agricultural and residential land uses, providing only marginal benefits to resident wildlife. Flooding conditions within the study area have prompted land owners/managers to alter (e.g., ditching) natural landscape features to provide flood relief to residents, road access, and optimize agricultural production. It appears that many years of continuous anthropogenic activity in this area is correlated with invasion of exotic species and roadside (including vacant lots) accumulation of human refuse (e.g., household garbage, derelict appliances and vehicles, and spent containers of hazardous materials). These conditions significantly reduce any potential for re-establishment of native vegetative communities as residential and agricultural development continue to proceed.

As noted during the numerous interagency field visits to the study area, existing conditions within the 8.5 SMA likely provide important resources to opportunistic small mammals, raccoons, rabbits, squirrels, songbirds, hawks, kestrels, crows, turkey vultures, frogs, and various reptiles. White-tailed deer were observed in ENP, but only limited resources for these large ungulates were apparent within the study area. During the on-site surveys, the greatest degree of species richness was observed in the forested wetland systems within the ENP to the west of the 8.5 SMA, whereas species richness was lowest in wetlands on higher elevations (7.0 to 8.0 feet NGVD) in the eastern extremity of the 8.5 SMA in close proximity to L–31N. Here, impacts to wetland function are more dramatic and less opportunistic flora and fauna with strict resource requirements likely do not thrive. This range in fish and wildlife diversity and wetland function correlates with an elevational gradient (increasing elevations from west to east) and land use. Both elevation and land use are inter-dependent co-variables as lower elevations correlate with frequent flooding that limits the extent and type of land use. Higher elevations are more compatible with agricultural, commercial, and residential land uses.

Everglades National Park

ENP portion of the study area in ENP includes long and short hydroperiod wetlands and forested wetlands at low elevations (approximately 5.0 to 6.0 feet NGVD) that have been impacted by regional water conveyance systems and flood control management over the past 60 years since the construction of the

Tamiami Trail in 1929; followed by the construction of WCA 3, the C–4 Canal, and the L–31N Levee and Canal (circa 1960s). Generally, the function and structure of these wetlands have been altered by an unnatural hydropattern from diversion of natural sheet flows.

Future Without Project

Continuing trends that compromise and preclude natural sheet flow in the eastern Everglades, including the 8.5 SMA, would not likely reverse without remedial action. Deleterious processes that continue to degrade fish and wildlife habitats include unnatural fire regimes and unnatural hydropatterns from water management practices, seepage loss through canals, landscape and habitat alteration from existing land use practices, exotic species invasion, and accumulation of human refuse and waste material. Additionally, continued human inhabitation of the study area, without an adequate buffer zone between NESRS and developed lands, would compromise efforts to restore natural sheet flow to ENP.

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Chapter 3 — Natural Resource Concerns

Introduction

The previous discussion presents a hydrological, ecological, and trust resource overview for the study area. The intent of this section is to define these resource values in terms of the issues and areas of concern generated by the proposed project. The major fish and wildlife habitat issue for the proposed project is optimized restoration of natural hydrological and ecological systems of Everglades habitats, including the eradication of invasive exotic plants, remediation of contaminated lands, and reduction of releases of water of poor quality into ENP. As an integral feature of the MWD Project, use of all or part of the 8.5 SMA could significantly contribute to environmental restoration throughout the eastern Everglades by enabling the conveyance of increased flows into NESRS, which would provide seasonal water resources to downstream wetland systems. Additionally, restoration and subsequent increase of wetland acreage within the 8.5 SMA would be consistent with the goals and objectives of the South Florida Management and Coordination Working Group's Science Coordination Team regarding spatial extent of wetlands in the eastern Everglades.

Resource Concerns

Wetland Resources

According to DERM (1999a), about 1,684 acres of wetlands exist within the 8.5 SMA. Of this total, several hundred acres of minimally disturbed wetlands consisting of short-hydroperiod marl prairies are located along the western extremity of the area. Here, they are exposed to minimal disturbance by humans and are mostly influenced by the nearby NESRS. Data collected from Wetlands Rapid Assessment Procedures (WRAP) surveys (December 1999 and February 2000) indicate disturbed, but adequately functioning, wetlands occur in this area, sometimes supporting diverse biological communities. These data also indicate even less disturbed wetlands immediately west of the 8.5 SMA (in ENP) provide diminished, yet important, foraging and breeding resources to wading birds, raptors, mammals, fish, amphibians, and aquatic invertebrates.

The Service's concerns regarding potential losses of wetlands from the authorized project described in the 1990 CAR in the 1992 GDM were well documented prior to Congressional authorization. The Service discussed losses of wetlands from construction and operation of the levees in correspondence to the Corps (March 23, 1987). This letter to the District Engineer presented the Service's position that anticipated levels of water in the agricultural and residential areas of

the 8.5 SMA were overestimated. Subsequently, the Service recommended that levee and seepage canal construction be substituted with a pumping operation.

Habitat Degradation

The 1990 CAR for the MWD Project indicates reduced hydroperiods in NESRS degraded a rich and diverse slough habitat into a "degraded marsh with low-standing stocks of aquatic animals". Flood control releases into ENP dispersed prey concentrations, which disrupted wading bird feeding and nesting. The diversion of natural flows into ENP from east to west resulted in dry season pooling outside the main channel of northern Shark Slough. Pooling here is less persistent and less productive. Generally, diversion of natural overland flows and the operation of the L–31N and L–31W canals have resulted in drier conditions in the eastern Rocky Glades and Taylor Slough headwaters, which serve as important dry season feeding areas for wading birds. In the opinion of DOI, the juxtaposition of the 8.5 SMA to these important regional wildlife resources clearly mandates the implementation of an alternative that is not only consistent with the MWD Project's overall objectives, but also provides optimal potential for restoration of local resources in and around the action area.

Status of ESA Section 7 Consultation Process

The overall MWD Project was evaluated for potential impacts to listed species in a Final Biological Opinion (1999 FBO) dated February 19, 1999. The Service determined the project would not jeopardize the existence of any listed species or adversely modify or destroy any designated critical habitat. The 1999 FBO documents that project construction would likely adversely affect snail kites, wood storks, and American crocodiles. In the 1999 FBO, the Service addressed effects of the action and incidental take for these species.

Currently, the Corps is reevaluating the 8.5 SMA component of the MWD Project and documenting this evaluation in a SEIS. The Corps is currently preparing a Biological Assessment (BA) on the Recommended Plan's effects on listed species. The Service will review the BA and respond in accordance with section 7 of the ESA.

Summary/Planning Objectives

Since the C&SF Project was first constructed and operational, East Everglades' wetland resources have been significantly affected. Resident fish and wildlife communities native to the eastern Everglades that depend upon seasonal distribution of water resources, have been negatively impacted as natural hydropatterns, native landscapes, and plant community composition have been altered through water management primarily tasked to provide water supply and flood control to a high-density and rapidly growing South Florida population. Channelization, detention, and flow diversion associated with the C&SF Project's operations and facilities continue to favor biological communities that demonstrate opportunistic strategies. Consequently, fish and wildlife communi-

ties that are sensitive to the seasonal distribution of natural resources continue to be negatively impacted under existing conditions. The goal for the MWD Project is to provide natural sheet flow of water into ENP. Establishment of a buffer zone within the 8.5 SMA would effectively provide an appropriate and adequate conveyance for waters in the Shark Slough basin to flow southward to ENP.

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Chapter 4 — Project Alternatives

Recommended Plan/Project

The Recommended Plan is a variation of Alternative 6D described below. The modifications to Alternative 6D will be made during the final design phase of the project to meet recommendations made by the SFWMD (Appendix F) and DOI (Chapter 10). In general, the modifications include changes to the alignment of the perimeter levee for purposes of maximizing wetlands within the buffer area and changes to the alignment of the interior canal and levee for purposes of minimizing the impacts to residents in the protected area. It is also the understanding of DOI that the Corps will provide assurances to the SFWMD and DOI to address project operations for mitigation purposes only, assurances that the operations will only impact ENP to the extent of the hydrologic modeling on Alternative 6D detailed in the Final SEIS, and also provide assurances for water quality treatment of runoff from the 8.5 SMA and management of fish and wildlife It is also the understanding of DOI that the SFWMD will use any available authority to prevent/curtail further development within the 8.5 SMA.

Other Alternatives

Some of the proposed alternatives were modified from their original conceptual deign in order to investigate performance of minor refinements to the original design. Examples of the types of modifications made by the Corps include changes to pump station capacity and depth of the seepage collector canal. These design modifications resulted in the multiple variations for a given alternative. These alternatives were designated with an alpha suffix after the alternative such as 2A or 6B. A complete explanation of each variation of an alternative is provided in Appendix A of the Draft SEIS.

Alternative 1 — Authorized GDM Plan (No Action)

This alternative was the plan selected by the Corps and described in the Final EIS for the MWD Project in 1992. The MWD Project consists of major structural modification of, and additions to, the existing system of water control features in the central and southern Everglades that are meant to restore more natural timing, volume, and placement of water flows through the action area. In general, the MWD Project attempts to reroute large volumes of water that currently pass through WCA–3A into western Shark Slough, instead passing the water from WCA–3A to WCA–3B and then from WCA–3B to NESRS. This alternative includes the construction of several structural features and modifications to the operation of existing structures. Modification to the operation of new and existing structural components of the project would be developed through an iterative experimental program (adaptive management) in order to develop the

best possible strategy to deliver flows to ENP. This plan, the "Full Structural Plan", which includes the construction and operation of a flood mitigation system, is to be operated to prevent increased flood risk to the 8.5 SMA from increased flows in NESRS.

This alternative consists of a major levee along the western perimeter of the 8.5 SMA from the L–31N canal on the north to high ground at SW 168th Street. A seepage canal would be constructed immediately east of the major levee to collect ground water underflow. A minor levee would be constructed east of the seepage canal. It is hypothesized that surface run-off will have poor water quality characteristics and the minor levee would prevent mixing with the higher quality seepage water.

Two new pump stations would be required to convey the seepage water. One station, S–357, which would be located in the canal at the northeastern edge of the 8.5 SMA, would convey seepage water north into the L–31N canal. Another new pump structure, S–356, would then convey water from the L–31N canal into the L–29 canal for eventual discharge into NESRS. This Plan "recirculates" the seepage water into ENP.

Alternative 2 — Modified GDM Plan

This Plan is a slight modification of the first alternative to increase compatibility with the overall Comprehensive Everglades Restoration Plan (CERP). This alternative would account for higher flows and stages expected upon implementation of the CERP and would discharge seepage water south instead of north.

This alternative consists of a major levee around the western perimeter of the 8.5 SMA proceeding from the L–31N canal to high ground at SW 168th Street. A seepage canal would be constructed east of the major levee to collect ground water underflow. A minor levee would be constructed east of the seepage canal. It is hypothesized that surface run-off will have poor water quality characteristics and the minor levee would prevent mixing with the higher quality seepage water.

Only one pump station would be required to convey the seepage water. The proposed structure (S–357), which would be located at the southwest corner of the 8.5 SMA, would convey the seepage water into a proposed Stormwater Treatment Area (STA) to be located south of the 8.5 SMA. The STA would provide for additional "polishing" or cleaning of the seepage water before it is released into NESRS.

Alternative 3 — Deep Seepage Barrier Plan

This alternative proposes the construction of a deep seepage barrier to reduce groundwater underflow into the 8.5 SMA. The seepage barrier would be used in lieu of a seepage canal and pump station.

This alternative consists of a major levee following the same alignment as under Alternative 1 from the L–31N canal to high ground at SW 168th Street. A seepage barrier, possibly located within the levee, would extend down to an undetermined

elevation. The seepage barrier would be made of an engineered barrier or curtain wall, such as slurry wall or sheet piles. The barrier must be installed at elevation below the aquifer (estimated at 50 to 70 feet). This would eliminate the need for the seepage canal and minor levee. Surface water runoff from within the 8.5 SMA would be contained by the minor levee and infiltrate or run overland into L–31N and controlled by existing structures in the L–31N canal.

Alternative 4 — Residents' Choice Land Acquisition

Under this alternative, no structural features would be constructed and no significant changes in the operation of existing structures or systems would occur. Instead, this alternative would require the acquisition of land within the 8.5 SMA through one or a combination of the following based on the choice of the resident:

- Buyout — Government purchases the property (fee simple).
- Flowage easements — Government pays property owners cash as flood mitigation for periodic flooding. The current owner retains ownership rights to the property.
- Life estates — Current owners retain ownership and full use of the property for the duration of their lives. Then, the Government becomes the property's owner.

Modeling would be used to assess the elevation and extent of flooding. This modeling would assist the owners in making their choice.

Alternative 5 — Total Buyout Plan

Originally, total buyout was developed and evaluated as an alternative in the 1992 GDM. The Governor's East Everglades 8.5 SMA Study Committee also considered total buyout as an alternative. Under this alternative, the Government would obtain all land within 8.5 SMA either from willing sellers or by condemnation. No structural improvements would be constructed nor would any significant changes occur in the operation of existing structures or system.

Public purchase (Fee Simple Acquisition) would enable conversion of lands within the study area to a buffer zone between ENP and developed areas to the east. The ultimate disposition and use of the land has not been determined. However, it is likely that clean up (e.g., hazardous waste, contamination, refuse, litter, removal of structures), habitat restoration, and long-term management of all lands within the study area would be performed at some level in the future.

Alternative 6 — Western Portion of 8.5 SMA as Buffer Plan

Under this alternative, the western portion of the 8.5 SMA would be converted to a shallow impoundment to be used as a buffer between the developed area and ENP. The eastern part of the 8.5 SMA would be provided flood protection through the construction of a flood protection levee and drainage system. A major perimeter levee would be constructed along 202nd Avenue down to 168th Street. A seepage canal, which would be designed to collect ground water underflow, would be located just east of the major levee. A minor levee would be constructed east of the seepage canal to prevent surface water from running into the seepage canal and mixing with seepage water.

A single pumping structure (S–357) would be constructed at the southern terminus of the levee/canal system. This station would convey seepage water into a spreader canal running west along the south side of 168th Street. The spreader canal would release the water south into the C–111 Project. No major changes to the operation of existing structures or system would occur.

Alternative 6C — Save Our Rivers Alignment as Eastern Boundary of Buffer Area

Under this alternative, the western portion of the 8.5 SMA would be converted to a shallow impoundment to be used as a buffer between the developed area and ENP. The eastern part of the 8.5 SMA would be provided flood protection through the construction of a flood protection levee and drainage system. A major perimeter levee would be constructed along 202nd Avenue down to 168th Street. A seepage canal, which would be designed to collect ground water underflow, would be located just east of the major levee. A minor levee would be constructed east of the seepage canal to prevent surface water from running into the seepage canal and mixing with seepage water.

A single pumping structure (S–357) would be constructed at the southern terminus of the levee/canal system. This station would convey seepage water into a spreader canal running west along the south side of 168th Street. The spreader canal would release the water south into the C–111 Project. No major changes to the operation of existing structures or system would occur.

Alternative 6D — Canal Between 6B and 6C

The eastern part of the 8.5 SMA would be provided mitigation through the construction of a flood protection levee and drainage system. Alternative 6D was formulated as a flood mitigation alternative that provides some incidental flood protection benefits. The alternative consists of approximately 35,000 linear feet of exterior levee, 21,000 linear feet of seepage canal and 21,000 linear feet of interior water quality protection levee. The seepage canal is stepped back from the exterior levee in order to minimize drawdown impacts into ENP. The seepage canal will collect excess flood waters and convey them west then south to a proposed new pumping station number S–357. This pumping station will be

approximately 500 cfs in total capacity and will further convey the collected water south toward the C–111 project buffer lands. The water will be conveyed in a pipe or swale system under Richmond Drive and on southward. It is anticipated that three bridge structures will be required within the 8.5 SMA to cross over the new seepage canal. These single span bridge structures will cross the seepage canal at 152nd, 136th and 197th (two east-west crossings and 1 north-south crossing).

The levee alignment will start at Richmond Drive in the southern portion of the 8.5 SMA and proceed north along the western side of 213th until it intersects with 148th. It then will proceed east along the north side of 130th until it intersects with the Florida Power and Light (FPL) easement. It then will proceed north along the western side of the FPL easement until it intersects with 120th. From here the levee will proceed along the north side of 120th until it intersects with 197th. It then proceeds along the western side of 197th to approximately 105th (close to structure G–211). Here it will tie into the existing L–31North levee system.

The seepage canal alignment will start at Richmond Drive in the southern portion of the 8.5 SMA and proceed north along the eastern side of 205th until it intersects with 128th (approximate location) and then travels east along the south side of the FAA radar property until it links up with the L–31N system.

Alternative 7 — Elevation of all Public Roads Plan

This alternative would involve raising the elevation of all public access roads in the 8.5 SMA. The roads would be raised in-kind (i.e., paved roads would be paved, gravel roads would be surfaced with gravel, dirt roads would not be improved). The roads would be raised so they would not be flooded as a result of the MWD Project. All other areas would remain in their current condition and at their current elevation. Internal drainage could be handled through the use of culverts or by obtaining flowage easements. No allowances for relocating or buying out residents are included in alternative.

Alternative 8 — Western Portion of the 8.5 SMA as a Flow-way

This alternative would use the western portion of the 8.5 SMA as a buffer zone to ENP to the west and as a natural flow-way for diverting flow from ENP to the C–111 area. An interior perimeter levee would extend from just north of 120th Street south and west around the FAA tract along 202nd Avenue down to 168th Street. An exterior diversion levee would run approximately parallel to the interior levee and serve as a containment barrier for a natural swale flow-way. The containment levee would be small enough to allow surface water flow from ENP but big enough to divert flow contained within the flow-way.

A single pumping structure (S–357) would be constructed at 168th Street. This structure would convey seepage water into the C–111 Project.

Alternative 9 — Adaptive Refinement of GDM Plan

This alternative is a combination of Alternatives 1 and 2. It has the same layout of levees and seepage canals as Alternatives 1 and 2. It also includes pumping structures at locations on the northeastern corner of the 8.5 SMA and at the intersection of L–31N and L–29 as proposed under Alternative 1. It also includes a future pumping structure located at the southern terminus of the seepage canal at the southwestern corner of the 8.5 SMA.

Chapter 5 — Hydrologic Impact Evaluation

The purpose of this analysis was to evaluate hydrologic model outputs for the alternatives to determine to what extent each meets the following objectives:

Legislative Requirements:

1. Evaluate effects on hydropatterns in NESRS according to Section 104 of the 1989 Everglades National Park Protection and Expansion Act of 1989.

2. Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD project according to Section 104 of the 1989 Everglades National Park Protection and Expansion Act of 1989.

3. Evaluate effects on Federal and State Listed Endangered Species survival in accordance with the Endangered Species Act of 1973. (This objective is primarily addressed in Chapter 7)

Other Objectives:

4. Analyze effects to ecological functions (This objective is primarily addressed in Chapter 6).

5. Measure compatibility with the Comprehensive Everglades Restoration Plan and C–111 Project without adversely impacting the current level of flood protection east of L–31N.

Each alternative was modeled by the Corps using the MODBRANCH hydrologic model (Swain and Wexler 1993). The MODBRANCH model couples the MODFLOW groundwater model with the BRANCH streamflow model. Overland flow in wetlands was simulated in the MODBRANCH model as laminar flow through a highly permeable aquifer layer. This approach for modeling overland flow is limited in that resistance to flow is not allowed to decrease as the total depth of flow increases, as it would in a natural system. This approximation allows deep surface water that would run off in a natural system to "mound up" in the model. The topography used for the 8.5 SMA was the best available. However, the data include surveys along roadways and are appropriate only for feasibility level modeling. The alternatives were modeled by the Corps using boundary conditions from the SFWMD's 2x2 model to simulate regional hydrology. The boundary conditions used included the following:

D13Rbc Simulates restored regional water levels with the MWD project in place.

95bc Simulates regional water levels as they exist today under experimental test7 operating rules.

83bc Simulates regional water levels under the operating rules authorized for the no-action alternative in the 1992 GDM for the MWD Project.

A detailed list of model runs used for each performance measure is included as Appendix B. Each alternative was simulated for both a wet year (1995) and a dry year (1989). A synthetic 1-in-10 year storm was added to the 1995 rainfall between May 15 and May 24. The addition of the synthetic event increases hydroperiods and causes water levels to rise during and after the synthetic storm (Figures 2 and 3).

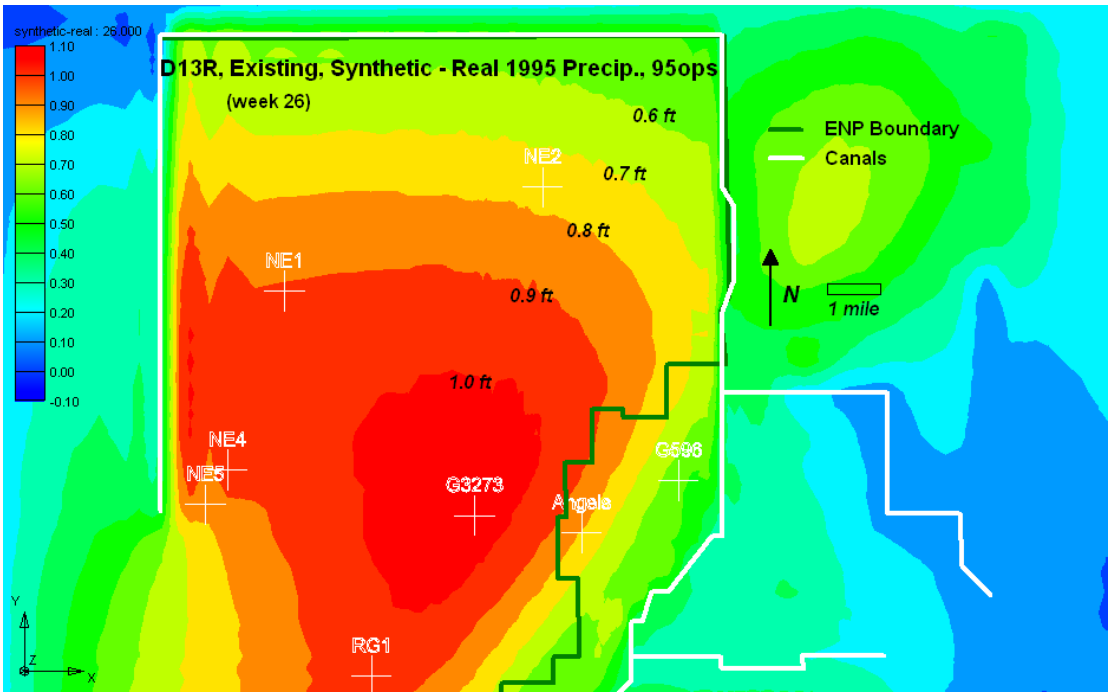


Figure 2 The Synthetic 1 in 10 Year Storm Increases Water Levels in NESRS and the 8.5 SMA by 0.4 to 1.0 Foot

It was assumed that the C–111 Project would be in place for all alternatives. However, there are no set operational rules approved for the C–111 Project. Model simulations that included the C–111 Project caused increased water levels in the 8.5 SMA (Figure 4). However adjustments to the pump capacity and distribution would most likely eliminate these increases. Because this analysis was evaluating MWD flood mitigation alternatives, not the C–111 Project, the C–111 Project was implemented in both existing and all alternative model runs to avoid interpreting C–111 Project impacts as MWD Project impacts.

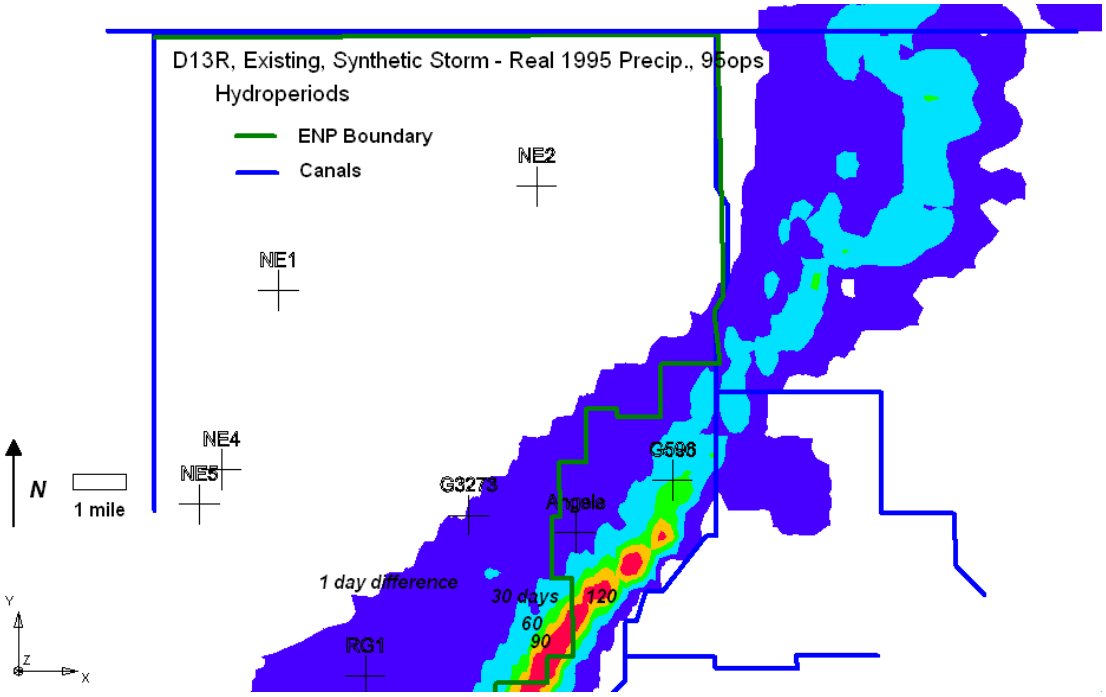


Figure 3 The Synthetic 1 in 10 Year Storm Increased the Number of Days of Inundation in the 8.5 SMA by 40 to 140 Days

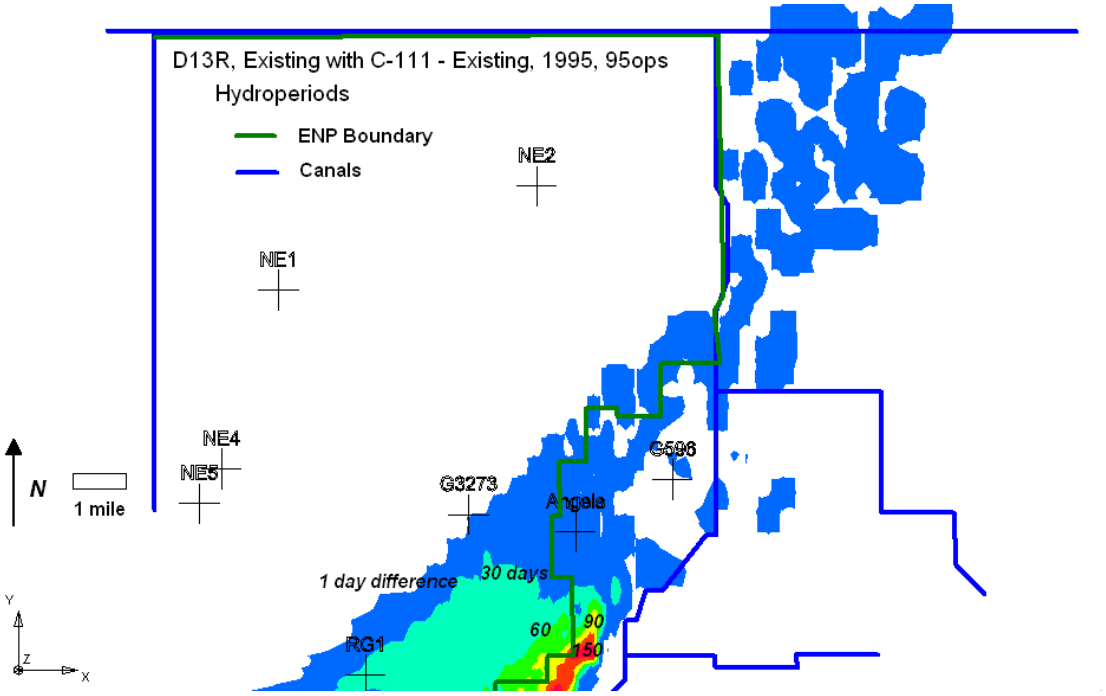


Figure 4 The Effect of the C–111 Project in the Model Simulations was an Increase in Hydroperiod Southwest of the 8.5 SMA by 20 to 160 Days

Operating Rules

Two sets of rules for operating structures were modeled. They were:

83ops Structures operated according to rules authorized for the no-action alternative in the 1992 GDM for the MWD Project.

95ops Structures operated according to rules temporarily authorized under the Experimental Water Deliveries program that was in place in 1995.

Impacts of Operating Rules

In South Florida, changes in operational criteria for pumps and gates result in major impacts to wildlife, residential areas, and agriculture. Since 1983, an experimental program has been in place to determine operating rules that best meet all of these constituencies. Test 7 phase I rules associated with the experimental program are the most recent set of operating rules to be implemented and were in place in 1995. Hence, they are referred to as 95ops.

Under 95ops, water levels in L–31N are maintained 0.5 feet higher than in the 1983 operations before the experimental program began (83ops). Comparison of model simulations of 83ops and 95ops shows that the benefits of higher water levels in NESRS related to 95 ops are relatively minor compared to the detrimental effects to lands east of L–31N (Figure 5). Therefore it seems unlikely that these experimental operational rules will be retained.

Currently, the South Dade conveyance system is operating under emergency rules designed to avoid impacts to the endangered Cape Sable seaside sparrow. This leads to a dilemma in evaluating the flood mitigation plans for the 8.5 SMA. Uncertainty as to which operational scheme most closely resembles what would be the final operational scheme when the MWD Project is constructed led the Corps to model all of the alternatives under both 83 and 95 operating rules. However, the alternatives considered in this analysis are proposed under the 95 operating rules. Because the objective of this study is to compare the alternatives, not set the operating rules for the South Dade conveyance system, it is essential that the alternatives be compared under the same operating rules and boundary conditions. Failure to do so would lead to incorrectly attributing impacts or benefits of the temporary operations to the flood mitigation plan. Therefore, all of the alternatives have been evaluated under 95 operational rules. In doing so, it is recognized that the operational rules for this project have not yet been determined and DOI's acceptance of one of these alternatives does not constitute approval for the operating rules simulated for this analysis.

Northeast Shark River Slough Hydropattern Restoration

The primary objective of the MWD Project is to re-establish hydropatterns in NESRS to the maximum extent practicable. To reestablish historical hydropatterns in NESRS, it is necessary to increase hydroperiod and water depth to restore the peat-forming environment that was historically maintained. To

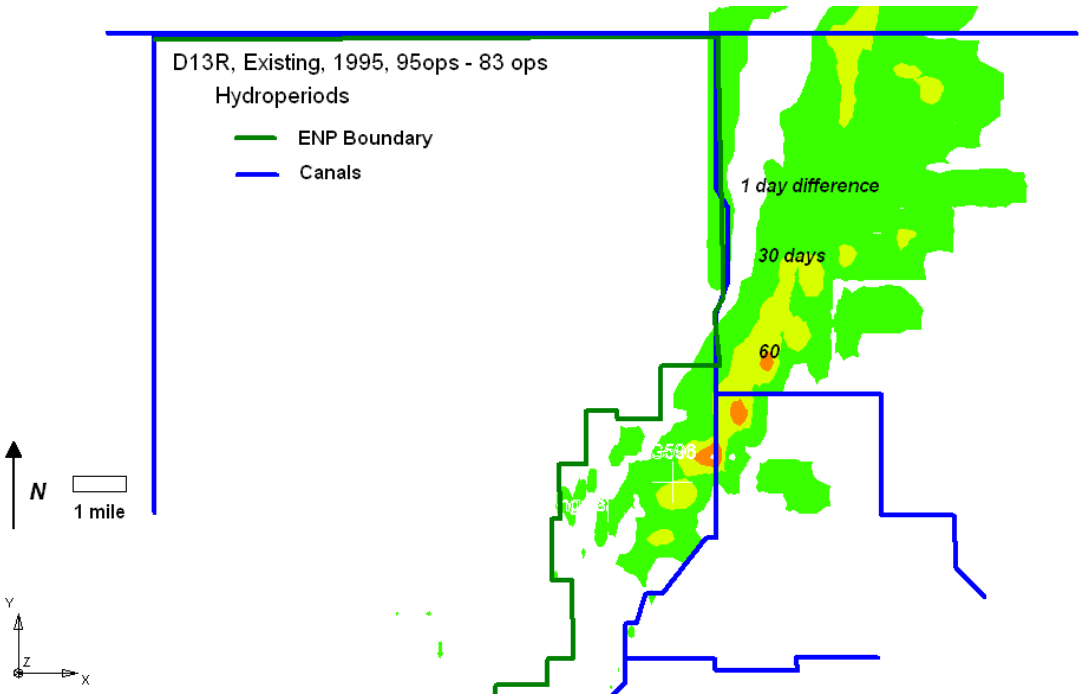


Figure 5 Comparison of Simulated Hydroperiods for 83 Ops and 95 Ops; 95 Ops Result in Longer Hydroperiods (by up to 90 Days) East of L–31N (shown in greens) and Shorter Hydroperiods (by up to 50 Days) Southwest of the 8.5 SMA (shown in reds)

evaluate the re-establishment of hydropatterns, DOI assessed the alternatives for their relative ability to allow for restoration of historical hydropatterns in NESRS. Figure 6 depicts the historical flow pattern in NESRS. Historical flows crossed through the 8.5 SMA and south through the Rocky Glades and into Taylor Slough.

Using current topography and average wet and dry year water levels from the Natural Systems Model, historical wet and dry season water levels can be visualized for the 8.5 SMA (Figures 7 and 8). Under average historical water levels, the 8.5 SMA was inundated during the wet season and dry during the dry season. During the period between the wet and dry seasons, water levels receded, creating a fringe area of short hydroperiod marl prairie that would have been highly valuable as foraging habitat for wading birds (Figure 9).

As a result of the C&SF Project and subsequent operations, water levels in the 8.5 SMA have steadily decreased. As these water levels have decreased, the 8.5 SMA has been developed and populated. The MWD Project is being designed to restore historical flows to NESRS by increasing water deliveries to NESRS. Because the 8.5 SMA is located along the boundary of the historical flow-path, restoration of flows into NESRS necessitates increases in water levels in the 8.5 SMA. Damage from these increased water levels must be mitigated, either by acquiring property and flowage easements or by structural solutions, such as canals, levees, and seepage barriers.

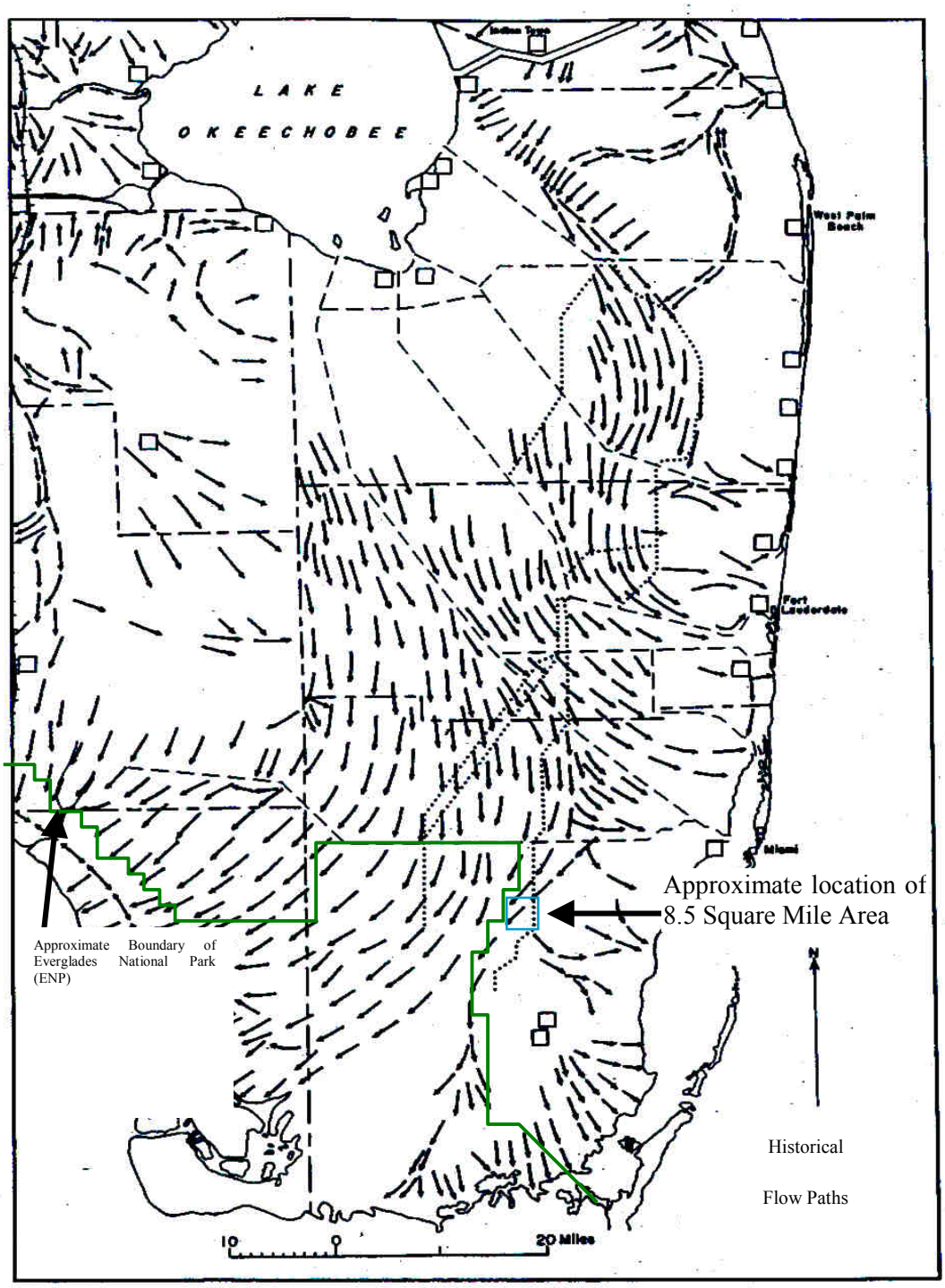


Figure 6 Historical Flow Pattern in NESRS. From Parker et al. (1955) and Parker (1974). Major pre-1950's Canals (dashed lines) and 1990s Canals or Levees (dotted lines) Included for Location

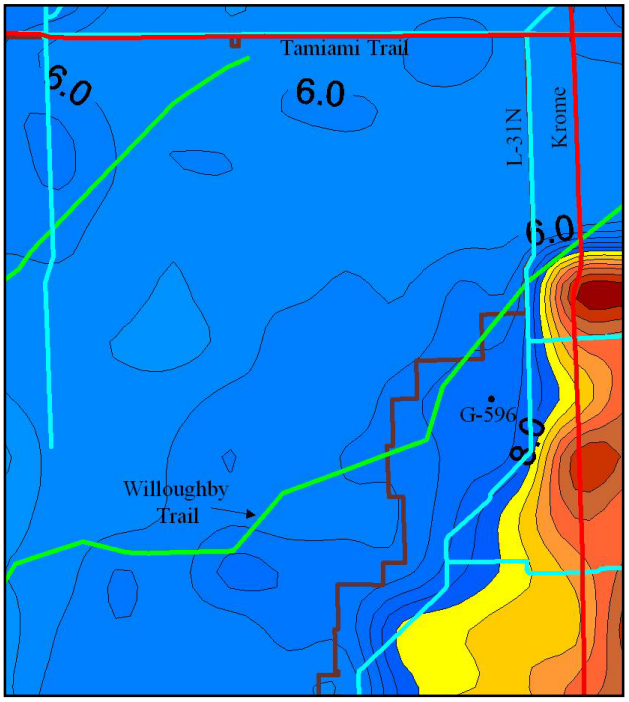


Figure 7 Historical Wet Season Water Levels in the 8.5 Square Mile Area. Contour intervals are topography. Blue area indicates where water is over the land surface. Green line indicates path of canoe trip through the Everglades by Hugh Willoughby (Willoughby, 1898) in 1897

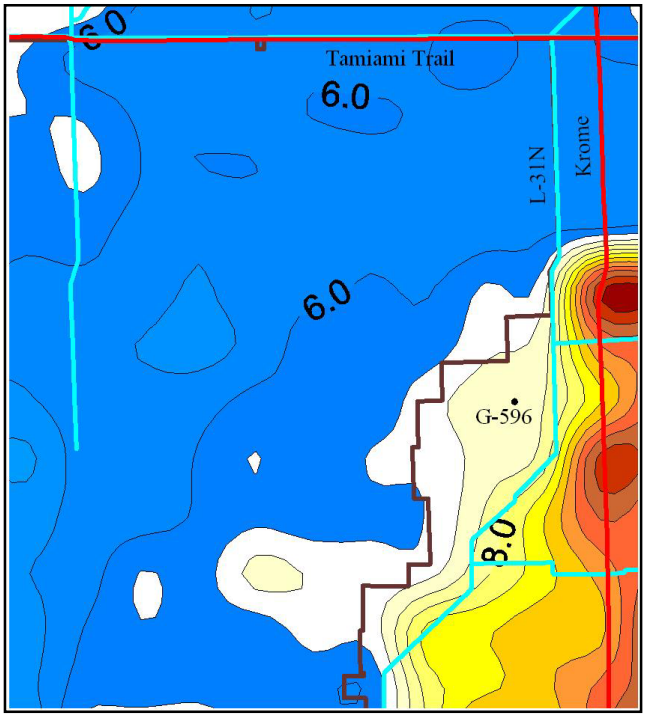


Figure 8 Historical Dry Season Water Levels in the 8.5 Square Mile Area. Contour intervals are topography. Blue area indicates where water is over the land surface

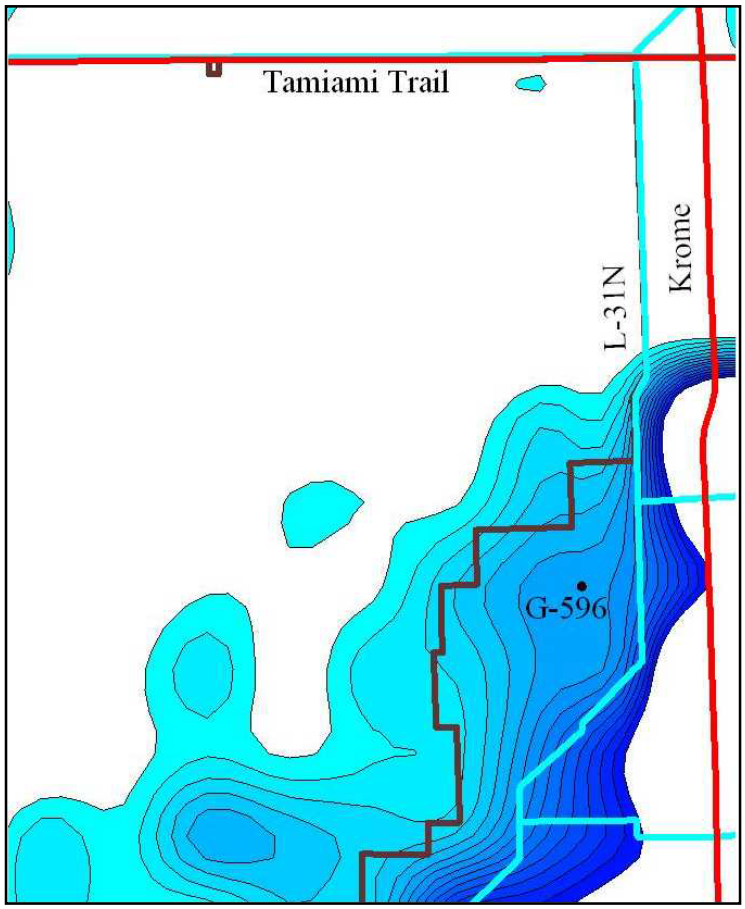


Figure 9 Historical Short Hydroperiod Marl Prairie Peripheral Wetlands. Contour Intervals are Topography. Blue Area Indicates Short Hydroperiod Peripheral Wetlands

Most of the structural flood mitigation alternatives that are being considered have some impact to the hydrology and ecology of NESRS, as does continued development in the 8.5 SMA. These impacts include reduction of water depth and hydroperiod due to canal drawdowns, rapid changes in water levels due to pumping, and elimination of transitional fringe water levels that provide for wading bird foraging. The objective of this analysis was to identify the hydrologic effects of each alternative.

Two quantitative measures of hydropattern are the spatial distribution of hydroperiod and depth of water. Increases and decreases in hydroperiod and water depth were modeled by the Corps for existing conditions, restored conditions, and each of the alternatives.[1] The results of this analysis are summarized in Table 2. Hydroperiod maps for the existing conditions, the restored condition, and the modeled alternatives are presented in Figures 10 through 32. To re-establish historical hydropatterns in NESRS, it is necessary to increase hydroperiod and water depth to recreate the peat-forming environment that was historically maintained. Comparing Figure 13 and Figure 15, the

[1] Alternative 4,5, and 7 model runs are the same as the restored model runs.

difference in hydroperiods for MWD Project restoration and Plan 2B reveals how placement of a canal and levee around the 8.5 SMA would have a detrimental effect on hydroperiods west of the levee in NESRS.

Table 2 Spatial Increases and Decreases in Hydroperiod and Average Water Depth in NESRS Relative to Restored Hydroperiod and Water Depth for Wet Year (1995)

	Hydroperiod		Depth	
Plan	Increased (acres)	Decreased (acres)	Increased (acres)	Decreased (acres)
Plan 1	0	3,158	0	27,173
Plan 2B	0	3,275	0	36,640
Plan 3	82	0	14,934	0
Plan 4	0	0	0	0
Plan 5	0	0	0	0
Plan 6B	0	294	0	6,035
Plan 6C	0	1,996	0	27,446
Plan 6D	0	282	0	5,845
Plan 7	0	0	0	0
Plan 8A	0	286	0	705
Plan 9B	0	3,275	0	36,640

Restored hydroperiods in NESRS would be reduced in more than 3,000 acres of ENP marsh under plans 1, 2B, and 9B. The effect of increasing pumping capacity to achieve flood mitigation translates to increased impacts to long hydroperiod wetlands. Plan 2B would decrease hydroperiods in 3,275 acres. Plan 6C would reduce hydroperiods on almost 2,000 acres, whereas the effects of Plan 6D on hydroperiod would be similar to those of Plan 6B.

By moving the canal and levee alignment further east, as in plans 6B, 6C, and 6D, these impacts would be shifted to the short hydroperiod marl prairie wetlands on the western edge of the 8.5 SMA. The result would be a loss of short hydroperiod wetlands in plans 6B, 6C, and 6D. Under Plan 3, no long-hydroperiod wetlands would be lost in NESRS. NESRS hydroperiods are increased over restored levels in 82 acres. Under Plan 8A, increased pumping at the southern end of the flow-way would result in 286 acres with reduced hydroperiods. There are, of course, no changes in restored hydroperiods for the non-structural Alternatives 4, 5, and 7.

Another critical measure of NESRS wetland restoration is water depth (Table 2). Under Alternatives 1 and 6C, nearly 30,000 acres of wetlands in NESRS would have reduced water depths. Under plans 2B and 9B water levels would be reduced in 36,640 acres. Even when the canal and levee are moved east into the 8.5 SMA, as in plans 6B and 6D, there would be about 6,000 acres of wetlands with reduced water depths. Plan 3 would increase water depths in all of NESRS as water stacks up on the western side of the levee and slurry wall. Plan 8 would not increase or decrease water depths, however Plan 8A would decrease water depth in the immediate vicinity of the pump. Under plans 4, 5, and 7 there are no anticipated impacts to water depths in NESRS.

