DRAFT 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

March 23, 2000

Revised March 30, 2000

United States Department of the Interior

National Park Service
Everglades National Park
4001 State Road 9336
Homestead, FL 33034

Fish and Wildlife Service
Office of the State Supervisor
P.O. Box 2676
Vero Beach, FL 32962

March 31, 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: Revised Draft 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 Revised Draft Report for the Corps of Engineers' (Corps) Draft Supplemental Environmental Impact Statement/General Reevaluation Report (SEIS/GRR) for the Modified Water Deliveries (MWD) to Everglades National Park, 8.5 Square Mile Area (SMA), Miami-Dade County, Florida. This will serve as the Draft Fish and Wildlife Coordination Act (FWCA) report and draft cooperating agency analysis from the National Park Service (NPS) and the Fish and Wildlife Service (Service), which we ask be appended to the publicly released draft SEIS. This Revised Draft Report replaces the previous draft report submitted to the Corps on March 24, 2000, and has been modified as a result of comments we received from your staff during an intensive review process of the Draft SEIS and Draft Coordination Act Report on March 27-28, 2000. We feel the modifications do much to clarify our analysis and we appreciate your candid and thorough analysis during this process.

The Final FWCA report, including the views and recommendations of the U.S. Florida Fish and Wildlife Conservation Commission, will be submitted for inclusion in 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. The Department will

also submit formal comments on the Draft SEIS/GRR that may address additional issues not analyzed in this report.

Pending the selection of a federally preferred alternative and receipt of the Corps's effect determination on federally listed species, the Service anticipates coordination with the Corps pursuant to the consultation requirements of section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*).

We would welcome any questions or comments on our Revised Draft Report that will help us improve our analysis and finalize the FWCA report. For ease of access and review, we have posted this revised Coordination Act Report on the NPS Internet ftp site: ftp.nps.gov/everglades. The user name is "anonymous" and the password is the accessing user's e-mail address. Two files have been posted to this site:

1. dcar_rev0330.pdf (Adobe portable document file)
2. dcar_rev0330.exe (Self-extracting zip file requiring much less time to download)

We look forward to joining the Corps in reviewing our analysis and recommendations with the Governing Board of the South Florida Water Management District in the near future. Additionally, we appreciate the Corps' concerted efforts to prepare a Draft SEIS/GRR for the 8.5 SMA project under such limited time constraints.

Sincerely yours,

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

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

Enclosure

cc:
Executive Director, SFWMD, West Palm Beach, FL
Executive Director, FWCC, Tallahassee, FL
Environmental Services, FWCC, Vero Beach, FL
Miccosukee Tribe of Florida, Miami, FL
Seminole Tribe of Florida, Hollywood, FL
Service, So. Fla. Ecological Services Office, Vero Beach, FL

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Revised March 30, 2000

This Draft Fish and Wildlife Coordination Act Report (CAR) has been prepared by the Fish and Wildlife Service and 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 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 nine 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 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 benefit to NESRS)	Structural Mitigation Provided (acres not 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 (acres protected)
1 — GDM plan (No action)	Poor (14,063)	6,646	263	Sk: 3 Ws: 2	Poor (-2,765)	Poor	< 3 years	Not provided (586)[3]
2 — Modified GDM	Poor (11,130)	6,909	0	Sk: 1 Ws: 4	Poor (-2,765)	Poor	< 3 years	Not provided (704)[3]
3 — Deep Seepage Barrier	Good (21,042)	2,652	4,257	Sk: 9 Ws: 1	Poor (-1,775)	Poor	< 3 years	Poor (586)
4 — Residents' Choice Land Acquisition	Good (21,042)	0	6,909	Sk: 8 Ws: 9	Good (2,448)	Good	< 3 years	Good (6,909)[3]
5 — Total Buyout	Best (21,042)	0	6,909	Sk: 8 Ws: 9	Best (2,448)	Best	< 3 years	Good (6,909)[3]
6 — Buffer Plan	Fair (20,174)	1,992	4,917	Sk: 4 Ws: 7	Fair (1,606)	Fair	< 3 years	Good (1,452)
7 — Raise all public roads	Good (21,042)	0	6,909	Sk: 8 Ws: 5	Good (1,290)	Good	< 3 years	Not provided (586)[3]
8 — Western Flow-way	Good (20,925)	2,975	3,934	Sk: 5 Ws: 6	Good (2,240)	Good	< 3 years	Not provided (737)[3]
9 — Adaptive Refinement of GDM	Poor (11,130)	6,909	0	Sk: 1 Ws: 4	Poor (-2,765)	Poor	< 3 years	Not provided (704)[3]

[1]Rank from 1 (Lowest) to 9 (Highest)

[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, acreage represents area provided incidental 1 in 10 year flood protection

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. Alternatives 4, 5, and 6B satisfy these criteria.

It is the opinion of DOI that Alternative 5 is the best 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. Alternative 8 meets the restoration criteria but does not meet the full flood mitigation criteria. It is the opinion of DOI that the remaining alternatives do not meet multiple legislative requirements, as well as the other project objectives.

For alternatives 4, 5, and 6B, significant supplemental benefits in excess of the no-action alternative are accrued by the ecosystem in general and by ENP in particular. In recognition of these supplemental benefits, the Secretary of the Interior may decide to provide additional support in the implementation of the alternative selected.