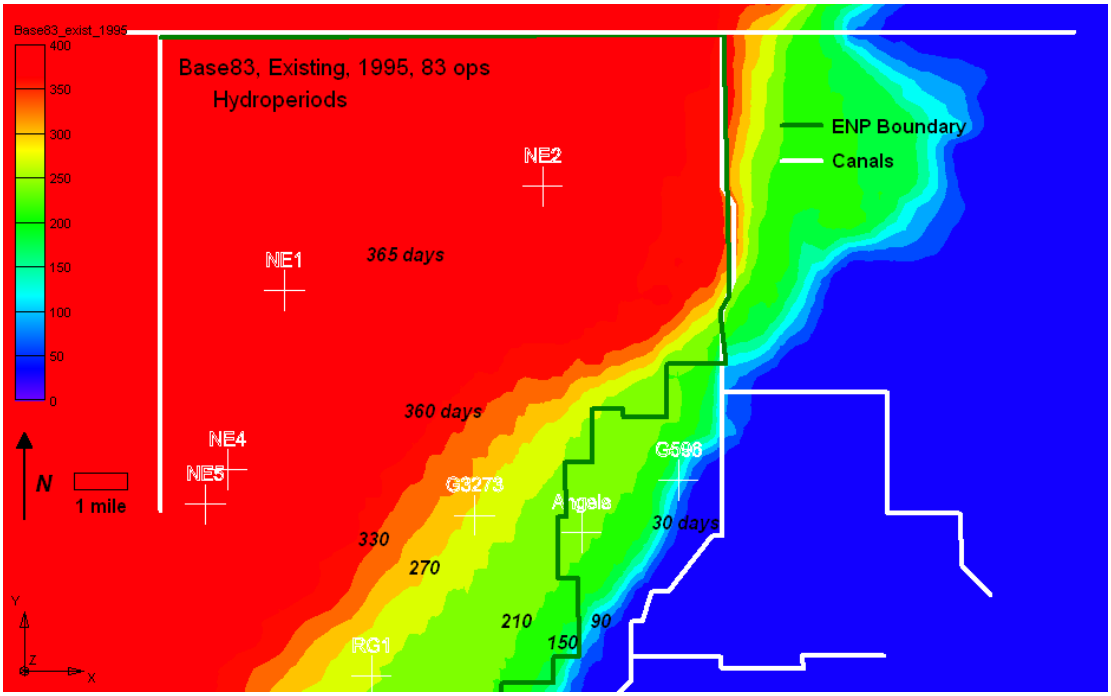
As demonstrated in Figures 12 through 18, changes in water depth during the wet year range from 0.1 feet to more than 1 foot over areas ranging from a few hundred acres to thousands of acres. The actual difference in average water volume decreases (acre-ft) between restoration and each Plan is an estimate of the volume of restored water lost as a result of the mitigation plan. This difference is determined by multiplying the cell area by the change in average water depth. These values are reported in Table 3 and Figure 32. Under plans 2B and 9B, 47 percent of the restored water would be lost. Under plans 1 and 6C, 33 percent and 32 percent of the restored water would be lost, respectively. Under plans 3, 4, 5, 6B, 6D, 7, and 8A, less than 5 percent of the restored water would be lost.

Table 3 Increases And Decreases In Water Volume In NESRS Relative To Restored Conditions for Wet Year (1995)

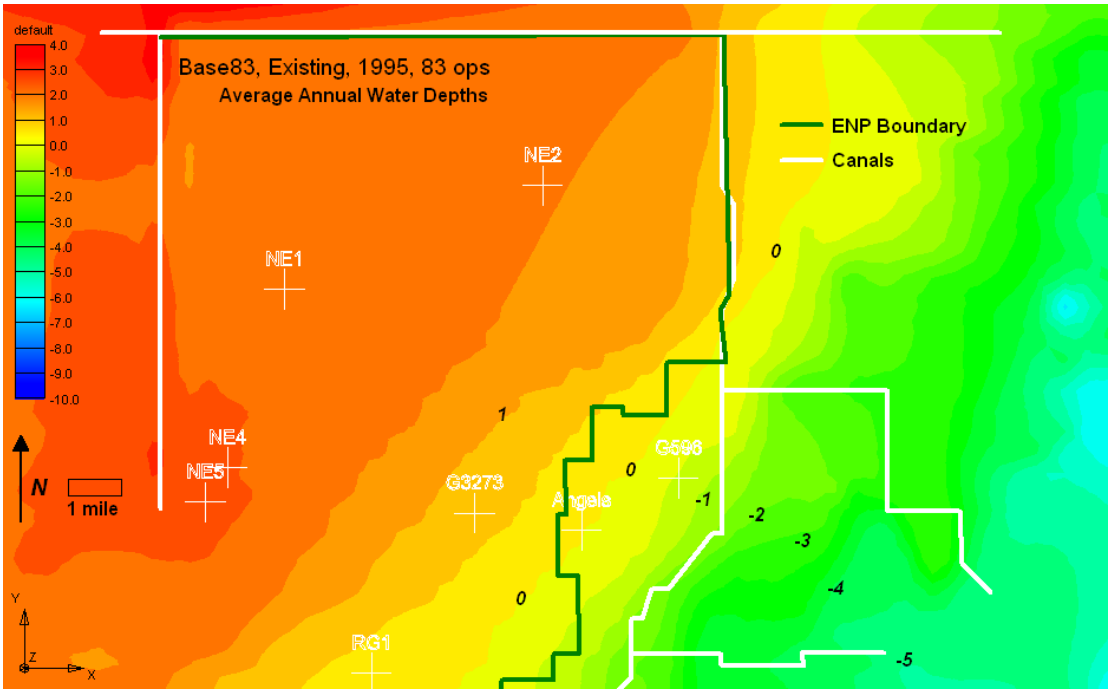
	Water Volume		
Plan	Increase (acre feet)	Decrease (acre feet)	Portion of restored water lost (percent)
Plan 1	0	6,979	33.2
Plan 2B	0	9,912	47.1
Plan 3	2,626	0	0
Plan 4	0	0	0
Plan 5	0	0	0
Plan 6B	0	868	4.1
Plan 6C	0	6,711	31.9
Plan 6D	0	889	4.2
Plan 7	0	0	0
Plan 8A	0	117	0.6
Plan 9	0	9,912	47.1

Structural Flood Mitigation and Structural Flood Protection

Structural flood mitigation was evaluated in terms of both increases in hydroperiod and average depth. The results are presented in Table 4. Plan 1 provides structural flood mitigation to the entire 8.5 SMA, except for a small portion. There would be 185 acres with increased surface water depths and 694 acres with increased hydroperiod. Plans 2B and 9B would provide full structural flood mitigation with respect to depth, but would result in 371 acres with increased hydroperiod. Plan 6C provides mitigation for the protected area. Plan 6D leaves 934 acres unprotected as a result of higher water levels. It is the intent of the Corps to acquire the land simple fee or purchase flowage easements in the areas not capable of being provided structural mitigation.

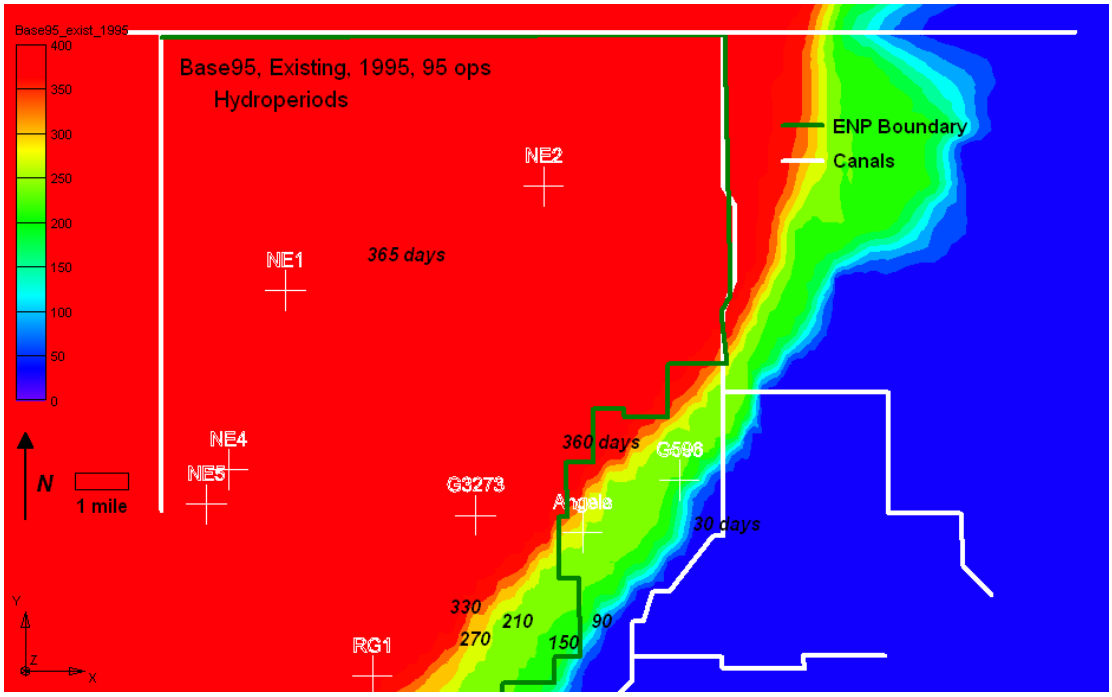


A) Hydroperiods

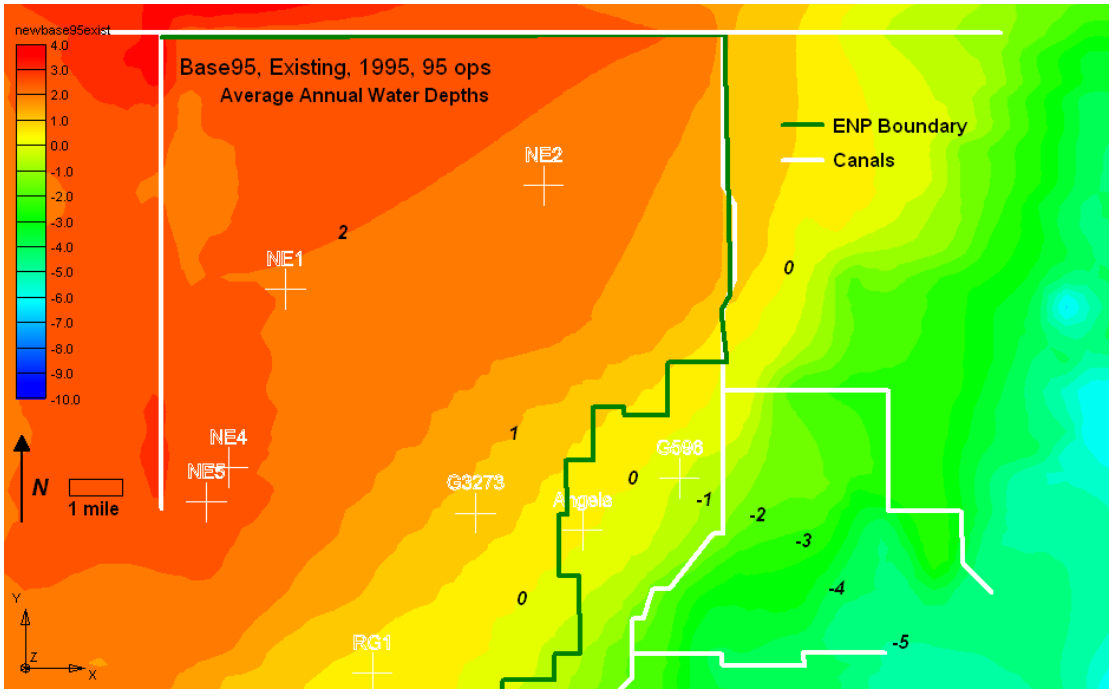


B) Average Depths

Figure 10 Hydroperiods and Average Depths for Existing Conditions (Base83 Boundary Conditions, 1995 Precipitation, 1983 Operational Conditions)

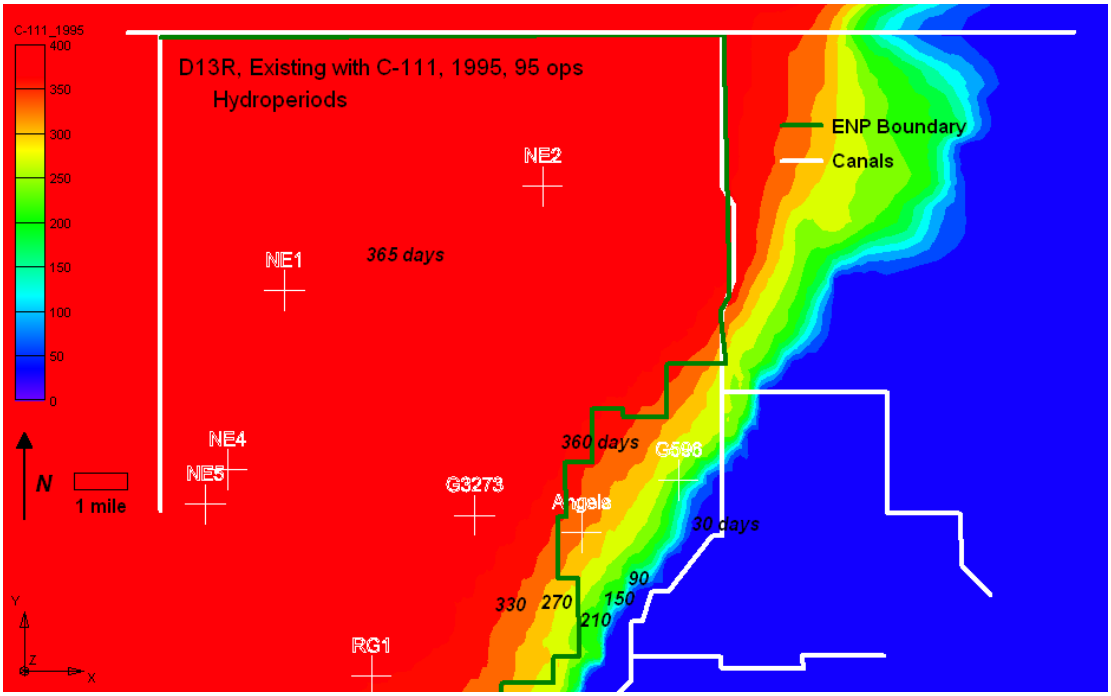


A) Hydroperiods

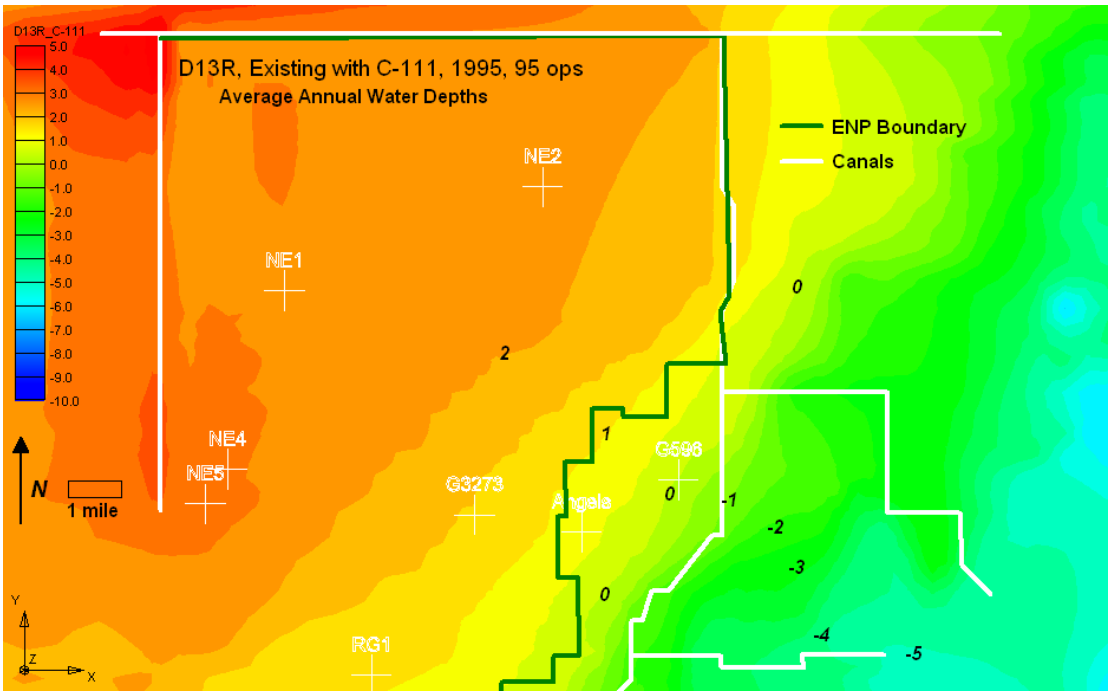


B) Average Depths

Figure 11 Hydroperiods and Average Depths for Existing Conditions (Base95 Boundary Conditions, 1995 Precipitation, 1995 Operational Conditions)

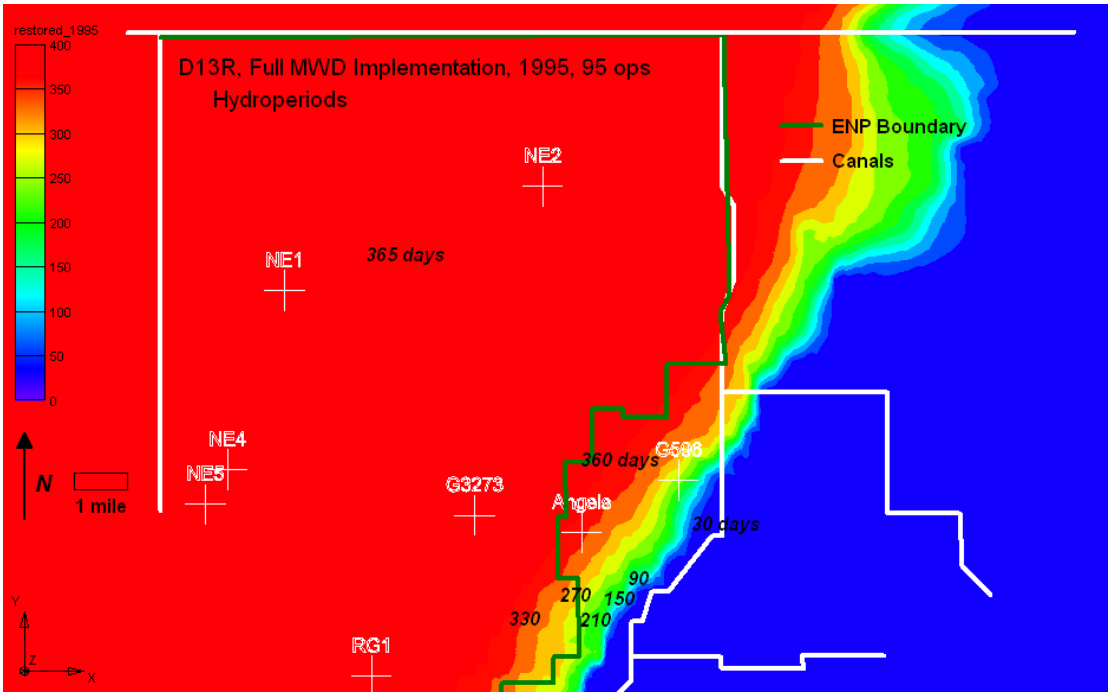


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

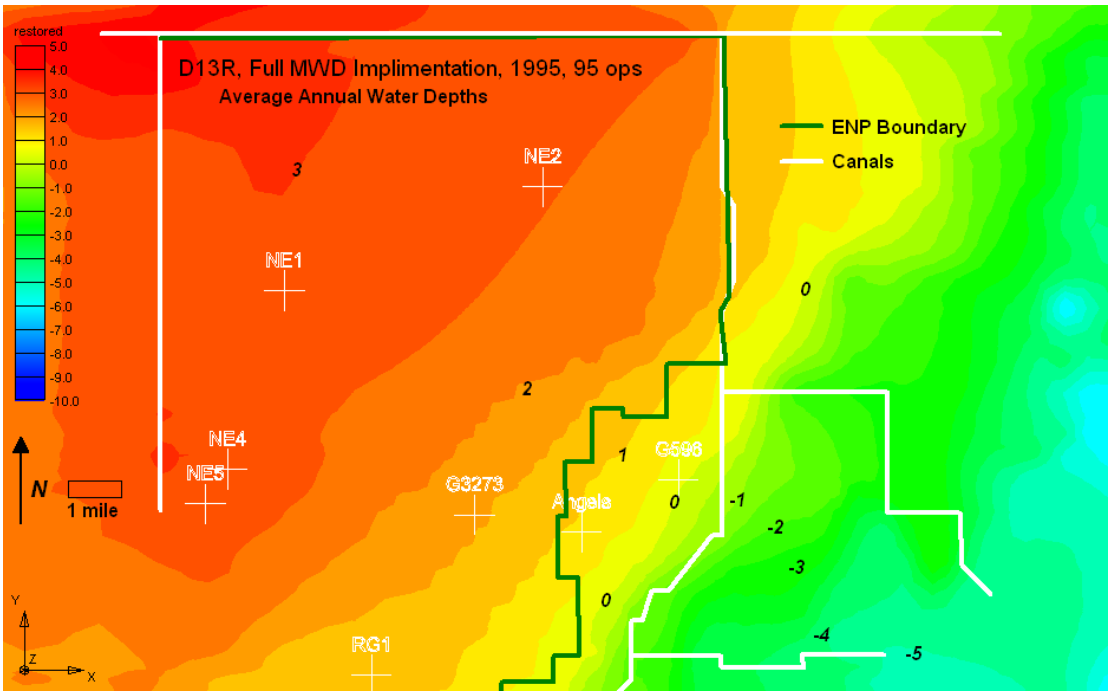


B) Average Depths (3.5 feet deep in NESRS to 1 foot below ground surface in southeastern part of 8.5 SMA)

Figure 12 Hydroperiods and Average Depths for Existing Conditions with C–111 Project Implementation.

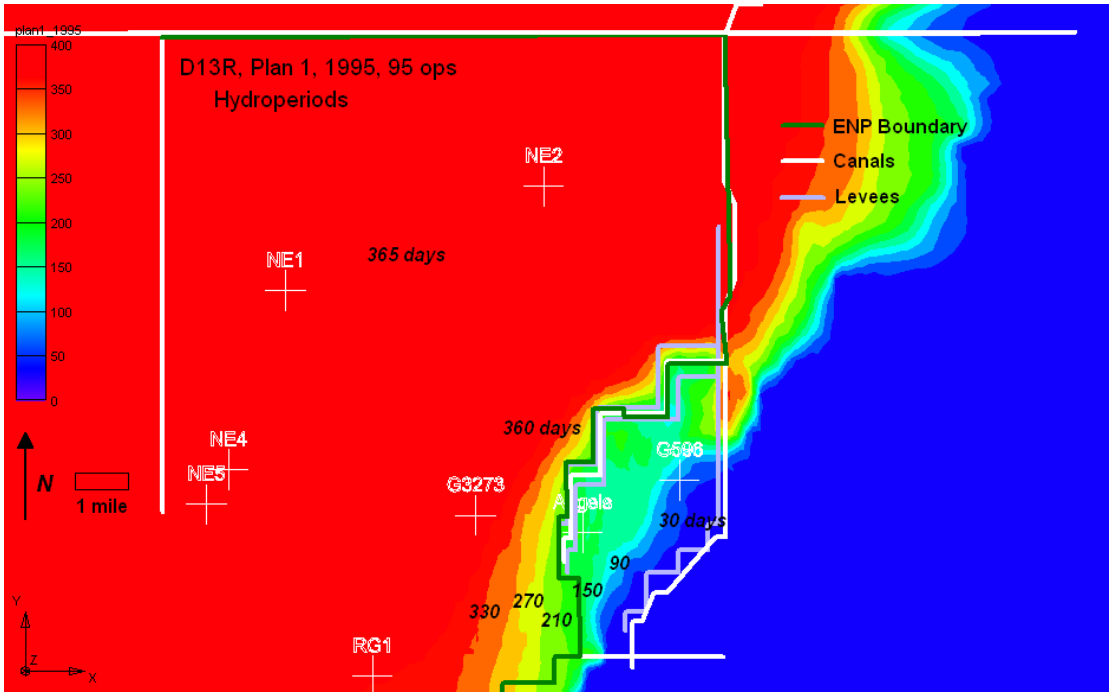


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

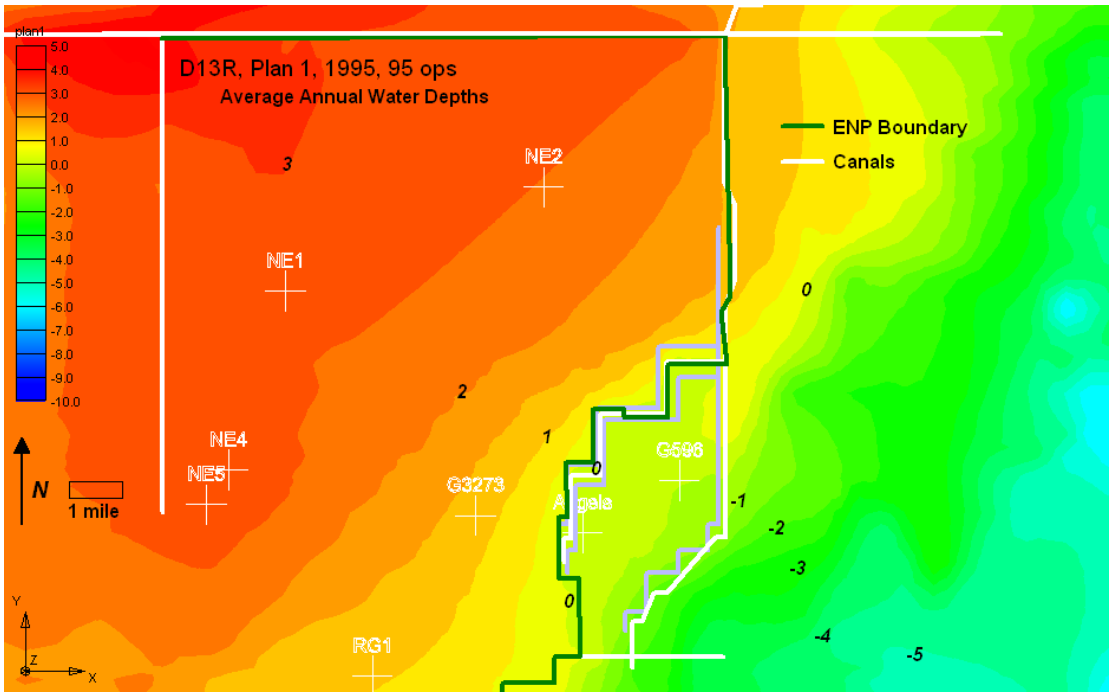


B) Average Depths (3.5 feet deep in NESRS to 1 foot below ground surface in southeastern part of 8.5 SMA)

Figure 13 Hydroperiods and Average Depths for Restored Conditions in ENP Following Full Implementation of MWD with C–111 Project Implementation

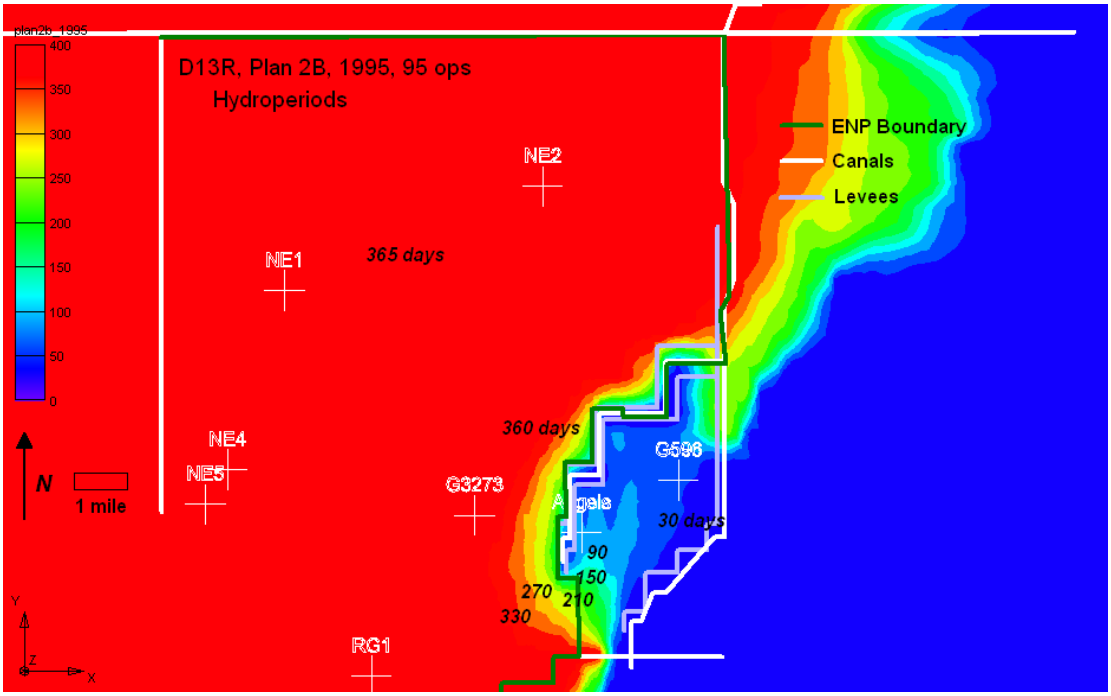


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

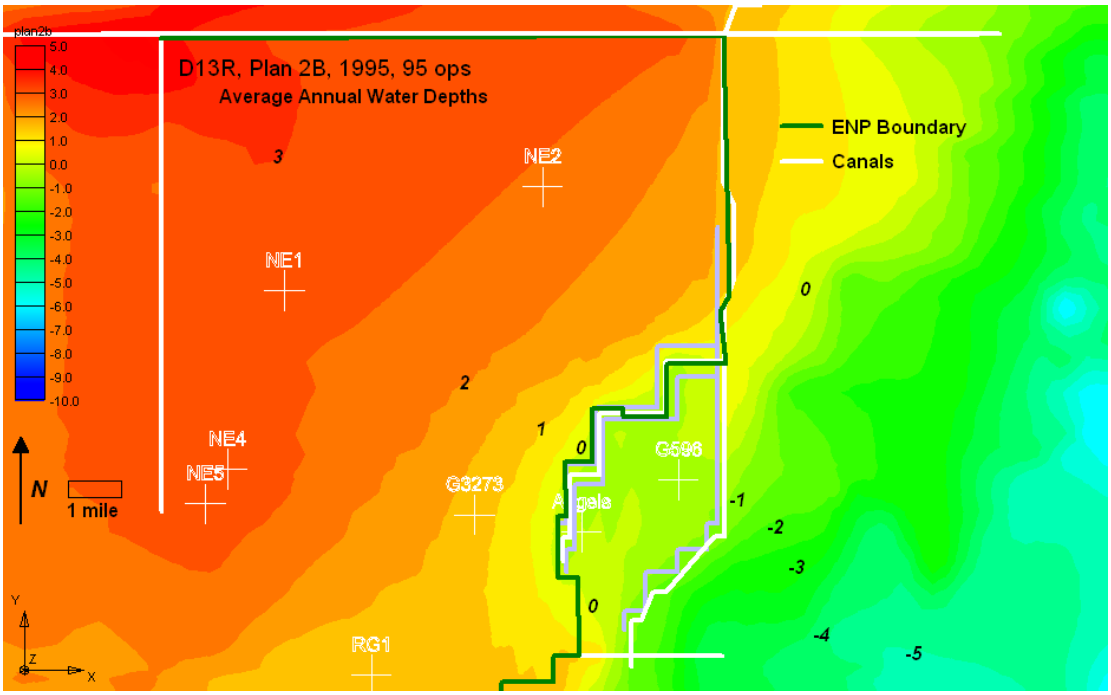


B) Average Depths (3.5 feet deep in NESRS to 1 foot below ground surface in southeastern part of 8.5 SMA)

Figure 14 Hydroperiods and Average Depths for Plan 1

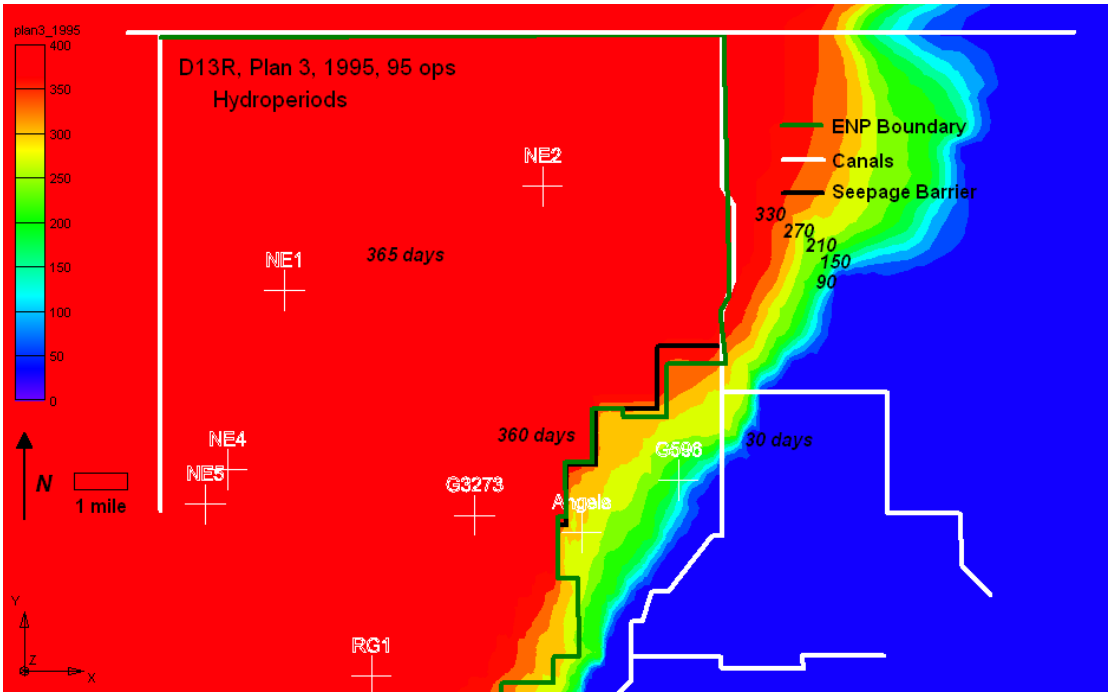


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

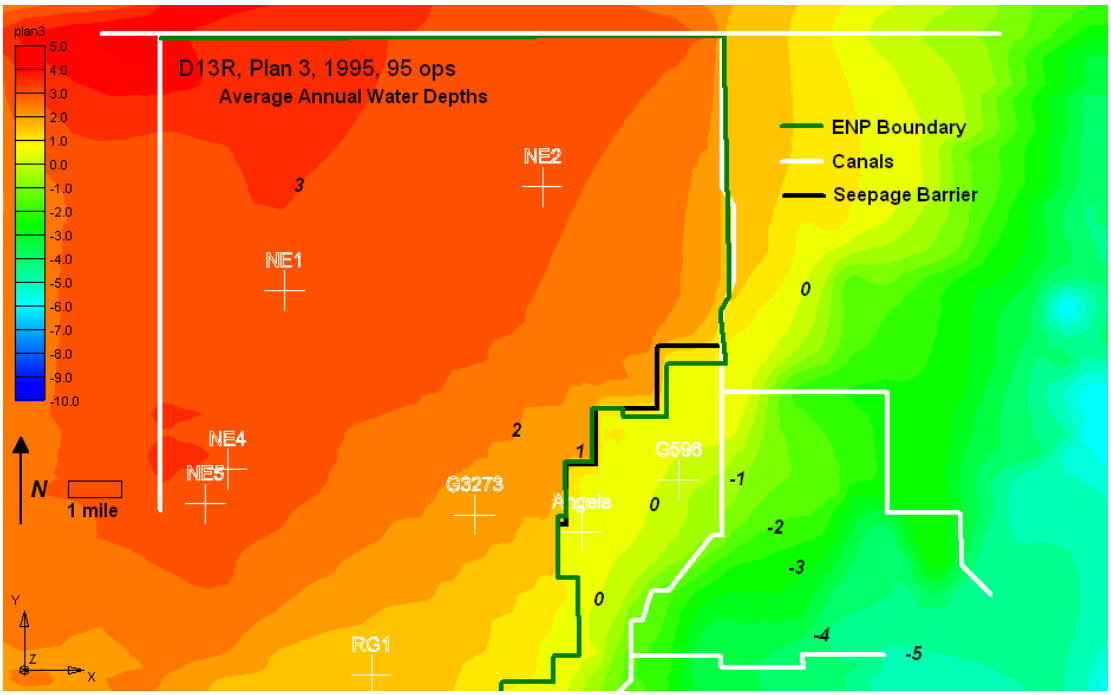


B) Average Depths (3.5 feet deep in NESRS to 1 foot below ground surface in southeastern part of 8.5 SMA)

Figure 15 Hydroperiods and Average Depths for Plan 2B

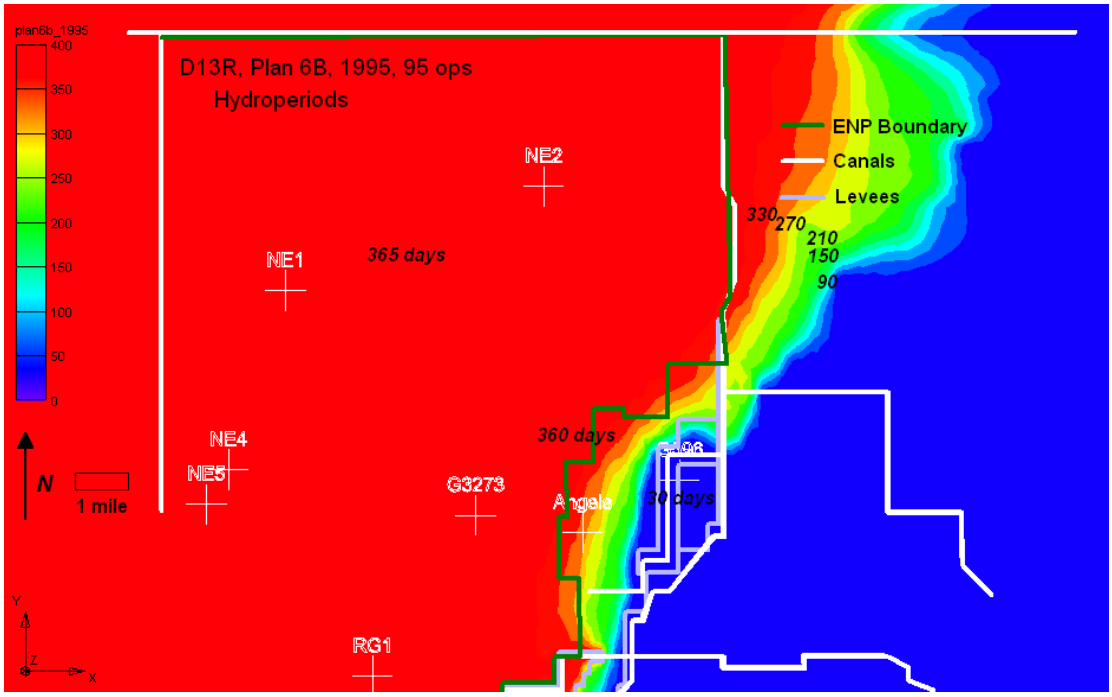


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

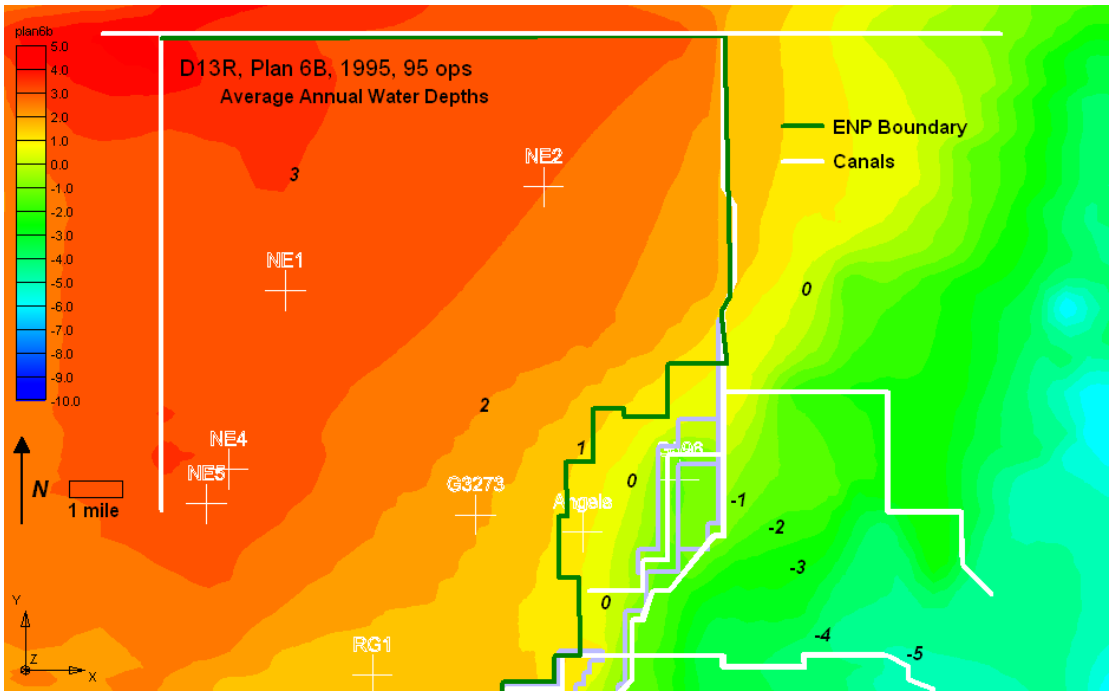


B) Average Depths (3.5 feet deep in NESRS to 1 foot below ground surface in southeastern part of 8.5 SMA)

Figure 16 Hydroperiods and Average Depths for Plan 3

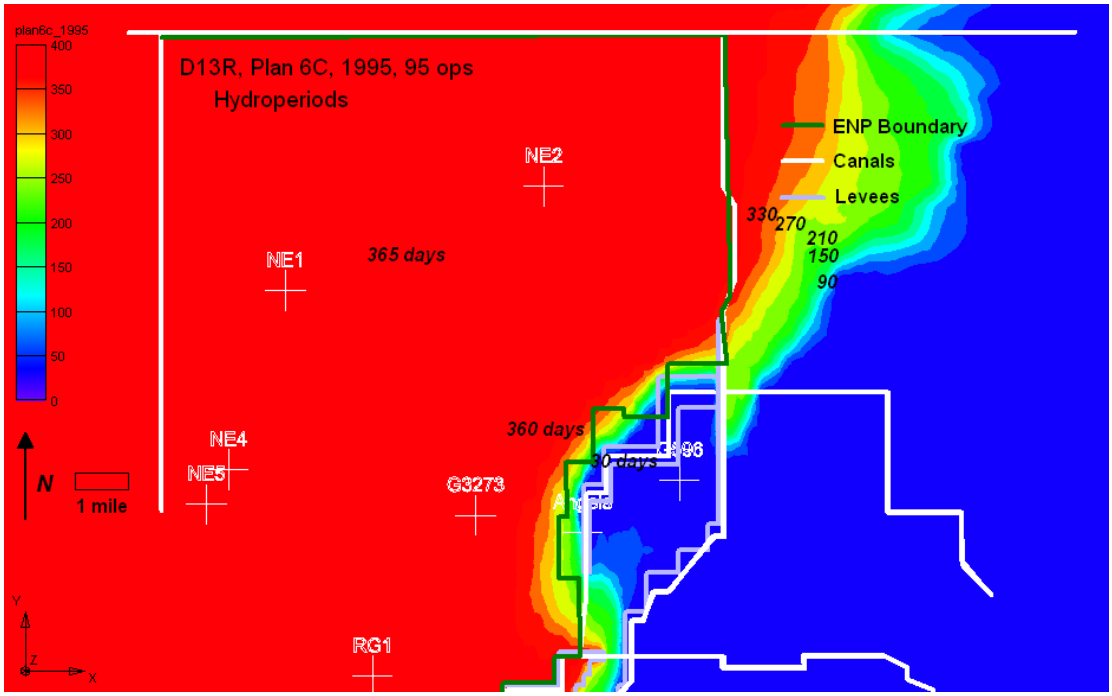


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

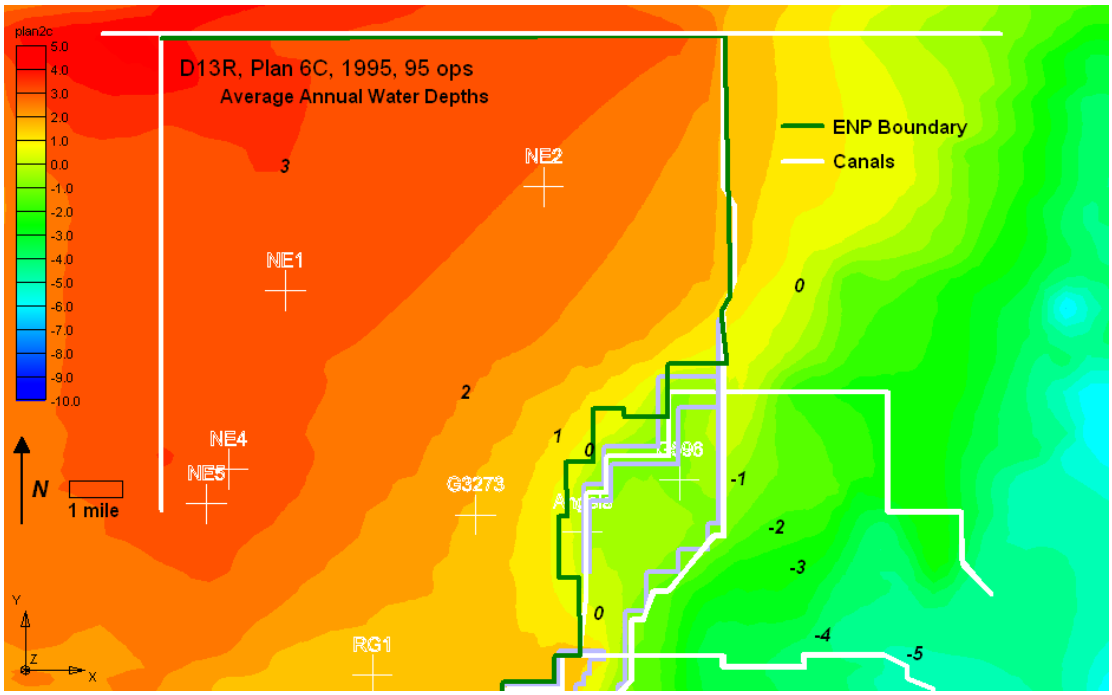


B) Average Depths (3.5 feet deep in NESRS to 1 foot below ground surface in southeastern part of 8.5 SMA)