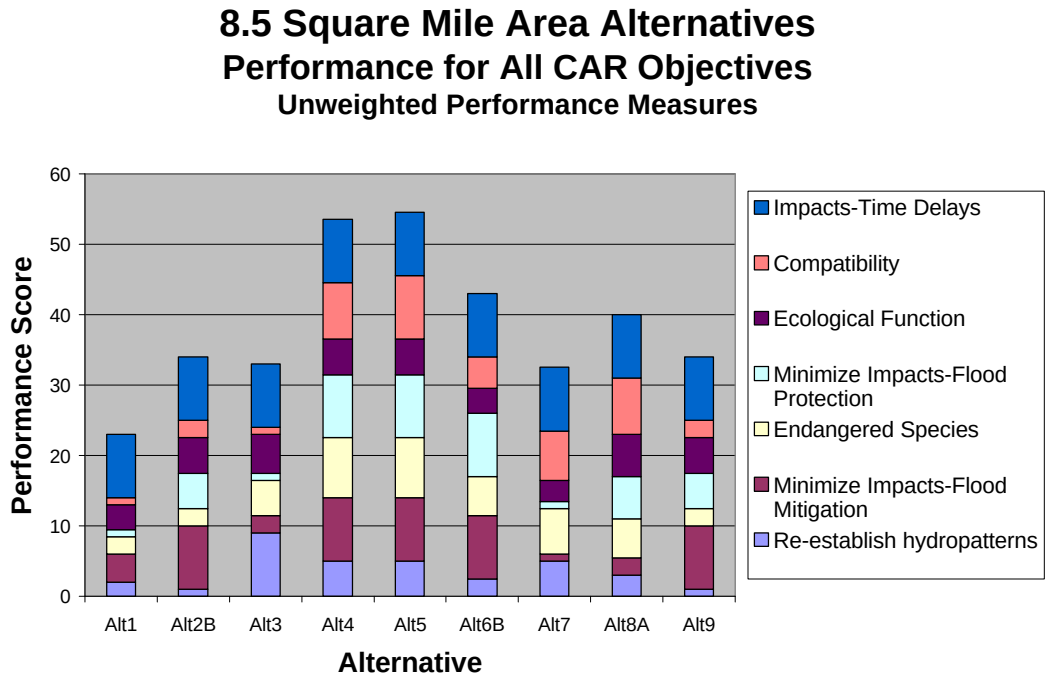

Figure ES–1 8.5 SMA Performance Scores for Objectives Analyzed in the CAR (unweighted)

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Chapter 1 — Project Purpose, Scope, and Authority

The Fish and Wildlife Service (FWS) and the Everglades National Park (ENP) have prepared this Draft 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 protection 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.). Once the views and recommendations of the Florida Fish and Wildlife Commission (FWC) have been incorporated into the preliminary document, a Final CAR will be provided to the Corps that will constitute the Secretary of the Interior's Report to Congress on these proposed modifications to the MWD Project in accordance with Section 2(b) of the Act.

This CAR provides the Department of the Interior's (DOI's) analyses and recommendations pertaining to nine 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 FWS 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 FWS 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 11 include evaluations of the alternatives, a review of supplemental benefits and recommendations, DOI's preliminary position, 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 preliminary position is based on the complete set of performance measures, 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 addition, Congress amended the Everglades National Park Protection and Expansion Act of 1989 allowing for acquisition of lands within the 8.5 SMA as another mechanism of addressing the flood protection system provisions of the original authorization.

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. Based on the analysis presented in the SEIS, the SFWMD will select a locally preferred alternative (LPA).

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.

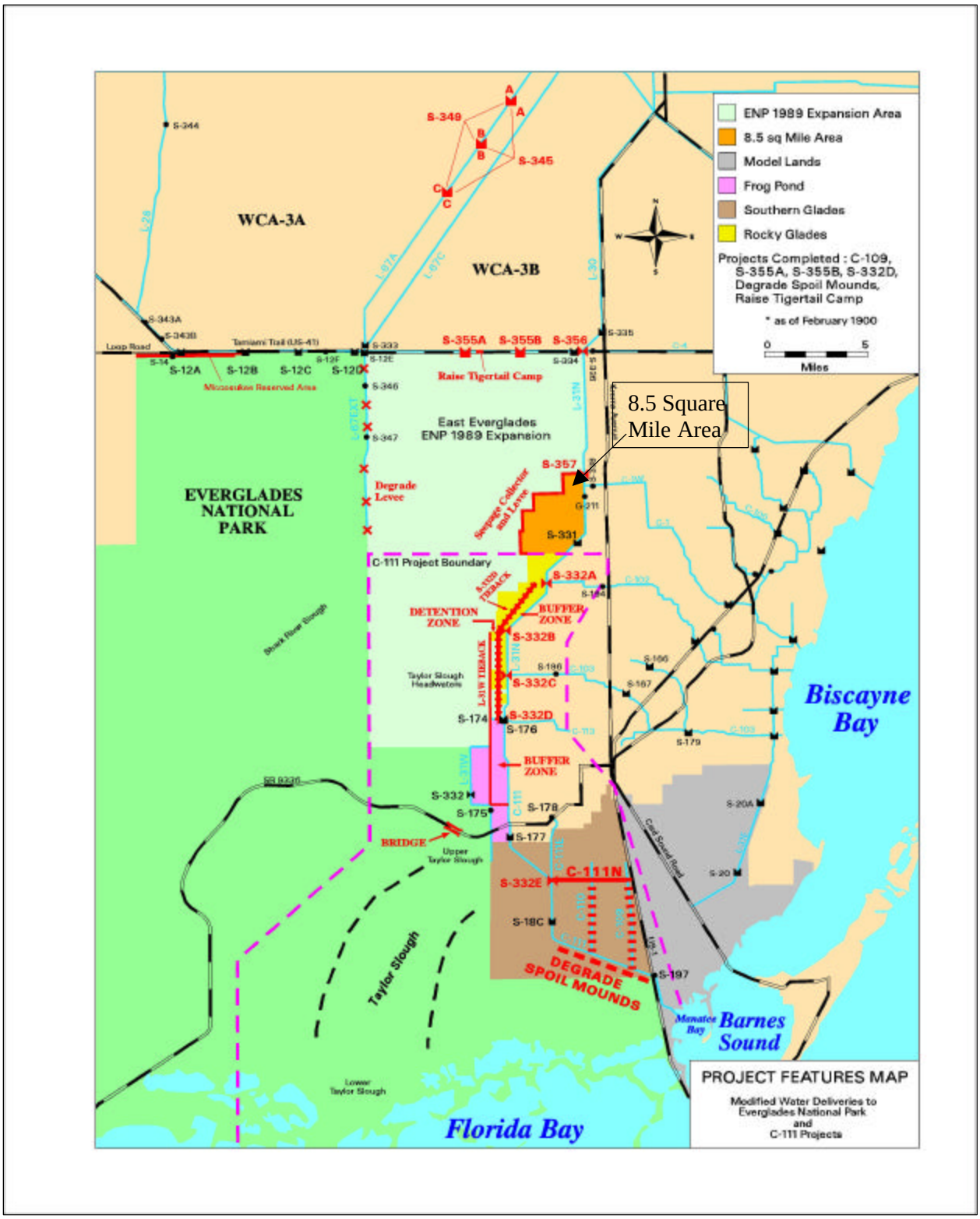


Figure 1 Location of the 8.5 Square Mile Area

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 Project. Recognizing this overall goal, several objectives have been identified for the 8.5 SMA component of the MWD Project.

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 functional units 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 latter comparison allowed for quantifying of Supplemental Benefits.

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 will provide an analysis of the nine proposed alternatives in April 2000. The analysis will be in the form of a Draft SEIS and during the public comment period, the Governing Board will select its preferred alternative. This alternative will be known as the Locally Preferred Alternative (LPA).

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 FWS 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 addition, Congress amended the 1989 Act in 1994 authorizing the use of land acquisition within the 8.5 SMA as another mechanism to implement the flood protection provisions of the original Act. 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 FWS 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 1994, Congress amended the 1989 Act and recognized that the flood protection system specified in the 1989 Act could necessitate land acquisition within the area. Under the amended project authorization, the Secretary of the Interior may provide up to 25 percent of the total cost of specific lands acquired for the restoration of natural flows to ENP or Florida Bay.

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 FWS. The Endangered Species Act (ESA) requires federal agencies to consult with the FWS 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 requirements, each agency is to use the best scientific and commercial data available (FWS 1998). This section of the ESA sets out the consultation process, which is further implemented by regulation (50 CFR §402).

The FWS 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 FWS 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 FWS 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 FWS 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 FWS, 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 FWS, 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 DOI recognizes implementation of at least some of the alternatives to the action authorized in the 1992 GDM and Final EIS (Alternative 1 in the SEIS) would facilitate a higher degree of restoration of the ecosystem in general and NESRS in particular (viewed as additional or supplemental benefits by DOI) than would occur under Alternative 1. Additionally, these alternatives would involve higher costs. Currently, the Corps maintains that any increase in costs originating from selection of another alternative must be provided by the SFWMD. Depending upon the degree of additional or supplemental benefits to the Everglades ecosystem and ENP may experience from the SFWMD and Corps' selection of an alternative other than Alternative 1, the SFWMD may request that DOI share in the additional cost. In such a case, the Secretary of the Interior may make other decisions concerning the DOI's participation in the implementation of the alternative selected.

The DOI has identified four sources that may be used to provide additional federal funds for the project, depending upon the alternative selected. 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, if a decision is made by the SFWMD to select a LPA that includes land acquisition and if the DOI concurs on a request by the SFWMD to provide up to 50 percent of the cost of such acquisition.

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 specifically address funding for the acquisition of lands under the 1989 Act. Under the amended project authorization, The Secretary of the Interior may 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.

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
Mussels		
Florida tree snail	*Liguus fasciatus*	Special Concern

Source: Florida Game and Freshwater Fish 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 domesti-cus*), 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.

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 FWS' 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 FWS 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 FWS' position that anticipated levels of water in the agricultural and residential areas of the

8.5 SMA were overestimated. Subsequently, the FWS 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 FWS 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 FWS 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. Because it is not clear at this point whether the Corps will select another alternative as the federally preferred alternative, a formal determination from the Corps regarding potential effects of the 8.5 SMA component on listed species has not been made.