Figure 17 Hydroperiods and Average Depths for Plan 6B

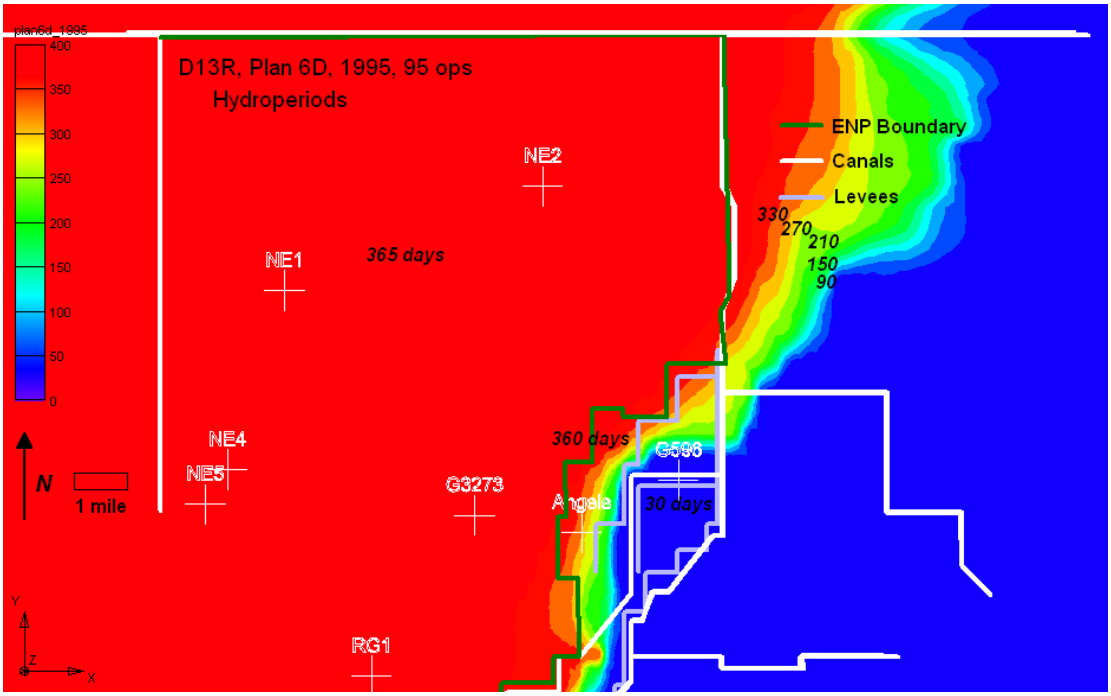


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

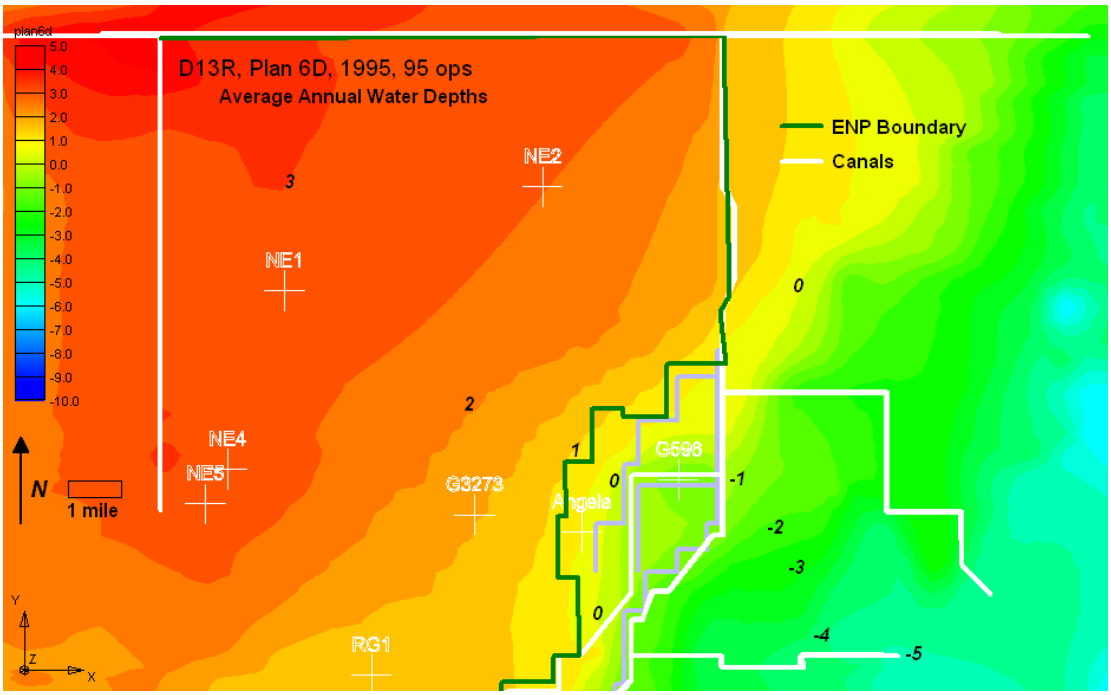


B) Average Depths (3.5 feet in NESRS to 1 foot below ground surface in the southeastern part of the 8.5 SMA)

Figure 18 Hydroperiods and Average Depths for Plan 6C

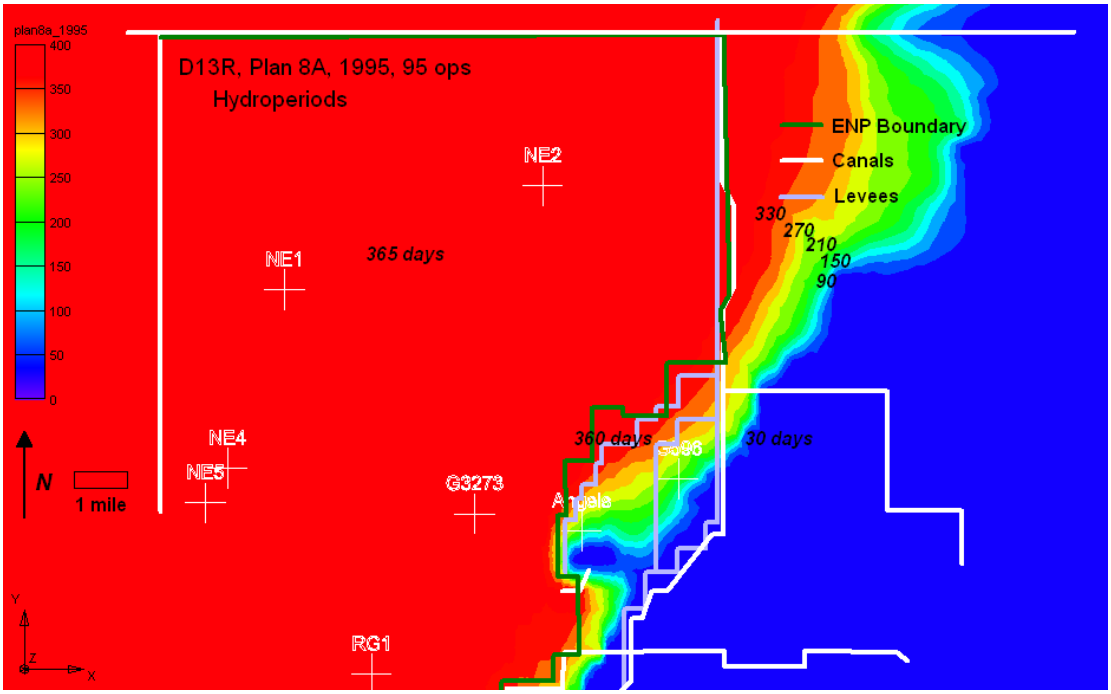


A) Hydroperiods (360 days in NESRS to 0 days next to the canal in the 8.5 SMA)

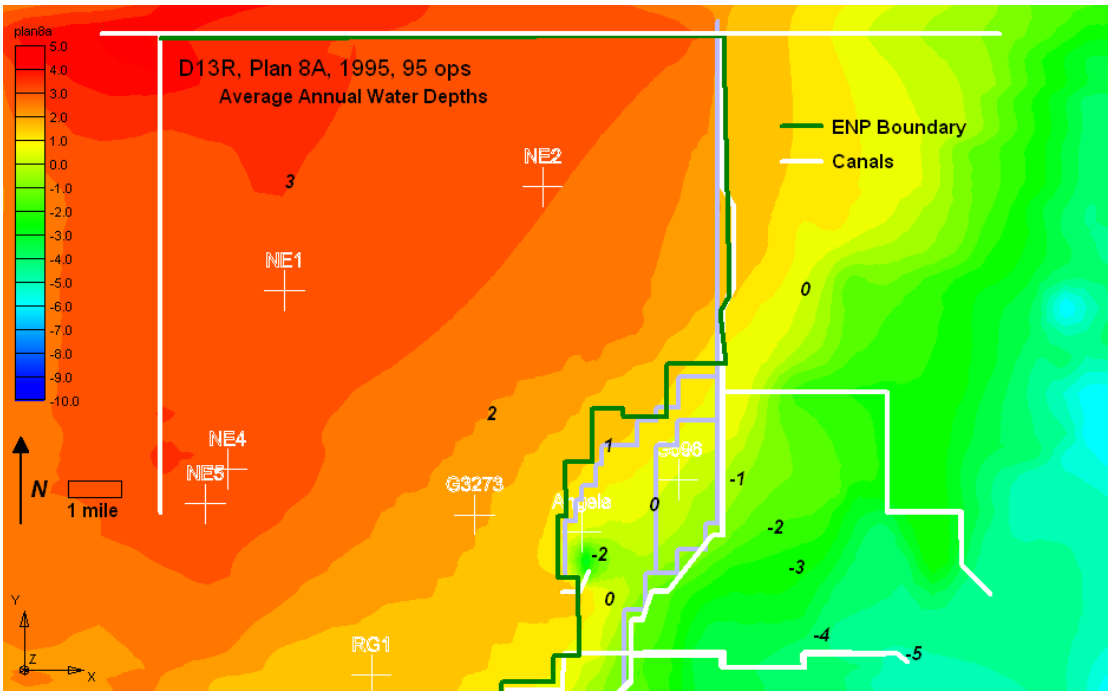


B) Average Depths (3.5 feet in NESRS to 1 foot below ground surface in the southeastern part of the 8.5 SMA.

Figure 19 Hydroperiods and Average Depths for Plan 6D



A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)



B) Average Depths (3.5 feet deep in NESRS to 1 foot below ground surface in southeastern part of 8.5 SMA)

Figure 20 Hydroperiods and Average Depths for Plan 8A

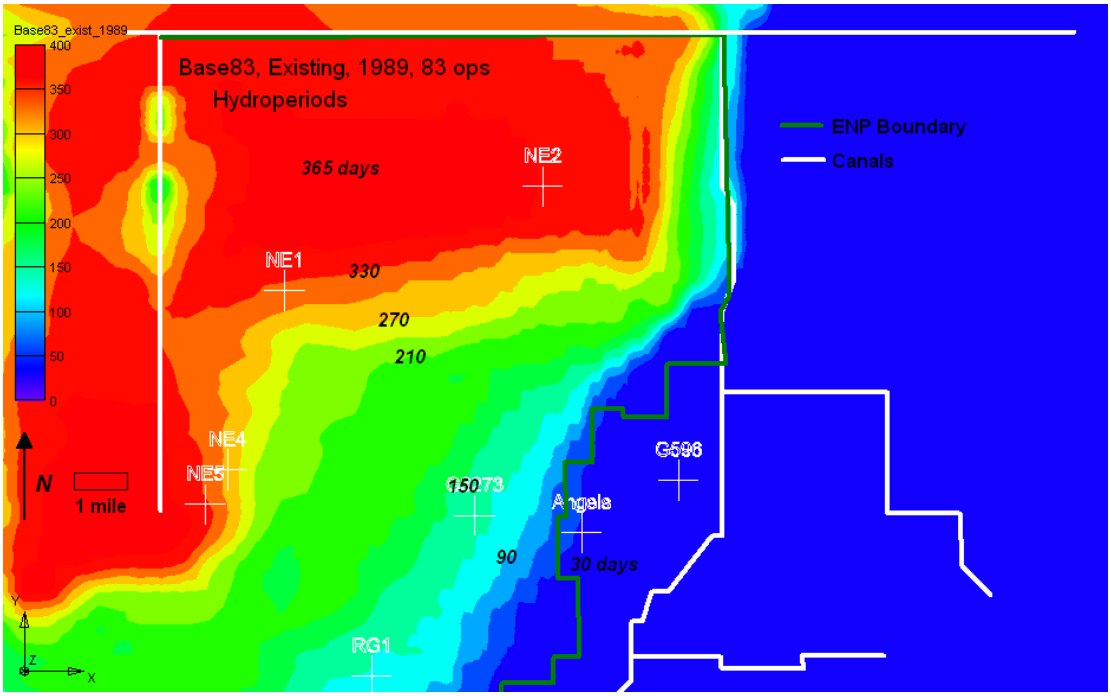


Figure 21 Hydroperiods for Existing Conditions (for the dry year, hydroperiods for existing conditions (Base83) range from 360 days in the northern part of NESRS to 0 days in the 8.5 SMA)

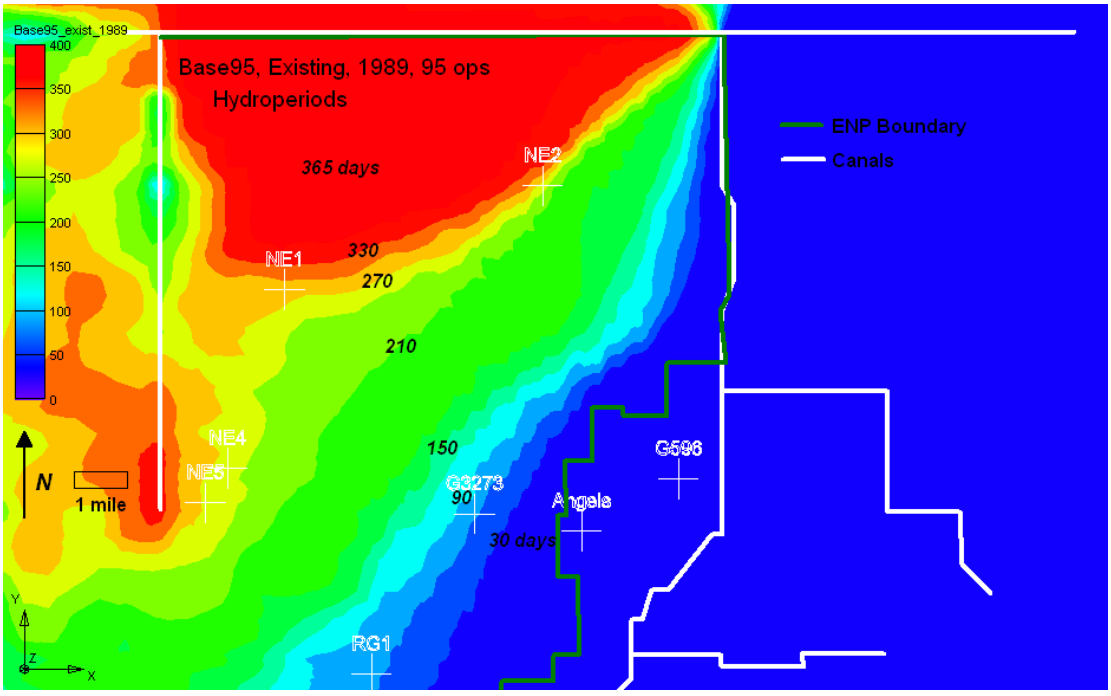


Figure 22 Hydroperiods for Existing Conditions (for the dry year, hydroperiods for existing conditions (Base95) range from 360 days in the northern part of NESRS to 0 days in the 8.5 SMA)

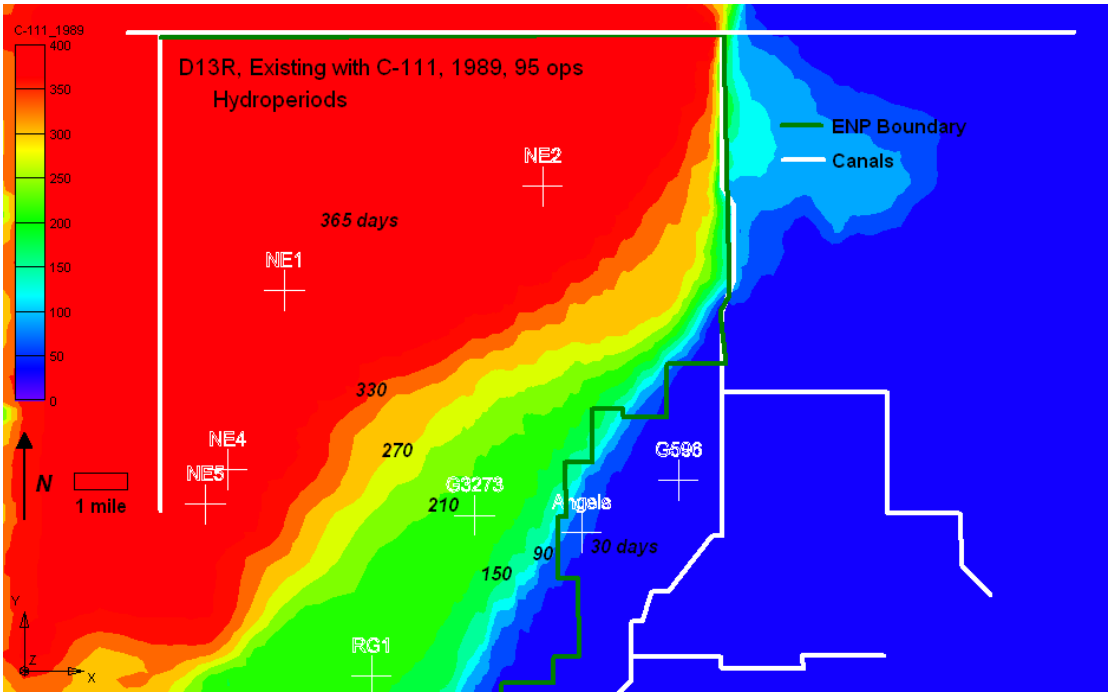


Figure 23 Hydroperiods for Existing Conditions with C–111 Project Implementaton (360 days of inundation in northern part of NESRS to 0 days of inundation in 8.5 SMA)

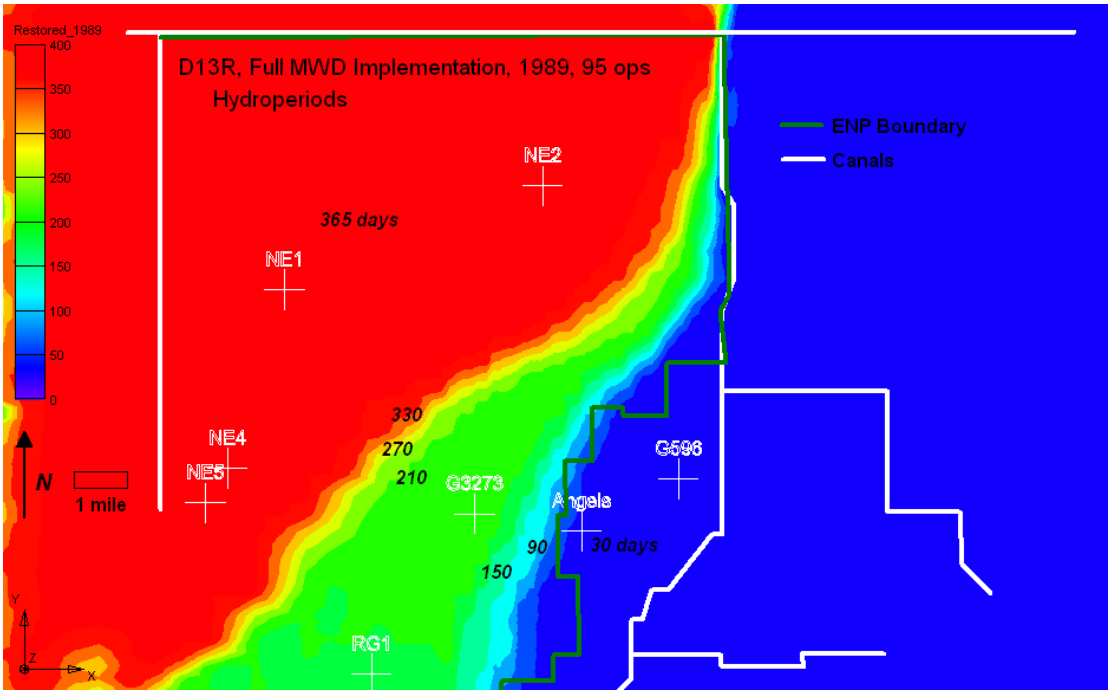


Figure 24 Hydroperiods for Restored Conditions (360 days of inundation in northern part of NESRS to 0 days of inundation in southeastern part of NESRS)

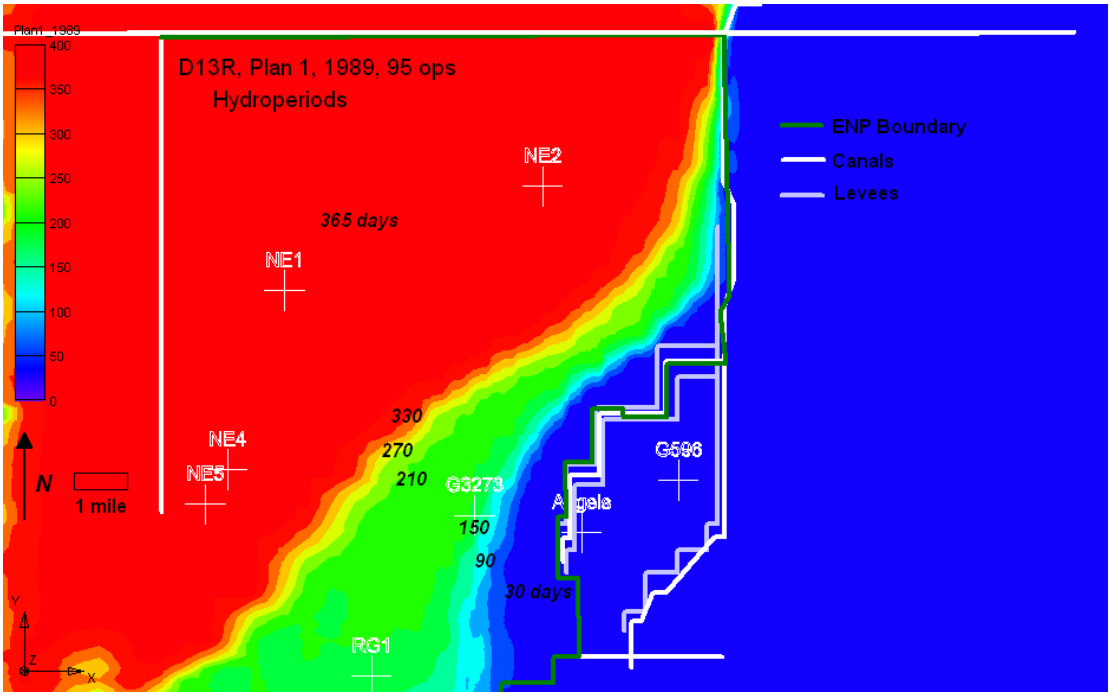


Figure 25 Hydroperiods for Plan 1 (360 days of inundation in northern part of NESRS to 0 days of inundation in the southeastern part of NESRS)

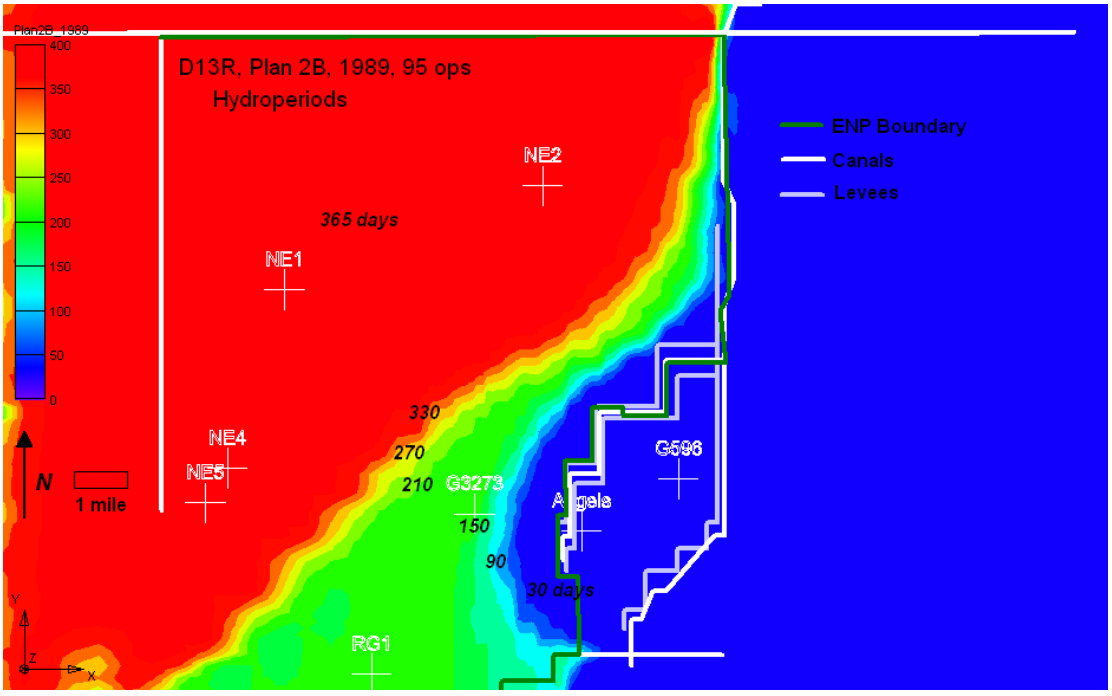


Figure 26 Hydroperiods for Plan 2B (360 days of inundation in northern part of NESRS to 0 days of inundation in the southeastern part of NESRS)

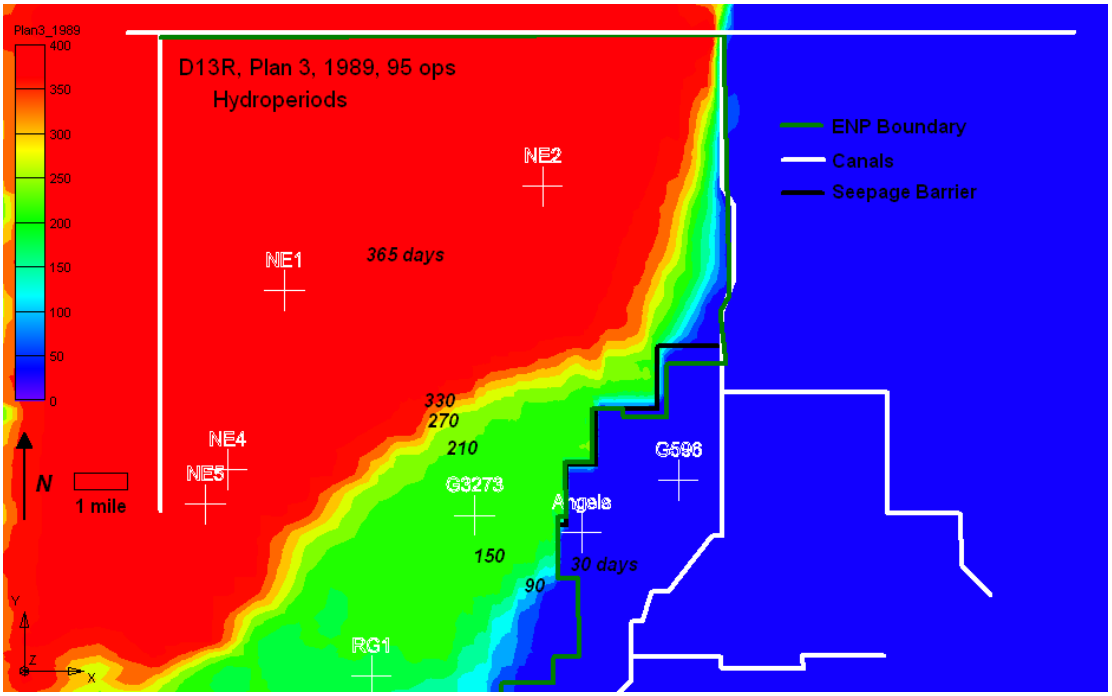


Figure 27 Hydroperiods for Plan 3 (360 days of inundation in northern part of NESRS to 0 days of inundation inside slurry wall at ENP boundary)

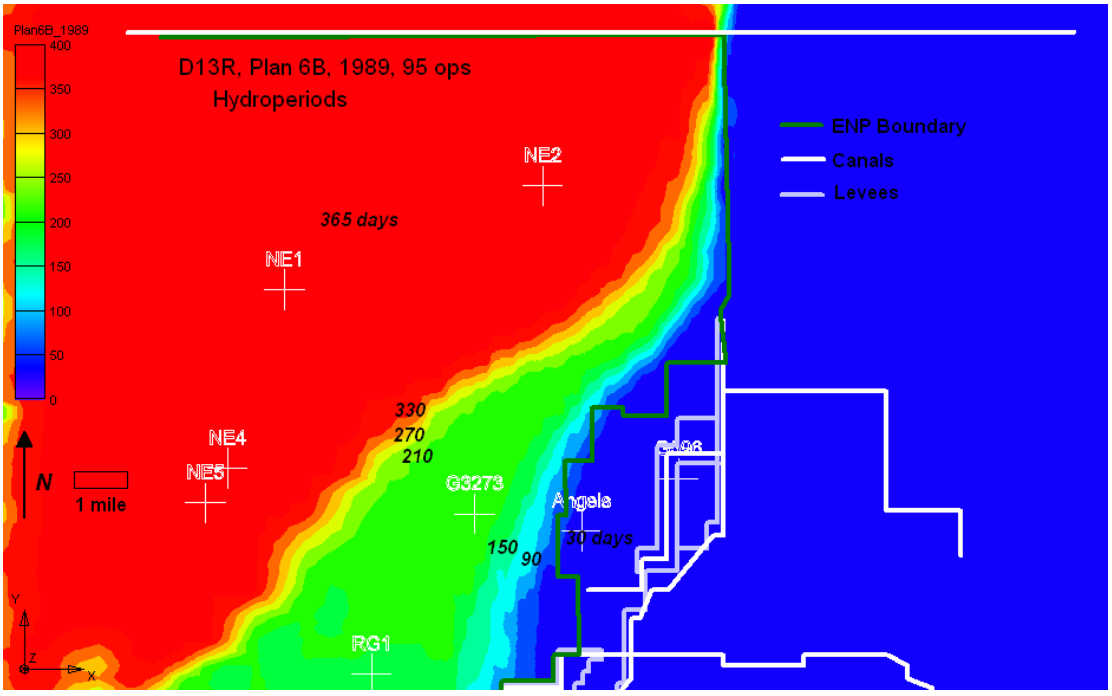


Figure 28 Hydroperiods for Plan 6B (360 days of inundation in northern part of NESRS to 0 days outside ENP boundary)

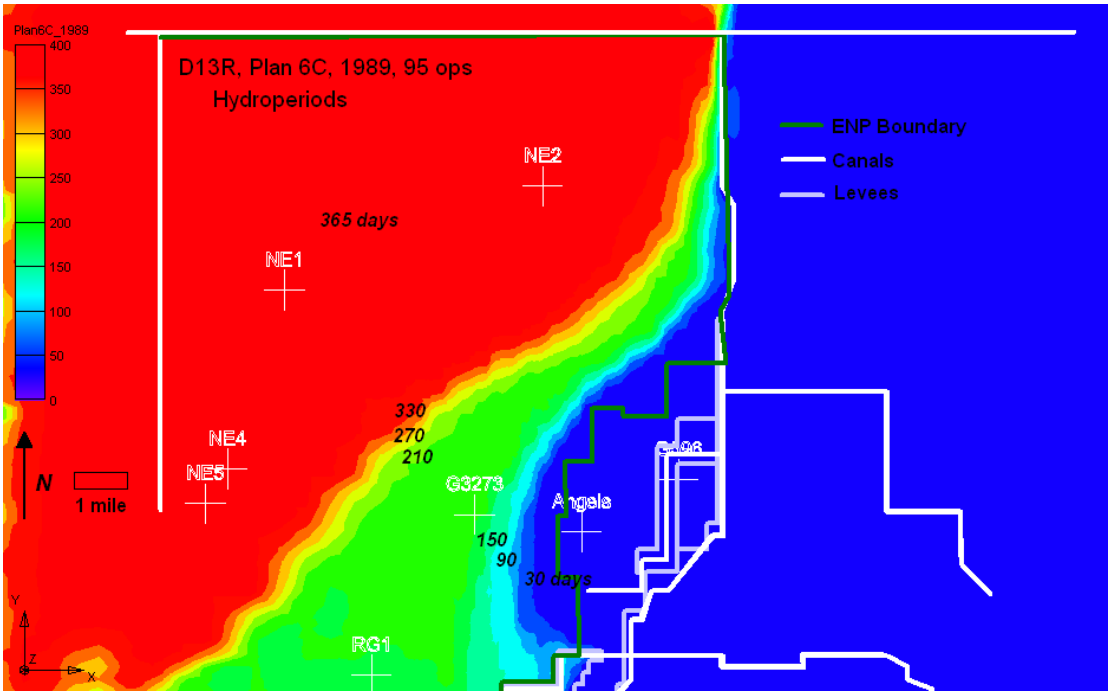


Figure 29 Hydroperiods for Plan 6C (360 days of inundation in northern part of NESRS to 0 days outside ENP boundary)

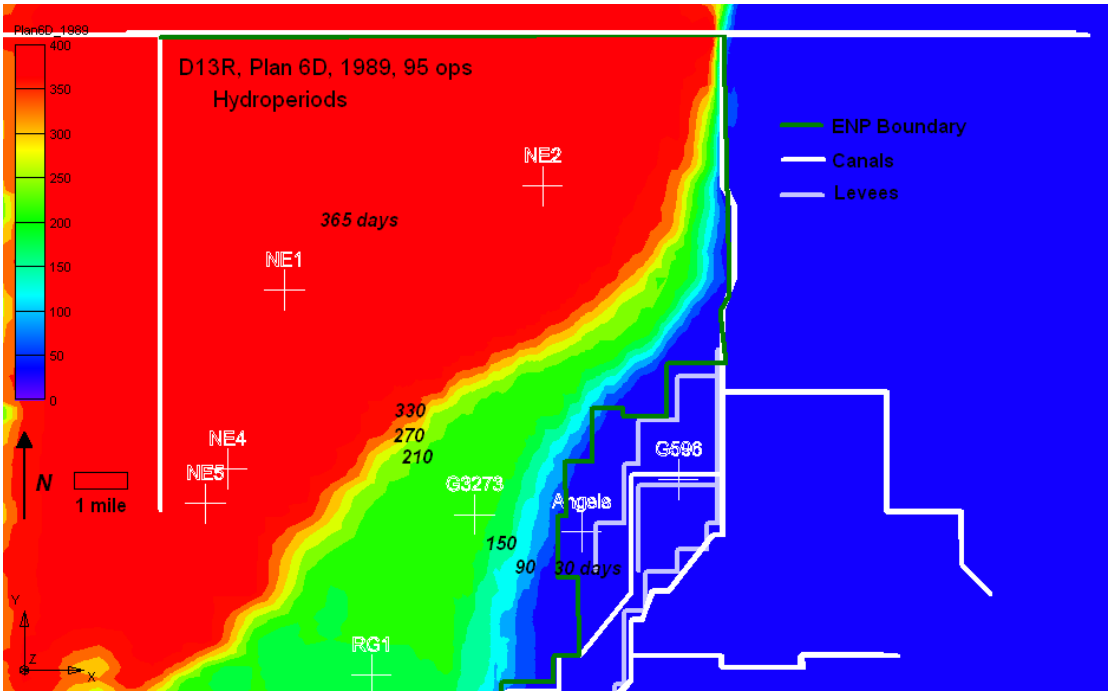


Figure 30 Hydroperiods for Plan 6D (360 days of inundation in northern part of NESRS to 0 days outside ENP boundary)

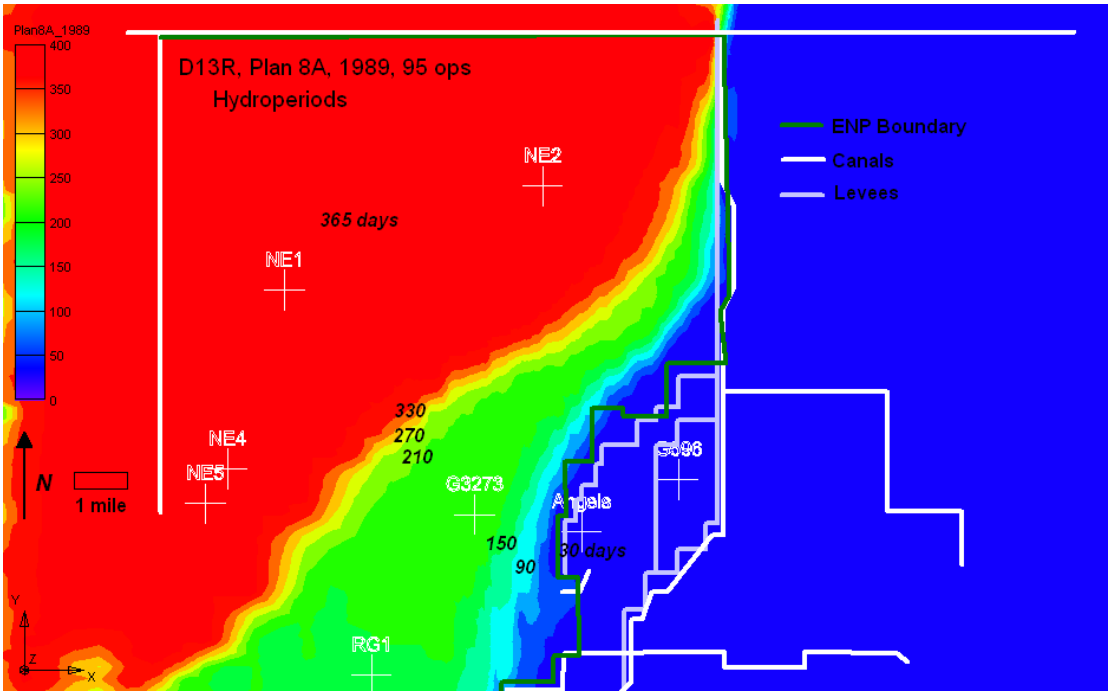


Figure 31 Hydroperiods for Plan 8A (360 days of inundation in northern part of NESRS to 0 days outside ENP boundary)

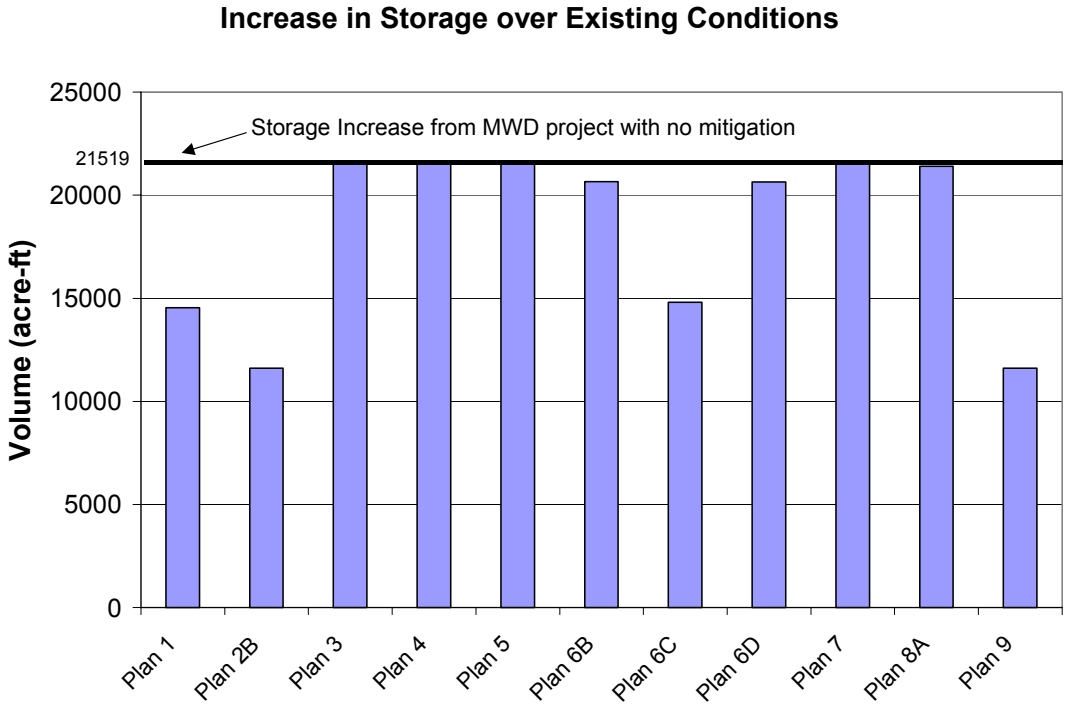


Figure 32 Increase in Storage (Water Volume) over Existing Conditions

Table 4 Mitigation: Spatial Extent of Inundation and Changes in Hydroperiod and Average Water Depth In the Designated Protected Area Relative To Existing Conditions (Base 83) for Wet Year (1995)

	Hydroperiod		Depth		Area Not
	Increased	Decreased	Increased	Decreased	Mitigated
Plan	(acres)	(acres)	(acres)	(acres)	(acres)
Plan 1	694	5.416	185	4.173	694
Plan 2B	371	6,063	0	5,325	371
Plan 3	5,018	1,082	4,155	0	5,018
Plan 4	6,135[a]	0	5,402[a]	0	0[a]
Plan 5	6,135[a]	0	5,402[a]	0	0[a]
Plan 6B	0	1,192	0	1,748	0
Plan 6C	0	3,928	0	4,263	0
Plan 6D	305	2,703	934	2,377	934
Plan 7	6,135	0	5,402	0	6,135
Plan 8A	4,257	2,014	3,722	944	4,257
Plan 9B	371	6,063	0	5,325	371

Note:

a. For plans 4 and 5, flood mitigation is achieved through life estates or acquisition.

Structural flood protection in the 8.5 SMA was evaluated for all of the plans, although only plans 3 and 6 were proposed as flood protection alternatives. Parcels were considered to receive structural flood protection if the water surface was below the ground surface during week 26 (the week in which peak stages occurred in the model). These results are presented in Table 5. The structural flood protection zone for all plans, except 6B, 6C, and 6D, is the entire 8.5 SMA (6,909 acres). For plans 6B, 6C, and 6D, the structural flood protection zone is limited to the area inside the external protective levee (2,250, 4,656, and 3,768 acres, respectively).

Table 5 Areal Extent of Area Within Flood Protection Zone And The 8.5 SMA Receiving Flood Protection

Plan	Areal Extent Flooded (acres)	Areal Extent Protected (acres)	Portion Flooded (percent)	Portion Protected (percent)
Exist	6,264	645	90.7	9.3
C–111	6,323	586	91.5	8.5
Plan 1	6,323	586	91.5	8.5
Plan 2B	6,205	7.04	89.8	10.2
Plan 3	6,323	586	91.5	8.5
Plan 4	6,323	6,909	91.5	100
Plan 5	6,323	6,909	91.5	100
Plan 6B	258	1,992	11.5	88.5
Plan 6C	2,857	1,799	61.4	38.6
Plan 6D	1,492	2,276	39.6	60.4
Plan 7	6,323	586	91.5	8.5
Plan 8A	6,172	737	89.3	10.7
Plan 9	6,205	704	89.8	10.2

Only Plan 6B would provide full flood protection. The success of this Plan can be attributed to the relatively high elevations designated for flood protection. Plan 3 would provide flood protection to 586 acres, leaving 6,323 acres unprotected. Plans 2B and 9 would provide flood protection to 704 acres, leaving 6,205 acres unprotected. For all of the structural plans except 6B, more than 89 percent of the 8.5 SMA would be flooded during a ten-year event. Under existing conditions, 90 percent of the 8.5 SMA is flooded during a ten-year event. All of the plans that were designed for flood mitigation fail to significantly alleviate flooding in the 8.5 SMA. Plan 7 would be expected to temporarily alleviate flood impacts by providing residents with transportation corridors, but it is unlikely that these roads would last under high water conditions if they are built "in kind" as is proposed. In addition, health hazards from septic system failure, crop damage and damage to homes would still occur during a ten-year event. These same hazards exist under current conditions and would worsen with the construction of the MWD Project.

For plans 4 and 5, flood protection would be provided for the entire 8.5 SMA through life estates or acquisition. Under Plan 4, residents would continue to experience flooding impacts similar to those recently experienced after Hurricane Irene. Under Plan 5, no landowners would experience flood damage.

Water Quality Concerns

In response to the identification of a variation of Alternative 6D as the Federally Recommended Plan, a preliminary analysis was performed to estimate the water quality resulting from placement of the mitigation canal central to the developed area rather than on the periphery, as with the other alternatives examined. This alignment has a higher potential for land-use related contaminants entering the canal. This preliminary analysis of phosphorous loading indicates the potential for water quality problems related to Alternative 6D.

In order to predict the average annual phosphorous concentration at S–357, it was necessary to identify the source of the water and its phosphorous concentration. To identify the source of the water, drawdown contours were created by subtracting the average 1995 modeled stages for Alternative 6D from the average 1995 modeled stages for full MWD implementation. The difference between these two model stages represents the average annual discharge volume at S–357. This volume of water is divided into three volumes of water with three different concentrations, the volume of water from ENP (ENP), the volume of water from between the exterior levee and the mitigation canal (WEST), and the volume of water between the mitigation canal and L–31N (EAST). Figure 33 shows the depth of drawdown and the area in acres for each of the drawdowns for each zone. Taking the area of drawdown (A) times the depth of drawdown (D) times the concentration of phosphorous (P) gives the average annual concentration of phosphorous discharged at S–357. Table 6 and Table 7 show the results of these calculations for various assumptions regarding the concentration of phosphorous. The assumed phosphorous levels are determined to be representative based on measurements of phosphorous at S–331, S–332D and S–332B. These calculations indicate average annual concentrations at S–357 ranging from 8 to 23 ppb

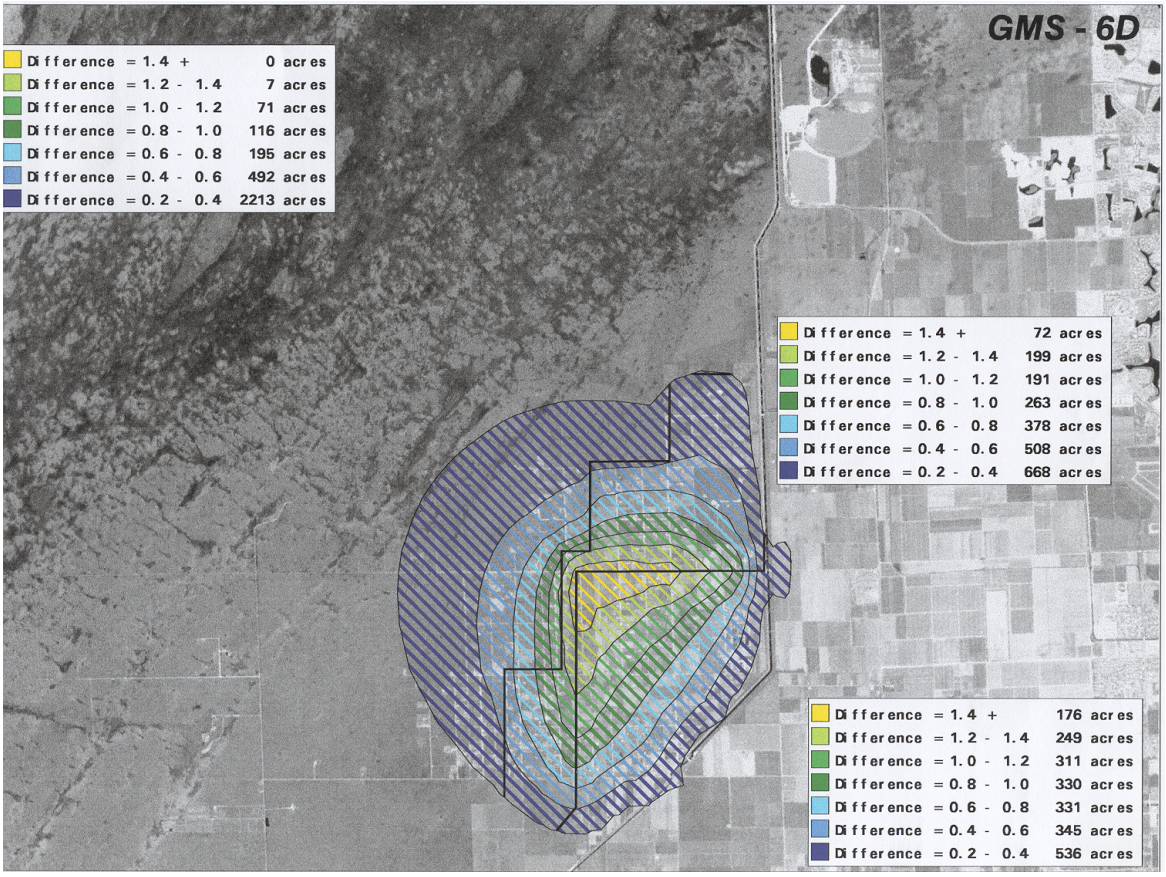


Figure 33 Distribution of Estimated Average Annual Phosphorus Concentrations

phosphorous. Based on these calculations, it is likely that water from S–357 would require treatment before being discharged to ENP.

Effects to Ecological Functions

Marl Forming Wetlands

Marl forming wetlands have been identified as a landscape remnant that has been lost or greatly diminished. Research indicates the following characteristics exist for marl forming wetlands (Browder 1982, Taylor 1983, Olmsted et al. 1980, Tropical BioIndustries 1990):

1) Water table recessions greater than 1.5 feet below the land surface for no more than 1 month in the driest years,

2) Hydroperiods between 1 and 6 months, and

3) Water depths greater than 2 feet for no more than 30 days.