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.

Chapter 4 — Project Alternatives

Selected Plan/Project

At this stage in the planning process, there has yet to be identified a federally preferred alternative for the 8.5 SMA SEIS.

Other Alternatives

A total of nine alternatives were evaluated. Some of the 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 permiter 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 staion, 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 undetermed 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 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 sytem would occur.

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 nine 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

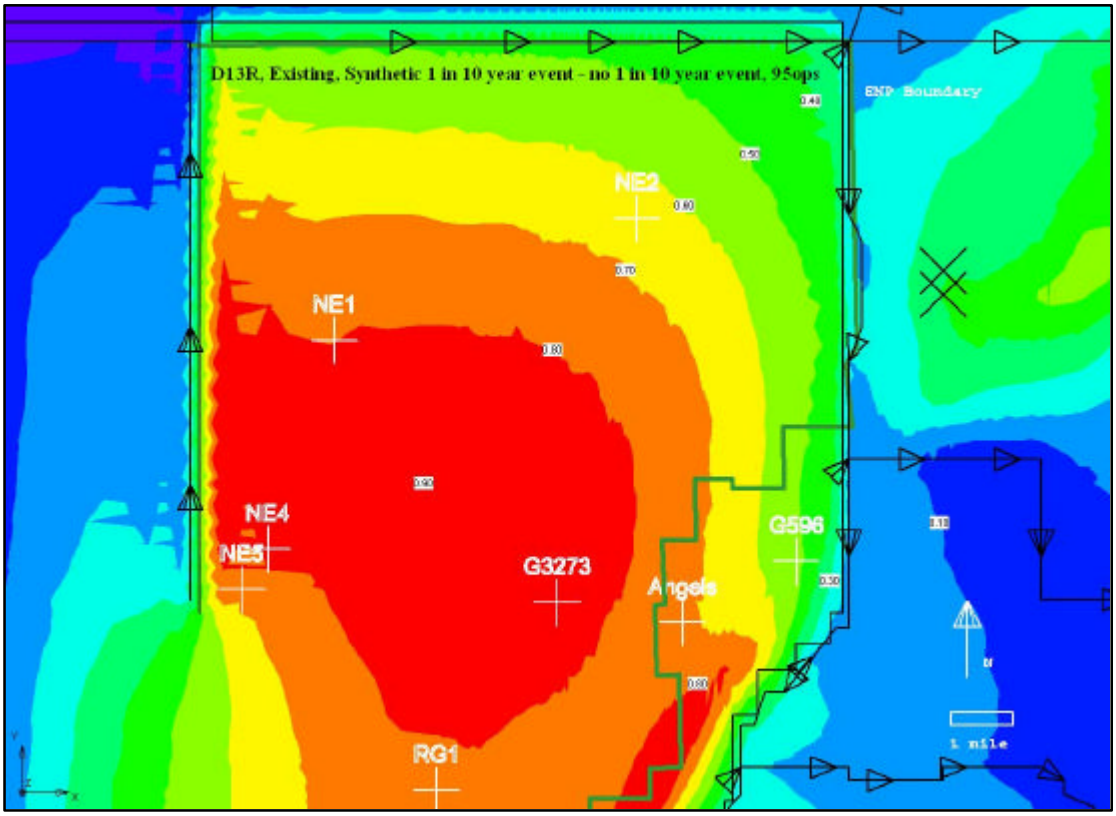


Figure 2 The Synthetic 1 in 10 Year Storm as Increased Water Levels in NESRS and the 8.5 SMA by 0.4 to 0.8 Feet

hydroperiods and causes water levels to rise during and after the synthetic storm (Figures 2 and 3).

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.

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.

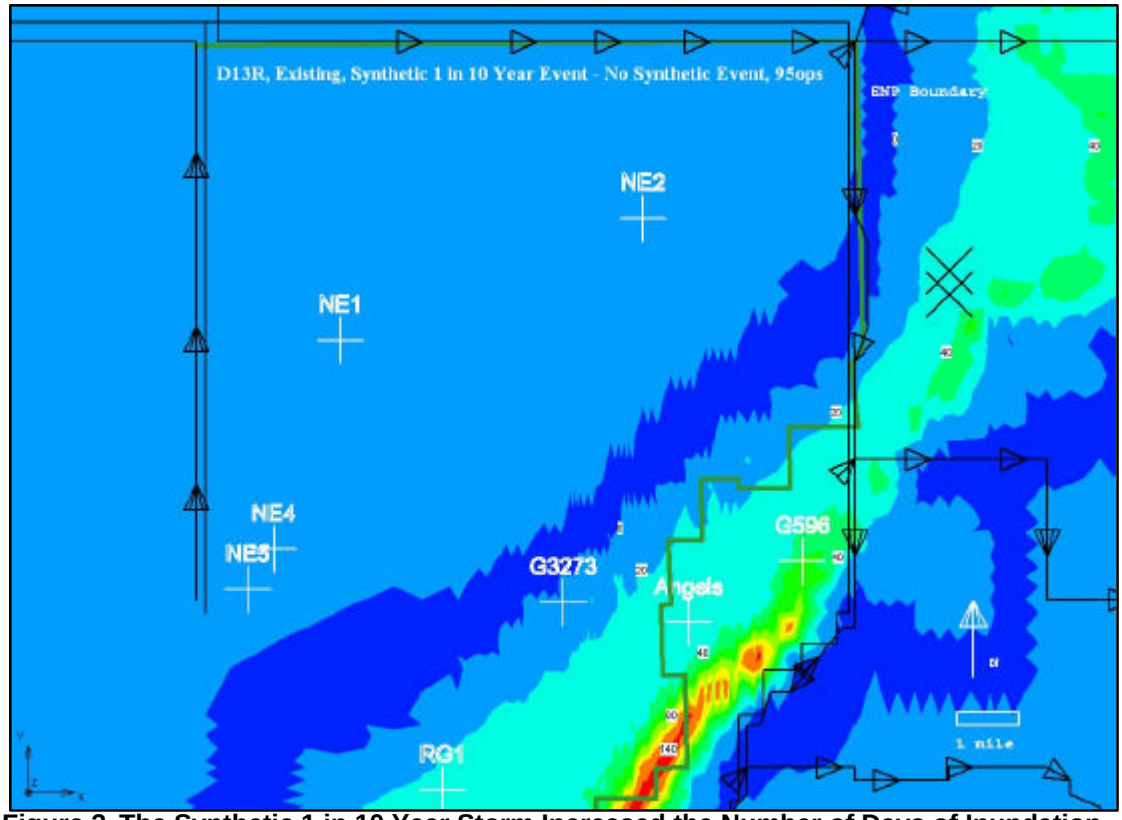


Figure 3 The Synthetic 1 in 10 Year Storm Increased the Number of Days of Inundation in the 8.5 SMA by 40 to 140 Days

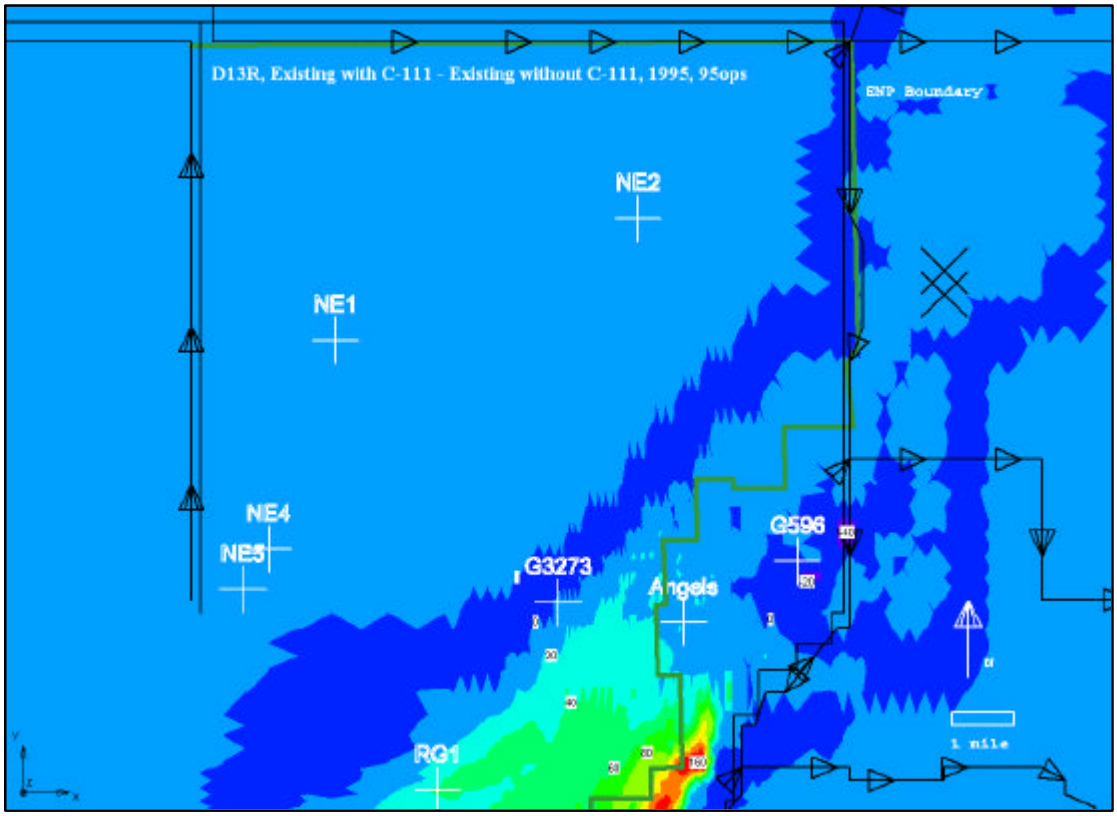


Figure 4 The Effect of the C–111 Project in the Model Simulations was an Increase in Hydroperiod Southwest of the 8.5 SMA by 20 to 160 Days

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 nine alternatives does not constitute approval for the operating rules simulated for this analysis.