Table 6 Source Area Volumes for Alternative 6D S–357 Discharge

	Drawdown Depth (ft)	Area Acres)	Volume (acre-ft)	Volume fraction
ENP				
	1.5		0	
	1.3	7	9.1	
	1.1	71	78.1	
	0.9	116	104.4	
	0.7	195	136.5	
	0.5	492	246	
	0.3	2,213	663.9	
Total			1,238	0.27
WEST				
	1.5	72	108	
	1.3	199	258.7	
	1.1	191	210.1	
	0.9	263	236.7	
	0.7	378	264.6	
	0.5	508	254	
	0.3	668	200.4	
Total			1,532.5	0.34
EAST				
	1.5	176	264	
	1.3	249	323.7	
	1.1	311	342.1	
	0.9	330	297	
	0.7	331	231.7	
	0.5	345	172.5	
	0.3	536	160.8	
Total			1,791.8	0.39
TOTAL			4,562.3	1.00

Table 7 Estimated Average Annual Phosphorus Concentration for S–357 Discharge

Source	Volume Fraction	Source Concentration (ppb)	Source Concentration (ppb)	Source Concentration (ppb)
ENP	0.27	5	5	5
West	0.34	10	20	30
East	0.39	10	20	30
S–357 Discharge		8.6	15.9	23.2

These characteristics were applied to model output to screen for potential locations of marl forming prairie. For existing conditions, these criteria indicated marl-forming wetlands along the edge of NESRS, including the western edge of the 8.5 SMA (Figure 34). The presence of muhly grass noted by WRAP members confirmed these results. In general, the higher water levels of full MWD implementation push the existing marl forming wetlands east to higher ground. East of L–31N, the wetland pattern resulting from Plan 6D mimics full MWD implementation. However, wetlands are eliminated in the central and southern part of the 8.5 SMA (where the drainage is most severe) while some areas to the south are restored as a result of structural discharges.

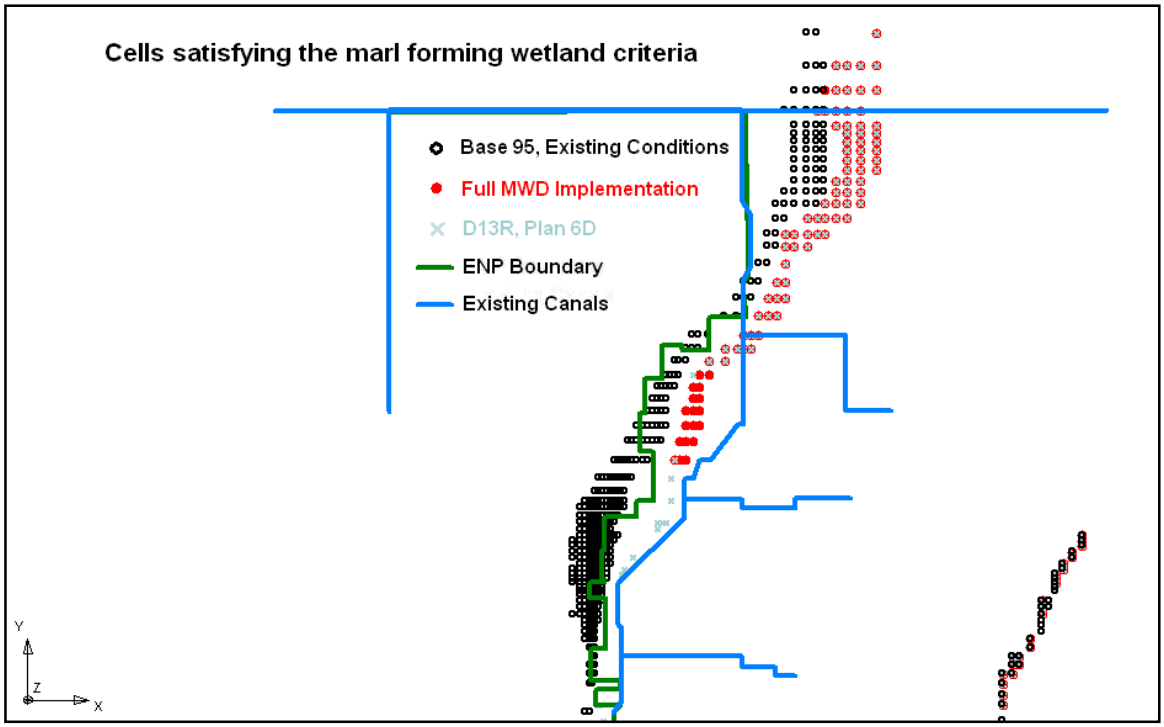


Figure 34 Location of Existing and Predicted Marl-forming Wetlands

Acreages of marl forming wetlands in NESRS and the 8.5 SMA are reported on Table 8. Existing modeled marl forming wetlands encompassed 1,885 acres, with 1,564 of those acres in the 8.5 SMA. Under Plan 1, all of the 8.5 SMA marl forming wetlands would be eliminated and 2,428 acres of marl forming wetland would be created in ENP by draining existing peat forming wetlands. Under plans 2B and 9B, 1,204 acres of marl forming wetlands would remain in the 8.5 SMA and 3,675 acres would be created by draining peat-forming wetlands in ENP. Under Plan 6C, only 38 acres of marl forming wetlands are left in the 8.5 SMA with 556 acres left in ENP. Under Plan 6D 1,309 acres of the marl forming would be lost, leaving 468 acres of marl forming wetlands in the 8.5 SMA and draining 108 acres of peat forming wetlands in ENP to create marl forming wetlands. Under Plan 3, 2,002 additional acres of marl forming wetlands would be found in the 8.5 SMA. Under Plan 6B, 483 acres would be left in the 8.5 SMA, with 576 acres left in ENP. Plan 8A eliminates 834 acres of marl forming wetlands in ENP. Under plans 4, 5, and 7, 1,397 acres of marl forming wetlands would be retained, 1,289 in the 8.5 SMA.

Compatibility with Future Restoration and C-111

Features Needing Rehabilitation or Removal

Model scenario D13R from the Comprehensive Everglades Restoration Plan utilizes structure S–356 for water supply to NESRS. Under the current model

runs for the 8.5 SMA, S–356 is located along the L–29 alignment near S–334. Because proposed future restoration calls for filling in the L–29 canal, S–356 would have to be moved to L–31N. Relocation of this structure may have unforeseen impacts on the northeast portion of the 8.5 SMA.

Table 8 Acres of Marl forming Wetlands

	Areal Extent of Marl-forming Wetlands in:	
Parameter	NESRS + 8.5 SMA (acres)	8.5 SMA only (acres)
Existing	1,885	1,564
D13R_95ops:		
Plan 1	2,428	1,387
Plan 2B	3,675	1,204
Plan3	2,110	2,002
Plan 4	1,397	1,289
Plan 5	1,397	1,289
Plan 6B	591	483
Plan 6C	556	38
Plan 6D	576	468
Plan 7	1,397	1,289
Plan 8A	1,051	943
Plan 9B	3,675	1,204

This structure relocation would occur under all the plans, but is considered least deleterious under Plan 5, because the 8.5 SMA would be under public ownership. Relocation of S–356 would be most problematic for Plan 1, which depends on moving water from S–357 north into L–31N. Any of the alternatives where residents remain in the 8.5 SMA would be potentially affected by moving S–356. However under Plan 6B the remaining residents would be located close to the L–31N canal and at higher elevations and so would be less vulnerable to increased water levels. Under the residents' choice, Plan 4, the residents would be vulnerable to higher water levels and would have agreed to the consequences. Under the raise the roads plan, residents would be vulnerable to the higher water levels and no agreement would be in place regarding the flooding of property, should relocation of S–356 prove to cause increased flooding.

Plan 8A causes higher water depths as water levels in the 8.5 SMA are already high under this Plan. Under plans 2B and 6D, residents would have the expectation of flood protection with the canal and levee in place and might experience higher water levels when S–356 is relocated.

Function Of 8.5 SMA In Historical Flow Regime And Future Restoration

The 8.5 SMA functioned as a perimeter wetland in the historical Everglades. These perimeter wetlands are the prime habitat for a diverse population of aquatic and terrestrial species, including wading birds and, especially, wood

storks. Although it is a small piece of the massive Everglades system, it is an essential component of the required landscape mosaic. It provides the flow-way for water delivery to the Rocky Glades and recharge to Taylor Slough (Merritt 1996).

As restoration proceeds, there would be a tendency to build canals, levees, and other barriers to allow high water levels to be retained in marshes while at the same time allowing for agricultural and residential uses in neighboring landscapes. This effect can be observed in the vicinity of the C–111 project in Figure 33 where restoration water levels converted existing short-hydroperiod wetlands to long-hydroperiod wetlands and canal drainage prohibited the development of short-hydroperiod wetlands on higher ground to the east. The perimeter areas that historically were wet in the wet season and dry during the dry season, would be in danger of being lost to a system in which canals and levees keep water levels high on the wet side and low on the dry side (Figure 35). However, it is these exact same perimeter zones that are needed to complete the landscape and restore ecological function. If predicted losses of marl-forming wetlands in the vicinity of the C–111 project are accurate, and a mitigation plan that eliminates wetlands in the 8.5 SMA is chosen, the wetlands to the north become invaluable. Unfortunately, their proximity to high growth areas of Dade County make them vulnerable to drainage for development, and every effort must be made to protect these areas.

The future of a healthy and fully functional Everglades would not be met if these important peripheral wetlands were eliminated one piece at a time. For this reason, plans that allow for continued development in the 8.5 SMA are regarded as consistent with the long-term goal of restoring Everglades ecological function. Plans involving levees and canals (1, 2B, 3, 6B, 6C, and 6D, and 9) are the

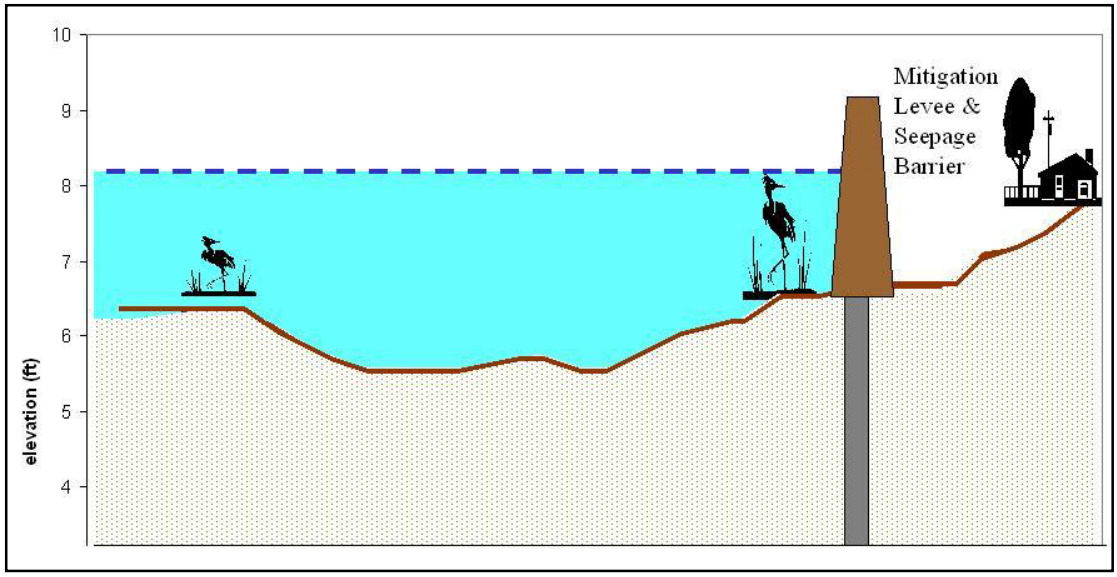


Figure 35 Effect of Canals, Levees, and Seepage Barriers on Water Level Gradients

consistent. Plan 3 would be a permanent irretrievable barrier to the natural flow path. Plan 7 is a concern because residents would remain in the area and existing roads may provide additional resistance to flow. Plans 4 and 8 are less intrusive, with barriers to flow in Plan 4 being the current roads and the concerns for residents. Plan 8 is located along a natural flow-path and attempts to provide protection without major disruption to natural flow patterns. Plan 8, however has concerns for residents as a potential impediment to future restoration efforts. Under Plan 5, concerns for the residents are removed and future restoration can include the important peripheral wetlands within the 8.5 SMA.

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Chapter 6 — Wetland Functional Evaluation

Wetland Rapid Assessment Procedure

To compare relative differences (both losses and gains) in wetland function between the "existing condition" and the project alternatives, the WRAP was employed (Miller and Gunsalus 1997). The WRAP methodology has been adopted by the Corps as the most reliable and consistent approach to account for changes in wetland function for Everglades restoration projects in south Florida (letter dated August 4, 1999).

WRAP is a matrix developed to assist in the functional evaluation of wetland sites. The matrix can be used in combination with professional judgment to provide an accurate and consistent evaluation of wetland sites. The WRAP matrix establishes a numerical ranking for individual ecological and anthropogenic factors (variables) that can strongly influence wetland function. The numerical output for the variables is then used to evaluate current wetland condition. Each wetland type is rated according to its attributes and characteristics. WRAP variables include the following: (1) wildlife utilization, (2) wetland overstory/shrub canopy of desirable species, (3) wetland vegetative ground cover of desirable species, (4) adjacent upland/wetland buffer, (5) field indicators of wetland hydrology, and (6) water quality input and treatment systems. The score of each wetland habitat type (polygon) is then multiplied by the acreage of that habitat type to derive "Functional Units" (FUs) for comparison purposes.

To adequately evaluate wetland function within the study area, wetland habitat polygons were systematically developed by overlaying 4 basic wetland habitat types (graminoid, herbaceous, shrubby, and forested) over 3 ranges of topography (<6.5 feet, 6.5 to 7.0 feet, and >7.0 feet NGVD) within the 8.5 SMA. To adequately evaluate wetlands potentially impacted by project operations, wetlands in ENP adjacent to 8.5 SMA were included (short hydroperiod wetlands, long hydroperiod wetlands, forested wetland systems, and forested exotic wetlands).

From December 1999 through February 2000, the WRAP Team conducted a series of on site field investigations, consisting of 37 survey sites representative of 17 wetland habitat types (polygons) inside and adjacent to the 8.5 SMA to establish the "existing condition" wetland functional conditions. On February 17, 18, and 22, 2000, the WRAP Team (without representatives from the SFWMD and Miccosukee Tribe) convened to calculate the "with-project" wetland functional projections for the nine original alternatives proposed for the project. The team met again on April 18, and May 1, 2000 to consider additional alternatives 6C and 6D, respectively. Best professional judgment in combination with hydrologic model outputs (MODBRANCH, U.S. Army Corps of Engineers), which quantified spatial hydroperiod projections developed for construc-

tion and operational features for each alternative, were used to perform this component of the evaluation. The results of the WRAP assessment are described below.

Wetland Rapid Assessment Procedure Results

Existing Condition WRAP Assessment

Wetlands in the study area are located within the Rocky Glades region of the Everglades, defined by shallow marl soils over Karst limestone bedrock. Historically, the study area was primarily a mosaic of short hydroperiod wetlands, interspersed with bayheads, tropical hardwood hammocks, and sawgrass prairies mostly influenced by NESRS and local rainfall. Generally, hydroperiods gradually increased westward to NESRS and decreased with higher elevations associated with the Atlantic Coastal Ridge to the east.

These Rocky Glades wetlands were primarily dominated by short hydroperiod graminoid species interspersed with tropical hardwoods found on bayheads and hammocks. Sawgrass communities dominated the long hydroperiod wetlands while muhly grass dominated the short hydroperiod wetlands. Today, this continues to be true within ENP where these graminoid communities remain intact, although negatively impacted by regional water management facilities to the north (C–4, L–29, WCA 3) and east (L–31N). However, within the 8.5 SMA, anthropogenic activities, such as confined animal feeding operations, row crop/grove/nursery agriculture, and residential development, have disturbed and fragmented these wetland ecosystems, sparing only those wetlands that could not be economically maintained due to frequent flooding. Generally, the higher quality wetlands were found in the lower elevations along the northern and western extremities of the 8.5 SMA with vegetative quality and function decreasing along an easterly gradient approaching the L–31N levee and canal, at approximately 8.0 feet NGVD. Only the FAA parcel demonstrated functional graminoid wetland characteristics above the 7.0-foot NGVD contour (WRAP worksheets are available upon request).

Wetlands evaluated for this study were delineated according to the following definitions:

1. **Forested Wetland — ENP**: Predominately native woody and herbaceous species typical to the fringe vegetative community of hardwood hammocks and willow heads.

2. **Marl Prairies:**

Long Hydroperiod Wetland — ENP: Predominantly sawgrass vegetative community characterized by inundation periods ranging from 7 to 12 months per average year. This wetland type was the most dominant, comprising 70 percent of the graminoid prairies in the ENP's portion of the study area.

Short Hydroperiod Wetland — ENP: Predominantly muhly grass vegetative community characterized by inundation periods ranging from 3 to 6 months per average year.

3. **Graminoid Wetland**: Prairie vegetative community dominated by grasses typical to short hydroperiod wetlands such as muhly grass, *Juncus* spp., white-top sedge, *Spartina* spp., cattail, broomsedge, bluestem, and beakrush, with scattered sawgrass in depressions.

4. **Herbaceous Wetland — Low to Moderate Soil Disturbance**: Short hydroperiod wetland community dominated by non-woody, non-invasive, ruderal herbaceous species, which demonstrates a soil substrate characterized by previous disturbance, such as farming, recreation, building construction, livestock, and other activities that were relatively short-lived and/or minor in size and scope.

5. **Herbaceous Wetland — High Soil Disturbance**: Short hydroperiod wetland community dominated by non-woody but undesirable herbaceous species, which demonstrates a soil substrate characterized by previous disturbance, such as farming, recreation, building construction, livestock, and other activities that were intensive and continuous throughout a relatively long period of time, leaving distinctive surface scars and obvious landscape alteration.

6. **Shrubby Wetland**: Wetland dominated by native woody shrub species, such as salt bush and wax myrtle, frequently co-dominated by exotics, such as Brazilian pepper, bottlebrush, and other invasive ornamentals. Herbaceous species could include muhly grass, sawgrass, Napier grass, cattail, broomsedge, sedges, and rushes.

7. **Forested Exotic Wetland**: Forested wetland (>50 percent canopy cover) dominated by exotic species, such as *Melaleuca quinquinervia*, Australian pine, and Brazilian pepper.

8. **Forested Native Wetland**: Forested wetland (>50 percent canopy cover) within the 8.5 SMA dominated by native species, such as figs, red bay, sweet bay, magnolia, coco plum, pond apple, and Dahoon holly.

The distribution of these wetlands is shown on Figure 36.

Everglades National Park

As shown on Table 9, Forested Wetland Systems demonstrated the highest wetland function in the low elevation ENP lands (WRAP score = 0.91). Short Hydroperiod Wetlands (WRAP score = 0.90) and Long Hydroperiod Wetlands (WRAP score = 0.88) also demonstrated a relatively high level of wetland function. Forested Exotic Wetlands, primarily stands of *Melaleuca* and Brazilian pepper, scored lowest (WRAP score = 0.53).

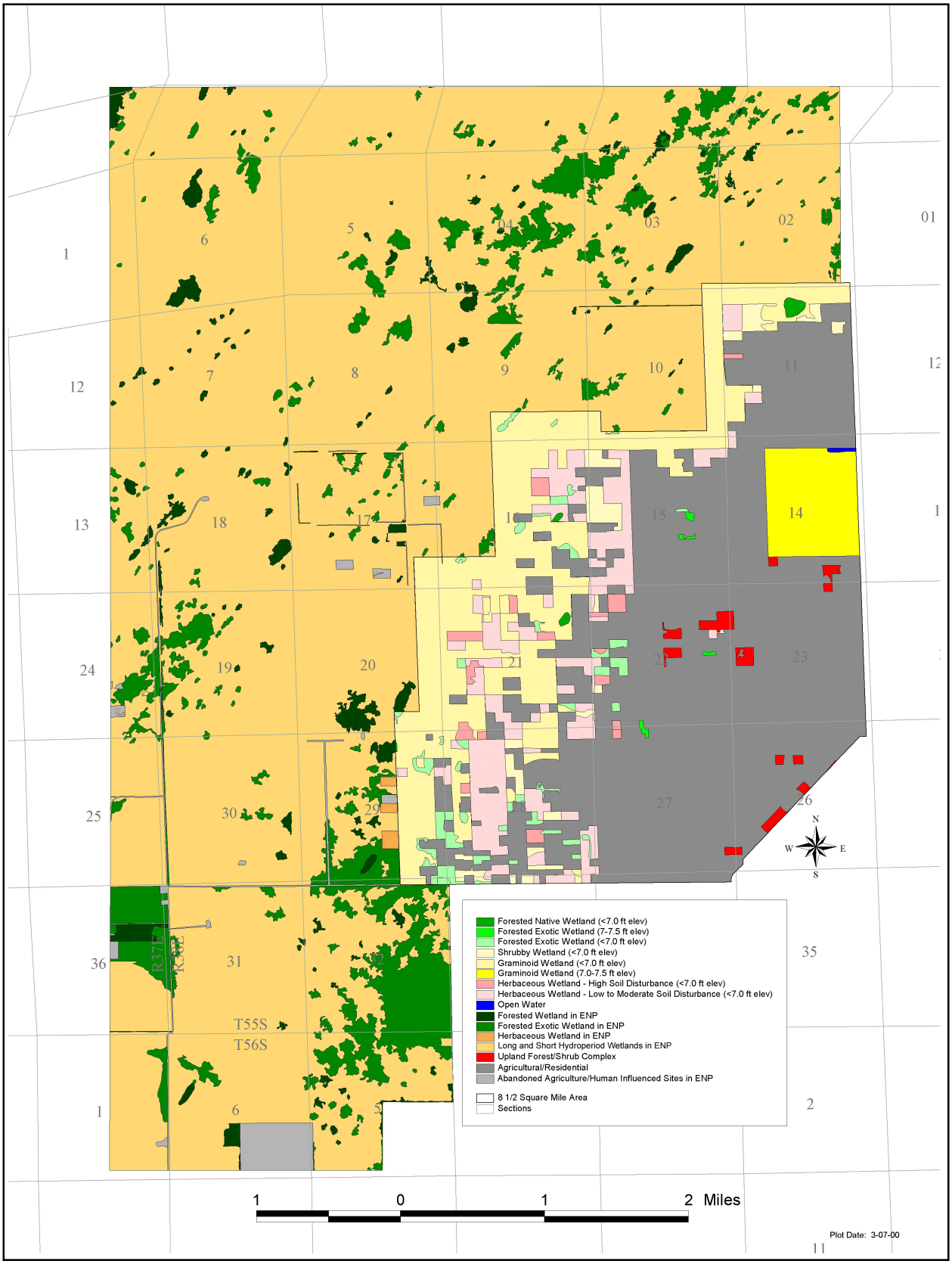

Figure 36 Distribution of Wetlands in the Study Area

8.5 SMA Low Elevation (<6.5 feet NGVD)

The western portion of the 8.5 SMA is more disturbed by anthropogenic activities than ENP wetlands to the west. However, in as much as these wetlands are impacted by ongoing anthropogenic activities, a propensity for frequent flooding limits the potential for development in this part of the study area. Graminoid Wetlands at this elevation are generally a mosaic of sawgrass and muhly vegetative communities. These wetland habitats demonstrated minimally impacted wetland function (WRAP score = 0.77); characterized by significant invasions of exotic and nuisance plants (e.g., Brazilian pepper, Australian pine, *Melaleuca*, Napier grass, and torpedo grass); partitioning within buffer areas (e.g., roads, ditches, utility lines, and other anthropogenic structures), and limited disturbance from agricultural and residential development. Shrubby Wetlands, Herbaceous Wetlands (low to moderate disturbance), Herbaceous Wetlands (high disturbance), and Forested Exotic Wetlands are areas impacted by agricultural land uses, past and present. The degree of disturbance appears to be adequately reflected in their respective scores (Table 9).

Table 9 Existing Condition WRAP Polygon Scores, Acreages, and Functional Units for the 8.5 Square Mile Area, Miami-Dade County, Florida

Wetland Type	Score	Acres	Functional Units
Everglades National Park			
Forested Wetland	0.91	889	809
Forested Exotic	0.53	3,209	1,701
Long Hydroperiod Graminoid	0.88	7,188	6,325
Short Hydroperiod Graminoid	0.90	3,081	2,773
Subtotal		14,367	11,608
8.5 SMA			
Graminoid Wetland <7.0 feet	0.72	1,448	1,043
Graminoid Wetland @>7.0 feet	0.53	300	159
Herbaceous Wetland low-moderate Disturbance <7.0 feet	0.69	572	395
Herbaceous Wetland high Disturbance <7.0 feet	0.56	82	46
Shrubby Wetland < 7.0 feet	0.54	143	73
Forested Exotic Wetland 6.5–7.0 feet	0.51	128	65
Forested Exotic Wetland @>7.0 feet	0.46	7	3
Forested Native Wetland	0.86	15	13
Subtotal		2,695	1,797
Total		17,062	13,405

8.5 SMA Mid Elevation (6.5 to 7.0 feet NGVD)

This portion of the 8.5 SMA is mostly found in the central areas, interfacing intense agriculture and residential development to the east with less disturbed areas to the west. Many wetlands evaluated at this elevation were formerly

disturbed by agriculture and some limited residential land uses. Generally, wetlands at this elevation did not score significantly different than similar wetlands at the low elevation (Table 9). Only Graminoid Wetlands at this elevation reflected a significantly lower score than Graminoid Wetlands <6.5 feet (WRAP score = 0. 72).

8.5 SMA High Elevation (>7.0 feet NGVD)

Only two wetland types were observed at this elevation: Graminoid (WRAP score = 0.53) and Forested Exotic (WRAP score = 0.46). The graminoid site was the 300-acre FAA air traffic radar facility adjacent to the L–31N levee in the northeastern portion of the 8.5 SMA. The forested site was a 7-acre Australian pine stand at the intersection of SW 168th Street and 209th Avenue.

With-Project WRAP Assessment

Assumptions

The interagency WRAP Team established the following assumptions for the with-project WRAP assessment:

1) **Project Life:** The Project Life is 50 years; therefore, all wetland functional assessments will be projected to the year 2050;

2) **Geographic Area**: The WRAP assessment area includes all wetlands 2 miles south of SW 168th Street (the southern boundary for the 8.5 SMA) from L–31N to 2 miles west of SW 220th Avenue, proceeding north to approximately 2 miles north of SW 112th Street (the northern-most boundary). This area includes lands both inside and adjacent to the 8.5 SMA that are hydrologically altered based on modeling conducted by the Corps and ENP for the life of the project, or 50 years;

3) **Elevational Delineation of Wetlands in the 8.5 SMA:** Base mapping data for the MODBRANCH hydrologic model, used to evaluate existing and projected hydrologic conditions, did not recognize the 6.5-foot NGVD contour within the 8.5 SMA, which was used in field surveys to differentiate low from mid-elevation wetlands. For the purpose of analysis, wetland polygons that were developed at low elevations (<6.5 feet NGVD) were pooled with those at the mid-level (6.5 to 7.0 feet NGVD).

4) **Hydrologic Base:** A comparison of the stage-hydrographs modeled by the Corps revealed that the difference between the 1983 base hydrological condition and the 1995 base hydrological condition were inconsequential for the purposes of WRAP; therefore, the use of either base was appropriate;

5) **Wetland Delineation:** All wetlands included in the WRAP assessment were delineated in accordance with the Corps' 1987 Wetlands Delineation Manual (COE 1987).

6) **Flood Protection:** For the purposes of WRAP, this term applies for either: A) the mitigation for increases of standing water in the 8.5 SMA that could be attributed to hydrologic conditions resulting from implementation of the MWD Project; or B) the Corps' definition of Congressionally authorized flood protection at any level as described by hydrologic modeling (i.e., MODBRANCH);

7) **Projected Land Use Changes**: Projected changes in land use in the 8.5 SMA are based on a combination of Miami-Dade County's Comprehensive Land Use Plan and best professional judgment based on past land use practices in the area. Lands in public ownership (except the FAA site) are considered to be private lands subject to projected changes in land use. Any perceived level of flood protection (flood mitigation or protection) would result in an increase in zoning density from the existing 1:40 to 1:5, with increased filling for roads, pads, and subsequent drainage improvements within the protected area by 2050. No wetland functional change is anticipated for the FAA's site under structural Alternatives 1, 2, 3, and 9. The WRAP Team concluded that regional permitting in the 8.5 SMA would result in all wetland compensatory mitigation for future wetland losses being conducted off-site and that any perceived level of flood protection would ultimately result in total build-out and subsequent loss to wetland resources within that protected area. This compensatory mitigation shall incorporate the Service's mitigation policy in its development;

8) **C&SF Restudy**: The hydrologic modeling assumed that Restudy Alternative D13R regional hydrology is in place;

9) **Land Availability**: It is assumed that all lands required for project implementation are available;

10) **Habitat Management**: It is assumed that all public lands in the 8.5 SMA that are not flood mitigated, would be actively managed over the life of the project, or 50 years (e.g., removal of fill, exotic control and fire management). Management guidance to achieve optimal habitat maintenance for lands in the 8.5 SMA is presented in Appendix C.

Alternative Assessment

Alternatives 1, 2, and 9

These alternatives are flood mitigation plans and are identical regarding the potential to impact wetlands. Accordingly, they were evaluated jointly by the WRAP Team. Hydrologic modeling output indicates that these alternatives create a "hydrologic edge effect," affecting wetlands in ENP adjacent to and within approximately 2 miles of the levee and seepage canal. This edge effect would likely cause long-term drydowns to these wetlands during project operations, ultimately resulting in diminished hydroperiods. Shorter hydroperiods would likely result in significant functional loss to short hydroperiod wetlands, resulting in an increase in the frequency of disruptive fires, encroachment of woody vegetation and further persistence of exotic species.

Any long hydroperiod wetlands proximal to the levee and canal also would demonstrate functional losses, shifting from the existing vegetative composition to a short hydroperiod community. Further west of the levee and canal, long hydroperiod wetlands and forested wetlands would be impacted less proportionately from shifts in species composition resulting from over inundation during wet years (e.g., tree island flooding). Forested exotic wetlands should experience no effect from these alternatives because the project's features and functions would neither benefit nor hinder ongoing management practices.

Table 10 lists the with-project WRAP results, by polygon scores, acreages, and FUs, for Alternatives 1, 2 and 9. The highest WRAP scores calculated were for the Forested Wetland Systems (0.83) and Long Hydroperiod Wetlands (0.83) during the wet season. The lowest WRAP score calculated (0.53) was for the Forested Exotic Wetlands. WRAP scores for wet and dry season conditions were averaged to calculate a single Functional Unit (FU) score by habitat type.

Table 10 With-Project Condition WRAP Polygon Scores, Acreages, and Functional Units for Alternatives 1, 2, and 9 for the 8.5 Square Mile Area, Miami-Dade County, Florida

Wetland Type	Score	Acres	Functional Units
Everglades National Park			
Forested Wetland	0.82	889	729
Forested Exotic	0.53	3,209	1,701
Long Hydroperiod Graminoid	0.82	7,188	5,894
Short Hydroperiod Graminoid	0.70	3,081	2,157
Subtotal		14,367	10,481
8.5 SMA			
Graminoid Wetland @>7.0 feet (FAA Site)	0.53	300	159
All Other Wetlands	0.0	2,395	0
Subtotal		2,695	159
Total		17,062	10,640

Alternative 3

This alternative is a flood protection plan and incorporates a levee alignment identical to that of Alternatives 1, 2, and 9 without a seepage canal and pump station. The primary feature is the construction of a seepage barrier, keyed between 50 and 90 feet below the surface. Modeling data suggest a significantly lesser degree of hydrologic edge along the levee alignment, providing more hydroperiod benefit to adjacent wetlands. Hydroperiods west of the levee also appear to be longer than those associated with Alternatives 1, 2, and 9. Short hydroperiod wetlands, as with the previously mentioned alternatives, would likely be vulnerable to disruptive fire, woody invasion, and exotic persistence that accompany inadequate hydroperiod. However, long hydroperiod and forested wetlands should not experience significant negative impacts as hydroperiods would either be slightly improved or unchanged from the existing

condition. Forested Exotic Wetland function would likely improve without converting to another wetland habitat type.

Table 11 lists the with-project WRAP results, by polygon scores, acreages and FUs, for Alternative 3. The highest WRAP scores calculated were for the Forested Wetland Systems (.089) and Long Hydroperiod Wetlands (0.90). The lowest WRAP score calculated (0.64) was for the Forested Exotic Wetlands. WRAP scores for wet and dry season conditions were the same.

Table 11 With-project Condition WRAP Polygon Scores, Acreages, and Functional Units for Alternative 3 for the 8.5 Square Mile Area, Miami-Dade County, Florida

Wetland Type	Score	Acres	Functional Units
Everglades National Park			
Forested Wetland	0.89	889	791
Forested Exotic	0.64	3,209	2,054
Long Hydroperiod Graminoid	0.90	7,188	6,469
Short Hydroperiod Graminoid	0.70	3,081	2,157
Subtotal		14,367	11,471
8.5 SMA			
Graminoid Wetland @>7.0 feet (FAA Site)	0.53	300	159
All Other Wetlands (Leveed and Protected Area)	0.0	2,395	0
Subtotal		2,695	159
Total		17,062	11,630

Alternatives 4 and 5

These alternatives are identical regarding the potential for impacts to wetlands. Accordingly, they were evaluated jointly by the WRAP Team. Alternatives 4 and 5 are non-structural solutions without flood protection or flood mitigation features. Alternative 4 would incorporate a combination of voluntary land acquisition, flowage easements and life estates whereas Alternative 5 is total acquisition of the 8.5 SMA.

Generally, a combination of easements, life estates, and voluntary buyouts would likely result in similar future with-project conditions as a total buyout by 2050; assuming post-construction land management guidance is implemented (see Appendix C). A combination of proper post-construction management and hydrologic restoration would likely improve function of all wetland habitats in the study area and restore a large portion of existing non-jurisdictional lands as well. Most remarkably, wetland polygons that tend to be dominated by exotic species (Forested Exotic Wetlands and Shrubby Wetlands) would likely be converted to Herbaceous Wetlands (Low to Moderate and High Disturbance habitats). Additionally, those marginal wetlands that tended to be most impacted by intense land use and anthropogenic activity, as well as poor hydrology, would improve dramatically by the end of the project's life. It is anticipated that agricultural/residential lands that fall within the 180-day hydroperiod (generally

just below the 7.0-foot NGVD contour) would be restored to optimally functioning graminoid wetlands with minimum to moderate management intensity under the non-structural plans. Within the 180-day hydroperiod, re-hydration by modeled flows, periodic (2- to 5-year intervals) prescribed burning, limited mechanical removal of Brazilian pepper, and initial herbicide treatment of particular exotic stands should be completely successful and result in maximum wetland restoration by 2050. Lands that demonstrate lesser hydroperiods would likely require some level of surface scraping and frequent exotic removal to maintain wetland function.

Table 12 lists the with-project WRAP results, by polygon scores, acreage, and FUs, for Alternatives 4 and 5. The highest WRAP scores calculated were for the Forested Wetland Systems (0.94), Forested Native Wetlands (0.93), Short Hydroperiod Wetlands (0.93), and Long Hydroperiod Wetlands (0.90). The lowest WRAP score calculated (0.85) was for Graminoid and Herbaceous Wetlands in the 8.5 SMA. Forested Exotic and Shrubby Wetland (converted to Herbaceous Wetlands) acreage was pooled into respective Herbaceous Wetland acreage for WRAP score calculation. WRAP scores for wet and dry season conditions were the same.

Table 12 With-project Condition WRAP Polygon Scores, Acreages, and Functional Units for Alternatives 4 and 5 for the 8.5 Square Mile Area, Miami-Dade County, Florida

Wetland Type	Score	Acres	Functional Units
Everglades National Park			
Forested Wetland	0.94	889	836
Herbaceous Wetland	0.85	3,209	2,728
Long Hydroperiod Graminoid	0.90	7,188	6,469
Short Hydroperiod Graminoid	0.93	3,081	2,865
Subtotal		14,367	12,898
8.5 SMA			
Graminoid Wetland <7.0 feet	0.85	1,448	1,231
Graminoid Wetland @>7.0 feet (FAA Site)	0.53	300	159
Herbaceous Wetland low-moderate Disturbance <7.0 feet	0.85	700	595
Herbaceous Wetland high Disturbance <7.0 feet	0.85	225	191
Forested Native Wetland	0.93	15	14
Restored Agricultural/Residential	0.85	900	765
Subtotal		3,588	2,955
Total			15,853

Alternative 6B

Alternative 6B incorporates flood protection with levee and seepage canal features that protect mostly agricultural/residential lands approximately 7.0 feet NGVD and higher, leaving a large western portion of the 8.5 SMA as a hydrologic buffer. The levee alignment proceeds west from the G–211 pump

station, enclosing the FAA's tract then south along SW 202nd Avenue to high ground on SW 168th Street. Because buffer lands would be acquired and available to land management, existing wetlands would experience the same level of benefit as described for Alternatives 4 and 5. Similar to other structural alternatives involving the construction and operation of a seepage canal, a hydrologic edge effect would be associated with project conditions with Alternative 6B created by seepage into the designed canal, making optimal restoration of agricultural/ residential lands unlikely.

Preliminary information on the footprint for the levee and canal suggests construction would displace 23 acres of Herbaceous Low to Moderate Disturbance wetlands, 3 acres of Graminoid wetlands, 12 acres of Shrubby wetlands, and 3 acres of Forested Exotic wetlands. These wetlands would lose all function (Table 13).

Table 13 With-project Condition WRAP Polygon Scores, Acreages, and Functional Units for Alternative 6B for the 8.5 Square Mile Area, Miami-Dade County, Florida

Wetland Type	Score	Acres	Functional Units
Everglades National Park			
Forested Wetland	0.94	889	836
Herbaceous Wetland	0.85	3,209	2,728
Long Hydroperiod Graminoid	0.90	7,188	6,469
Short Hydroperiod Graminoid	0.93	3,081	2,865
Subtotal		14,367	12,898
8.5 SMA			
Graminoid Wetland <7.0 feet	0.85	1,445	1,228
Graminoid Wetland @>7.0 feet (FAA Site)	0.33	300	99
Herbaceous Wetland low-moderate Disturbance <7.0 feet	0.85	697	592
Forested Native Wetland	0.93	15	14
Herbaceous Wetland high Disturbance <7.0 feet	0.85	212	180
Wetlands Within the Containment Levee			
Herbaceous Wetland low-moderate Disturbance <7.0 feet	0.00	23	0
Shrubby Wetland < 7.0 feet	0.00	12	0
Forested Exotic Wetland	0.00	3	0
Graminoid Wetlands < 7.0 feet	0.00	3	0
Subtotal		2,695	2,113
Total		17,062	15,011

Throughout the life of the project (50 years), the FAA's tract (Graminoid Wetland >7.0 feet) would experience negative hydrologic impacts resulting from the construction of the seepage canal immediately south of the area. This would result in a 20 percent functional loss as some vegetative ground cover would be lost, the encroachment of woody and exotic species would increase, and the potential for disruptive fire would increase. Other than the FAA's tract, wetlands

would exist in the protected area. All wetlands within the study area that fall outside the protected area would experience identical hydrologic benefits to those described regarding Alternatives 4 and 5.

Alternative 6C

This alternative is a flood mitigation plan and although presented as a revision of Alternative 6B, appears to more closely resemble the general alignment, format and function of Alternative 2. Generally, levee and canal alignment correspond to the existing "Save Our Rivers" land acquisition boundary, which follows a similar alignment, ranging from 0.25 to 0.75 miles east and south of those same features associated with Alternatives 1, 2, and 9. Predictably, ecological effects are similar to those resulting from the implementation of Alternatives 1, 2, and 9. However, drydown of wetland habitats from hydrologic edge effect is not as significant and implementation of this alternative would likely result in the restoration of an additional 1,200 acres of existing short hydroperiod wetlands when compared to Alternative 1. Functional lift of these wetlands would result primarily due to the location of the canal and levee alignment and through appropriate ecological management. Little or no hydrologic improvement from construction and operation of this Plan would be realized. Functional lift of these lands should be consistent with maximum lift attainable through total acquisition of the area, including conversions of shrubby and exotic-dominated habitats to native landscapes over the project life of 50 years.

Further west of the levee and canal, long hydroperiod wetlands and forested wetlands would be impacted from shifts in species composition. Forested exotic wetlands in ENP would experience no effect from implementation of this alternative because associated features and functions would neither benefit nor hinder ongoing management practices. Wetland function in ENP would be the same for this alternative as Alternatives 1, 2, and 9, except for the loss of 125 acres of short hydroperiod graminoid wetlands in the Doctors' Ranches area of ENP which fall under and within the levee and canal alignment adjacent to Section 11 in the upper-most northeastern portion of the 8.5 SMA.

Table 14 presents the with-project WRAP results, by polygon scores, acreage and FUs, for Alternative 6C. The highest WRAP scores calculated were for the 8.5 SMA wetlands, which would be restored after acquisition (0.85). The lowest WRAP score calculated (0.53) was for the Forested Exotic Wetlands in ENP. WRAP scores for wet and dry season conditions were averaged to calculate a single score by habitat type.

Alternative 6D

The WRAP Team with representatives from the Corps, the Service, and Miami-Dade DERM, reconvened on May 1, 2000 at the Corps Regulatory Office in Kendall, Florida, to evaluate this alternative. Hydrologic modeling output, consistent with that generated to evaluate the other ten alternatives, was used in this analysis.

Table 14 With-Project Condition WRAP Polygon Scores, Acreages, and Functional Units for Alternative 6C for the 8.5 Square Mile Area, Miami-Dade County, Florida

Wetland Type	Score	Acres	Functional Units
Everglades National Park			
Forested Wetland	0.82	889	729
Forested Exotic	0.53	3,209	1,701
Long Hydroperiod Graminoid	0.82	7,188	5,894
Short Hydroperiod Graminoid	0.70	2,956	2,069
Subtotal		14,242	10,393
8.5 SMA			
Graminoid Wetland @ > 7.0 feet (FAA Site)	0.53	300	159
Graminoid Wetland @ < 7.0 feet (SOR Lands)	0.85	800	680
Herbaceous Wetland Low to Moderate Disturbance @ < 7.0 feet	0.85	200	170
Herbaceous Wetland High Disturbance <7.0 feet	0.85	35	30
Shrubby Wetlands (converted to Herbaceous Low to Moderate Disturbance)	0.85	105	89
Forested Native Wetlands	0.85	15	14
Forested Exotic Wetlands (Converted to Herbaceous Low to moderate Disturbance)	0.85	80	65
All Other Wetlands (inside levee and canal)	0.00	1,410	0
Subtotal		2,695	1,207
Total		17,062	11,600

This alternative, selected by the Corps as the Federally Recommended Plan, is a flood mitigation plan and is similar in function to Alternative B, although the containment levee more closely follows the Save Our Rivers (SOR) Boundary which lies immediately to the west. The canal alignment is very similar to that of Alternative 6B but extends approximately one-half mile further west. Predictably, ecological effects are similar to those resulting from the implementation of Alternative 6B. However, approximately 360 acres of existing wetlands within the 8.5 SMA lie east of the levee and vulnerable to drydown from close proximity to the drainage canal. Impacts to wetland habitats from hydrologic edge effect is not as significant as those associated with Alternatives 1, 2, and 9, and implementation of this alternative would likely result in the protection and restoration of an additional 2,000 acres of existing short hydroperiod wetlands when compared to Alternative 1. Functional lift of these wetlands would result primarily due to the location of the canal and levee alignment and through appropriate ecological management. Some hydrologic improvement from construction and operation of this Plan would likely be realized along the levee alignment as the canal is distant and a significant edge effect is not apparent. Functional lift of these lands should be consistent with maximum lift attainable through total acquisition of the area, including conversions of shrubby and exotic-dominated habitats to native landscapes over the project life of 50 years.

Throughout the life of the project (50 years), the FAA tract (Graminoid Wetland >7.0 feet) would experience negative hydrologic impacts resulting from the construction of the seepage canal immediately south of the area. This would result in a .20 functional index loss as some vegetative ground cover would be lost, the encroachment of woody and exotic species would increase, and the potential for disruptive fire would increase. Other than the FAA tract, approximately 360 acres of wetlands exist in the protected area. Wetland function of these lands would be lost to development within the life of the project.

Further west of the levee and canal, long hydroperiod wetlands, forested wetlands, and forested exotic wetlands in ENP would experience benefits identical to those associated with Alternatives 4, 5, and 6B

Table 15 presents the With-Project WRAP results, by polygon scores, acreage and FUs, for Alternative 6D. The highest WRAP scores calculated were for the Forested Wetland Systems (0.94), Forested Native Wetlands (0.93), Short Hydroperiod Wetlands (0.93) and Long Hydroperiod Wetlands (0.90). The lowest WRAP score calculated (0.33) was for Graminoid Wetlands >7.0 ft. NGVD (the FAA tract) in the 8.5 SMA. Forested Exotic and Shrubby Wetland (converted to Herbaceous Wetlands) acreage was pooled into respective Herbaceous Wetland acreage for WRAP score calculation. WRAP scores for wet and dry season conditions were the same.

Table 15 With-Project Condition WRAP Polygon Scores, Acreages, and Functional Units for Alternative 6D for the 8.5 Square Mile Area, Miami-Dade County, Florida

Wetland Type	Score	Acres	Functional Units
Everglades National Park			
Forested Wetland	0.94	889	836
Forested Exotic	0.85	3,209	2,728
Long Hydroperiod Graminoid	0.90	7,188	6,469
Short Hydroperiod Graminoid	0.93	3,081	2,865
Subtotal		14,367	12,898
8.5 SMA			
Graminoid Wetland @<7.0 feet	0.85	1,384	1,176
Graminoid Wetlands @>7.0 feet (FAA tract)	0.33	300	99
Herbaceous Low to Mod. Disturbance <7.0 ft. NGVD	0.85	393	334
Herbaceous High Disturbance <7.0 ft. NGVD	0.85	49	42
Shrubby Wetlands (converted to Herb. Low to Mod. Disturbance)	0.85	97	83
Forested Native Wetlands	0.93	15	14
Forested Exotic Wetlands (converted to Herb. Low to Moderate Disturbance)	0.85	95	81
All Other Wetlands (inside levee and canal)	0.0	362	0
Subtotal		2,695	1,829
Total		17,062	14,727

Alternative 7

This alternative involves the raising of all roads within the 8.5 SMA to accommodate model flows. There would be no other structures or operations and no land acquisition would be authorized. Because lands would remain in private ownership, habitat management would not be possible. Without management, model flows would improve hydrology throughout the study area, but improvements to wetland function would be difficult to estimate. The intensity of agricultural and residential land use would likely increase in areas that do not experience frequent flooding ($\geq$ 7.0 feet NGVD) whereas intensity would likely decrease in the lower elevations ($\leq$ 6.5 feet NGVD) where existing land uses would continue to be vulnerable to inundation. The encroachment of exotic species would likely increase in density and areal coverage, especially where these species are already established, decreasing wetland function of those areas. Throughout the project's life, as new developments establish, existing wetland functions would be significantly decreased or lost. As existing land uses diminish in areas receiving too much water to maintain adequate living or cultivation conditions, habitat connectivity and buffer area would increase, thereby improving wetland function. ENP lands would experience identical hydrologic conditions as described for Alternatives 4 and 5. However, the quality of water down gradient of the 8.5 SMA could become problematic as septic systems fail more frequently than under existing conditions.

Generally, in the absence of socio-economic projections of the area that incorporate no levees or canals, no quantifiable information exists to indicate changes in future development potential of the area. Predictability of land use trends for this area is ambiguous. Therefore, it is reasonable to conclude that overall existing conditions of the 8.5 SMA wetlands would prevail, based on the assumption that anthropogenic dynamics result in balanced trade-offs between activities that cause wetland functional losses as well as improved hydrology throughout project life. Table 16 describes the predicted wetland conditions for Alternative 7.

Alternative 8

This alternative is a passive flow-way (swale) with buffer that involves construction of a levee that generally follows the 7.0-foot NGVD contour, tying into G–211 at the northern extremity, enclosing the FAA's tract, then proceeding south along SW 202nd Avenue, terminating at 168th Street. Additional features include the construction of a natural flow-way that generally runs parallel to the containment levee and terminates at the proposed S–357 pump station immediately north of SW 168th Street. A perimeter levee along the western boundary of the flow-way would be constructed to isolate flows. This alternative is conceptually similar to Alternative 6 as it provides flood protection to residents in the eastern-most portion of the 8.5 SMA, leaving the western portion as a buffer between ENP and the levee.

Table 16 With-project Condition WRAP Polygon Scores, Acreages, and Functional Units for Alternative 7 for the 8.5 Square Mile Area, Miami-Dade County, Florida

Wetland Type	Score	Acres	Functional Units
Everglades National Park			
Forested Wetland	0.94	889	836
Herbaceous Wetland	0.85	3,209	2,728
Long Hydroperiod Graminoid	0.90	7,188	6,469
Short Hydroperiod Graminoid	0.93	3,081	2,865
Subtotal		14,367	12,898
8.5 SMA			
Graminoid Wetland <7.0 feet	0.72	1,448	1,043
Graminoid Wetland @>7.0 feet (FAA Site)	0.53	300	159
Herbaceous Wetland low-moderate Disturbance <7.0 feet	0.69	572	395
Herbaceous Wetland high Disturbance <7.0 feet	0.56	82	46
Shrubby Wetland < 7.0 feet	0.54	143	73
Forested Exotic Wetland 6.5–7.0 feet	0.51	128	65
Forested Native Wetland @> 7.0 feet	0.46	7	3
Forested Native Wetland	0.86	15	13
Subtotal		2,695	1,797
Total		17,062	14,695

Generally, this design eliminates the hydrologic edge effect, using the flow-way (outside the levee) to convey overland flows away from the protected area while maximizing water availability to wetlands in the western portion. This Plan should maintain good water quality throughout the 8.5 SMA wetlands and provide a similar hydropattern to ENP wetlands as described in WRAP evaluations for Alternatives 4 and 5. Additionally, optimal restoration of agricultural/residential lands west of the levee would, as well, occur in similar fashion as Alternatives 4 and 5. In contrast to Alternative 6 conditions, the FAA Graminoid Wetland >7.0 feet would maintain existing condition function because no seepage canal would be constructed in close proximity to this area.

Some negative effects appear to correlate with the operation of the G–357 pump station because it decreases water levels within a 0.5-mile radius during pumping operations. Wetland losses from construction of the containment levee would be similar to Alternative 6B. The perimeter levee would be lower in elevation and have a top width significantly narrower than the containment levee. However due to its extended length, the structure would displace approximately 60 acres of Graminoid Wetlands <7.0 feet, 25 acres of Herbaceous Low to Moderate Disturbance Wetlands <7.0 feet, and 10 acres of Herbaceous High Disturbance Wetlands. Table 17 lists the with-project WRAP results, by polygon scores, acreage, and FUs, for Alternative 8.

Table 17 With-project Condition WRAP Polygon Scores, Acreages, and Functional Units for Alternative 8 for the 8.5 Square Mile Area, Miami-Dade County, Florida

Wetland Type	Score	Acres	Functional Units
Everglades National Park			
Forested Wetland	0.94	889	836
Herbaceous Wetland	0.85	3,209	2,728
Long Hydroperiod Graminoid (ENP)	0.90	7,188	6,469
Short Hydroperiod Graminoid (ENP)	0.93	3,081	2,865
Subtotal		14,367	12,898
8.5 SMA			
Graminoid Wetland <7.0 feet	0.82	1,388	1,138
Graminoid Wetland @>7.0 feet (FAA Site)	0.53	300	159
Herbaceous Wetland low-moderate Disturbance <7.0 feet	0.82	649	532
Herbaceous Wetland high Disturbance <7.0 feet	0.82	203	166
Forested Native Wetland	0.93	15	14
Restored Agricultural/Residential Wetland	0.82	900	738
Wetlands Within the Containment Levee			
Herbaceous Wetland low-moderate Disturbance <7.0 feet	0.00	23	0
Shrubby Wetland < 7.0 feet	0.00	12	0
Forested Exotic Wetland	0.00	3	0
Wetlands Between Perimeter Levee and Containment Levee			
Herbaceous Wetland low-moderate Disturbance <7.0 feet	0.00	25	0
Herbaceous Wetland high Disturbance <7.0 feet	0.00	10	0
Graminoid Wetlands < 7.0 feet	0.00	60	0
Subtotal		3,588	2,747
Total		17,955	15,645

Comparison of Existing WRAP Condition to With-Project Condition

Comparisons are expressed in net losses or gains in wetland FUs relative to existing condition FUs. Table 18 presents comparisons of wetland FUs among the project alternatives and existing conditions. Figure 37 graphically displays functional gains and losses for all the alternatives compared to the existing condition wetland function.

The WRAP analysis suggests construction and operation of Alternatives 1, 2, 3, 6C, and 9 would result in wetland losses when compared to the existing condition. A total loss of 2,765 FUs (1,127 in ENP and 1,638 within the 8.5 SMA) is associated with Alternatives 1, 2, and 9, whereas construction and

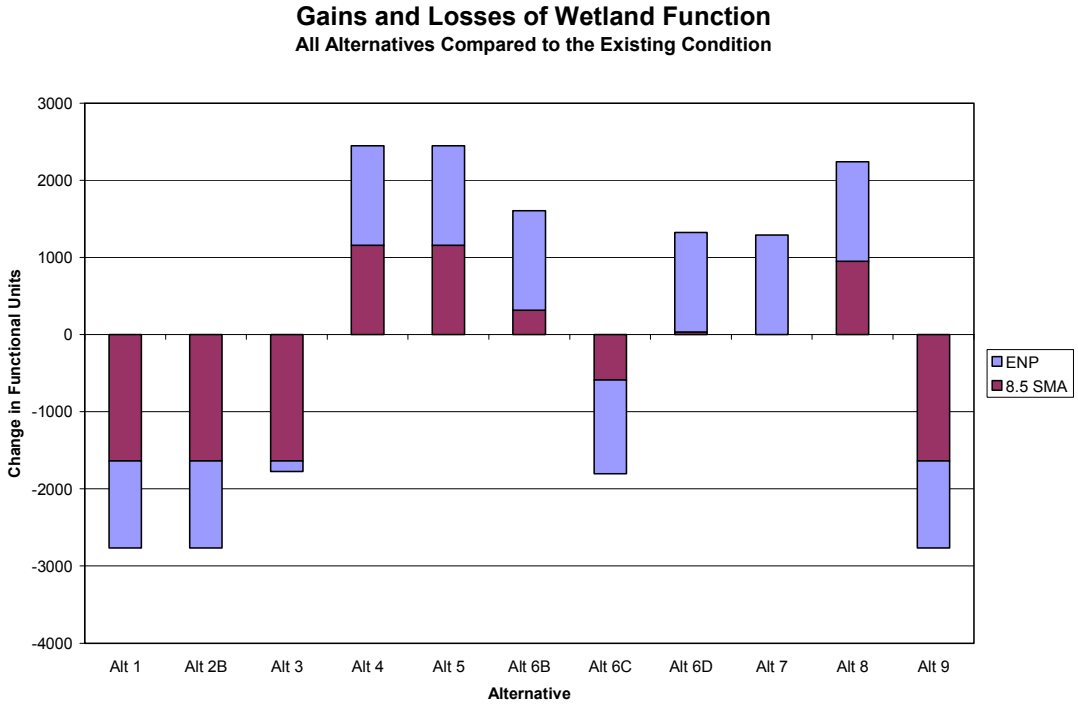

Figure 37 Gains and Losses in Wetland Function from the Existing Condition for the 8.5 SMA Alternatives

operation of Alternative 3 would result in a loss of 1,775 FUs (137 in ENP and 1,638 within the 8.5 SMA). This significant difference (990 FUs) between losses associated with Alternatives 1, 2, and 9 and losses from Alternative 3 (designs that describe the same levee dimensions and footprint) is primarily attributed to the seepage canal feature, which causes a hydrologic edge effect. Alternative 3 is designed with a seepage barrier without a canal, which minimizes wetland functional loss attributed to drydown associated with seepage into the canal. Alternative 6C also demonstrates a plan featuring a levee and canal, which results in losses to wetland function (1,215 FUs in ENP and 590 FUs in the 8.5 SMA). This design minimizes wetland losses within the 8.5 SMA by locating the canal and levee further east than described in Alternatives 1, 2, 3, and 9, thereby facilitating the restoration of approximately 1,200 acres of short hydroperiod wetlands presently within the western and northern portions of the 8.5 SMA.

A gain in wetland function should be realized by predicted hydrologic and ecological improvements from the implementation of Alternatives 4, 5, 6B, 6D, 7, and 8. Alternatives 4, 5, and 7 are non-structural, whereas Alternatives 6B, 6D, and 8 involve the construction of levees. Alternatives 6B and 6D also would involve the construction and operation of a seepage canal and pump station within the protected area, whereas Alternative 8 features a natural flow-way and pump station outside the protected area. Alternative 6B would improve existing wetland function by 1,606 FUs (1,290 in ENP and 316 within the 8.5 SMA). Alternative 6D would increase wetland function by 1,322 FUs (1,290 in ENP and 32 within the 8.5 SMA), whereas the implementation of Alternative 8 would result in an increase of 2,240 FUs (1,290 in ENP and 950 within the 8.5 SMA).

Table 18 Summary Comparison of Wetland Functional Units for the 8.5 Square Mile Area among Project Alternatives and Existing Condition

		Alternative										
Wetland Type	Existing	1	2	3	4	5	6B	6C	6D	7	8	9
Everglades National Park												
Forested Wetland	809	729	729	791	836	836	836	729	836	836	836	729
Forested Exotic	1,701	1,701	1,701	2,054	0	0	0	1,701	0	0	0	1,701
Long Hydrp Gram	6,325	5,894	5,894	6,469	6,469	6,469	6,469	5,894	6,469	6,469	6,469	5,894
Short Hydrp Gram	2,773	2,157	2,157	2,157	2,865	2,865	2,865	2,044	2,865	2,865	2,865	2,157
Herbaceous Wetland	na	na	na	na	2,728	2,728	2,728	na	2,728	2,728	2,728	na
Subtotal	11,608	10,481	10,481	11,471	12,898	12,898	12,898	10,393	12,898	12,898	12,898	10,481
8.5 Square Mile Area												
Graminoid Wetland < 7.0 ft	1,043	0	0	0	1,231	1,231	1,228	680	1,176	1,043	1,138	0
Graminoid Wetland > 7.0 ft	159	159	159	159	159	159	99	159	99	159	159	159
Herb. Wetl. Low-mod. Disturb. < 7.0 ft	395	0	0	0	595	595	592	324	498	395	532	0
Herb. Wetl. high Distub. <7.0 ft.	46	0	0	0	191	191	180	30	42	46	166	0
Shrubby Wetland	73	0	0	0	0	0	0	0	0	73	0	0
Forested Exotic Wetl. 6.5–7.0 ft	65	0	0	0	0	0	0	0	0	65	0	0
Forested Exotic Wetl. >7.0 ft	3	0	0	0	0	0	0	0	0	3	0	0
Forested Native Wetl.	13	0	0	0	14	14	14	0	14	13	14	0
Restored Agricultural/ Residential	0	0	0	0	765	765	0	0	0	0	738	0
Subtotal	1,797	159	159	159	2,955	2,955	2,113	1,207	1,829	1,797	2,747	159
Total	13,405	10,640	10,640	11,630	15,853	15,853	15,011	11,600	14,727	14,695	15,645	10,649

na = not applicable

One difference between these structural alternatives exists in each plan's potential to restore agricultural and residential lands to natural wetlands. Alternatives 4, 5, 6B, 6D, 7, and 8 provide restoration benefits to existing wetlands within the 8.5 SMA as well as improvements to ENP wetlands. However, Alternative 8 would provide optimal hydrologic conditions to wetlands adjacent to the containment levee and the FAA tract by eliminating the hydrologic edge effect associated with the seepage canal; a prominent feature of Alternatives 6B and 6D. Seepage losses to adjacent lands (generally along the levee alignment of 6B) would likely preclude restoration of those agricultural lands to functional wetlands and very few agricultural lands exist outside the containment levee of 6D. Alternative 7 would improve existing wetland function by 1,290 FUs, all of which are derived from improvements to ENP wetlands resulting from unimpeded restorative flows. Alternatives 4 and 5 demonstrate the greatest improvements to wetland function (2,448 FUs: (1,290 in ENP and 1,158 within the 8.5 SMA). Implementation of these alternatives would enable restoration of all lands that fall within the 180-day hydroperiod to optimally functioning short-hydroperiod wetlands. Implementation of either alternative would result in improvement to ENP wetlands from unimpeded restorative flows.

Comparison of Alternatives 2 Through 9 to Alternative 1 (No Action Plan)

The Corps has identified Alternative 1 as the No Action Alternative. This is the federally authorized project, documented in the 1992 GDM "Modified Water Deliveries to Everglades National Park", and would be the default federal action should no other alternative be selected as a result of this study. This section provides a comparison of Alternatives 2 through 9 to the No Action Alternative.

Alternative 2 — No difference

Alternative 3 — This alternative represents an improvement of 990 FUs compared to the No-Action Alternative. All FUs are realized in ENP and can be attributed to hydrologic edge caused by the seepage canal feature in the No-Action plan.

Alternative 4 — This alternative represents an improvement of 5,213 FUs compared to the No-Action Alternative. ENP wetlands would realize an improvement of 2,796 FUs, primarily from unimpeded restorative flows associated with features of the MWD Project. Wetland function within the 8.5 SMA would realize an improvement of 2,796 FU by optimization of existing wetlands (2,031 FU) and restoration of existing agriculture/residential lands within the 180-day hydroperiod (765 FU).

Alternative 5 — Same as Alternative 4.

Alternative 6B — This alternative represents an improvement of 4,371 FUs compared to the No Action Alternative. ENP wetlands would realize an improvement of 2,417 FUs due to restoration flows as described with Alternatives 4 and 5. Inside the 8.5 SMA, wetland function would be 1,954 FUs higher for Alternative 6 than that of the No Action Alternative due to restoration of existing wetlands within the 8.5 SMA.

Alternative 6C: This alternative represents an improvement of 960 FUs compared to the No Action Alternative. A total lift of 1,048 FUs is realized within the 8.5 SMA and can be attributed to the restoration of acquired wetlands within the "Save Our Rivers" boundary. A loss of 88 FUs is attributed to the placement of levee and canal features within ENP (Doctors' Ranches), resulting in the loss of 125 acres of Short Hydroperiod Graminoid wetlands (WRAP Score = 0.70).

Alternative 6D: This alternative represents an improvement of 4,087 FUs compared to the No Action Alternative. A total lift of 1,829 FUs is realized within the 8.5 SMA and can be attributed to the restoration of acquired wetlands west of the containment levee. A total lift of 2,417 FUs is realized in ENP and is attributed to unimpeded restoration flows resulting from the implementation of the MWD.

Alternative 7 — This alternative represents an improvement of 4,055 FUs; 2,417 derived from benefits to ENP wetlands and 1,638 FUs from maintaining the value of existing wetlands within the 8.5 SMA.

Alternative 8 — This alternative represents an improvement of 5,005 FUs compared to the No Action Alternative. ENP wetlands would realize an improvement of 2,417 FUs due to restoration flows as described for Alternatives 4, 5, 6, and 7. Wetland function within the 8.5 SMA would be 2,588 FU higher for Alternative 8 than that of the No Action Alternative due to restoration of agricultural and residential lands and hydrologic benefits provided by the flow-way concept.

Alternative 9 — Same as the No Action Alternative.

Compensatory Mitigation for Fish and Wildlife Losses

U.S. Fish and Wildlife Service Mitigation Policy

The Service's Mitigation Policy, found in the Federal Register, dated Friday, January 23, 1981; U.S. Fish and Wildlife Service Mitigation Policy; Vol. 46, No. 15, provides guidance for Service personnel involved in making recommendations to protect or conserve fish and wildlife resources. The policy is needed to: (1) ensure consistent and effective Service recommendations, (2) allow Federal and private developers to anticipate Service recommendations and plan for mitigation needs early, and (3) reduce Service and developer conflicts as well as project delays. The intended effect of the policy is to protect and conserve the most important and valuable fish and wildlife resources while facilitating balanced development of the nation's resources.

In developing the policy, the agreed upon principles guiding the mitigation are: (1) that avoidance or compensation be recommended for the most valued resources, and (2) that the degree of mitigation requested correspond to the value and scarcity of the habitat at risk. Four resource categories of decreasing importance were identified (Table 19).

Table 19 U.S. Fish and Wildlife Service Mitigation Policy

Resource Category	Designation Criteria	Mitigation Planning Goal
1	High value for evaluation species and unique and irreplaceable.	No loss of existing habitat value.
2	High value for evaluation species and scarce or becoming scarce.	No net loss of in-kind habitat value.
3	High to medium value for evaluation species and abundant.	No net loss of habitat value while minimizing loss of in-kind habitat value.
4	Medium to low value for evaluation species.	Minimize loss of habitat value.

For the 8.5 SMA Project, the Service applied the Mitigation Policy by selecting evaluation species for the various habitat types affected. Currently, twelve major vegetative habitat types exist within the study area (4 in ENP and 8 in the 8.5 SMA). These include:

- Short Hydroperiod Wetlands (ENP)
- Long Hydroperiod Wetlands (ENP)
- Forested Wetlands (ENP)
- Forested Exotic Wetlands (ENP)
- Forested Native Wetlands
- Forested Exotic Wetlands @ <7.0 feet NGVD
- Forested Exotic Wetlands @ >7.0 feet NGVD
- Shrubby Wetlands
- Graminoid Wetlands @ <7.0 feet NGVD
- Graminoid Wetlands @ > 7.0 feet NGVD
- Herbaceous Wetlands: low to moderate soil disturbance @ < 7.0 feet NGVD
- Herbaceous Wetlands: high soil disturbance @ , 7.0 feet NGVD

The Service established the following resource categories for the twelve habitat types listed in Table 20. Based on these habitat types, the Service selected the following evaluation species to determine resource categories:

1) Short Hydroperiod Wetland (ENP): swamp rabbit, raccoon, opossum, white-tailed deer, crayfish, mosquito fish, great blue heron, great egret, tri-colored egret, green back heron, and red-shouldered hawk;

2) Long Hydroperiod Wetland (ENP): American alligator, *Hyla* sp. frog, leopard frog, swamp rabbit, raccoon, belted kingfisher, great blue heron, great egret, tri-colored egret, green back heron, belted kingfisher, pygmy sunfish, sailfin mollie, and mosquito fish;

3) Forested Wetland (ENP): swamp rabbit, raccoon, opossum, white-tailed deer, red-shouldered hawk, cooters, soft-shelled turtles, common snapping turtle, red-eared slider, mud turtle, and passerine birds;

4) Forested Exotic Wetlands (ENP): raccoon, opossum, swamp rabbit, cooters, soft-shelled turtles, common snapping turtle, red-eared slider, mud turtle, passerine birds, and red-shouldered hawk;

5) Forested Native Wetlands: swamp rabbit, raccoon, opossum, white-tailed deer, red-shouldered hawk, cooters, soft-shelled turtles, common snapping turtle, red-eared slider, mud turtle, and passerine birds;

Table 20 Resource Category Determination

Habitat Type	Resource Category Determination
Everglades National Park	
Short Hydroperiod Wetland	**Category 1**: High habitat value, unique, protected and managed for optimal diversity. No net loss of existing habitat value.
Long Hydroperiod Wetland	**Category 2**: High value, protected and managed for optimal diversity. No net loss of in-kind habitat value.
Forested Wetland	**Category 1**: High habitat value, unique, protected and managed for optimal diversity. No net loss of existing habitat value.
Forested Exotic	**Category 4**: Low value but protected and likely to be managed for exotic control and or removal. Minimize loss of habitat value.
8.5 Square Mile Area	
Forested Native	**Category 1:** High habitat value, unique, protected and managed for optimal diversity. No net loss of existing habitat value.
Forested Exotic @< or > 7.0 feet NGVD	**Category 4:** Low value but protected and likely to be managed for exotic control and or removal. Minimize loss of habitat value.
Shrubby	**Category 4:** Low value but protected and likely to be managed for exotic control and or removal. Minimize loss of habitat value.
Graminoid Wetland @< or 7.0 feet NGVD	**Category 1:** High habitat value, unique, protected and managed for optimal diversity. No net loss of existing habitat value.
Herbaceous Wetlands: low to moderate soil disturbance @ < 7.0 ft. NGVD	**Category 3:** Medium value, abundant habitat type in 8.5 SMA. No net loss of habitat value while minimizing loss of in-kind habitat value.
Herbaceous Wetlands: low to moderate soil disturbance @ > 7.0 ft. NGVD	**Category 3:** Medium value, disturbed but sustains wildlife community. No net loss of habitat value while minimizing loss of in-kind habitat value.

6) Forested Exotic Wetlands @ <7.0 feet NGVD: passerine birds, raptors, white-tailed deer, swamp rabbit, raccoon, and opossum;

7) Forested Exotic Wetlands @ > 7.0 feet NGVD: passerine birds, raptors, white-tailed deer, swamp rabbit, raccoon, and opossum;

8) Shrubby Wetlands: passerine birds, raptors, white-tailed deer, swamp rabbit, raccoon, opossum, cotton rat, and deer mouse;

9) Graminoid Wetlands @ <7.0 feet NGVD: swamp rabbit, raccoon, opossum, cotton rat, deer mouse, white-tailed deer, box turtle, crayfish, mosquito fish, *Hyla* sp. frog, leopard frog, great blue heron, great egret, tri-colored egret, green back heron, passerine birds, and red-shouldered hawk;

10) Graminoid Wetlands @ > 7.0 feet NGVD: swamp rabbit, raccoon, opossum, cotton rat, deer mouse, box turtle, crayfish, mosquito fish, great blue heron, great egret, tri-colored egret, green back heron, passerine birds, and red-shouldered hawk;

11) Herbaceous Wetlands: low to moderate soil disturbance @ < 7.0 feet NGVD: swamp rabbit, raccoon, opossum, cotton rat, deer mouse, white-tailed deer, box turtle, crayfish, great blue heron, great egret, tri-colored egret, green back heron, passerine birds, and red-shouldered hawk; and

12) Herbaceous Wetlands: high soil disturbance @ , 7.0 feet NGVD: swamp rabbit, raccoon, opossum, cotton rat, deer mouse, white-tailed deer, box turtle, crayfish, great blue heron, great egret, tri-colored egret, green back heron, passerine birds, and red-shouldered hawk.

Fish and Wildlife Management Plan

A substantial body of literature exists on the design of wetland construction projects (Kusler and Kentula 1989). However, construction of a properly functioning wetland based on thoughtful design can be complicated, often involving a very challenging and adaptive implementation process characterized by several iterative steps. The following presentation describes a conceptual foundation for such a process which has evolved from information gleaned from scientific literature, expert opinion, and best professional judgment based on years of designing, implementing, and monitoring wetland restoration in south Florida. Features discussed in this Plan are necessarily conceptual in nature and would need to undergo detailed design on a case-by-case basis. The ecological goals used to design these features include:

1) ***Maximize the spatial extent of short-hydroperiod wetlands***. The Science Sub-Group of the Everglades Restoration Task Force identified that short-hydroperiod wetlands in the eastern Everglades in Palm Beach, Broward, and Miami-Dade counties represent a "landscape remnant" that have been greatly diminished due to past land management practices (Science Sub-Group 1993). In recognition of this finding, these features are designed to integrate short-hydroperiod wetlands into levees and water storage areas.

2) ***Maximize structural diversity for fish and wildlife resources***. In order to enhance fish and wildlife values within project design, features are proposed which will concentrate forage fishes for wading birds, provide secure, vertical substrate for nesting/perching avifauna, provide upland refugia for terrestrial species during periods of high water, buffer these habitats from adjacent disturbances, increase recreational opportunities, and provide fish refugia during periods of low water. These features, taken as a whole, would significantly enhance ecological functions consistent with the project's stated purpose.

3) ***Maximize opportunities to enhance water quality.*** These design features also incorporate the concept of establishing shallow wetland littoral shelves in the design of the project to increase nutrient uptake of flow-through wa-

ter. In addition, excavations for fish refugia add to the ability of project components to remove suspended sediments.

This design concept includes major features such as tree islands, vegetated nesting islands, fish refugia, littoral shelves, and foraging sloughs inside pools and/or borrow areas. Outside these pools, vegetated buffer zones should be established to screen these features from urban areas and disturbances. Material for construction of these features would likely be available on-site. For example, material for the construction of tree and other nesting islands could come from the excavation of the drainage canal, fish refugia, and foraging sloughs in order to minimize cost.

The primary objective of the design of littoral shelves along conveyance canals and borrow pits is to maximize waterbird foraging opportunities by concentrating forage fishes. Littoral shelves would be constructed at different elevations along the canal to maximize shelf performance. For example, shelve elevations can be staggered between one foot below high water to as deep as two feet in order for shelves to continually concentrate fish at various canal stages. An occasional drydown of the littoral shelf zone is not undesirable, provided that drydown is not prolonged. Since canals are designed to primarily move water, the flow-through wetland shelves should remain wetted for maximum water quality benefits. If canal stages are designed to drop greater than three feet for significant periods of time, then the littoral shelf design will have to be adjusted to meet this target.

Large water fluctuations in any proposed water storage areas (i.e., Stormwater Treatment Areas), on the other hand, are less problematic, in that the fish refugia design depth (-10 feet NGVD) should be sufficient to hold water for fish survival during periods of low water. Foraging sloughs, on the other hand, are designed to dry down in order to concentrate forage fishes for feeding waterbirds as the water storage areas stages are lowered. Nesting islands are designed to remain dry (plus 3 feet above high water stage in the center), and would be planted with wetland tolerate species around the periphery and upland plant species on the crowns of these islands. These islands are designed to not flood out and lose their vegetative characteristics. Conceptual designs are in Appendix C.

On a larger scale, the potential to restore historical tree islands exists within the study area along the western boundary of the 8.5 SMA. Hofstetter and Associates (Hofstetter et al. 1979) identified several historical tree island locations within the 8.5 SMA based on aerial photography taken in 1938, providing an opportunity to select ideal locations for the reconstruction of several tree islands ranging from 1 to 10 acres (Appendix C). These tree islands would likely be revegetated with a variety of native hardwood hammock species such as red bay, willow, *Ficus* sp., white stopper, magnolia, wax myrtle, sweet bay, dahoon holly, cocoplum, pond apple, and elderberry. Prior to revegetation, removal of exotics and bedding with peat would be necessary (Appendix C).

Integral to these features are revegetation and exotic/nuisance species removal plans. For higher elevations such as nesting islands, it is proposed to plant hardwood trees and shrubs to provide cover and nesting/perching substrate for avifauna. Littoral shelves would be graded and re-mucked and then planted with

wetland vegetation. A revegetation plan, prepared in sufficient detail to facilitate this effort, should be developed.

Overall, the Service envisions that these features would be compatible with hydrologic operational scheduling, and could always be adjusted to accommodate new operational schedules as need be. Information needed to further refine the Fish and Wildlife Management Plan include hydrologic operational plans for impoundments and canals, potential seepage issues, availability of suitable substrate for revegetation, and plans to control of exotic/nuisance species. A fully developed and coordinated Fish and Wildlife Management Plan will be prepared during the detailed design phase of this project for incorporation of the above-mentioned refinements and managing and monitoring the response of fish and wildlife resources to these features.

Wetland Compensatory Mitigation

Authorities and Goals

In accordance with Executive Order 11990, the Clean Water Act 404(b)(1) Guidelines, and various Corps policies and guidelines, the 8.5 SMA Project would be evaluated with the goal of achieving "no net loss" of wetland function.

In-Kind and Out-of-Kind Compensation

Short hydroperiod wetlands bordering the eastern periphery of the Everglades are scarce or becoming scarce. The Science Sub Group of the South Florida Ecosystem Restoration Task Force concluded that short hydroperiod wetlands on the eastern side of the Everglades (Palm Beach, Broward, and Miami-Dade counties) constitute "landscape remnants" that have been lost or greatly diminished (Science Sub Group Report 1993). As such, compensatory mitigation for this habitat type would be designed to fully replace in-kind functional losses. It is deemed that long hydroperiod wetlands are more plentiful in the ecoregion, and that compensatory mitigation would be designed to fully replace in-kind or out-of-kind functional losses. Other wetland habitat types, such as forested, herbaceous and graminoid, also would experience functional losses, and a similar in-kind versus out-of-kind determination would be necessary prior to the full development of a wetland compensatory mitigation plan for the 8.5 SMA Project.

Wetland Mitigation for 8.5 SMA Project Alternatives

Structural Alternatives with Operations and Maintenance Components

Alternatives 1, 2, 3, 6B, 6C, 6D, 8, and 9 feature levees, canals, pump stations, and other components designed to mitigate or protect lands in the 8.5 SMA from flooding. Of these, hydrologic modeling and the WRAP analyses indicated that

Alternatives 1, 2, 3, 6C, and 9 demonstrate the potential to reduce wetland function within the 8.5 SMA and ENP throughout project life, when compared to the existing condition. Functional losses attributed to Alternatives 1, 2, 6C, and 9 are primarily associated with the operation of pumps and canals, which would result in accelerated and increased agricultural/residential development within the 8.5 SMA. In addition to these losses within the protected area, data analysis indicated these alternatives would likely drain and drydown a large area of ENP wetlands just west of the proposed structures, along the western and northern boundary of the 8.5 SMA, resulting in significant losses of wetland function.

Avoidance and minimization of impacts to these wetlands should be thoroughly explored with all of these structural alternatives. The Corps should investigate: 1) modifications to final levee footprint design that minimize wetland destruction; 2 water retention features that ameliorate hydrologic edge effects to adjacent wetlands, as well as, any other affected aquatic and semi-aquatic wildlife habitat in the local area; 3) minimization of construction access roads or paths that directly impact wetlands and local fish and wildlife resources; and 4) avoidance of any unnecessary disturbance to local wetlands or other fish and wildlife resources associated with the construction process. The Corps should also develop pump and canal operating procedures that allow adequate flexibility for fish and wildlife enhancement, integrating seasonal water availability that is consistent with ecological needs common to Everglades flora and fauna while minimizing sharp and disruptive hydrological changes over short-term periods of operation. Unavoidable wetland losses attributed to the construction and operation of structural project alternatives would be mitigated in accordance with guidance provided in Table 20.

Non-structural Alternatives

Alternatives 4, 5, and 7 do not involve the construction of levees, canals, seepage barriers, or any operation of pumps. However, as mentioned earlier, WRAP analysis for these alternatives was based on the assumption that all lands at the 7.0-foot NGVD contour and below would be managed throughout the life of the project to minimize exotic encroachment and maximize wetland function by appropriate landscape modification and restoration of natural hydropatterns. Because these alternatives do not result in wetland functional loss and they would involve some level of long-term management, mitigation for these non-structural alternatives should not be necessary.

Costs

The cost of mitigating for wetland functional losses is considered by the Corps to be a construction cost, which would be included in the overall cost of the 8.5 SMA Project (ER 1105–2–-100). More recent guidance from the Corps' headquarters (Policy Guidance Letter No. 46, dated 22 April, 1998) provides guidance on the use of mitigation banks for the Corps' civil works projects. Based on this policy, and pending the selection of a federally preferred alternative, the authority is provided to utilize mitigation banks, established pursuant to the Federal Guidelines for the Establishment, Use, and Operation of Mitigation

Banks; Federal Register Volume 60, No, 228, November 28, 1995, to meet the compensatory mitigation requirement of civil works projects.

At this time, private mitigation banks within the Mitigation Service Area of the 8.5 SMA Project charge between $20,000 and $50,000 per credit, where one credit equals one FU. Assuming this project would receive an average cost ($35,000 per credit), the costs of fully mitigating for wetland functional losses for the 8.5 SMA Project under each alternative are listed in Table 21.

Table 21 Relative Costs Associated with the Use of One or More Mitigation Banks to Compensate for Wetland Functional Losses Associated with Implementing the 8.5 SMA Project

Alternative	Cost ($ millions)
1	96.8
2	96.8
3	62.1
4	00.0
5	00.0
6B	00.0
6C	63.2
6D	00.0
7	00.0
8	00.0
9	96.8

A comparison of these costs reveals that Alternatives 1, 2, and 9 incur considerable mitigation costs. Alternative 3 and 6C also have significant mitigation costs, but are about $30 million less than Alternative 1. Implementation of Alternatives 4, 5, 6B, 6D, 7, or 8 would not incur any mitigation costs because no wetland functional losses would occur under these alternatives.

Chapter 7 — Federally Listed Threatened or Endangered Species

This chapter presents DOI's evaluation of potential effects of the proposed alternatives on federally listed threatened or endangered occurring or potentially occurring in the study area. Section 7 (ESA) issues regarding these species are addressed in Chapter 3. Descriptions of the alternatives can be found in Chapter 4. The evaluation addresses the snail kite and wood stork only. Evaluations of the Cape Sable seaside sparrow, as stated in the March 30, 2000 version of the CAR were not appropriate due to the insufficient hydrologic modeling output. Thorough evaluations of potential project impacts to all listed species, including the Florida panther and eastern Indigo snake, will occur during the section 7 interagency coordination process for the Federally Recommended Plan.

Snail Kite

Snail kites prefer long hydroperiod wetlands that experience drydown frequencies not greater than two to four years. Snail kite habitat consists of fresh-water marshes and the shallow vegetated edges of lakes where apple snails can be found. Low trees and shrubs are often interspersed with the marsh and open water. Snail kites require foraging areas that are relatively clear and open in order to visually search for apple snails. Therefore, dense growth of herbaceous or woody vegetation is not conducive to efficient foraging. The interspersed emergent vegetation enables apple snails to climb near the surface to feed, breathe, and lay eggs. Nesting almost always occurs over water. Nesting substrates include small trees and shrubs. Roosting sites are also almost always located over water (Service 1999).

The distribution of hydroperiods (represented as an average over multiple years, rather than a given single year) for nesting kites ranges from approximately 80 to 99 percent (292 to 361 days) with a peak at about 90 percent (329 days). Foraging snail kites during non-breeding periods, however, often use habitats ranging as low as about 70 percent (256 days) hydroperiod (Bennetts and Kitchens 1997). Bennetts and Kitchens (1997) believe that maintaining deep (e.g., > 1.3 to 1.5 meters) impounded pools will result in nesting habitat degradation due to a loss of woody vegetation and degradation of foraging habitat due to a loss of wet prairie communities. They concluded that restoring more of the spatial extent and hydrologic integrity (e.g., sheet flows) of south Florida wetlands will help maintain the long hydroperiod components of these wetlands important to snail kites with less of the habitat degradation than exists under the current system of water management.

With the above in mind, and within the limits of the time and model data provided, the performance measure to evaluate each alternative's potential to provide suitable snail kite habitat within the study area was developed to

compare the relative performance of each alternative for this endangered species. This performance measure estimates the number of acres with water depth between 0.2 and 1.3 meters for greater than 360 days**.** The greater number of acres in NESRS that meets this performance measure is considered more beneficial for the snail kite. Evaluation of this performance measure was derived from hydrologic modeling performed by the Corps using the MODBRANCH model simulations for all alternatives with restudy (D13R) conditions under 1995 operations during a wet year (1995) and limited simulations for restudy (D13R) conditions under 1995 operations during a dry year (1989). Results for alternatives 4, 5, and 7 are the same, as they are all based on the modeling of restored conditions (see Chapter 4 for description of the alternatives). Modeling output for this performance measure is presented in Table 22.

Table 22 Acres Of Suitable Snail Kite Habitat in NESRS Simulated for a Wet Year (1995) And Dry Year (1989) for the 8.5 SMA Project, Miami-Dade County, Florida

	Extent of Suitable Habitat	
Alternative	Wet Year (1995) (acres)	Dry Year (1989) (acres)
Existing Condition with C–111	51,987	not available
1	54,847	22,109
2B	53,700	22,392
3	60,367	21,295
4	58,569	22,159
5	58,569	22,159
6B	57,400	22,392
6C	55,217	22,392
6D	57,578	22,364
7[a]	58,569	22,392
8A	57,832	21,076
9	53,700	22,392

Note:

a. Alternative 7 provides an identical hydrological improvement as the restored condition. However, in the absence of post-project habitat management, some portion of foraging habitat within the 8.5 SMA would be unavailable due to the encroachment of exotic plants and continuing anthropogenic land uses.

Based on this analysis, available suitable habitat for snail kites in NESRS during a wet year is roughly twice the area (range is from 51,987 acres to 60,367 acres for all alternatives including existing conditions) as during a dry year (range is from 21,076 acres to 22,392 acres for all alternatives except existing conditions which was not run for a dry year). For the 1995 wet year, all the alternatives provide more preferred suitable habitat when compared to the existing condition with the C–111 Project. Thus, it appears that all the alternatives are compatible with hydrologic benefits provided by the restudy (D13R) conditions, although to varying degrees.

Alternative 3 (Seepage Barrier) is most compatible with the restored condition (D13R) and provides the greatest benefit (60,367 acres), followed by Alternative 4 (Total Buyout) and Alternative 5 (both at 58,569 acres). Conversely, Alternative 2B (Modified GDM Plan) and Alternative 9 provide the least benefit (both at 53,700 acres). The ranking from the greatest to lowest benefit, by alternative, is as follows: Alternative 3, Alternative 5**,** Alternatives 4 and 7, Alternative 8A, Alternative 6D, Alternative 6B, Alternative 6C, Alternative 1, and Alternatives 2B and 9. Alternatives 4, 5 and 7 would provide a hydrological improvement identical to the restored condition, however, anthropogenic dynamics could likely result in trade-offs between activities that cause losses of suitable kite habitat as well as improved habitat throughout project life. Therefore, Alternative 4 and 7 were ranked below Alternative 5.

Compared to Alternative 1 (No Action Alternative), Alternatives 3, 4, and 5 provide an additional 5,520 acres, 3,722 acres, 3,722 acres, respectively, of suitable snail kite habitat, respectively.

Wood Stork

As tactile feeders, wood storks depend on the recessional fringe for foraging. It is this recessional fringe that provides a concentration of prey (fish) at an appropriate water depth. This is especially critical during the breeding season. The desirable condition for wood storks is to see a steady increase in foraging habitat during the breeding season.

According to Ogden (1996) storks feed primarily in water between 5 and 40 cm (2 to 15 inches) deep, where the water is relatively calm and uncluttered by aquatic vegetation. Almost any shallow wetland depression where fish tend to become concentrated, either through local reproduction by fishes or as a consequence of area drying, may be good feeding habitat. These sites include drying marshes, shallow roadside or agricultural ditches, narrow tidal creeks and pools, and depressions in cypress heads or swamp sloughs. However, Ogden (1996) notes, all such sites must have sufficiently long annual hydroperiods or adequately strong hydrological connections with more permanent water to produce or make available necessary densities of fishes as prey for storks.

In south Florida, wood stork colonies that traditionally formed during November and December in most years now form during January, February, and March. This change in timing is correlated with a sharp decline in the number of pairs in colonies and in increased rates of nesting failures when nestlings do not fledge before the initiation of summer rains in May and June (Ogden, 1996). The changes in timing of colony formation apparently are due to the loss or degradation of substantial areas of early dry season foraging habitat in relatively higher elevation marshes (e.g., the 8.5 SMA) and in the mainland estuaries.

These once extensive peripheral short-hydroperiod wetlands provided extensive (shallow water) foraging habitat during the late wet/early dry season, the pre-nesting period. The disproportionate reduction (85 percent) of this specific habitat known to have occurred due to loss from development and/or degradation (overdrainage) has been suggested as a major cause of late colony formation of

wading birds at traditional colony sites located in the headwater region of downstream estuaries of the Everglades (Fleming et al. 1994).

Wood storks are highly mobile and individuals can move across the landscape as their needs change or as the landscape itself changes. Only by having a large spatial area available are individual wood storks able to meet their demands for food, and especially the demands of offspring, over an entire yearly cycle. The lack of significant foraging area in the landscape forces the birds to postpone nesting until later in the dry season, when water levels in the long hydroperiod wetlands have declined sufficiently that feeding is possible in them (Fleming et al. 1994).

Without both the short hydroperiod wetlands to influence proper timing of nest initiation and the long hydroperiod wetlands to provide available prey to sustain adults and nestlings through the later part of the nesting period, reproduction cannot be successful (Fleming et al. 1994). Modeling studies by Fleming et al. (1994) suggest this spatial heterogeneity must be restored if wood stork populations are to recover. The authors specifically recommend restoration of at least some of the short hydroperiod wetlands that were removed on the eastern edge of the historical Everglades (e.g., the 8.5 SMA).

For this analysis wood stork habitat was defined as the number of acres with a depth of water between 0.1 and 0.25 meters. Modeled water depths were analyzed throughout NESRS and the 8.5 SMA to determine where potential stork habitat would be found and how that habitat would be changed by each alternative. These results are presented in Appendix D.

The most striking result of this analysis is that most of the potential foraging habitat for the wood stork would occur within the 8.5 SMA. This is in complete agreement with the previous analysis indicating that the 8.5 SMA was historically the fringe area that consisted of short hydroperiod marl prairie.

Project alternatives were qualitatively ranked by interpreting the plotted curves of adequate wood stork foraging habitat (Appendix D) and a determination of sustained habitat availability with a minimum of disruption (abrupt changes) to that availability. Rankings are as follows:

1. Alternatives 4 & 5
2. Alternative 6B & 6D
3. Alternative 8A
4. Alternative 7
5. Alternative 6C
6. Alternatives 2B & 9
7. Alternative 1
8. Alternative 3

The most ideal conditions for foraging appear to be associated with Alternatives 4 and 5 where several weeks of sustained forage availability would occur within

the NESRS and 8.5 SMA. (Results for alternatives 4, 5, and 7 are the same, as they are all based on the modeling of restored conditions.

Alternatives 6B and 6D provide similar conditions; however, they would not sustain as many acres of adequate habitat over time as Alternatives 4 and 5. Alternative 8A appears to provide a similar scenario as Alternative 6B; however, pumping of the flow-way would cause some disruption between weeks 8 and 12, making this alternative less desirable. Alternative 7 would provide an identical hydrological improvement as the restored condition. However, in the absence of post-project habitat management, some portion of foraging habitat within the 8.5 SMA probably would be unavailable due to exotic encroachment and continuing anthropogenic land uses.

Alternatives 2B and 9 would provide almost no adequate habitat in the 8.5 SMA. Alternatives 2B and 9 would provide adequate habitat in NESRS throughout the year with some moderate disruption between weeks 10 and 14. Alternative 6C is similar to Alternatives 2B and 9. However, Alternative 6C would provide more suitable foraging habitat in the 8.5 SMA compared to Alternatives 2B and 9. Alternative 6C also provides slightly greater total area of foraging habitat compared to Alternatives 2B and 9. As in Alternatives 2B and 9, Alternative 6C also exhibits some moderate disruption. Alternative 1 would provide a similar scenario as Alternatives 2B and 9; however a considerable disruption in both the 8.5 SMA and NESRS would occur between week 43 and 47.

The most severe impact to the stork's foraging habitat would occur under Alternative 3 (slurry wall), which would tend to raise water levels on one side of the wall and lower water levels on the other side creating uniform water levels on both sides. As a result, water levels would uniformly decrease creating large and abrupt changes in the availability of foraging habitat, with peaks early in weeks 43 and 3, followed by abrupt declines as the water surface falls below the land surface. This significant and lengthy disruption appears to correspond with nesting season. Because adequate resources would be available at the onset of nesting season, wood storks would likely be well into maximum energetic investment when these resources would become unavailable within just a few short weeks. Alternative 3 appears to create an attractive nuisance.

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Chapter 8 —Evaluation of Alternative Performance

Results from the analysis of the performance measures for each of the 8.5 SMA project objectives are detailed in Chapters 5 through 7. A brief narrative of the relative performance of each of the alternatives is provided below.

Figures for the structural alternatives in this chapter show differences in water depth between each alternative and the predicted water levels of full Mod Waters Implementation. The data used in the figures were produced by subtracting the water depth at each model cell for an alternative from the restored water depth. The most severe drawdowns are centered around the mitigation feature (a canal, seepage barrier, or pump) while the weakest drawdowns (0.1 foot) are furthest away from the feature and are shown as blue.

The Federally Recommended Plan

The Federally Recommended Plan is based on Alternative 6D, as modified by several assurances related to design and operation. These assurances and modifications are described in detail in Chapter 10.

The Federally Recommended Plan increases hydroperiod in NESRS by moving the canal and levee alignment to the east (relative to Alternative 1) and primarily limits hydroperiod reduction to lands within the flood-mitigated area east of the perimeter levee. The Recommended Plan provides the greatest degree of environmental benefits for the lowest cost among all project alternatives (based on cost per FU at a cost of $15,900 per FU when compared to Alternative 1). This represents approximately 80 percent additional wetland function potentially attained through total acquisition under Alternative 5 (5,213 FU) at less than half the cost, requiring no compensatory mitigation for unavoidable losses to wetland or fish and wildlife resources. See Section 6.4 of the GRR for a comparison of costs to FU.

The Recommended Plan provides suitable habitat for wood storks and an additional 2,731 acres of snail kite habitat compared to Alternative 1 (a 5 percent increase). The Recommended Plan results in an increase of short hydroperiod wetlands by 365 acres when compared with total acquisition (709 acres) at less than half the cost. The Recommended Plan would result in longer hydroperiods over an estimated 1,115 acres in NESRS. When compared to total acquisition, the Recommended Plan provides the same benefit over the same area at less than half the cost. In conjunction with the C–111 Project, the plan would also provide partial re-establishment of historical hydrologic regimes.

The Recommended Plan does not fully provide structural flood mitigation for 540 acres (primarily in the northern portion of the 8.5 SMA and east of the

perimeter levee). It is our understanding that supplemental non-structural options shall be implemented, including re-alignment of the perimeter levee in final design, fee-simple acquisition, and/or the purchase of flowage easements.

Alternative 1

Alternative 1 performed poorly for all of the legislative requirement hydrologic performance measures. This alternative lowers water levels in both the 8.5 SMA and in NESRS (Figure 38) that negate some of the benefits that could be derived from the MWD Project. It also does not provide full structural flood mitigation. In terms of the other objectives, the Plan does not provide flood protection and is least compatible with future restoration. By draining long-hydroperiod wetlands in the slough, the Plan provides an increase in short-hydroperiod wetlands over the restored conditions. The Plan performed poorly for wood storks and snail kites and had a WRAP score that reflected a loss of 2,765 FUs from existing conditions.

Alternative 2

Alternative 2 performed poorly in the legislative requirements performance measures related to restoration of NESRS, decreasing water depths in more than 35,000 acres in NESRS (Figure 39). The Plan fails to provide structural mitigation for 371 acres. In terms of the other hydrologic performance measures, Alternative 2 does not provide flood protection, but does increase the spatial distribution of short-hydroperiod wetlands by draining long period hydroperiod wetlands in ENP. It does not provide flood protection to the 8.5 SMA. It is more compatible with future restoration than Alternative 1 because it would move water to the south, but is still less compatible than other alternatives. Because residents of the 8.5 SMA would be allowed to remain, this alternative would provide the perception of flood protection. However, neither adequate flood mitigation nor protection would be provided. The alternative performed poorly for wood storks and snail kites. The WRAP score reflected a loss of 2,765 FUs from existing conditions. Thus, as with Alternative 1 Alternative 2 would result in a loss of functional wetlands if implemented.