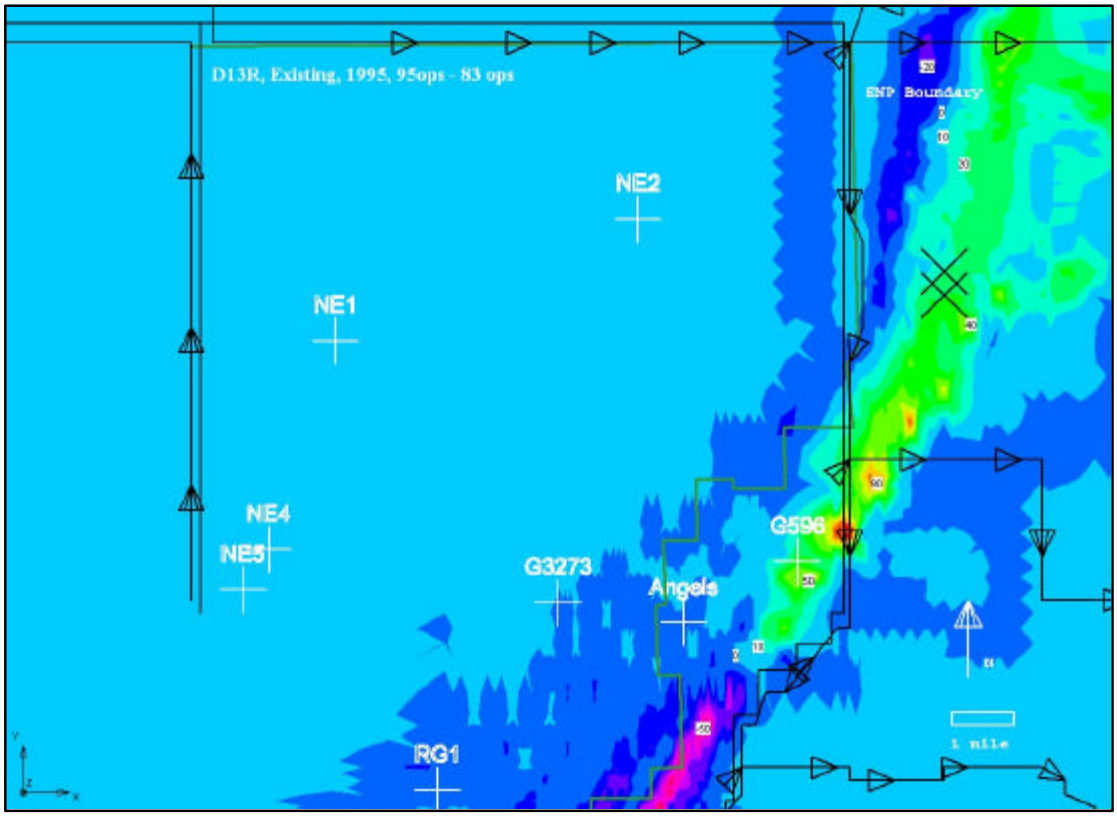


Figure 5 Comparison of Simulated Hydroperiods for 83 Ops and 95 Ops; 95 Ops Result in Longer Hydroperiods (by up to 90 Days) East of L–31N (shown in greens) and Shorter Hydroperiods (by up to 50 Days) Southwest of the 8.5 SMA (shown in reds)

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 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).