Alternative 3

Alternative 3 performed poorly in the legislative requirement hydrologic performance measures pertaining to flood mitigation. It does not provide full structural flood mitigation to more than 4,000 acres within the 8.5 SMA. Alternative 3 performed well in the re-establishment of hydropatterns in NESRS, increasing water depth over 12,000 acres in NESRS (Figure 40) and performing best for snail kite habitat. For the hydrologic performance measures associated with the other project objectives, the Plan ranked high in terms of providing short hydroperiod wetlands, but investigation into the wood stork performance measures demonstrated that the abrupt change from shallow to deep water at the seepage wall boundary would create unnatural drydown patterns and abrupt reductions in stork feeding habitat during the breeding season. It would not provide flood protection to the 8.5 SMA. The permanent nature of the seepage

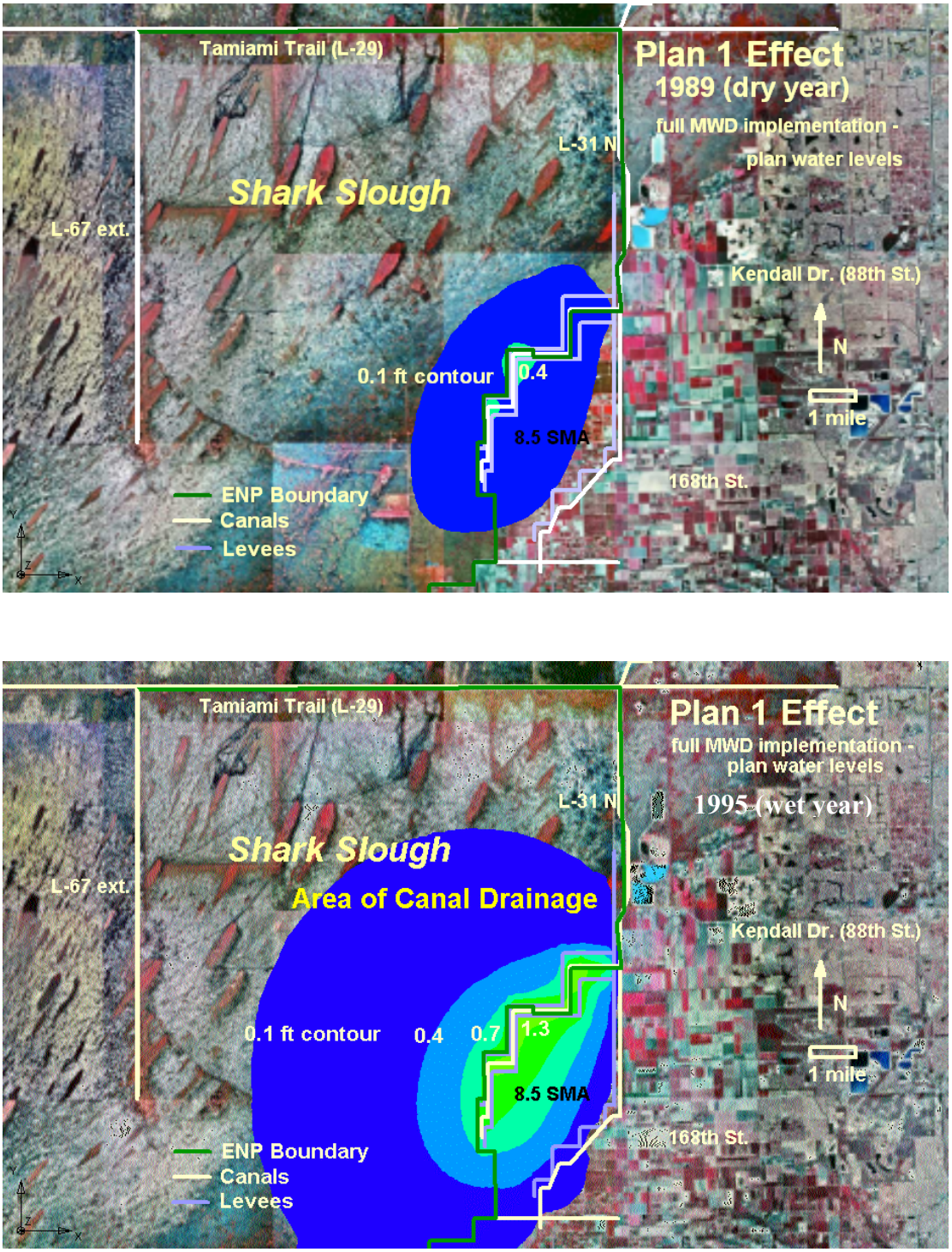

Figure 38 Difference in Average Water Depths Between the Restored Condition Following Full Implementation of MWD and Alternative 1 (Alternative 1 lowered water depths in NESRS by up to 1.0 foot in the wet year relative to restored conditions in ENP following full implementation of MWD)

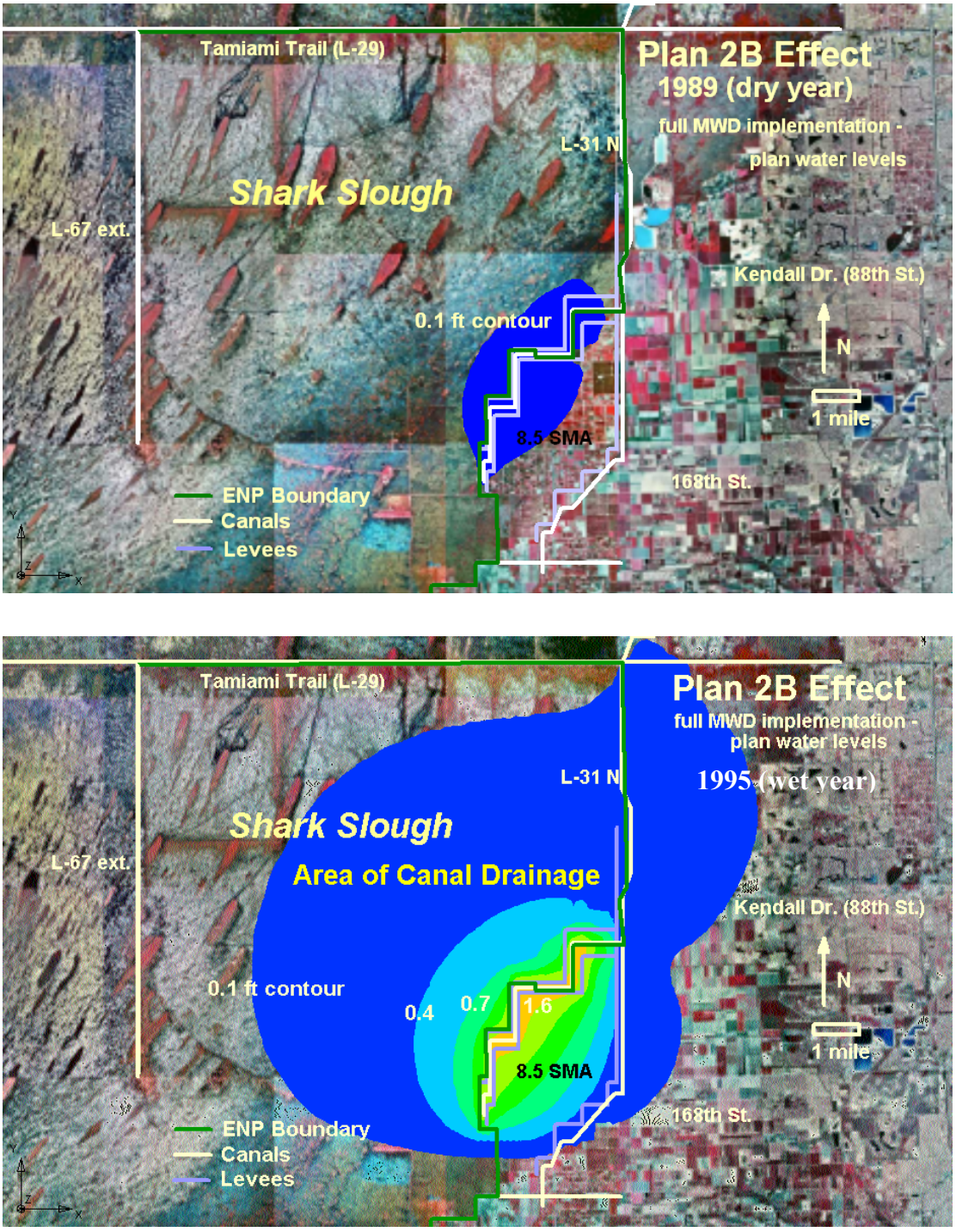

Figure 39 Difference in Average Water Depths Between the Restored Condition Following Full Implementation of MWD and Alternative 2B (Alternative 2B lowered water depths in NESRS by up to 1.5 feet in the wet year relative to the restored condition following full implementation of MWD)

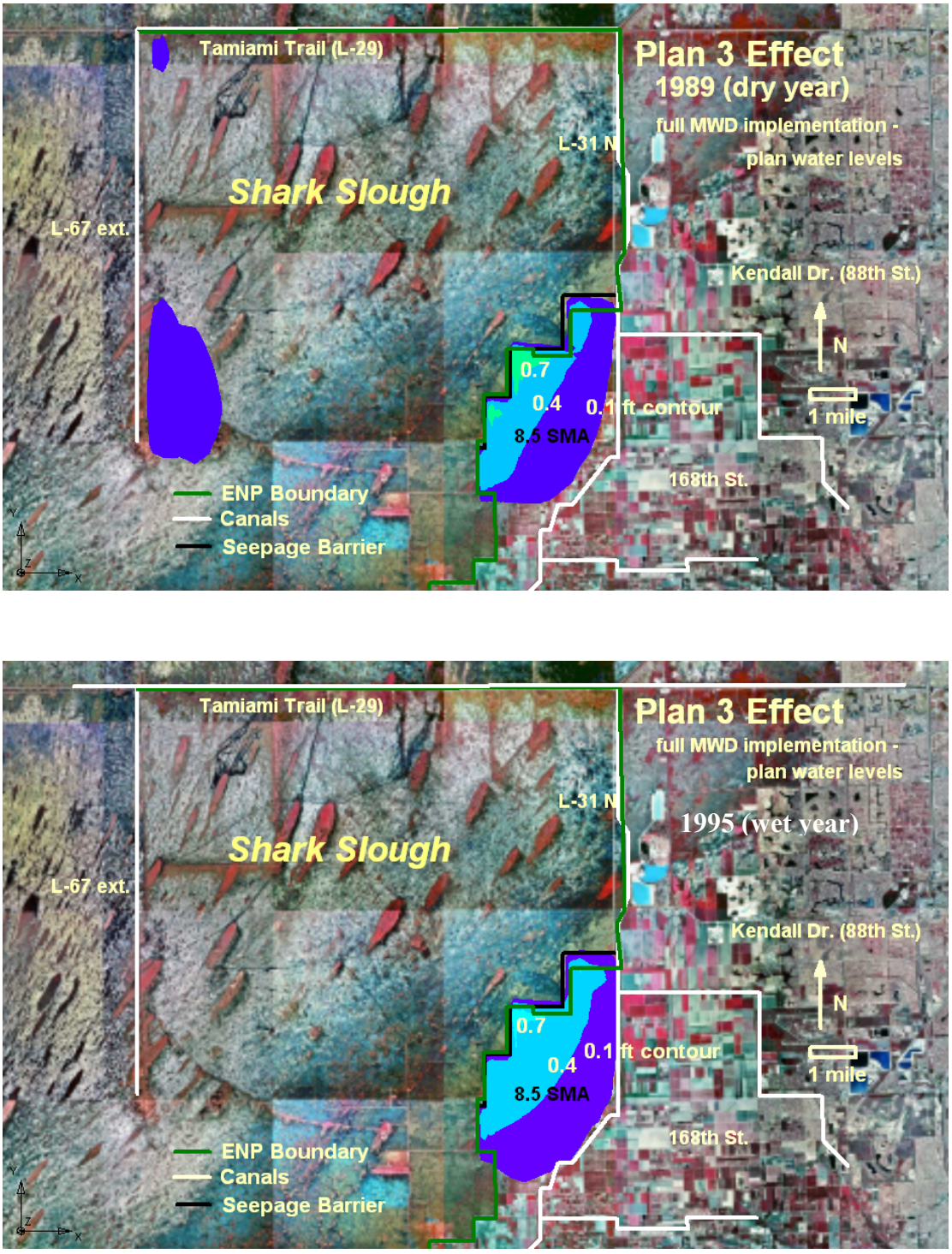

Figure 40 Difference in Average Water Depths Between the Restored Condition Following Full Implementation of MWD and Alternative 3 (Alternative 3 increased water depths in eastern NESRS by up to 0.7 feet in the wet year relative to the restored condition following full implementation of MWD)

barrier, its placement in the historical flow path, and the likelihood of increased flooding due to relocation of S–356 caused the Plan to perform poorly in regards to future restoration. Alternative 3 had a slightly better WRAP score than either Alternative 1 or 2, but its implementation would still result in a net loss of 1,175 FUs from existing conditions.

Alternative 4

Alternative 4 performed well in all of the legislative requirement hydrologic performance measures. Full flood mitigation would be achieved through buyout, flowage easements, and life estates. No reductions in hydroperiods or water levels would occur in NESRS. In terms of performance for the other objectives, the Plan would be less superior in providing for short hydroperiod wetlands. Damages due to flooding would not occur due to acquisition of the area. This alternative is considered more compatible with future restoration than the structural alternatives, but would be less compatible than full buyout because the residents might experience an increase in flooding due to relocation of S–356. Performance was high for wood stork habitat and moderate for snail kite. Wrap scores for Alternative 4 were the highest of all alternatives evaluated by the procedure. Implementation of this alternative would result in a net gain of 2,248 FUs from existing conditions.

Alternative 5

Alternative 5 performed well in all of the legislative requirement hydrologic performance measures. Full flood mitigation would be achieved through buyout. No water depth or hydroperiod reductions would occur in NESRS. In terms of the performance of the other project objectives, the Plan would be less superior in providing for short hydroperiod wetlands. Damages due to flooding would not occur due to acquisition of the area. It is considered more compatible with future restoration than structural options because there would be full flexibility in relocating S–356. Most importantly, restoration of the peripheral wetlands (Figure 9) that were once found in the 8.5 SMA would allow for the full ecological function to be restored and prevent loss of critical landscape remnants. Performance was high for the snail kite and wood stork. As with Alternative 4, this alternative also had a WRAP score that reflected a net gain of 2,248 FUs from existing conditions.

Alternative 6B

Alternative 6B reduces the spatial extent of lower water levels in NESRS by moving the canal and levee alignment to the east, but it still would reduce water depth over 8,000 acres in NESRS, reducing habitat for the endangered snail kite (Figure 41). Limiting the protected area to the higher elevations in the 8.5 SMA would allow attainment of full flood mitigation and protection. Development is expected to increase and the any future projects related to restoration would have to maintain that level of flood protection. This may require increases in pumping to accommodate the relocation of S–356. This increased pumping would cause

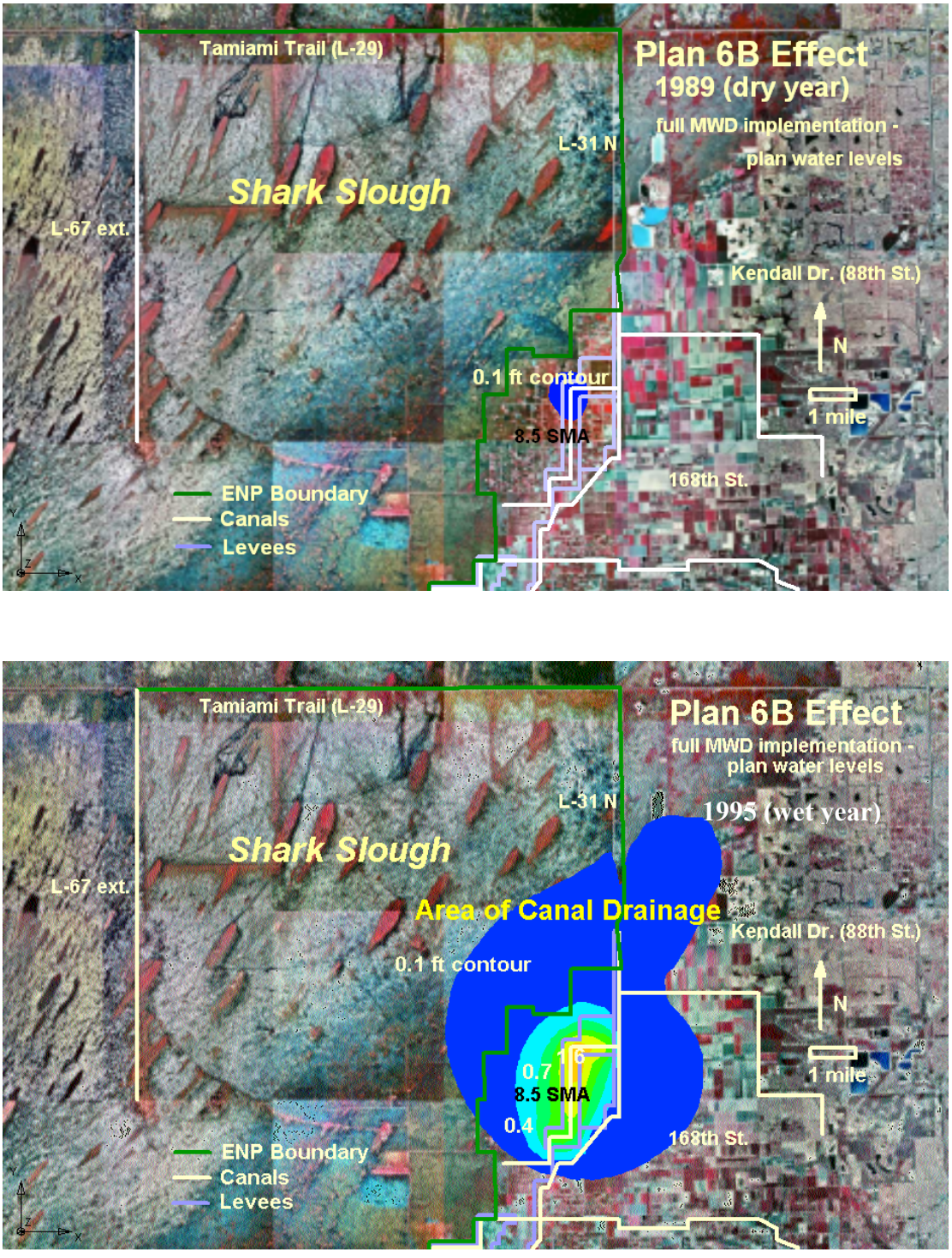

Figure 41 Difference in Average Water Depths Between the Restored Condition Following Full Implementation of MWD and Alternative 6B (Alternative 6B lowered water depths in eastern NESRS by up to 0.4 feet in the wet year relative to the restored condition following full implementation of MWD)

additional reductions in water depths in NESRS and additional losses of snail kite habitat. Once this 1-in-10 year flood protection is provided, there would be no potential for restoring water levels to the historic peripheral wetlands in the 8.5 SMA (Figure 9). Performance was moderate for wood storks. The WRAP score for Alternative 6B suggests implementation of this alternative would result in a net gain of 1,606 FUs.

Alternative 6C

Alternative 6C performed poorly in mandatory hydrological performance measures related to restoration of NESRS, decreasing water depths in more than 27,000 acres in NESRS (Figure 42). The Plan provided full flood mitigation but fails to provide flood protection for 3,452 acres, 66 percent of the designated flood protection zone. Alternative 6C drastically decreases the extent of marl-forming wetlands due to the placement of the canal and levee in the middle of the existing marl forming wetlands. This causes the loss of 75 percent of the existing marl forming wetlands in the study area (556 acres). Alternative 6C is more compatible with future restoration than Alternative 1 because it moves water south into the C–111 project, but it is still less compatible than other alternatives. This alternative would provide the perception of flood protection, however, adequate flood protection would not be provided and therefore is not viewed as a sustainable solution. The alternative performed poorly for wood storks and snail kites. The WRAP score reflected a loss of 1,215 FUs from existing conditions.

Alternative 6D

Alternative 6D causes minimal impacts to restored water levels in NESRS by moving the 6C canal and levee alignment to the east and raising the water levels in the seepage canal. These changes improve performance in mandatory requirements related to NESRS restoration, decreasing restored average annual storage losses in NESRS to 4.2 percent of the storage gained through full MWD implementation. Alternative 6D decreases the extent of marl-forming wetlands in the 8.5 SMA. The Plan provides structural mitigation for all but 540 acres within the flood protection zone and provides flood protection for 60 percent of the area within the flood protection zone. In providing 1-in-10 year flood protection to the residents, development is expected to increase and increased water levels that may result from future restoration (such as relocating S–356) could negatively impact these residences. Performance was moderate for snail kites and high for wood storks. The alternative would create an improvement of 4,087 wetland FUs compared to the No Action Alternative. Because most of the water that feeds the seepage canals would originate from the 8.5 SMA (not ENP) it is likely that water quality in the seepage canal will be poor.

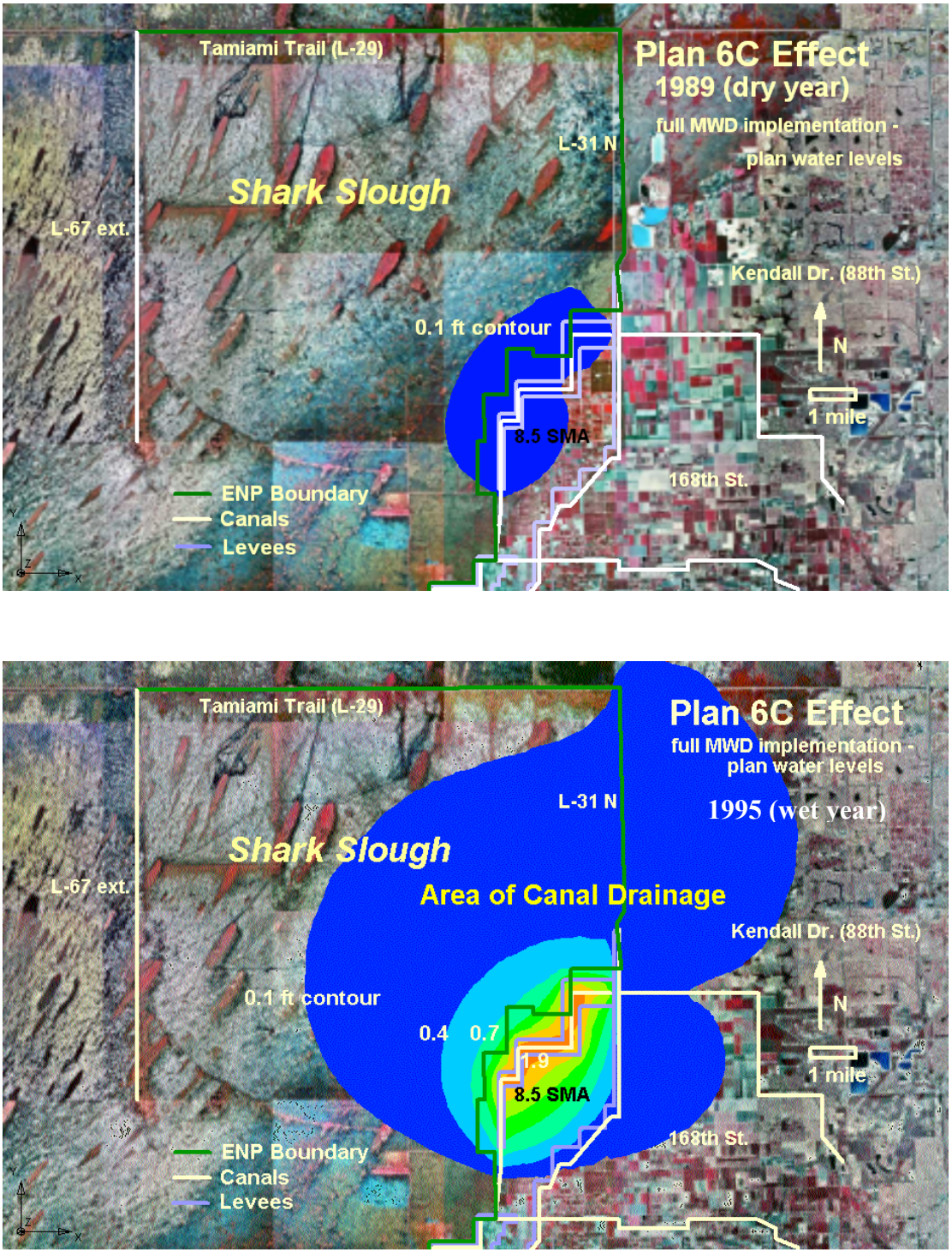

Figure 42 Difference in Average Water Depths Between the Restored Condition Following Full Implementation of MWD and Alternative 6C (lowered water depths in NESRS by up to 1.9 feet relative to restored conditions in ENP following full implementation of MWD)

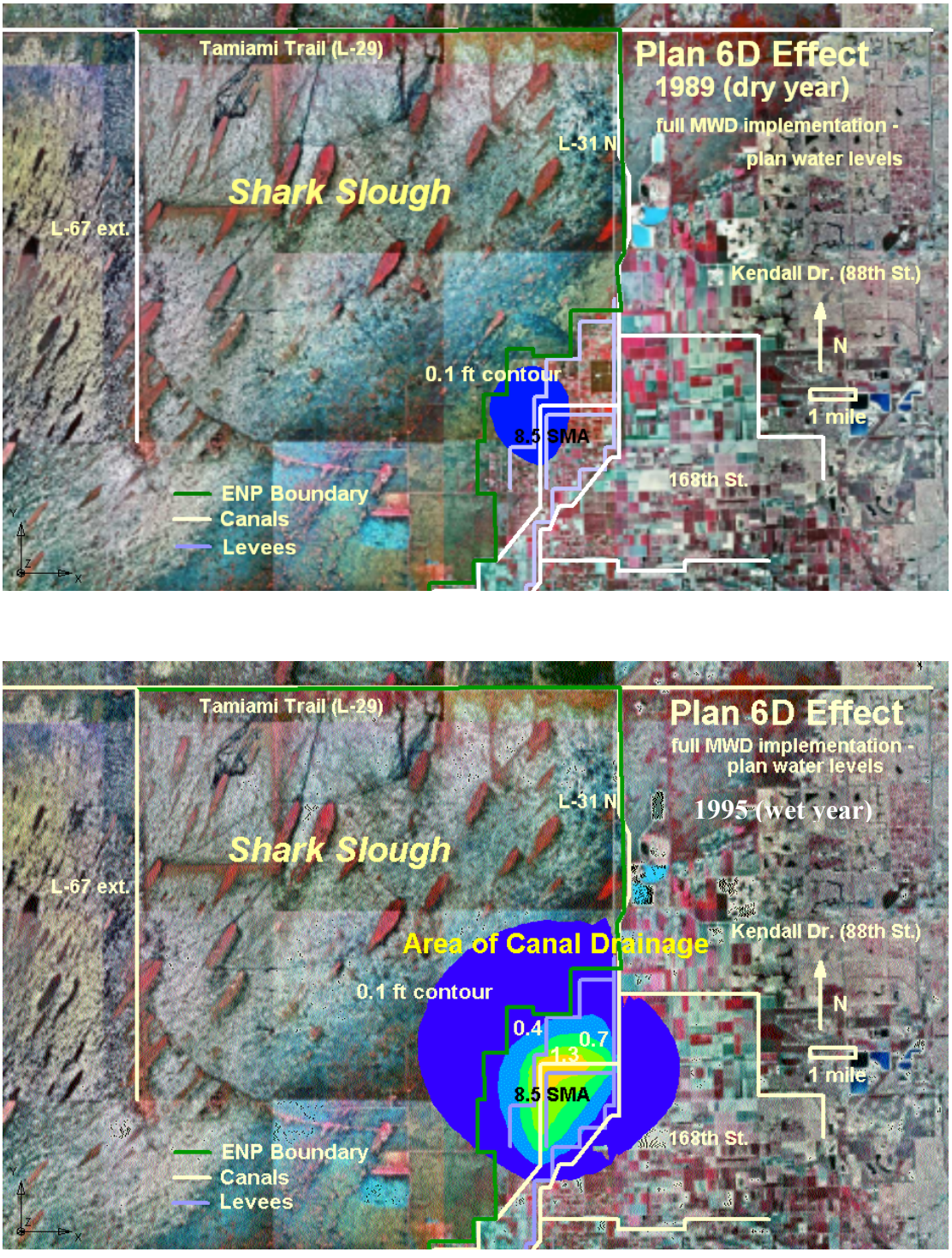

Figure 43 Difference in Average Water Depths Between the Restored Condition Following Full Implementation of MWD and Alternative 6D (Alternative 6D lowered water depths in NESRS by up to 0.4 feet in the wet year relative to restored conditions in ENP following full implementation of MWD)

Alternative 7

Alternative 7 performs well in that no reductions would occur in water depths or hydroperiods in NESRS. Structural flood mitigation would not occur under this alternative because residents would most likely incur more flooding as a result of raising the roads, particularly if the roads are not constructed with adequately sized culverts.

The area would not receive flood protection and would be vulnerable to increases in water levels due to relocating S–356. DOI does not consider this alternative reasonable in that raising the roads, in kind, without providing for secondary drainage is at best a temporary remedy and at worst, would cause increased flooding due to the higher retention depths of the roads. Performance was moderate for the snail kite and wood stork. The WRAP score indicates a net gain of 1,290 FUs from existing conditions would occur with implementation of this alternative. All of the improvements to wetland function for this alternative, however, would be confined to ENP.

Alternative 8A

Alternative 8 would not significantly impact restoration in NESRS, but it also would not provide structural flood mitigation to most of the 8.5 SMA (Figure 44). It would not provide flood protection, but would provide for increases in short hydroperiod wetlands. It would be more compatible with restoration due to the minimum of structural components and the orientation of enhanced flow paths and levees along natural flow-paths. Performance was moderate for both the snail kite and wood stork. The WRAP score indicates a net gain of 2,240 FUs from existing conditions would occur with implementation of this alternative. The creation of the flow-way within the western portion of the 8.5 SMA would allow for the creation of functional post-project wetlands.

Alternative 9

Alternative 9 would perform similarly to Alternative 2.

Overall Evaluation of Performance Measures

Numerous performance measures having multiple units were evaluated in this CAR. The units range from the highly quantitative such as acres impacted to the less exact, such as a relative score based on best professional judgment. In order to present all of the performance measures for all of the objectives into a unified evaluation tool, all performance measures were combined into a series of matrices for purposes of comparing alternatives. The method and resulting evaluation tool are described below.

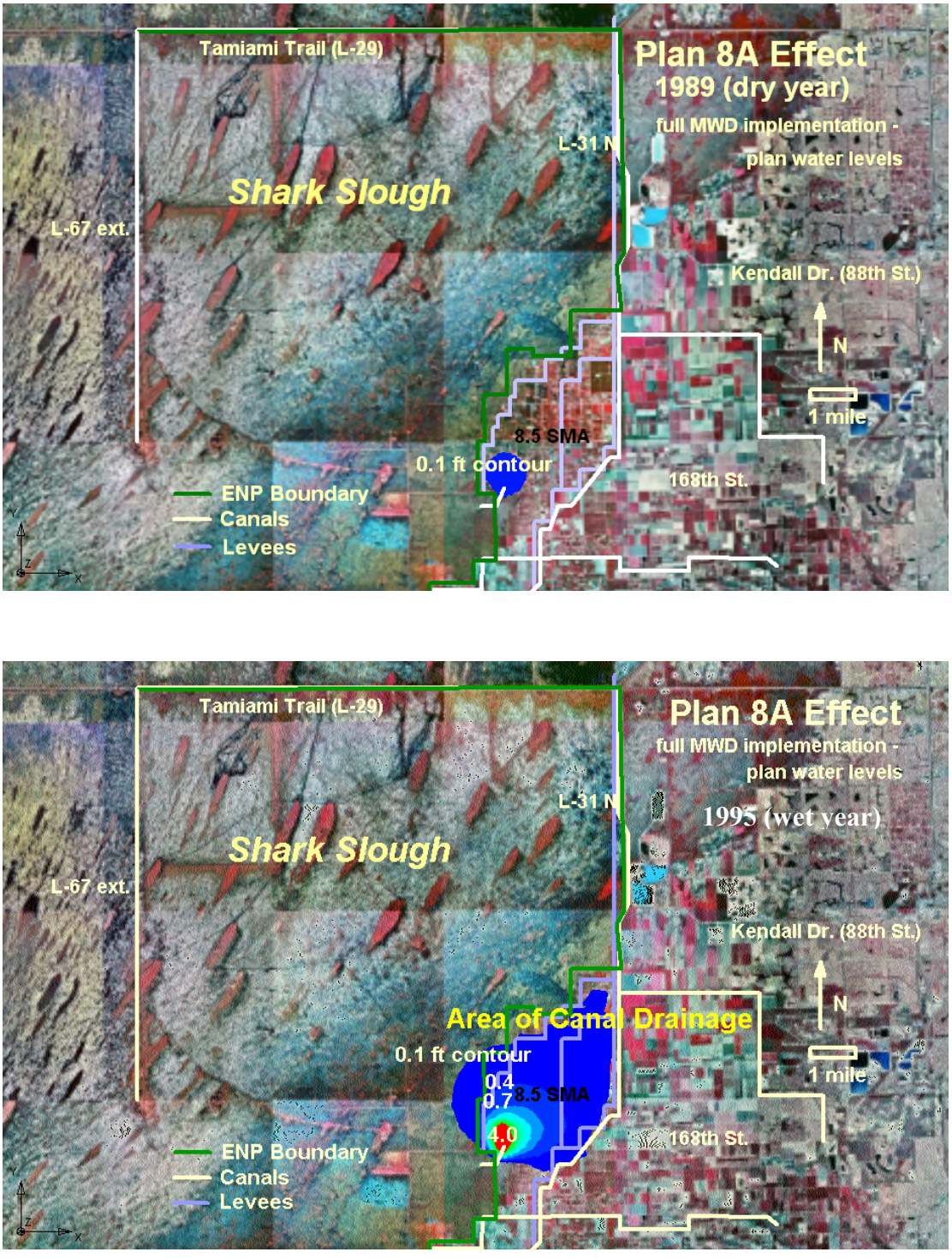

Figure 44 Difference in Average Water Depths Between the Restored Condition Following Full Implementation of MWD and Alternative 8A (Alternative 8A had little effect on water depth in NESRS and lowered depths near the pump by up to 2 feet in the wet year)

Results from the analysis of each of the performance measures for the set of 8.5 SMA project objectives reviewed in the CAR (Chapters 5 through 7) were incorporated into a series of three spreadsheets. The first spreadsheet (Table 23) contains the raw data for each of the performance measures as presented in the previous chapters. The second spreadsheet (Table 24) ranks the relative performance of each of the alternatives from 1 to 9 (worst to best) corresponding to the ability of each alternative in meeting the associated project objective. The ranking of alternatives was done so as to maintain the numeric range of 1 through 9 through the use of the following ranking algorithm, where *n*

$$rank = n + \frac{n + (m-1)}{(p-1)} + (m-1)$$

is the number of alternatives of a lower rank, *m* is the number of alternatives sharing the rank, and *p* is the total number of alternatives considered. The lowest performing alternative was assigned a rank of 1 and the remaining alternatives were ranked according to the expression above. Non-integer results were rounded up to the next highest integer. Ranking criteria for each performance measure depicted in Table 23 are provided in Table 26.

The third spreadsheet (Table 25) summarizes the performance for all objectives and renders a preliminary score. Table 25 also incorporates a weight for each performance measure based on the relative importance DOI attached to the particular performance measure in meeting the overall purposes of the MWD Project. The weights applied were as follows:

Critical: Performances measures were classified as critical by DOI if their performance was significantly linked to the purposes of the MWD Project. These purposes include hydrological and ecological restoration of NESRS and the identification of a flood protection system for the 8.5 SMA. These performance measures were given a relative weight of 3 and were as follows:

1. Decrease in hydroperiod in NESRS (Table 23, 1B)
2. Decrease in water depths in NESRS (Table 23, 1D)
3. Damages in 8.5 SMA by increases in hydroperiod (Table 23, 2A)
4. Damages in 8.5 SMA by increases in surface water depths (Table 23, 2B)
5. Cape Sable Seaside Sparrow (CSSS) nesting opportunity changes (Table 23, 3A)
6. CSSS Nesting habitat suitability changes (Table 23, 3B)
7. Wetland Rapid Assessment Procedure or WRAP (Table 23, 4B)

Note: CSSS performance measures were viewed as critical because the successful implementation of the MWD Project has the potential to remove the current jeopardy opinion. Data for the evaluation of the CSSS performance measures were not available for this version of the CAR. Wetland function performance was viewed as critical to meet the ecological restoration goals of the MWD Project.

Important: Performance measures were classified as important if their performance was considered by DOI to be of significant importance for the identification of a sustainable solution for the 8.5 SMA. These performance measures were given a relative weight of 2 and were as follows:

1. Impacts to business (Table 23, 2D)
2. Residents relocated (Table 23, 2E)
3. Lost agricultural lands (Table 23, 2F)
4. Unwilling sellers (Table 23, 2G)
5. Project costs (Table 23, 4A)
6. Local secondary costs (Table 23, 4B)
7. Spatial distribution of functional short hydroperiod wetlands (Table 23, 5A)
8. Retrofitting of project features (Table 23, 6A)
9. Potential to reestablish historical flow regimes (Table 23, 6B)

Note: Only important performance measures 7 through 9 above were evaluated in this CAR due to the availability of information from the Corps.

Desirable: Performance Measures were classified as desirable by DOI if their performance would enhance the overall performance of the 8.5 SMA component of the MWD Project. These performance measures were given a relative weight of 1 and were as follows:

1. Increase in hydroperiod in NESRS (Table 23, 1A)
2. Increase in water depths in NESRS (Table 23, 1C)
3. Snail kite habitat suitability changes (Table 23, 3C)
4. Wood stork habitat suitability changes (Table 23, 3D)
5. Damages in 8.5 SMA by not providing flood protection (Table 23, 2C)
6. Environmental and cultural resources (Table 23, 7A)
7. Ability to meet implementation schedule (Table 23, 7B)
8. Construction delays (Table 23, 7C)
9. Administrative requirements of alternatives (Table 23, 7D)

Table 23 Performance Measures Evaluation and Scoring Matrix (Raw Data)

		Unweighted Raw Data-Wet Year (1995) Raw Data											
Performance Measure	**Data units**	**Alt1**	**Alt2B**	**Alt3**	**Alt4**	**Alt5**	**Alt6B**	**Alt6C**	**Alt6D**	**Alt7**	**Alt8A**	**Alt9**	**Notes**
LEGISLATIVE REQUIREMENTS AND PERFORMANCE MEASURES													
1-Evaluate effects on hydropatterns in NESRS													
1A-NESRS increase in spatial distribution of hydroperiod	Acres	0	0	82	0	0	0	0	0	0	0	0	Relative to restored condition
1B-NESRS decrease in spatial distribution of hydroperiod	Acres	3,158	3,275	0	0	0	294	1,996	282	0	286	3,275	Relative to restored condition
1C-NESRS increase in spatial distribution of water depth	Acres	0	0	14,934	0	0	0	0	0	0	0	0	Relative to restored condition
1D-NESRS decrease in spatial distribution of water depth	Acres	27,173	36,640	0	0	0	6,035	27,446	5,845	0	705	36,640	Relative to restored condition
2-Evakuate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the Modified Water Delivery Project													
8.5 SMA Flood Mitigation													
2A-8.5 SMA damages due to increase in hydroperiod	Acres	263	0	4,257	0	0	0	0	0	5,976	3,934	0	Relative to existing condition
2B-8.5 SMA damages due to increase in surface water depth	Acres	102	0	3,669	0	0	0	0	541	5,059	3,796	0	Relative to existing condition
3-Provide conditions favorable to federal and state listed endangered species survival													
Cape Sable Seaside Sparrow													
3A-Nesting opportunity changes	Days	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Requires additional COE modeling
3B-Nesting habitat suitability changes	Days	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Requires additional COE modeling
Snail Kite													
3C-Habitat suitability changes	Acres	54,847	53,700	60,367	58,286	58,286	57,400	57,217	57,578	58,286	57,832	53,700	
Wood Stork													
3D-Habitat suitability changes	rank (1-11)	2	4	1	11	11	8	5	9	6	7	4	
OTHER OBJECTIVES AND PERFORMANCE MEASURES													
2- Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the Modified Water Delivery Project													
8.5 SMA Flood Protection													
2C-8.5 SMA damages by not receiving flood protection	Acres	6,323	6,205	6,323	0	0	258	2,857	1,492	6,323	6,172	6,205	
Socio-economic Factors													
2D-Impacts to business	No. businesses	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Will be provided by COE SEIS
2E-Residents relocated	No. residents	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Will be provided by COE SEIS
2F-Lost Agricultural lands	Acres	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Will be provided by COE SEIS
2G-Unwilling Sellers	No. owners	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Will be provided by COE SEIS
4-Analyze cost effectiveness													
4A-Project costs	1000's dollars	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Will be provided by COE SEIS
4B-Local secondary costs	1000's dollars	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Will be provided by COE SEIS
5-Analyze effects to ecological function													
5A-Spatial distribution of functional marl forming wetlands	Acres	2,428	3,675	2,110	0	0	591	556	576	0	1,051	3,675	
5B-Wetland Rapid Assessment Procedure (WRAP)	Functional Units	-2,765	-2,765	-1,775	2,448	2,448	1,606	-1,805	997	1,290	2,240	-2,765	Change from existing condition
6-Measure compatibility with CERP and C–111 Projects; maintain flood protection east of L–31N													
6A-Retrofitting of project features	Score (1-5)	1	2	1	3	5	3	2	2	3	3	2	(1=retrofitting high; 5=retrofitting
6B-Potential to re-establish historical flow regimes	Score (1-5)	1	1	1	4	5	1	1	1	3	4	1	(1=low potential; 5=high potential)
7-Avoid impacts and costs associated with time delays in implementation of alternatives													
7A-Environmental and cultural resources	Rank (1-11)	11	11	11	11	11	11	11	11	11	11	11	
7B-Ability to meet implementation schedule	Rank (1-11)	11	11	11	11	11	11	11	11	11	11	11	
7C-Construction delays	Rank (1-11)	11	11	11	11	11	11	11	11	11	11	11	
7D-Administrative requirements of alternatives	Rank (1-11)	11	11	11	11	11	11	11	11	11	11	11	

N/A= Information Not Available

Table 24 Performance Measures Evaluation and Scoring Matrix (Ranking)

		Unweighted Scores-Wet Year (1995)										
		Alternative Rankings										
Performance Measure	**rank (worst to best)**	**Alt1**	**Alt2B**	**Alt3**	**Alt4**	**Alt5**	**Alt6B**	**Alt6C**	**Alt6D**	**Alt7**	**Alt8A**	**Alt9**
LEGISLATIVE REQUIREMENTS AND PERFORMANCE MEASURES												
1-Evaluate effects on hydropatterns in NESRS												
1A-NESRS increase in spatial distribution of hydroperiod	1-11	1	1	11	1	1	1	1	1	1	1	1
1B-NESRS decrease in spatial distribution of hydroperiod	1-11	3	1	11	11	11	45	4	4	11	6	1
1C-NESRS increase in spatial distribution of water depth	1-11	1	1	11	1	1	1	1	1	1	1	1
1D-NESRS decrease in spatial distribution of water depth	1-11	4	1	11	11	11	5	3	3	11	6	1
2-Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the Modified Water Delivery Project												
8.5 SMA Flood Mitigation												
2A-8.5 SMA damages due to increase in hydroperiod	1-11	4	11	2	11	11	11	11	11	1	3	11
2B-8.5 SMA damages due to increase in surface water depth	1-11	4	11	3	11	11	11	11	4	1	2	11
3-Evaluate effects to federal and state listed endangered species survival												
Cape Sable Seaside Sparrow												
3A-Nesting opportunity changes	1-11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3B-Nesting habitat suitability changes	1-11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Snail Kite												
3C-Habitat suitability changes	1-11	3	1	11	10	10	5	4	6	10	7	1
Wood Stork												
3D-Habitat suitability changes	1-11	2	4	1	11	11	9	5	9	6	7	4
OTHER OBJECTIVES AND PERFORMANCE MEASURES												
2--Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the Modified Water Delivery Project												
8.5 SMA Flood Protection												
2C-8.5 SMA damages by not receiving flood protection	1-11	1	5	1	11	11	9	7	8	1	6	5
Socio-economic Factors												
2D-Impacts to business	1-11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2E-Residents relocated	1-11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2F-Lost Agricultural lands	1-11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2G-Unwilling Sellers	1-11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4-Analyze cost effectiveness												
4A-Project costs	1-11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4B-Local secondary costs	1-11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5-Analyze effects to ecological function												
5A-Spatial distribution of functional marl forming wetlands	1-11	8	10	7	1	1	5	4	5	1	6	11
5B-Wetland Rapid Assessment Procedure (WRAP)	1-11	1	1	5	11	11	7	4	6	6	8	1
6-Measure compatibility with CERP and C--111 Projects; maintain flood protection east of L--31N												
6A-Retrofitting of project features	1-11	1	5	1	9	11	9	5	6	9	9	5
6B-Potential to re-establish historical flow regimes	1-11	1	1	1	9	11	1	1	1	7	8	1
7-Analyze impacts and costs associated with time delays in implementation of alternatives												
7A-Environmental and cultural resources	1-11	11	11	11	11	11	11	11	11	11	11	11
7B-Ability to meet implementation schedule	1-11	11	11	11	11	11	11	11	11	11	11	11
7C-Construction delays	1-11	11	11	11	11	11	11	11	11	11	11	11
7D-Administrative requirements of alternatives	1-11	11	11	11	11	11	11	11	11	11	11	11

N/A= Information Not Available

Table 25 Performance Measures Evaluation and Scoring Matrix (Weighted Score)

		Weighted Scores-Wet Year (1995) Weighted Score										
Performance Measure	**PM Weight**	**Alt1**	**Alt2**	**Alt3**	**Alt4**	**Alt5**	**Alt6B**	**Alt6C**	**Alt6D**	**Alt7**	**Alt8**	**Alt9**
LEGISLATIVE REQUIREMENTS AND PERFORMANCE MEASURES												
1-Evaluate effects on hydropatterns in NESRS												
1A-NESRS increase in spatial distribution of hydroperiod	Desirable	1	1	11	1	1	1	1	1	1	1	1
1B-NESRS decrease in spatial distribution of hydroperiod	Critical	3	1	11	11	11	5	4	7	11	6	1
1C-NESRS increase in spatial distribution of water depth	Desirable	1	1	11	1	1	1	1	1	1	1	1
1D-NESRS decrease in spatial distribution of water depth	Critical	4	1	11	11	11	5	3	6	11	7	1
Objective Subtotal Score	**Mean**	**2.25**	**1**	**11**	**6**	**6**	**3**	**2.25**	**3.75**	**6**	**3.75**	**1**
2-Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the Modified Water Delivery Project												
8.5 SMA Flood Mitigation												
2A-8.5 SMA damages due to increase in hydroperiod	Critical	4	11	2	11	11	11	11	11	1	3	11
2B-8.5 SMA damages due to increase in surface water depth	Critical	5	11	3	11	11	11	11	4	1	2	11
Objective Subtotal Score	**Mean**	**4.5**	**11**	**2.5**	**11**	**11**	**11**	**11**	**7.5**	**1**	**2.5**	**11**
3-Evaluate effects on federal and state listed endangered species survival												
Cape Sable Seaside Sparrow												
3A-Nesting opportunity changes	Critical	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3B-Nesting habitat suitability changes	Critical	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Snail Kite												
3C-Habitat suitability changes	Desirable	3	1	11	10	10	5	4	6	10	7	1
Wood Stork												
3D-Habitat suitability changes	Desirable	2	4	1	11	11	9	5	9	6	7	4
Objective Subtotal Score	**Mean**	**2.5**	**2.5**	**5.5**	**9.5**	**9.5**	**6.5**	**4.5**	**7.5**	**7.5**	**6.5**	**2.5**
OTHER OBJECTIVES AND PERFORMANCE MEASURES												
2-Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the Modified Water Delivery Project												
8.5 SMA Flood Mitigation												
2C-8.5 SMA damages by not receiving flood protection	Desirable	1	5	1	11	11	9	7	8	1	6	5
Socio-economic Factors												
2D-Impacts to business	Important	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2E-Residents relocated	Important	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2F-Lost Agricultural lands	Important	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2G-Unwilling Sellers	Important	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Objective Subtotal Score	**Mean**	**1**	**5**	**1**	**11**	**11**	**9**	**7**	**8**	**1**	**6**	**5**
4-Analyze cost effectiveness												
4A-Project costs	Important	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4B-Local secondary costs	Important	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Objective Subtotal Score	**Mean**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
5-Analyze effects to ecological function												
5A-Spatial distribution of functional marl forming wetlands	Important	9	11	8	1	1	6	4	5	1	7	11
5B-Wetland Rapid Assessment Procedure (WRAP)	Critical	1	1	5	11	11	8	4	6	7	9	1
Objective Subtotal Score	**Mean**	**5**	**6**	**6.5**	**6**	**6**	**7**	**4**	**5.5**	**4**	**8**	**6**
6-Measure compatibility with CERP and C—111 Projects; maintain flood protection east of L–31N												
6A-Retrofitting of project features	Important	1	6	1	10	11	10	6	6	10	10	6
6B-Potential to re-establish historical flow regimes	Important	1	1	1	10	11	1	1	1	8	10	1
Objective Subtotal Score	**Mean**	**1**	**3.5**	**1**	**10**	**11**	**5.5**	**3.5**	**3.5**	**9**	**10**	**3.5**
7-Avoid impacts and costs associated with time delays in implementation of alternatives												
7A-Environmental and cultural resources	Desirable	11	11	11	11	11	11	11	11	11	11	11
7B-Ability to meet implementation schedule	Desirable	11	11	11	11	11	11	11	11	11	11	11
7C-Construction delays	Desirable	11	11	11	11	11	11	11	11	11	11	11
7D-Administrative requirements of alternatives	Desirable	11	11	11	11	11	11	11	11	11	11	11
Objective Subtotal Score	**Mean**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**
Aggregate Mean Scores for all Objectives		**27.25**	**40**	**39**	**65.5**	**66.5**	**53.5**	**43.35**	**46.75**	**40**	**48.25**	**40**
Final Rank Based on Aggregate Mean Scores		**11**	**9**	**10**	**1**	**1**	**3**	**6**	**5**	**9**	**4**	**9**
		Alt1	**Alt2B**	**Alt3**	**Alt4**	**Alt5**	**Alt6B**	**Alt6C**	**Alt6D**	**Alt7**	**Alt8A**	**Alt9**

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Table 26 Ranking criteria for each performance measure

Legislative Requirement/ Project Objective	Performance Measure	Least Desirable Performance (From Rank = 1)	Most Desirable Performance (To Rank = 9)
Evaluate effects on hydropatterns in NESRS according to Section 104 of the 1989 ENP Protection and Expansion Act	1A-Increase in restored hydroperiod	Least acreage having an increase in restored hydroperiod	Most acreage having an increase in restored hydroperiod
	1B-Decrease in restored hydroperiod	Most acreage having a decrease in restored hydroperiod	Least acreage having a decrease in restored hydroperiod
	1C-Increase in restored water depth	Least acreage having an increase in restored water depth	Most acreage having an increase in restored water depth
	1D-Decrease in restored water depth	Most acreage having a decrease in restored water depth	Least acreage having a decrease in restored water depth
Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from the implementation of the MWD Project according to Section 104 of the ENP Protection and Expansion Act	2A-Damages due to increases in hydroperiod	Most acreage with an increase in hydroperiod	Least acreage with an increase in hydroperiod
	2B-Damages due to increases in water depth	Most acreage with an increase in water depth	Least acreage with an increase in water depth
	2C-Acres of designated area not receiving defined level of flood protection	Most acreage not receiving desired level of flood protection	Least acreage not receiving desired level of flood protection
Evaluate effects on federal and state listed endangered species survival in accordance with the ESA of 1973	3A & 3B-Cape Sable Seaside Sparrow habitat suitability changes	N/A	N/A
	3C-Snail Kite Habitat suitability changes	Least acreage of suitable habitat	Most acreage of suitable habitat
	3D-Wood Stork habitat suitability changes	Provides least amount of desired habitat	Provides most amount of desired habitat
Analyze effects to ecological function	4A-Short hydroperiod wetlands	Least acreage of short hydroperiod wetlands	Most acreage of short hydroperiod wetlands
	4B-Wetland Rapid Assessment Procedure	Least Functional Units	Most Functional Units
Measure compatibility with Comprehensive Everglades Restoration Plan and C–111 Project without adversely impacting the current level of flood protection east of L–31N	6A-Retrofitting of project features	Most retrofitting required	Least retrofitting required
	6B-Potential to re-establish historical flow regimes	Low potential to re-establish historical flow regimes	High potential to re-establish historical flow regimes
Avoid impacts and costs associated with time delays in implementation of alternatives.	7A-Environmental and cultural resources 7B-Ability to meet implementation schedule 7C-Construction Delays 7D-Administrative requirements of Alternatives	Not completed prior to other MWD Project features (Tamiami Trail)	Completed prior to other MWD Project features (Tamiami Trail)

Note: The snail kite and wood stork performance measures, while legislative requirements, were classified as desirable performance measures due the accessibility of appropriate habitat for these species in close proximity to the NESRS and 8.5 SMA. This is not the case for the CSSS; hence, its classification as a critical performance measure as described above.

DOI assumes that the MWD Project will not be completely functional until all components of the project have been completed. Furthermore, the Corps has assured DOI and the public that all of the components of the MWD Project will be constructed and operational by December 2005, with the Tamiami Trail modifications being the limiting component. Given this information, DOI assumes that the 8.5 SMA component will also be completed within the December 2005 time frame, regardless of the alternative chosen for implementation. DOI therefore concludes that all of the alternatives will perform equally towards meeting this objective and ranked every performance measure for the objective "Avoid impacts and costs associated with time delays in implementation of alternatives" equally.

Using the ranking criteria from Table 26 and the weights as stated above (and included in Table 23), the mean rank score for each project objective was calculated as the mean of all performance measures associated with a given project objective. All mean scores for objectives were then summed across all objectives and the composite score ranked once again to identify the relative performance of each alternative with respect to each other for all performance criteria. Results of the final alternative ranking based on the relative contribution of the performance measures evaluated in the CAR are presented graphically in Figure 45 (using unweighted values) and Figure 46 (using weighted values).

From the results presented in Figures 45 and 46, the preliminary preference of alternatives for the implementation of the 8.5 SMA component of the MWD project is as follows:

Alternative 5	Performs Best for Performance Criteria Evaluated (Preferred Environmentally)
Alternative 4	Performs Well for Performance Criteria Evaluated
Alternative 6B	Meets the Performance Criteria Evaluated
Alternative 6D	Meets the Performance Criteria Evaluated upon implementation of final design modifications and operational assurances specified by DOI (see recommendations in Chapter 11) and SFWMD (see Appendix F).

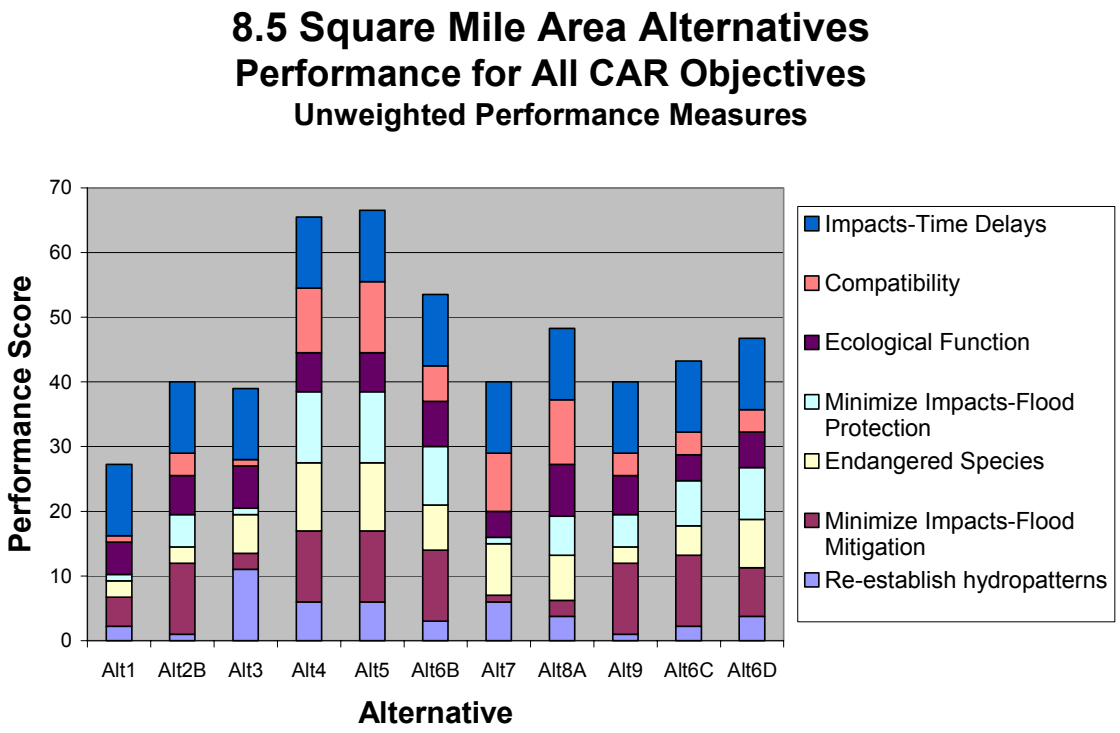

Figure 45 8.5 SMA Performance Scores (Unweighted)

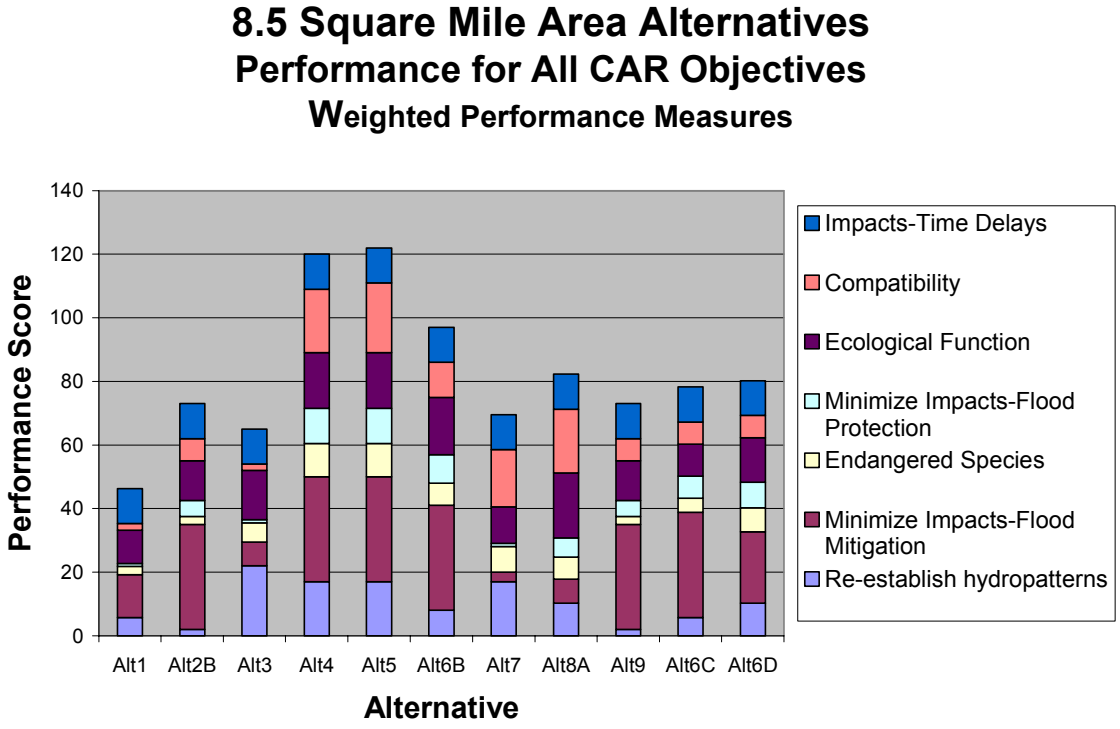

Figure 46 8.5 SMA Performance Scores (Weighted)

Alternative 5 meets the legislative requirements of the project by allowing for maximum restoration of NESRS while providing flood mitigation through acquisition of the entire area. Alternative 4 also meets the legislative requirements and also accomplishes flood mitigation through purchase of land through acquisition, flowage easements and life estates. Alternatives 6B and 6D, while meeting the legislative requirements, still caused a reduction in NESRS hydroperiods and water depths. However, the volume of water lost from NESRS was less than 5 percent of the total volume of NESRS (see table 4, Chapter 5) and considered by DOI to be just within acceptable limits. For this reason, DOI would consider supporting Alternatives 6B and 6D when the Corps addresses the following concerns:

1. That the decrease in water storage in restored NESRS following implementation of the final design of Alternatives 6B and 6D do not exceed 5 percent of the total storage of NESRS as defined in the CAR.

2. That the final operational criteria of the C–111 Project are completely compatible with the increases volumes of water discharged to the project from the final design of Alternatives 6B and 6D.

3. That adequate water quality is provided in the final design. Appropriate measures should be taken in the final design to assure that any water of substandard quality, originating in the 8.5 SMA, would receive treatment to meet applicable state and federal water quality standards prior to discharge to ENP. These concerns for water quality extend to nutrients, pesticides, herbicides, and other compounds, such as the priority pollutants detected in water samples collected following Hurricane Irene (see Appendix E). If the Corps decides that the treatment of contaminants originating in the 8.5 SMA would be treated using features associated with the C–111 Project, the Corps should also verify that the final design of these water quality features are sufficient to meet the needs associated with the quality and loadings of water originating in the 8.5 SMA.

4. That the Corps include in the final design, a realignment of the perimeter levee of 6B or 6D to maximize the wetlands within the buffer area as recommended by the SFWMD (Appendix F).

5. That the final canal and levee alignments incorporate the lands from willing sellers to increase the size of the buffer area.

6. All lands purchased by subject to the Fish and Wildlife Management Plan.

Chapter 9 —Summary Of DOI's Position

DOI's position on the alternatives is based solely on the evaluation of performance measures as stated in this version of the CAR. The Cape Sable seaside sparrow, socio-economic, and project costs are examples of performance measures not evaluated in the CAR. Additionally, DOI determined that alternatives had to meet all legislative requirements.

DOI also recognizes that the assumptions used in the CAR to define the restored MWD hydrologic condition (D13R) do not represent the conditions that will likely result when the Comprehensive Everglades Restoration Plan is implemented. DOI has long maintained that the restoration requirements of the ecosystem in general and ENP in particular exceed the conditions defined in this report.

The preliminary position of the DOI on the proposed alternatives for the 8.5 SMA component of the MWD Project and the rationale for this position is as follows:

Federally Recommended Plan — Meets the Performance Criteria Evaluated Upon Implementation of Final Design Modifications Based on Recommendations of DOI and SFWMD

Legislative Requirements

- Provides for partial re-establishment of hydropatterns in NESRS. Adverse impacts to the restored NESRS hydroperiods and water depths are within acceptable limits established by DOI.

- Provides for flood mitigation of the adverse hydrological impacts associated with the implementation of the MWD project through a combination of structural features, land acquisition, and flowage easements.

- Provides additional suitable habitats for snail kites and wood storks.

Other Objectives

- Does not provide flood protection to the designated areas of the 8.5 SMA.

- Does not increase the spatial extent of short hydroperiod wetlands.

- Provides for moderate increases in wetland function for both NESRS and the 8.5 SMA
- Could potentially require retrofitting of future restoration project features.
- Provides for some re-establishment of historical hydrological regimes.

Compensatory Mitigation

- Will not require compensatory mitigation for wetlands and fish and wildlife resource losses.

Alternative 5 — Performs Best for Performance Criteria Evaluated (Environmentally Preferred)

Legislative Requirements

- Provides for full re-establishment of hydropatterns in NESRS.
- Provides for full flood mitigation of the adverse hydrological impacts associated with the implementation of the MWD Project through full acquisition.
- Provides additional suitable habitats for snail kites (6,582 acres) and wood storks.

Other Objectives

- Flood protection is provided through full acquisition.
- Does not increase the spatial extent of short hydroperiod wetlands.
- Provides for the greatest increases in wetland function in both NESRS and the 8.5 SMA.
- Will not require retrofitting of future restoration project features.
- Provides the maximum capability for re-establishment of historical hydrological regimes through a non-structural solution.

Compensatory Mitigation

- Will not require compensatory mitigation for wetlands and fish and wildlife resource losses.

Alternative 4 — Performs Well for Performance Criteria Evaluated

Legislative Requirements

- Provides for full re-establishment of hydropatterns in NESRS.
- Provides for full flood mitigation of the adverse hydrological impacts associated with the implementation of the MWD Project through acquisition, flowage easements, and life estates.
- Provides additional suitable habitats for snail kites (6,582 acres) and wood storks.

Other Objectives

- Flood protection is provided through acquisition, flowage easements, and life estates.
- Does not increase the spatial extent of short hydroperiod wetlands.
- Provides for the greatest increases in wetland function for both NESRS and the 8.5 SMA.
- Will not require retrofitting of project features.
- Provides the maximum capability for re-establishment of historical hydrological regimes through a non-structural solution.

Compensatory Mitigation

- Will not require compensatory mitigation for wetlands and fish and wildlife resource losses.

Alternative 6B — Meets the Performance Criteria Evaluated

Legislative Requirements

- Provides for re-establishment of hydropatterns in NESRS. Adverse impacts to the restored NESRS hydroperiods and water depths are within acceptable limits established by DOI.
- Provides for full flood mitigation of the adverse hydrological impacts associated with the implementation of the MWD project through flood protection to a portion of the 8.5 SMA above the 7-foot ground surface contour.

- Provides additional suitable habitats for snail kites (5,413 acres) and wood storks.

Other Objectives

- Provides flood protection to the designated areas of the 8.5 SMA.
- Does not increase the spatial extent of short hydroperiod wetlands.
- Provides for moderate increases in wetland function for both NESRS and the 8.5 SMA.
- Could potentially require retrofitting of future restoration project features.
- Provides for re-establishment of historical hydrological regimes.

Compensatory Mitigation

- Will not require compensatory mitigation for wetlands and fish and wildlife resource losses.

Alternative 6D — Meets the Performance Criteria Evaluated Based on Modifications Associated with the Recommended Plan

Legislative Requirements

- Provides for partial re-establishment of hydropatterns in NESRS. Adverse impacts to the restored NESRS hydroperiods and water depths are within acceptable limits established by DOI.
- Provides for flood mitigation of the adverse hydrological impacts associated with the implementation of the MWD project through a combination of structural features, land acquisition, and flowage easements.
- Provides additional suitable habitats for snail kites and wood storks.

Other Objectives

- Does not provide flood protection to the designated areas of the 8.5 SMA
- Does not increase the spatial extent of short hydroperiod wetlands.
- Provides for moderate increases in wetland function for both NESRS and the 8.5 SMA
- Could potentially require retrofitting of future restoration project features.

- Provides for some re-establishment of historical hydrological regimes.

Compensatory Mitigation

- Will not require compensatory mitigation for wetlands and fish and wildlife resource losses.

Alternative 1 — Poor Performance for Criteria Evaluated

Legislative Requirements

- Prevents the re-establishment of hydropatterns in NESRS due to adverse impacts on hydroperiods (3,158 acres) and water depths (27,173 acres).

- Provides flood mitigation for adverse hydrological impacts of the MWD Project for all of the 8.5 SMA except for 263 acres adversely impacted through increases in hydroperiod and 102 acres adversely impacted by increased water depths.

- Provides limited additional suitable habitats for snail kites (2,860 acres) and wood storks.

Other Objectives

- Current levels of flooding would continue because flood protection is not provided.

- Provides for a moderate increase in the spatial extent of short hydroperiod wetlands but does so at the expense of long hydroperiod wetlands.

- Reduces wetland function in all of the 8.5 SMA and in significant portions of the NESRS.

- Least compatible alternative with future restoration project features.

- Seepage collector canal and levee prevent the re-establishment of historical hydrological regimes.

Compensatory Mitigation

- Will require significant compensatory mitigation for wetlands (2,765 FUs) and fish and wildlife resource losses.

Alternative 2B — Poor Performance for Criteria Evaluated

Legislative Requirements

- Prevents the re-establishment of hydropatterns in NESRS due to adverse impacts on hydroperiods (3,275 acres) and water depths (36,640 acres). Performed worse than Alternative 1 or the No Action Alternative.
- Provides flood mitigation for adverse hydrological impacts of the MWD Project for all of the 8.5 SMA.
- Provides limited additional suitable habitats for snail kites (1,713 acres) and wood storks.

Other Objectives

- Flood protection is not provided with this alternative.
- Provides for a moderate increase in the spatial extent of short hydroperiod wetlands but does so at the expense of long hydroperiod wetlands.
- Reduces wetland function in all of the 8.5 SMA and in significant portions of the NESRS.
- One of the least compatible alternatives with future restoration project features.
- Seepage water is directed south to C–111 Project, but presence of seepage collector canal and levee prevent the complete re-establishment of historical hydrological regimes.

Compensatory Mitigation

- Will require significant compensatory mitigation for wetlands (2,765 FUs) and fish and wildlife resource losses.

Alternative 3 — Poor Performance for Criteria Evaluated

Legislative Requirements

- Provides for full re-establishment of hydropatterns in NESRS. Increases hydroperiods (82 acres) and water depths (14,934 acres) above the levels attained in the restored condition.
- Does not provide flood mitigation for adverse hydrological impacts of the MWD Project for much of the 8.5 SMA. When compared to the ex-

isting condition, 4,257 acres would have increased hydroperiods while 3,669 acres would have increased surface water depths.

- Provides additional suitable habitats for snail kites (8,380 acres) and wood storks.

Other Objectives

- Does not provide flood protection to the designated areas of the 8.5 SMA..
- Provides for a moderate increase in the spatial extent of short hydroperiod wetlands. All of this benefit is within the 8.5 SMA in areas designated for flood protection.
- Reduces wetland function in all of the 8.5 SMA and in small portions of the NESRS.
- Permanent nature of seepage barrier would potentially interfere with future restoration project features.
- Seepage barrier prevents re-establishment of historical hydrological regimes.

Compensatory Mitigation

- Will require significant compensatory mitigation for wetlands (1,775 FUs) and fish and wildlife resource losses.

Alternative 6C — Poor Performance for Criteria Evaluated

Legislative Requirements

- Prevents the re-establishment of hydropatterns in NESRS due to adverse impacts on hydroperiods (1,996 acres) and water depths (27,446 acres).
- Provides for full flood mitigation of the adverse hydrological impacts associated with the implementation of the MWD project in the 5,251 acres east of the protective levee and canal.
- Provides limited additional suitable habitats for snail kites (3,230 acres) and wood storks.

Other Objectives

- Does not provide flood protection to 3,452 acres of the 5,521 acres designated for flood protection.
- Does not increase the spatial extent of short hydroperiod wetlands.

- Reduces wetland function in parts of both the 8.5 SMA and NESRS.
- One of the least compatible alternatives with future restoration project features.
- Seepage water is directed south to C–111 Project, but presence of seepage collector canal and levee prevent the complete re-establishment of historical hydrological regimes.

Compensatory Mitigation

- Will require significant compensatory mitigation for wetlands (1,805 FUs) and fish and wildlife resource losses.

Alternative 7 — Poor Performance for Criteria Evaluated

Legislative Requirements

- Provides for full re-establishment of hydropatterns in NESRS.
- Does not provide flood mitigation for adverse hydrological impacts of the MWD Project for much of the 8.5 SMA. When compared to the existing condition, 5,976 acres would have increased hydroperiods whereas 5,059 acres would have increased surface water depths or the worst performance of all alternatives examined.
- Provides additional suitable habitats for snail kites (6,582 acres) and wood storks.

Other Objectives

- Does not provide flood protection.
- Provides no increases in the spatial extent of short hydroperiod wetlands.
- Provides for no increases in wetland function for the 8.5 SMA, but provides moderate increases in wetland function within ENP.
- Moderately compatible with future restoration project features; relocation of Structure S–356 in the Comprehensive Everglades Restoration Plan could increase flood frequency in the 8.5 SMA.
- Elevated roads without additional culverts will prevent the re-establishment of historical hydrological regimes.

Compensatory Mitigation

- Will not require compensatory mitigation for wetlands and fish and wildlife resource losses.

Alternative 8A — Poor Performance for Criteria Evaluated

Legislative Requirements

- Provides for re-establishment of hydropatterns in NESRS. Reductions in storage were limited to less than 5 percent of the restoration volumes.
- Does not provide flood mitigation for adverse hydrological impacts of the MWD Project for much of the 8.5 SMA. When compared to the existing condition, 3,934 acres would have increased hydroperiods while 3,796 acres would have increased surface water depths.
- Provides additional suitable habitats for snail kites (5,845 acres) and wood storks.

Other Objectives

- Does not provide flood protection.
- Provides minimal increases in the spatial extent of short hydroperiod wetlands.
- Provides for increases in wetland function for both the 8.5 SMA and ENP.
- Moderately compatible with future restoration project features; relocation of Structure S–356 in the Comprehensive Everglades Restoration Plan could increase flood frequency in the 8.5 SMA.
- Utilization of the natural topographic features of the western portion of the 8.5 SMA would assist in the re-establishment of historical hydrological regimes.

Compensatory Mitigation

- Will not require compensatory mitigation for wetlands and fish and wildlife resource losses.

Alternative 9 — Poor Performance for Criteria Evaluated

Assumed performance identical to Alternative 2B.

Legislative Requirements

- Prevents the re-establishment of hydropatterns in NESRS through adverse impacts on hydroperiods (3,275 acres) and water depths (36,640 acres).

- Provides flood mitigation for adverse hydrological impacts of the MWD Project for all of the 8.5 SMA.

- Provides poor habitat conditions for snail kites and wood storks.

Other Objectives

- Does not provide flood protection.

- Provides for a moderate increase in the spatial extent of short hydroperiod wetlands but does so at the expense of long hydroperiod wetlands.

- Reduces wetland function in all of the 8.5 SMA and in significant portions of the NESRS.

- One of the least compatible alternatives with future restoration project features.

- Seepage water is directed south to C–111 Project but presence of seepage collector canal and levee prevent the complete re-establishment of historical hydrological regimes.

Compensatory Mitigation

- Will require significant compensatory mitigation for wetlands (2,765 FUs) and fish and wildlife resource losses.

Chapter 10 – Department of Interior Recommendations for the Design, Construction, and Operation of the Federally Selected Alternative (Alternative 6D)

DOI recommends that the assurances listed below be integrated into the design, construction and operation of the Federally Recommended Plan for the 8.5 SMA Project, and be included in the Corps of Engineers' Record of Decision in the Final GRR/SEIS for the Federally Recommended Plan. Because the MWD project is funded through the NPS, the DOI, as a Cooperating Agency, has a vested interest in the Final GRR/SEIS, and will assist the Corps of Engineers during the Design Phase to ensure these assurances are fully implemented in order to expeditiously move forward with Everglades restoration.

DOI concludes that the benefits derived from implementation of the Recommended Plan as described in the Final SEIS and Final Fish and Wildlife Coordination Act Report represent the baseline ecological and hydrological benefits of the 8.5 SMA Project that cannot be further eroded. Since the Corps of Engineers has agreed to include these modifications and assurances in the Recommended Plan for the 8.5 SMA Project, the Service and NPS would recommend to the Secretary of the Interior to request from Congress the necessary funding for the construction and implementation of this Plan.

Assurances

I. <u>Design</u>

(a) The perimeter levee location and footprint shall maximize the amount of wetlands included west and north of the perimeter levee, following the approximate boundary in Alternative 6D.

(b) Following the approximate boundary in Alternative 6D, the levees and seepage canal system should be optimized to minimize impacts to the residents of 8.5 SMA. For example, the levee's location should avoid residences and wetlands where practicable.

(c) The Recommended Plan, including all required lands, shall become a project feature of the MWD Project. Therefore, construction and land acquisition shall be implemented as part of the project. The Federal government will retain title to the project lands and grant the non-Federal sponsor an outgrant for the lands to implement operation and maintenance responsibilities including sufficient rights for project operation, maintenance, management, repair and rehabilitation.

(d) Seepage canal design will incorporate, insofar as practicable, enhancements that will increase the potential for improved water quality through biological treatment, and increase habitat for fish and wildlife. Additionally, all lands north and west of the perimeter levee and within the 8.5 SMA will be restored and managed to maximize the ecological quality of the area to the extent practicable.

(e) Appropriate and reasonable noise abatement features such as walls surrounding the facility or interior building soundproofing will be constructed as needed in the vicinity of the proposed pumping facility.

II. Operations

(a) Operations of the 8.5 SMA Project shall be detailed in an Operations and Maintenance Manual. As appropriate, this Manual shall be agreed to by ENP, USFWS, USACE, and SFWMD, and include provisions for monitoring, emergency operations as well as mechanisms for dispute resolution to assure compliance in a manner satisfactory to all agencies.

(b) The periodic flooding of landowners east of the proposed levee, before and after project implementation, will remain unchanged from conditions in existence prior to implementation of the MWD Project. Flood mitigation, not flood protection, should be provided by the design and operation of the Recommended Plan. No deviations are intended from the operations specified in the Manual (i.e., increased pumping in the seepage canal or the inclusion of additional pumps) due to anticipated public demand for increased flood relief inside the perimeter levee of the 8.5 SMA Project.

III. Monitoring and Operations Evaluation

(a) Implementation of the Recommended Plan shall not adversely harm the restoration levels of ENP's hydrology greater than that simulated through modeling of Alternative 6D. A monitoring, evaluation, and reporting program shall be implemented to ensure operations are consistent with these levels.

IV. Water Quality

(a) Water quality treatment shall be provided for the existing runoff at the time of implementation to meet applicable state water quality standards and applicable permitting requirements and not cause degradation of ambient conditions. The water quality treatment for the Recommended Plan assumes regulatory control and enforcement actions.

(b) Water quality monitoring shall be incorporated into the Plan, including stations, parameters, sampling frequencies, and data management.

V. Secondary and Cumulative Effects

(a) The Interior Agencies and the Corps of Engineers, consistent with their authorities and the recommendations of the Governing Board of the South Florida Water Management District, shall collaborate with state and local governments to ensure that existing uses and densities in the 8.5 SMA project area are maintained.

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Chapter 11 — References Cited

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Appendix A — Final Report of 8.5 SMA Performance Measures from the Corps of Engineers, February 15, 2000

8.5 Square Mile Area Performance Measures

What are Performance Measures?

Performance measures are quantitative or qualitative indicators of how well (or poorly) an alternative meets a specific objective. Ideal performance measures are quantifiable, have a specific target, indicate when that target has been reached, or measure the degree of improvement toward the target when it has not been reached.

Project Goal: (*The desired end result of this planning and study effort*)

Facilitate selection of a plan for the 8.5 SMA that would provide a technical solution for the hydrological and ecological restoration of the Everglades National Park as specified in the 1989 Act while maintaining compatibility with Comprehensive Everglades Restoration Project Objectives.

Project Requirements: (*The results required for any alternative to be viable*)

1. Do not negatively impact higher stages in ENP as specified in the Modified Waters Delivery Project.

2. Mitigate for increased stages within the 8.5 Square Mile Area resulting from implementation of the Modified Waters Delivery Project.

3. Develop a solution that can be permitted by regulatory interests under current and reasonably foreseeable regulations (i.e. water quality, wetlands).

4. Ensure no significant impact to existing habitat of endangered or threatened species.

5. Maintain current levels of flood protection for agricultural areas east of L–31.

Project Objectives: (*What we want to accomplish in the project*)

1. Evaluate effects on hydropatterns in the NESRS.

2. Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the Modified Water Delivery Project.

3. Analyze Cost Effectiveness.

4. Analyze Effects to Ecological Functions.

5. Evaluate effect on conditions favorable to Federal and State Listed Endangered Species survival.

6. Measure compatibility with Comprehensive Everglades Restoration Plan and C–111 Projects without adversely impacting the current level of flood protection east of L–31N.

7. Analyze impacts and costs associated with time delays in implementation of alternatives.

Model Specifications: (*The rules of the hydrologic modeling)*

Boundary Conditions – This represents the flow and head conditions along Tamiami Trail used in the model. There are three boundary conditions used:

Base83 – This represents the conditions along Tamiami Trail as authorized in the 1992 GDM for the MWD Project.

Base95 – This represents the conditions along Tamiami Trail as they exist today, based on experimental operating conditions authorized in 1995.

MWD Full Implementation (D13R) – This represents the projected conditions along Tamiami Trail in the future with the MWD Project in place.

Operating Procedures – This is a representation of how the entire system is operated.

a. 1983 – Represents the authorized canal levels and operations prior to the Experimental Water Deliveries Program Operation.

b. 1995 – Operation of the system approximately the same as it was operated in 1995. This is also approximately the same as it is operated today.

Precipitation – The precipitation records used for the model runs based on actual observed rainfall data.

c. 1989 – Dry year; used to evaluate conditions under the driest year.

d. 1995 – Wet year; used to evaluate conditions under the wettest year.

C–111 Rules – The runs for the future conditions assumed that the C–111 project would be in place. However, there are no set operations rules currently approved for this future project. Therefore, the model used certain standard operating conditions for this project and held them constant for all model runs with future conditions.

Project Conditions: (The conditions for which the alternatives will be analyzed)

Comparison of Project Conditions					
ID No.	**Project Condition**	**Operating Procedure**	**Boundary Conditions**	**C–111 Project**	**8.5 SMA Alts Considered**
1	Base 83	1983	1983	No	None
2	Base 95	1995	1995	No	None
3	Base 83 + Future w/o Project	1983	MWD (projected full implementation)	Yes	Alt #1 *(Authorized Plan)*
4	Base 95 + Future w/o Project	1995	MWD (projected full implementation)	Yes	Alt #1 *(Authorized Plan)*
5	Future w/ Project	1995	MWD (projected full implementation)	Yes	Alts # 2-9 *(Potential LPAs)*

The "Base 83" condition assumes stage and flow conditions and operations as they existed prior to the MWD Project. This is the base condition for which the federal requirement for flood mitigation must be verified.

The "Base 95" condition assumes stage and flow conditions and operations as they currently exist. This is the basis for which impacts of the alternatives to existing conditions will be measured.

The "Base 83 + future without project" condition assumes that the system is operating according to the 1983 operations, and the MWD project will be implemented with C–111 in place, and the Authorized Plan (Alt No. 1) will be constructed.

The "Base 95 + future without project" condition assumes that the system is operating according to the 1993 operations, and the MWD project will be implemented with C–111 in place, and the Authorized Plan (Alt No. 1) will be constructed. This is the base for which the "future with project" scenario will be compared.

The "future with project" conditions assumes that the MWD project will be implemented and the system is operating according to the 1995 operations with C–111 in place, and that any one of the potential LPAs (alts 2-9) would be implemented.

Alternative Comparisons: *(The basis for determining the performance of the alternatives for various conditions)*

Alternative Comparisons				
ID No.	Comparison	Purpose of Comparison	Base Condition	Proposed Condition
A	Federal Requirement	Verify mitigation requirements met by each alternatives	Condition 1	Conditions 4 & 5
B	Impacts to Existing Conditions	Impacts of each alternative to current conditions	Condition 2	Conditions 4 & 5
C	LPA Comparison	Differences in proposed LPAs to authorized plan	Condition 4	Condition 5

A. Federal Requirement - To determine if the federal mitigation requirement is being met for all alternatives; Conditions 4 and 5 will be compared back to Condition 1

B. Impacts to Existing Conditions- To determine impacts of all alternatives to current conditions; Conditions 4 and 5 will be compared back to Condition 2

C. LPA Comparison - To evaluate Authorized Plan (Alt 1) versus potential LPAs (Alts 2-9); Condition 5 will be compared back to Condition 4.

1. Evaluate effects on hydropatterns in NESRS.			
Measure	**Description**	**Metric/Comments**	**Comparison**
a. Hydroperiod Impacts	Increase or decrease in hydroperiods (stage and duration) for areas within NESRS.	Total number of days with an increase (+) or decrease (-) in stage for key indicator cells within NESRS. Determined by comparing the change in stage for each of the 52 (7-day) timesteps for each indicator cell.	B, C
b. Water depths	Increase or decrease in water depths for areas within NESRS.	Total number of acres within NESRS with an increase (+) or decrease (-) in water depths. Determined by comparing the average change in water depth for each cell during the model year (based on 52 7-day timesteps).	B, C
c. Effects on Seasonal variability	Change in stage variation (min, max, range) at key indicator cells.	Minimum/Maximum: Compare hydrograph for key indicator cells for four-week period (with min/max in middle). Range: Compare changes in ranges (max-min) for each indicator cell.	B, C
d. Duration of continuous flooding	Number of consecutive days with depths greater than 0.2 feet at key indicator cells.	Compare the number of consecutive days of depths > 0.2 feet for at key indicator cells.	B, C

2. Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the Modified Water Delivery Project			
Measure	**Description**	**Metric/Comments**	**Comparison**
Flood mitigation damages	Extent of project induced flood damages (area and duration) to areas designated for flood mitigation not prevented by mitigation structural features	Area: Total number of acres within the 8.5 SMA where the total depth of inundation is greater than the comparison base condition. Duration: Total number of acres within the 8.5 SMA where the total days of inundation are greater than the comparison base condition.	B, C
Flood protection damages	Extent of project induced flood damages (area and duration) to areas designated to receive 1-in-10 year flood protection not prevented by protection structural features.	Area: Total number of acres within designated protection area where the stage is greater than the comparison base condition during weeks 21-37 of the 1995 model year. Duration: Total number of days where the stage is greater than the comparison base condition within designated protection area during weeks 21-37 of the 1995 model year.	B, C
Impacts to business	Potential direct or indirect loss to local business activity.	Number of businesses impacted from PMs 2a. and 2b. above.	B, C
Residents relocated	Potential number of residents required to be relocated.	Number of residents relocated from PMs 2a. and 2b. above.	B, C
Lost agricultural lands	Potential number of acres of agricultural lands that will no longer be available for agricultural uses.	Number of acres of agriculture lands lost from PMs 2a. and 2b. above.	B, C
f. Unwilling sellers	Potential number property owners who are unwilling to sell their property	Number of owners unwilling to sell their property.	B, C

3. Analyze Cost Effectiveness

Measure	Description	Metric/Comments	Comparison
Project costs	Increase in overall project costs	Actual estimated cost of the alternative; includes capital construction costs and O&M costs	C
Local Costs	Secondary impact costs to Miami-Dade County and/or residents	Costs potentially incurred by the County as a result of any alternative implementation in conformance with applicable local ordinances.	C

4. Analyze Effects to Ecological Functions

Measure	Description	Metric/Comments	Comparison
Wetlands west of L–31N	Spatial extent of wetlands west of L–31N	Number of acres with water level > -1.5 feet of ground surface for at least 18 consecutive days.	B, C
Short Hydroperiod wetlands	Spatial extent of short hydroperiod wetlands (Marl forming)	Number of acres with depth between –1.5 feet and 2.0 feet for greater than 18 consecutive days and less than 90 consecutive days.	B, C
WRAP Score	Function and value of wetlands	Wetlands Rapid Assessment Protocol Score at selected indicator cells.	B, C

5. Evaluate effects on conditions favorable to Federal and State Listed Endangered Species survival			
Measure	**Description**	**Metric/Comments**	**Comparison**
Cape Sable Seaside Sparrow	Evaluate key indicator cells at CSSS habitat Area F.	No. of consecutive days from 3/1 through 7/15 with water levels below ground surface Total no. of days w/ water levels above ground for model year Range of depth during model year	B, C

6. Measure compatibility with CERP and C–111 projects without adversely impacting the current level of flood protection east of L–31N			
Measure	**Description**	**Metric/Comments**	**Comparison**
Compatibility with CERP	Need for project features to be removed or significantly rehabilitated to accommodate the CERP features	Qualitative discussion and assessment of ability of each alternative to meet this objective.	N/A
Compatibility with C–111	Ability to accommodate the C–111 project requirements	Qualitative discussion and assessment of ability of each alternative to meet this objective.	N/A
Agricultural lands east of L–31N	Potential increase in either stage or duration to agricultural lands east of L–31N	Total number of acres of agriculture lands east of L–31N with an increase (+) or decrease (-) in water depths. Determined by comparing the average change in water depth for each cell during the model year (based on 52 7-day timesteps).	B, C

7. Analyze impacts and costs associated with time delays in implementation of alternatives			
Measure	**Description**	**Metric/Comments**	**Comparison**
Environmental and cultural resources	Lost environmental resources due to higher water levels in WCA 3A, WCA 3B, and NESRS.	Qualitative discussion of the resources impacted if schedule is extended.	C
Ability to meet implementation schedule	Ability of each alt to be implemented before March 2003?	This will be a yes or no answer with estimate of projected completion.	C
Construction delays	Unknowns associated with construc-tability (including land acquisition issues)	Qualitative discussion of the implementation issues, that will impact scheduling	C
Administrative requirements of alternatives	Estimate potential delays associated with admin requirements of any potential LPA	Qualitative discussion of the administrative issues that will impact scheduling.	C

Appendix B — Hydrologic Modeling Results

The following are the modbranch output files used to produce the hydrologic results discussed in this report. Each of these files consists of weekly averages of the head data for each cell in the model domain so the full filename would be what is given below appended with "_weekly.hed"

The filenames are descriptive of the input file conditions. The first segment in the filename refers to the boundary conditions used, the second to the canal configuration implemented, the third to the precipitation year applied, and the fourth to the operating conditions of the canals. Files with "no10yrEvent" are 1995 precipitation year runs without the addition of the synthetic 1 in 10 year storm. Files with "356" are existing conditions runs with pumping added at S–356 in the Northeast corner of ENP so that they could be compared to the alternatives which all had pumping at S–356. Plan 2B results were reported for Plan 9B as well, since the effect was considered to be equivalent. In analyses where multiple files were compared to a standard, i.e. all the plans were compared to the restored condition, the standard filename is preceded by an *.

Figure 2 Effect of synthetic 1 in 10 year storm on water levels

D13Rbc_exist_1995_95ops
D13Rbc_exist_1995_95ops_no10yrEvent

Figure 3 Effect of synthetic 1 in 10 year storm on hydroperiods

D13Rbc_exist_1995_95ops
D13Rbc_exist_1995_95ops_no10yrEvent

Figure 4 Effect of C–111 in model simulations

D13Rbc_exist_1995_95ops
D13Rbc_C-111_1995_95ops

Figure 5 Comparison of simulated hydroperiods for 83 ops and 95 ops

D13Rbc_exist_1995_95ops
D13Rbc_exist_1995_83ops

Figures 10 – 31: Hydroperiods and Average Depths

Base83bc_exist_1995_83ops
Base95bc_exist_1995_95ops
D13Rbc_C-111_1995_95ops
D13Rbc_C-111_356_1995_95ops
D13Rbc_plan1_1995_95ops
D13Rbc_plan2B_1995_95ops
D13Rbc_plan3_1995_95ops
D13Rbc_plan6B_1995_95ops
D13Rbc_plan2C(6C)_1995_95ops
D13Rbc_plan6D_1995_95ops
D13Rbc_plan8A_1995_95ops

Base83bc_exist_1989_83ops
Base95bc_exist_1989_95ops
D13Rbc_C-111_1989_95ops
D13Rbc_plan1_1989_95ops
D13Rbc_plan2B_1989_95ops
D13Rbc_plan3_1989_95ops
D13Rbc_plan6B_1989_95ops
D13Rbc_plan2C(6C)_1989_95ops
D13Rbc_plan6D_1989_95ops
D13Rbc_plan8A_1989_95ops

Table 2 Increases and Decreases in Hydroperiod and Average Water Depth in NESRS Relative to Restored Hydroperiod and Water Depth

* D13Rbc_C-111_356_1995_95ops
D13Rbc_plan1_1995_95ops
D13Rbc_plan2B_1995_95ops
D13Rbc_plan3_1995_95ops
D13Rbc_plan6B_1995_95ops
D13Rbc_plan2C(6C)_1995_95ops
D13Rbc_plan6D_1995_95ops
D13Rbc_plan8A_1995_95ops

Table 3 Increases And Decreases In Water Volume In NESRS Relative To Restored Conditions for Wet Year (1995).

* D13Rbc_C-111_356_1995_95ops
D13Rbc_C-111_1995_95ops
D13Rbc_plan1_1995_95ops
D13Rbc_plan2B_1995_95ops
D13Rbc_plan3_1995_95ops
D13Rbc_plan6B_1995_95ops
D13Rbc_plan2C(6C)_1995_95ops
D13Rbc_plan6D_1995_95ops
D13Rbc_plan8A_1995_95ops

Table 4 Increases and Decreases in Hydroperiod and Average Water Depth in 8.5 SMA Relative to Existing Hydroperiod and Water Depth

* D13Rbc_C-111_1995_95ops
D13Rbc_C-111_356_1995_95ops (used to produce data for Plans 4, 5, 7)
D13Rbc_plan1_1995_95ops
D13Rbc_plan2B_1995_95ops
D13Rbc_plan3_1995_95ops

D13Rbc_plan6B_1995_95ops
D13Rbc_plan2C(6C)_1995_95ops
D13Rbc_plan6D_1995_95ops
D13Rbc_plan8A_1995_95ops

Figure 34 Existing short hydroperiod wetlands from modeled performance measure

Filtered average of:
Base95bc_C-111_1989_95ops
Base95bc_C-111_1995_95ops

Table 5 Areal Extent of Area Within Flood Protection Zone And The 8.5 SMA Receiving Flood Protection

D13Rbc_exist_1995_95ops
D13Rbc_C-111_1995_95ops
D13Rbc_plan1_1995_95ops
D13Rbc_plan2B_1995_95ops
D13Rbc_plan3_1995_95ops
D13Rbc_plan6B_1995_95ops
D13Rbc_plan2C(6C)_1995_95ops
D13Rbc_plan6D_1995_95ops
D13Rbc_plan8A_1995_95ops

Table 8 Acres of Short Hydroperiod Wetlands

Filtered average of each of the following pairs:
Base95bc_C-111_1989_95ops
Base95bc_C-111_1995_95ops
D13Rbc_plan1_1989_95ops
D13Rbc_plan1_1995_95ops
D13Rbc_plan2B_1989_95ops
D13Rbc_plan2B_1995_95ops
D13Rbc_plan3_1989_95ops
D13Rbc_plan3_1995_95ops
D13Rbc_plan6B_1989_95ops
D13Rbc_plan6B_1995_95ops
D13Rbc_plan2C(6C)_1989_95ops
D13Rbc_plan2C(6C)_1995_95ops
D13Rbc_plan6D_1989_95ops
D13Rbc_plan6D_1995_95ops
D13Rbc_plan8A_1989_95ops
D13Rbc_plan8A_1995_95ops

Figures 38–44 Water Depth Difference Maps (Restored – Plan)

D13Rbc_plan1_1995_95ops
D13Rbc_plan2B_1995_95ops
D13Rbc_plan3_1995_95ops
D13Rbc_plan6B_1995_95ops
D13Rbc_plan2C(6C)_1995_95ops
D13Rbc_plan6D_1995_95ops
D13Rbc_plan8A_1995_95ops

Appendix C — Fish and Wildlife Management Plan: Attachments

Invasive Exotic Plant Removal and Control

Removal of invasive exotic plant species can be accomplished through proven chemical and mechanical techniques based on plant morphology (herbaceous versus woody) and density of the species present. Typically, exotic grasses, such as *Neyraudia reynaudiana* and *Pennisetum purpureum*, must be treated mechanically first, either by mowing or cutting by hand to the soil surface, followed by treatment with herbicide such as glyphosate (Roundup). Glyphosate must be applied when the exotic grasses are re-sprouting. Woody exotic species can be eliminated by chemical or mechanical methods. If woody exotics are in small isolated stands or mixed with desirable species, they can be treated through aerial spraying or spot treatment with herbicide. The remaining standing dead piled and burned. However, if the woody exotic is a dense monospecific stand covering several hectares, mechanical removal using bulldozers or hydroaxes followed by stump removal is suggested. The remaining slash should be piled and removed (preferred) or burned to prevent the site from becoming eutrophic.

Once the invasive exotics are removed from an area, their reintroduction onto a restored site can be controlled through the reestablishment of a hydrological pattern on the 8.5 SMA. The depth, timing, and duration of inundation primarily control the distribution of vegetation in the Everglades. Tied directly to the hydrological pattern in controlling colonization of invasive exotics onto restored sites are secondary factors such as site elevation, surficial geology, and overlying soil type. These secondary factors are not any less important in influencing plant species composition and abundance than hydrological pattern and should not be ignored. The results of the Hole-in-the-Donut (HID) Wetland Restoration and Mitigation Program in Everglades National Park show that once a site is restored, invasive exotics, particularly *Schinus terebinthifolius*, can be controlled through the reestablishment of a hydrological pattern. In the HID the minimal hydroperiod that is expectable is six months in duration with a water depth of 15 to 20 cm.

In the 8.5 SMA, it is suggested that the final grade of the area be less than 6.5 feet to recreate, at a minimum, a short hydroperiod prairie. To achieve this final elevation any overlying artificial (rock-plowed) or natural soil or geologic feature be removed using currently available scrapping techniques. If the hydrologic pattern were restored, re-colonization by herbaceous and woody invasive exotics onto the restored sites would be minimal and could be controlled through water and fire management in concert with spot herbicide treatments.