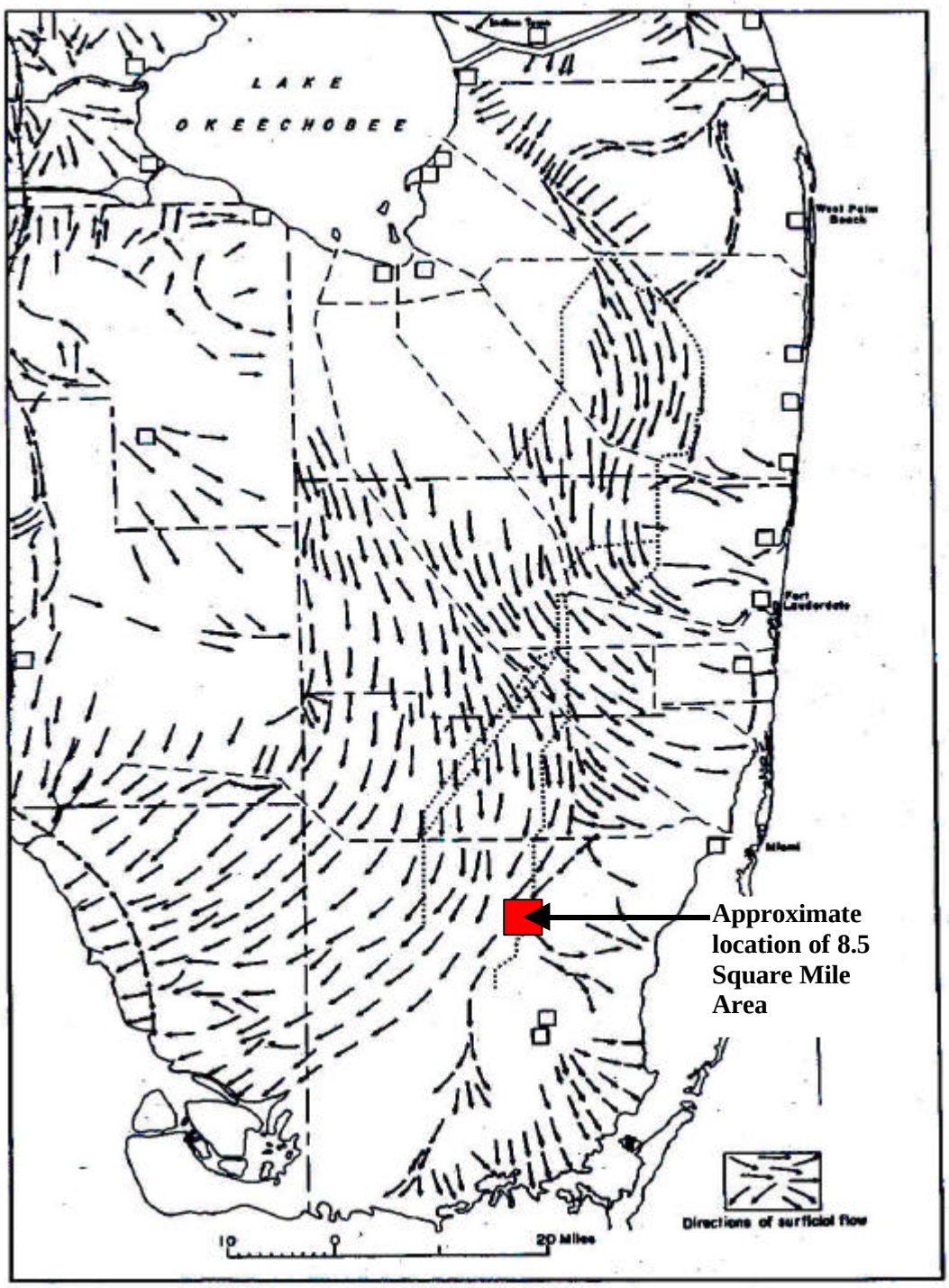


Figure 6 Historical Flow Pattern in NESRS. From Parker et al. (1955) and Parker (1974). Major pre-1950's Canals (dashed lines) and 1990s Canals or Levees (dotted lines) Included for Location

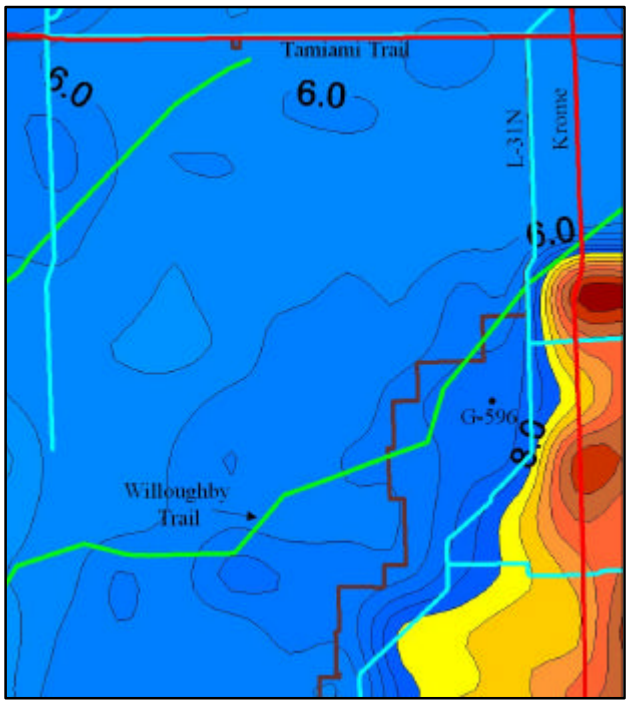


Figure 7 Historical Wet Season Water Levels in the 8.5 Square Mile Area. Contour intervals are topography. Blue area indicates where water is over the land surface. Green line indicates path of canoe trip through the Everglades by Hugh Willoughby (Willoughby, 1898) in 1897

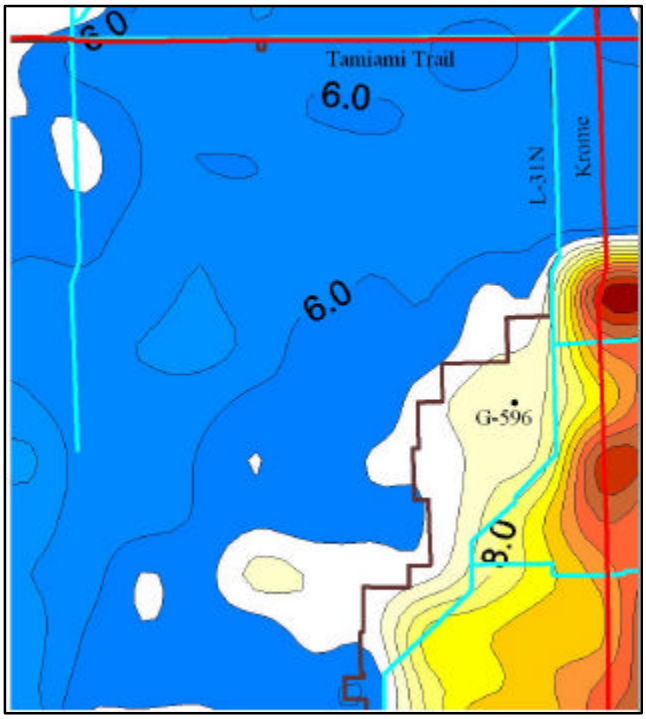


Figure 8 Historical Dry Season Water Levels in the 8.5 Square Mile Area. Contour intervals are topography. Blue area indicates where water is over the land surface