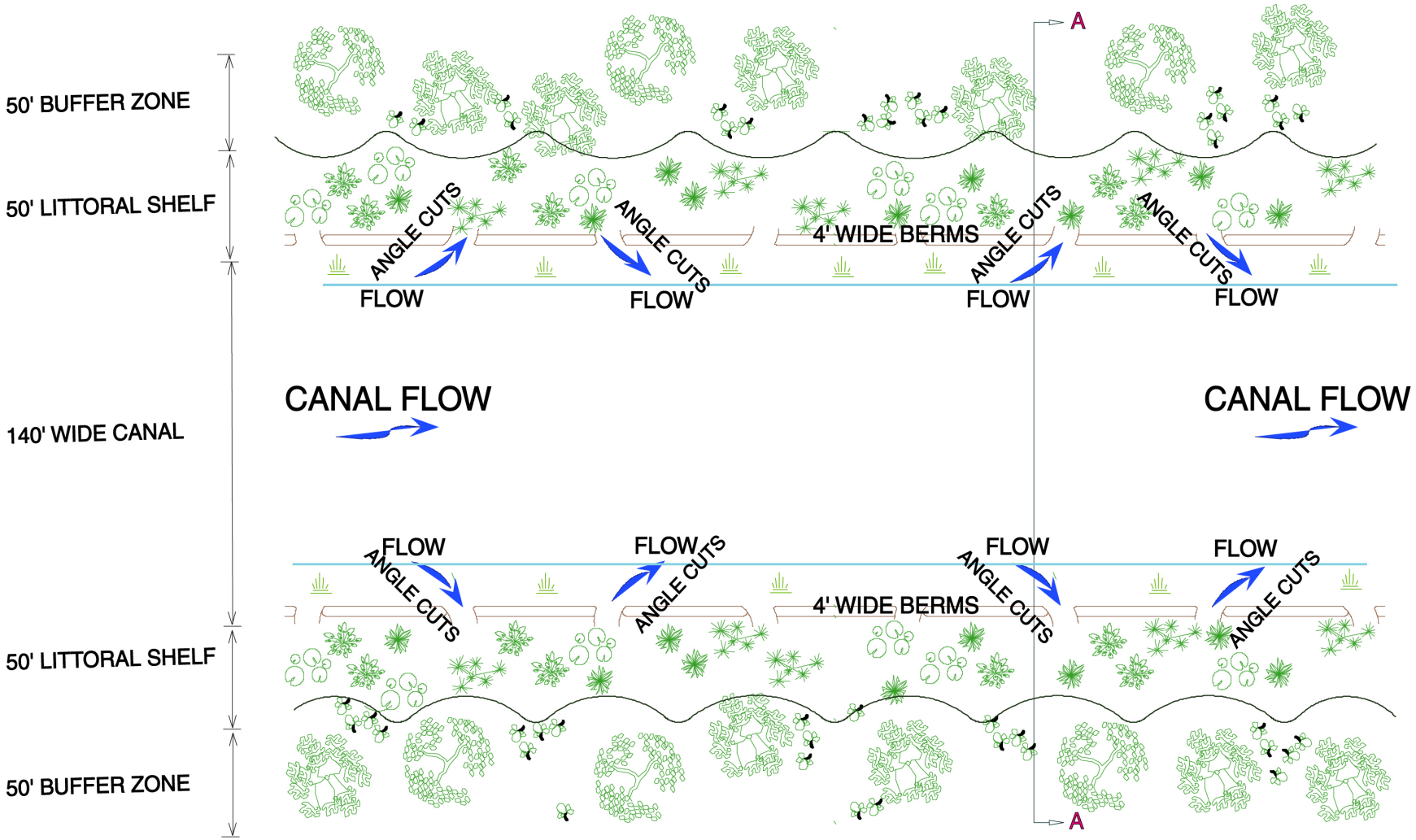


Plate 1. Plan view of conceptual design for littoral shelf along canal for habitat enhancement.

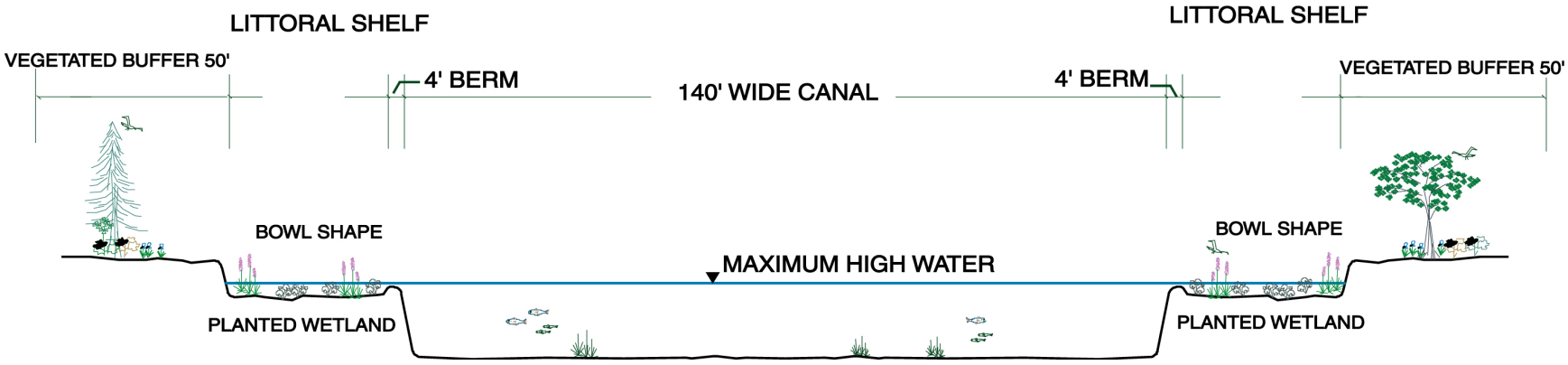


Plate 2. Cross-sectional view of conceptual design for littoral shelf along canal for habitat enhancement.

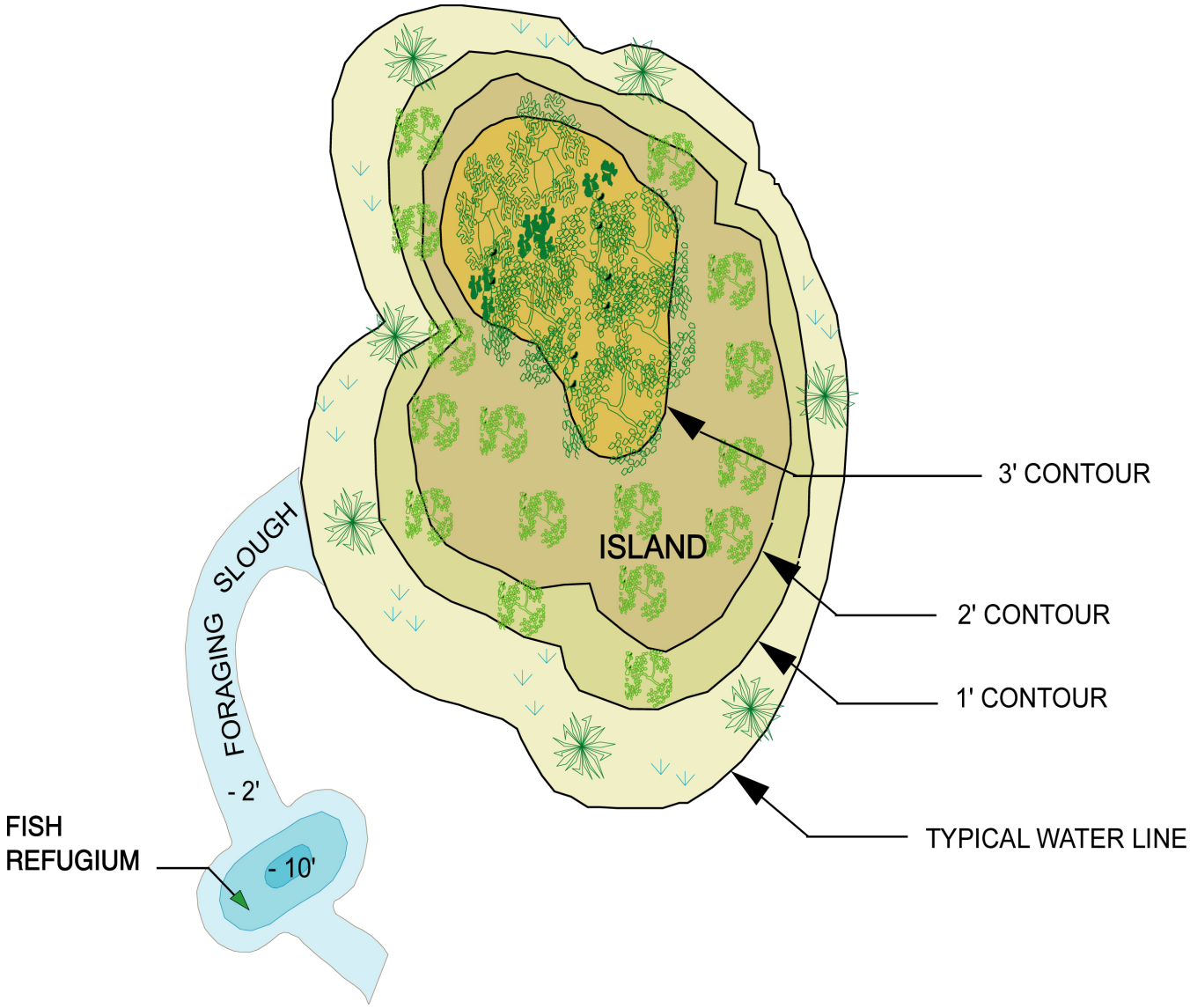
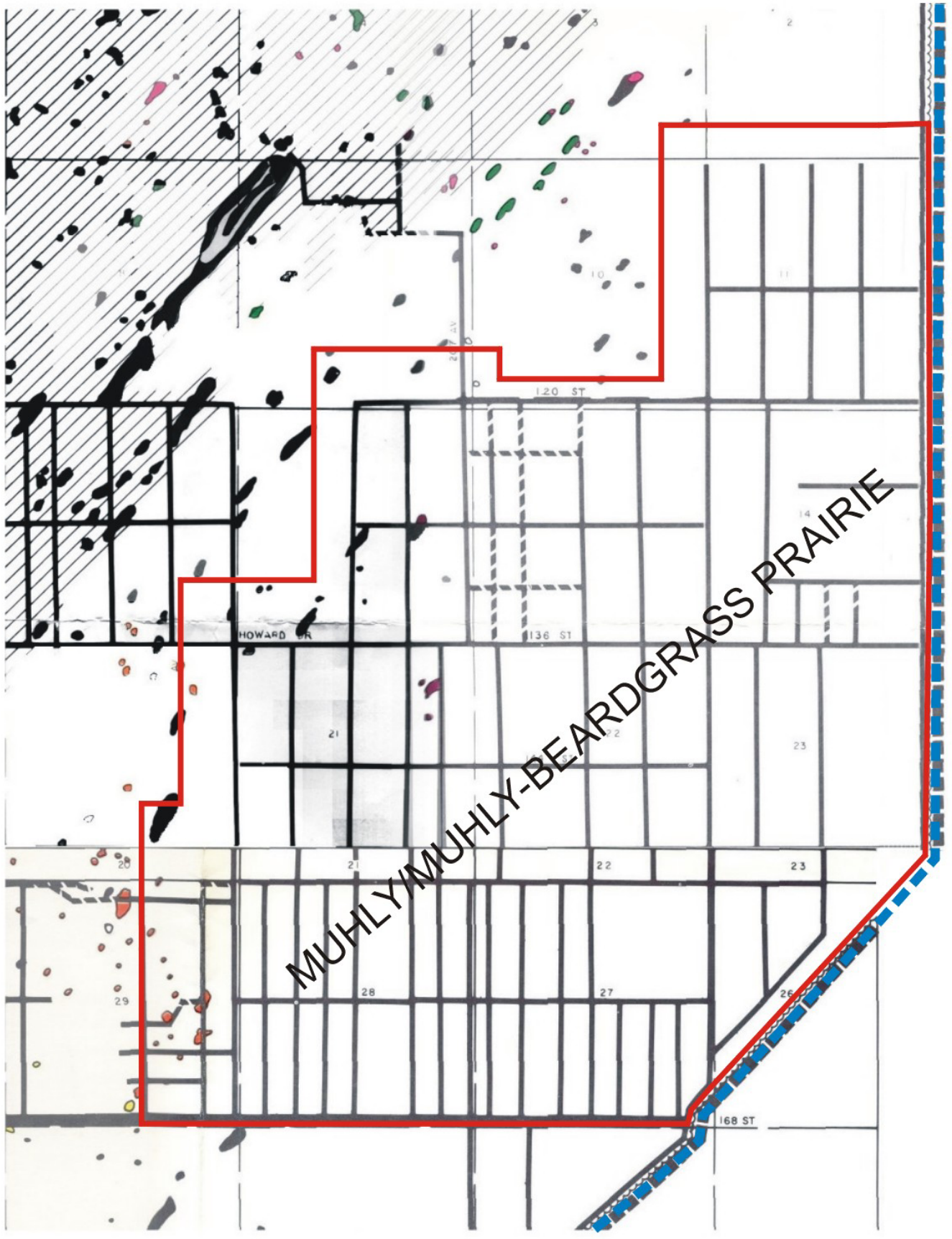


Plate 3. Plan view of conceptual design for tree island as habitat enhancement.



COMMUNITY TYPES

1	Sawgrass Glades
2	Spike Rush-Beak Rush
3	Maidencane Flats
4	Flag-Pickerel weed (Ponds)
5	Cattail Marshes
8	Narrow Beard Grass, Three-Awn Grass, Love Grass Prairies
9	Wax Myrtle-Saltbush Thickets
10	Willow Thickets
11	Cocoplum Thickets
	Willow-Pond Apple-Wax Myrtle Thickets
13	Buttonwood Strands
14	Scrub Mangrove Thickets
16	Open-Canopy Cypress Forests ("hatrack cypress")
17	Cypress Strand Forests
18	Cypress Dome Forests
21	Mangrove Forests
22	Mangrove-Tropical Hardwood Forests ("low hammocks")
	Shark Slough Forests
	Taylor Slough Bayhead Forests
	Bayhead-Tropical Hardwood Forests, including successional stages to tropical hammocks of Shark Slough Community and Taylor Slough Forests
	Tropical Hammock Forests
25	Midden Forests
	Marsh Thicket Mosaic Communities
	Post-burn Recovery Vegetation of Former Bayhead
	Post-burn Recovery Vegetation of Former Cypress Dome Formation
	Post-burn Recovery Vegetation of Hammock Communities

COMMUNITY MOSAICS

- Community Types 1, 2, 3 (in order of abundance)
- Community Types 2, 1, 3 " "
- Muhly Prairies, Community Types 1 & 2 and Muhly-Beardgrass Prairie
- Muhly Prairie Community and Muhly-Beardgrass Prairie Community
- Post-burn Recovery Vegetation of Former Bayhead, Former Cypress Dome Formation or Hammock Communities, Prairie Tree Island Communities, including Narrow Beard Grass, Three-Awn Grass, Love Grass Prairies and Wax Myrtle-Saltbush Thickets

LEGEND

- WATER BODIES
- PAVED ROADS
- IMPROVED(filled) ROADS
- UNIMPROVED(not shown in agricultural areas) ROADS
- TRAILS
- STUDY AREA BOUNDARY

Source: Modified from Hofstetter et al. 1979: Map 1 of 5

Date of field mapping: Sept. 1978 - April 1979

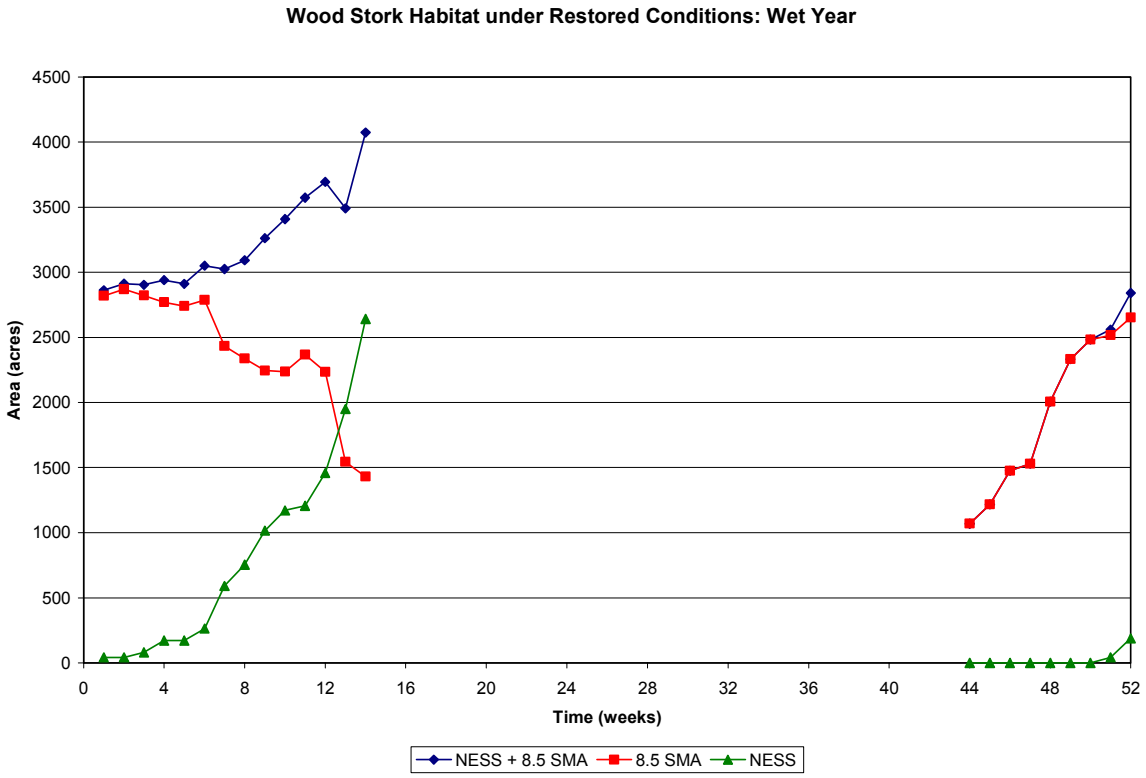
CENTRAL AND SOUTHERN FLORIDA
MODIFIED WATER DELIVERIES TO
EVERGLADES NATIONAL PARK, FLORIDA
8.5 SQUARE MILE AREA

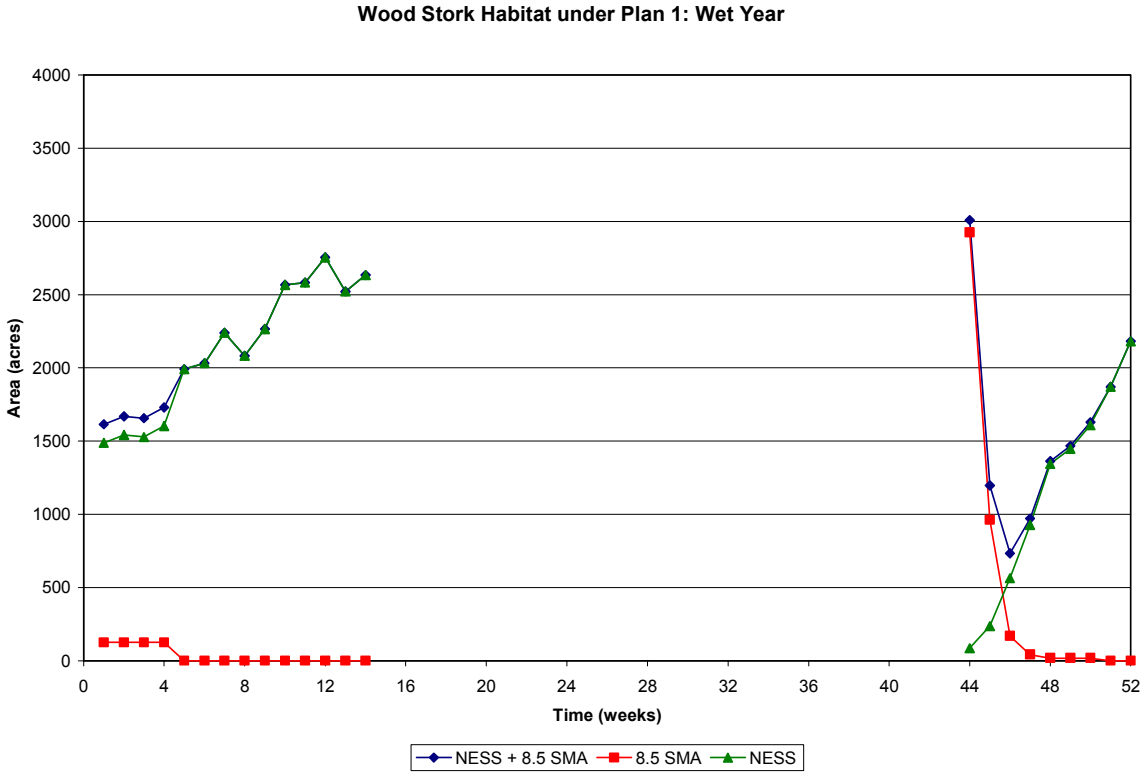
PLANT COMMUNITIES IN THE 8.5 SQUARE MILE AREA AND ADJOINING SECTIONS OF THE EAST EVERGLADES

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

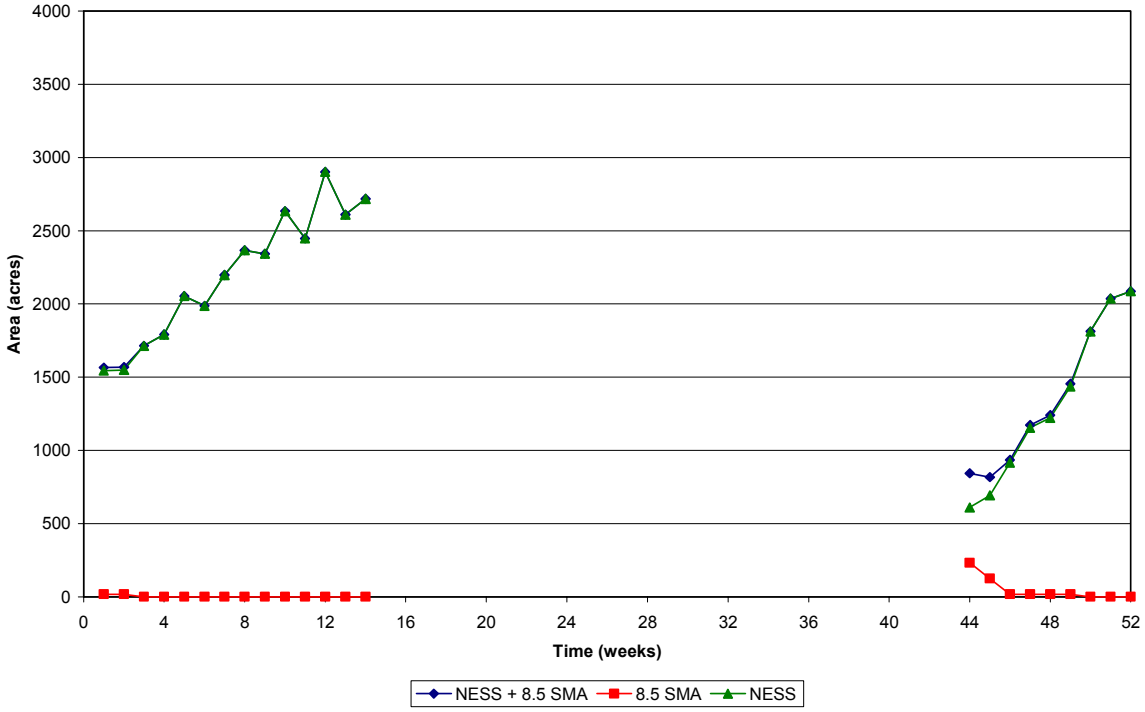
TO ACCOMPANY PLANNING DOCUMENT DATED:_____
FILE NO.

Appendix D — Wood Stork Analysis Results

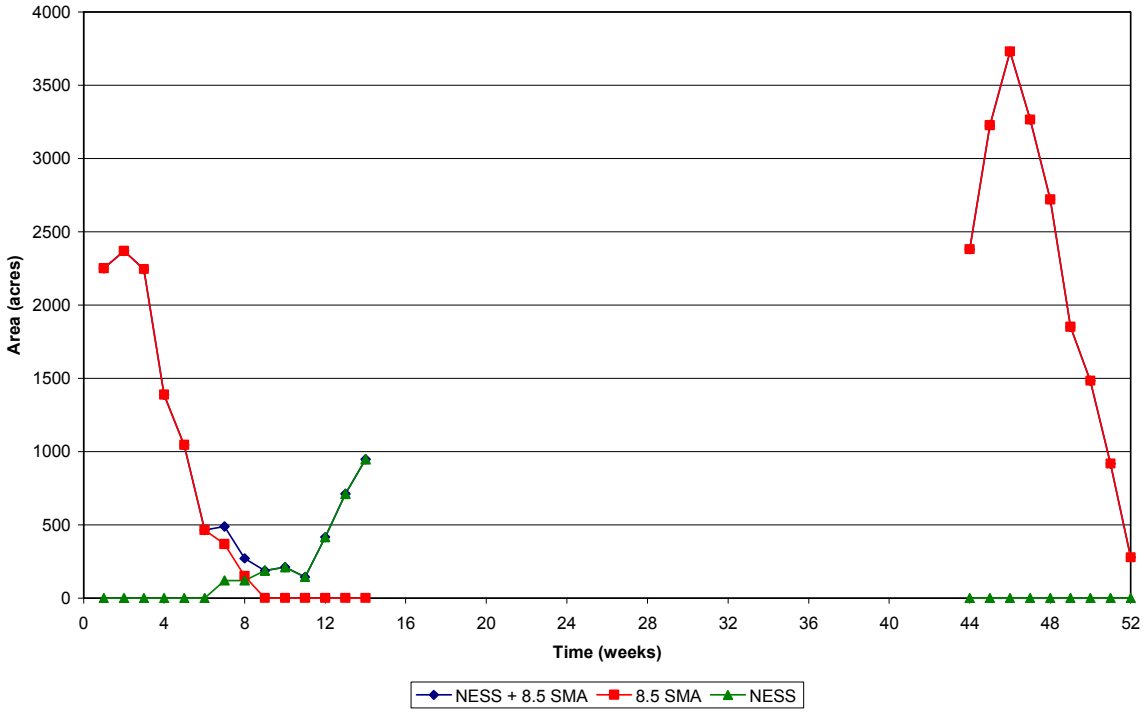

Wood Stork Habitat under Restored Conditions: Wet Year
Area (acres)
Time (weeks)
NESS + 8.5 SMA
8.5 SMA
NESS

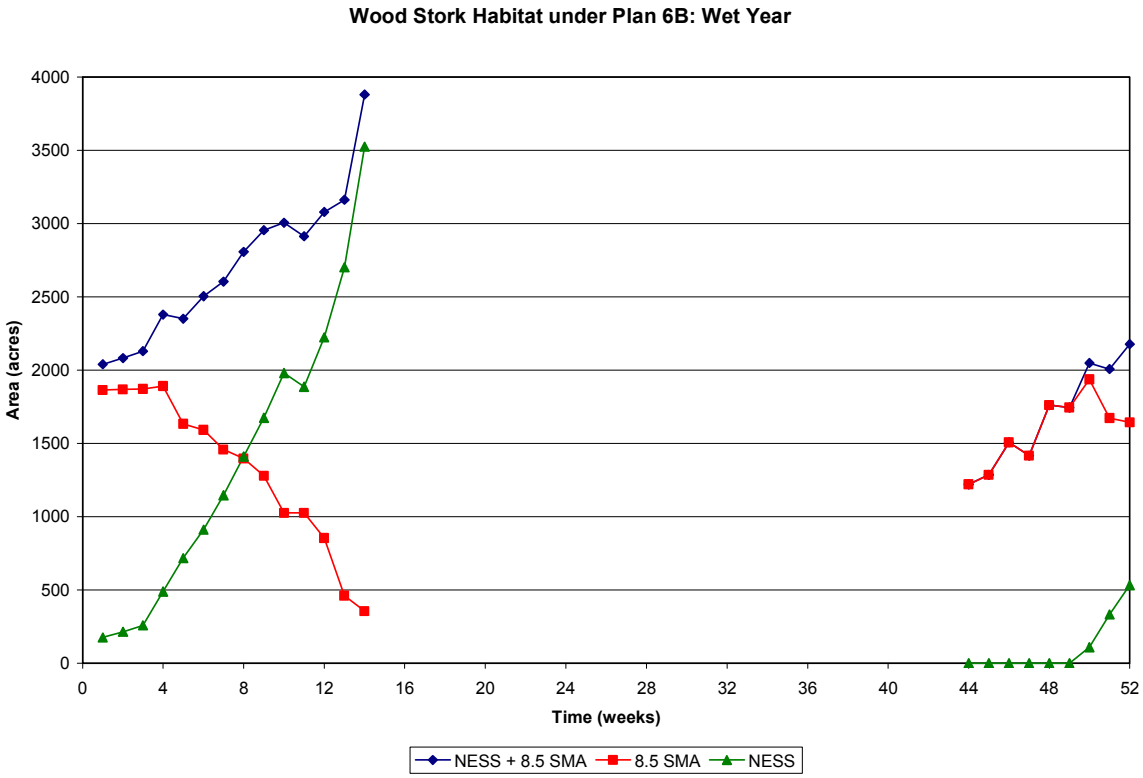

Wood Stork Habitat under Plan 1: Wet Year
Area (acres)
Time (weeks)
NESS + 8.5 SMA
8.5 SMA
NESS

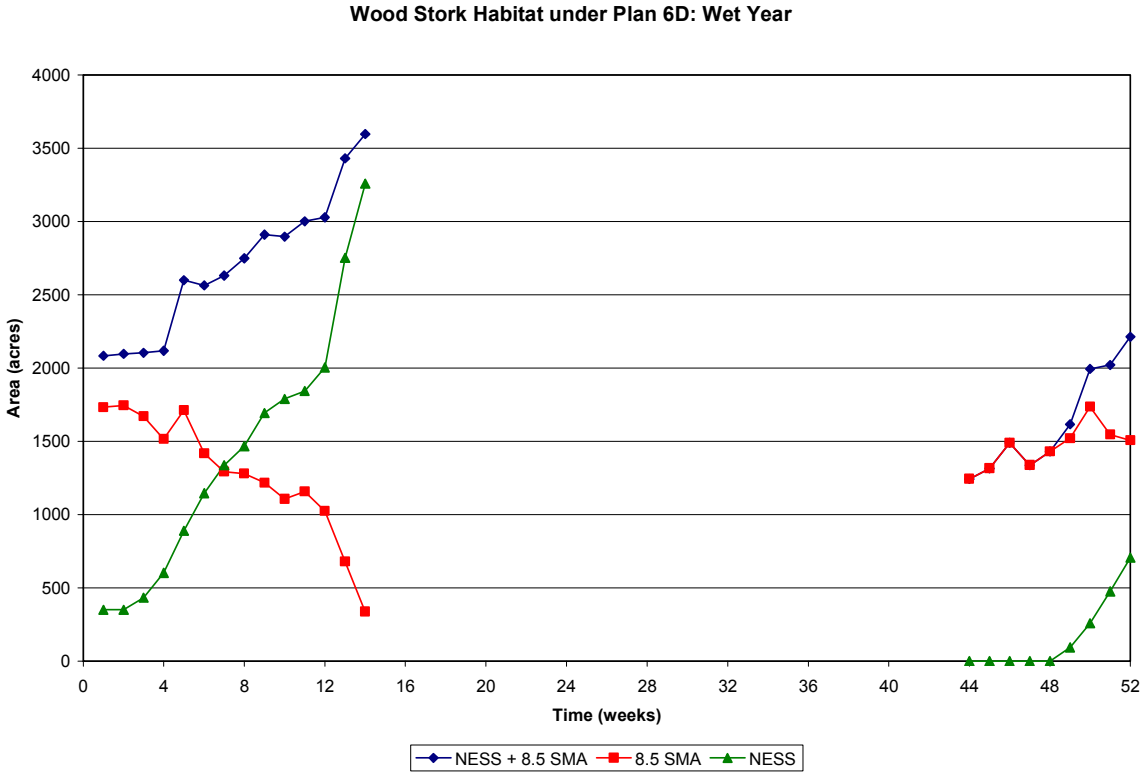
Wood Stork Habitat under Plan 2B and 9B: Wet Year

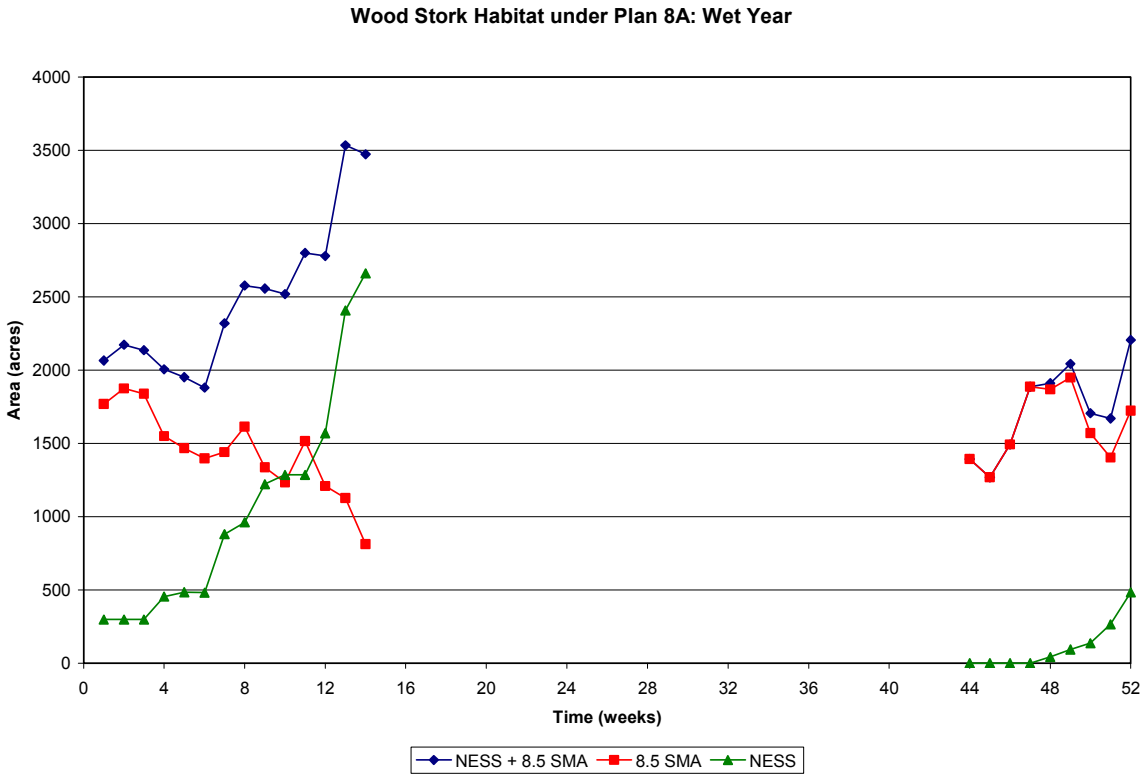


Wood Stork Habitat under Plan 3: Wet Year




Wood Stork Habitat under Plan 6B: Wet Year
Area (acres)
0
500
1000
1500
2000
2500
3000
3500
4000
0
4
8
12
16
20
24
28
32
36
40
44
48
52
Time (weeks)
NESS + 8.5 SMA
8.5 SMA
NESS


Wood Stork Habitat under Plan 6D: Wet Year
Area (acres)
0
500
1000
1500
2000
2500
3000
3500
4000
0
4
8
12
16
20
24
28
32
36
40
44
48
52
Time (weeks)
NESS + 8.5 SMA
8.5 SMA
NESS


Wood Stork Habitat under Plan 8A: Wet Year
Area (acres)
0
500
1000
1500
2000
2500
3000
3500
4000
0
4
8
12
16
20
24
28
32
36
40
44
48
52
Time (weeks)
NESS + 8.5 SMA
8.5 SMA
NESS

Appendix E — Evaluation of DERM Water Quality Data from the 8.5 SMA Following Hurricane Irene

The phosphorus samples were analyzed first by PBS&J (Post, Buckley, Shue, & Jerrnigun); a month and one-day after they were collected. This is one day over QA/QC protocols (EPA recommended). In a court of law these samples would not be admissible. However, total phosphorus concentrations will not change if the holding times are not meet. The samples were then analyzed by the DERM laboratory. The PBS&J laboratory has done poorly in the FDEP round-robin phosphorus testing. Looking at the blanks, it appears that the PBS&J MDL for total phosphorus is 20 ppb, which is well above the MDL of most Everglades labs. However, the PBS&J and DERM total phosphorus concentrations are fairly close. DERM values are slightly less.

Given the above limitations; there is concern with these TP values in the 8.5 SMA after a large storm event. All TP values from the DERM lab were above the Consent Decree standard for Shark Slough of 8 ppb and Taylor Slough of 6 ppb. The lowest values are the western-most stations (5 and 6) and the highest values were south and eastern sections.

Two "Priority Pollutants" were detected. The SFWMD categorizes these two compounds as purgeables. They are methylene chloride and toluene. Both of these are organic solvents. Methylene chloride was detected at one station (8SQM-6) and in the trip blank. The DERM laboratory MDL for methylene chloride is 5.00 ug/L (ppb). The value at 8SQM-6 is 5.74 ug/L, which is slightly above the MDL, and the value from the Trip Blank is 10.6 ug/L. It appears likely that the appearance of methylene chloride in this case is due to sampling or laboratory contamination.

Contamination of toluene is more significant. It appears in 6 of the 10 sampling locations and does not appear in any of the blanks. The DERM laboratory MDL for toluene is 0.37 ug/L (ppb). The following is a summary:

Station ID	Station Location[1]	MDL (mg/L)	Results (mg/L)
8SQM-1	SW 160 St. & SW 198 Ave.	0.37	0.37
8SQM-2	SW 160 St. & SW 202 Ave.	0.37	0.37
8SQM-3	SW 160 St. & SW 208 Ave.	0.37	4.66
8SQM-4	SW 160 St. & SW 212 Ave.	0.37	4.32
8SQM-5	SW 167 St. & SW 217 Ave.	0.37	0.49
8SQM-6	SW 143 St. & SW 212 Ave.	0.37	0.51
8SQM-7	SW 144 St. & SW 205 Ave.	0.37	1.24
8SQM-8	SW 129 St. & SW 202 Ave.	0.37	2.18
8SQM-8FD	SW 129 St. & SW 202 Ave.	0.37	2.70
8SQM-9	SW 128 St. & SW 194 Ave.	0.37	0.37
8SQM-10	SW 144 St. & SW 194 Ave.	0.37	0.37
Trip Blank	NA	0.37	0.37
Blank D	NA	0.37	0.37
Blank A	NA	0.37	0.37

Note:
1. Locations of the stations are shown on Figure E–1.

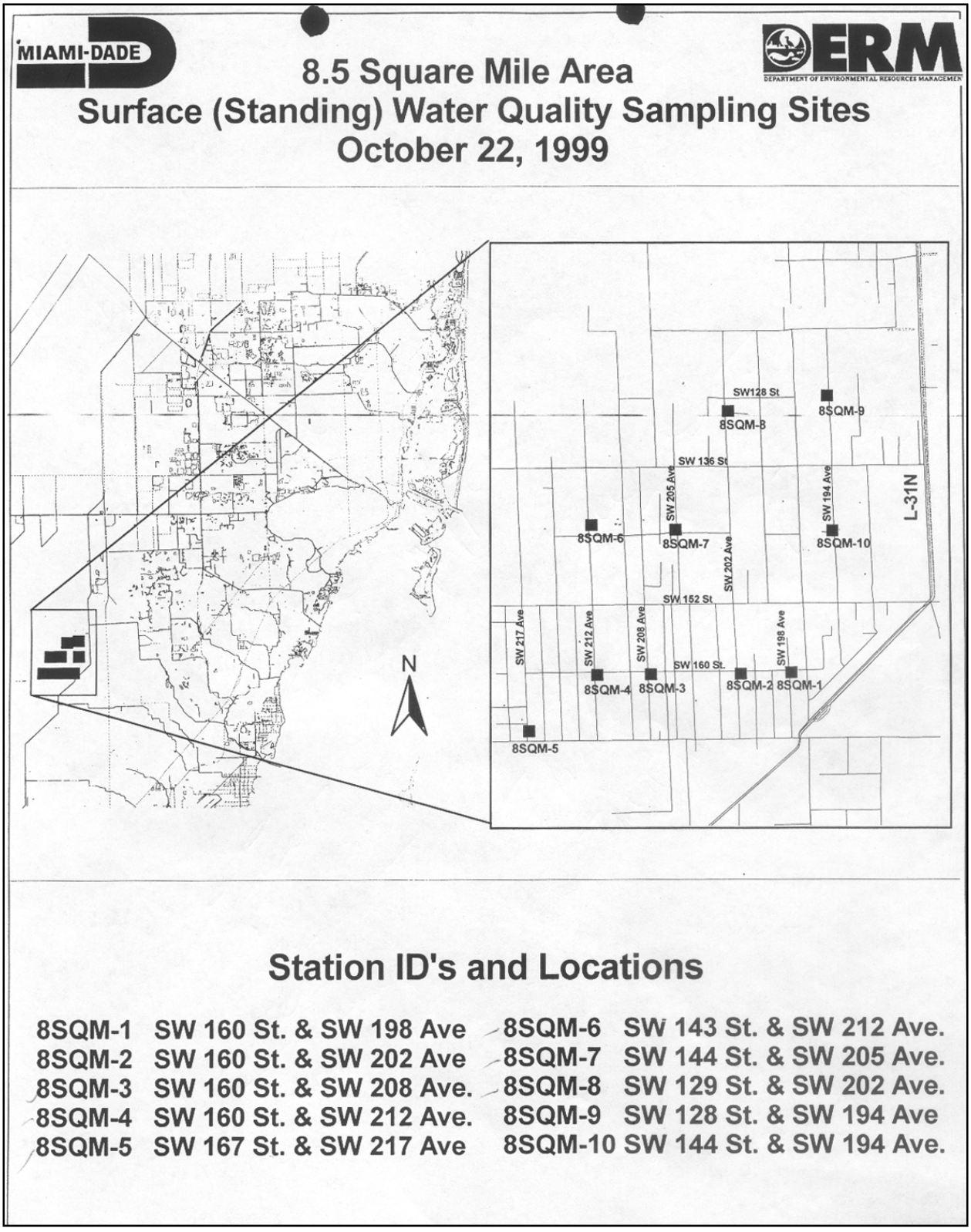


Figure E-1 Location of Sampling Stations

The highest values are at 8SQM-3 (4.66 ug/L) and at 8SQM-4 (4.32 ug/L), which are an order of magnitude above the MDL. These concentrations suggest the source of the contamination probably is near these two sampling locations. The station to the southwest (8SQM-5) and the station directly north (8SQM-6) have toluene concentrations barely above the MDL. Stations directly east (8SQM-2 and 8SQM-1) and the stations to the northeast (8SQM-9 and 8SMQ-10) had toluene levels below the MDL. Thus, there seems to be a north-northeast gradient as stations 8SQM-7 and 8SMQ-8 have toluene concentrations between the highest values and the low values at stations to the west and east.

Toluene is not used in agricultural activities but is often used as an organic industrial solvent. It is often used to clean machinery parts and instruments, remove paint, and manufacture drugs. Toluene can also be obtained at local hardware stores and has been reported in the groundwater of some residential areas. There is no Specific State of Florida surface water criteria for toluene. It is classified as a moderately toxic organic compound through inhalation and ingestion (Fundamentals of Environmental Chemistry, Stanley E. Manahan). Toluene probably is included in the State's "Free Forms" – Section 62-302.500 F.A.C.

The State of Florida has two criteria for Bacteriological Quality of Class III freshwater for a discrete sample. For Fecal Coliform Bacteria, it is the number per 100 ml sample of MPN (Most Probable Number) or MF (Membrane Filter) count not to exceed 800 on any given day. For Total Coliform Bacteria, it is the number per 100 ml of sample of MPN and MF count not to exceed 2,400 at any time. The Miami-Dade County's surface water quality standard is less than 1,000 coliform forming units (cfu) per 100 ml. The following is a summary of their Hurricane Irene sampling results:

Location	Station	Date	Total Coliform (cfu/100ml)	Violation Y=1,N=0	Fecal Coliform	Violation Y=1,N=0
SW 168 St & 197 Ave.	SD1	10/18/99	25,000	1	6,000	1
SW 168 St & 209 Ave.	SD2	10/18/99	37,000	1	5,500	1
SW 168 St & 197 Ave.	SD1	10/20/99	>5,600	1	>5,600	1
SW 168 St & 209 Ave.	SD2	10/20/99	>7,700	1	>7,700	1
19051 SW 136 St	SD3	10/20/99	>9,900	1	>9,900	1
SW 168 St & 197 Ave.	SD1	10/22/99	4,000	1	3,800	1
SW 168 St & 209 Ave.	SD2	10/22/99	420	0	510	0
SW 168 St & 197 Ave.	SD1	10/25/99	2,620	1	2,620	1
SW 168 St & 209 Ave.	SD2	10/25/99	1,740	1	1,010	1
SW 168 St & 197 Ave.	SD1	10/27/99	15,600	1	7,000	1
SW 168 St & 209 Ave.	SD2	10/27/99	200	0	120	0

In conclusion, during a major storm event (like Hurricane Irene) in which there are high water levels in the 8.5 SQMA, there will be water quality violations of the Consent Decree standard for phosphorus entering Everglades National Park and the State of Florida standard for Bacteriological Quality (Fecal and Total Coliform Bacteria). There is also the possibility of other chemicals entering surface and groundwater (like toluene) when this area is flooded.

Appendix F — Governing Board Motion of the South Florida Water Management District for the Implementation of Alternative 6D

Governing Board Motion for 8.5 SMA — June 15, 2000

Because of the features of Alternative 6D that optimize protection of wetlands and minimize impacts to landowners within the 8.5 square mile area (SMA), I move that the Board identify Alternative 6D as the optimal plan for the Modified Water Deliveries Project to Everglades National Park subject to the following design, feature enhancements and conditions:

(a) The Perimeter Levee¹s location and footprint should maximize the amount of wetlands included in the buffer area, following the approximate boundary in Alternative 6D.

(b) The Internal Levee and seepage canal system should be optimized to minimize impacts to the residents of 8.5 SMA. For example, the levee¹s location should avoid residences where practicable. Upon exhaustion of reasonable efforts to avoid landowner impacts, residents should receive fair market value or be provided equivalent property at no expense to themselves.

(c) Water quality treatment should be provided for the runoff to meet state water quality standards and not cause degradation of ambient conditions.

(d) Alternative 6D, including all required lands, should become a project feature of the Modified Water Deliveries Project. Therefore, construction and land acquisition shall be implemented through full federal funding, programs and/or procedures, consistent with the 1994 Project Cooperation Agreement.

(e) The potential for flooding of landowners who are east of the proposed levee, before and after project implementation is unchanged consistent with the federal Supplemental Environmental Impact Statement. Flood mitigation, not flood protection, should be provided by the design, construction and operation of Alternative 6D as enhanced herein.

(f) Miami-Dade County is strongly encouraged to enforce existing land use ordinances in order to preserve existing uses and densities, and sustain a willing seller program for all lands within the entire 8.5 square mile area.

(g) For those lands within the 8.5 square mile area which fall east of the proposed levee, a willing seller program, free from fear of condemnation, for all lands should be continued utilizing appropriate and available programs and funds. The District shall utilize its regulatory authority to protect the water resources of the area and undertake rulemaking where necessary to address secondary and cumulative impacts. The District shall also exercise its authority to review any comprehensive plan amendments proposed by Miami-Dade County.

(h) Implementation of Alternative 6D, as enhanced above, should not adversely harm the restoration levels of Everglades National Park¹s hydrology greater than that simulated through modeling of Alternative 6D.