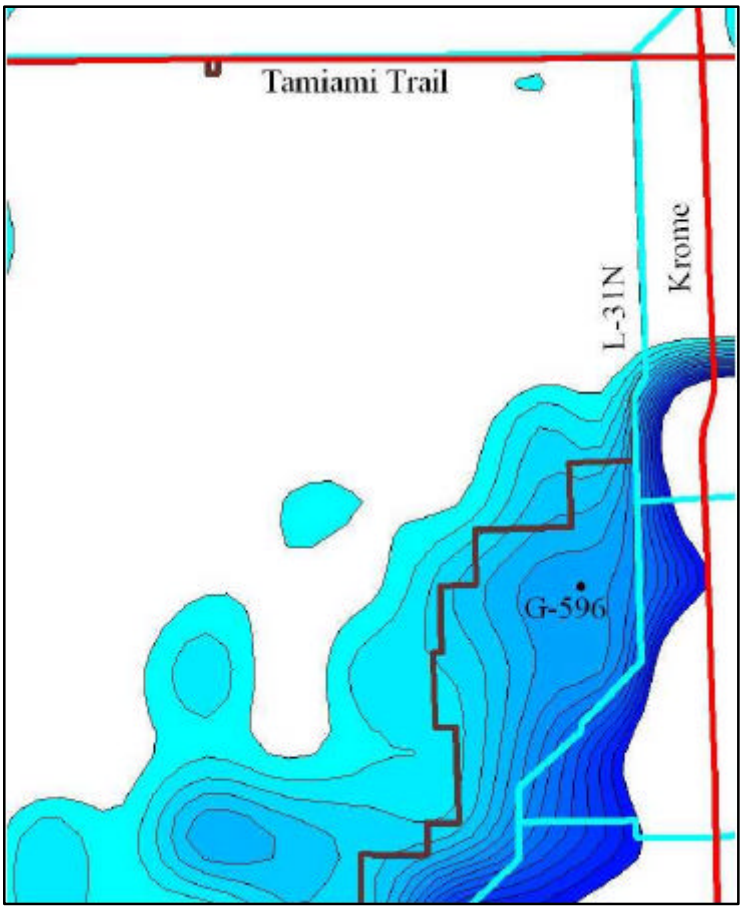


Figure 9 Historical Short Hydroperiod Marl Prairie Peripheral Wetlands. Contour Intervals are Topography. Blue Area Indicates Short Hydroperiod Peripheral Wetlands

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.

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 these analyses are summarized in Table 2 and Table 3. Hydroperiod maps for the existing conditions, the restored condition, and the modeled alternatives are presented in Figures 10 through 26. 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 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 1A	0	3,338	0	27,321
Plan 2	82	1,144	1,243	6,288
Plan 2A	0	3,147	0	31,429
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 6	39	67	537	699
Plan 6A	39	67	0	3,447
Plan 6B	0	294	0	6,035
Plan 7	0	0	0	0
Plan 8	0	67	0	0
Plan 8A	0	286	0	705
Plan 9B	0	3,275	0	36,640

Hydroperiods in NESRS would be reduced in more than 3,000 acres of ENP marsh under plans 1, 1A, 2A, 2B, 9A and 9B. The effect of increasing pumping capacity (pumping in 2B > 2A > 2) to achieve flood mitigation translates to increased impacts to long hydroperiod wetlands. Plan 2 would decrease hydroperiods in 1,144 acres compared to 3,275 acres with decreased hydroperiod in plan 2B.

By moving the canal and levee alignment further east, as in plans 6, 6A, and 6B, 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 6, 6A, and 6B. Under plan 3, no long hydroperiod wetlands

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

would be lost in NESRS. 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 hydroperiod for the non-structural Alternatives 4, 5, and 7.

Table 3 Spatial Extent of Inundation and Average Water Depth In 8.5 SMA Relative To Existing Conditions for Wet Year (1995)

	Hydroperiod		Depth		Area Not
	Increased	Decreased	Increased	Decreased	Mitigated
Plan	(acres)	(acres)	(acres)	(acres)	(acres)
Plan 1	263	5,897	102	4,400	263
Plan 1A	263	5,951	102	4,400	263
Plan 2	5,260	708	2,679	0	5,260
Plan 2A	115	5,951	0	4,744	115
Plan 2B	0	6,155	0	5,251	0
Plan 3	4,257	1,585	3,669	0	4,257
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 6	0	765	0	1,214	0
Plan 6A	0	805	0	1,318	0
Plan 6B	0	805	0	1,603	0
Plan 7	6,135	0	5,402	0	6,135
Plan 8	5,976	188	4,986	0	5,976
Plan 8A	3,934	1,944	3,796	840	3,934
Plan 9B	0	6,155	0	5,251	0

Note:

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

Another critical measure of NESRS wetland restoration is water depth (Table 2). Under Alternatives 1 and 1A, 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 6, 6A and 6B, there would be as many as 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 plan. This difference is determined by multiplying the cell area by the change in average water depth. These values are reported in Table 4 and Figure 26. Under plans 2B and 9B, 47 percent of the restored water would be lost. Under plan 1, 33 percent of the restored water would be lost. Under plans 3, 4, 5, 6B, 7 and 8A, less than 5 percent of the restored water would be lost.

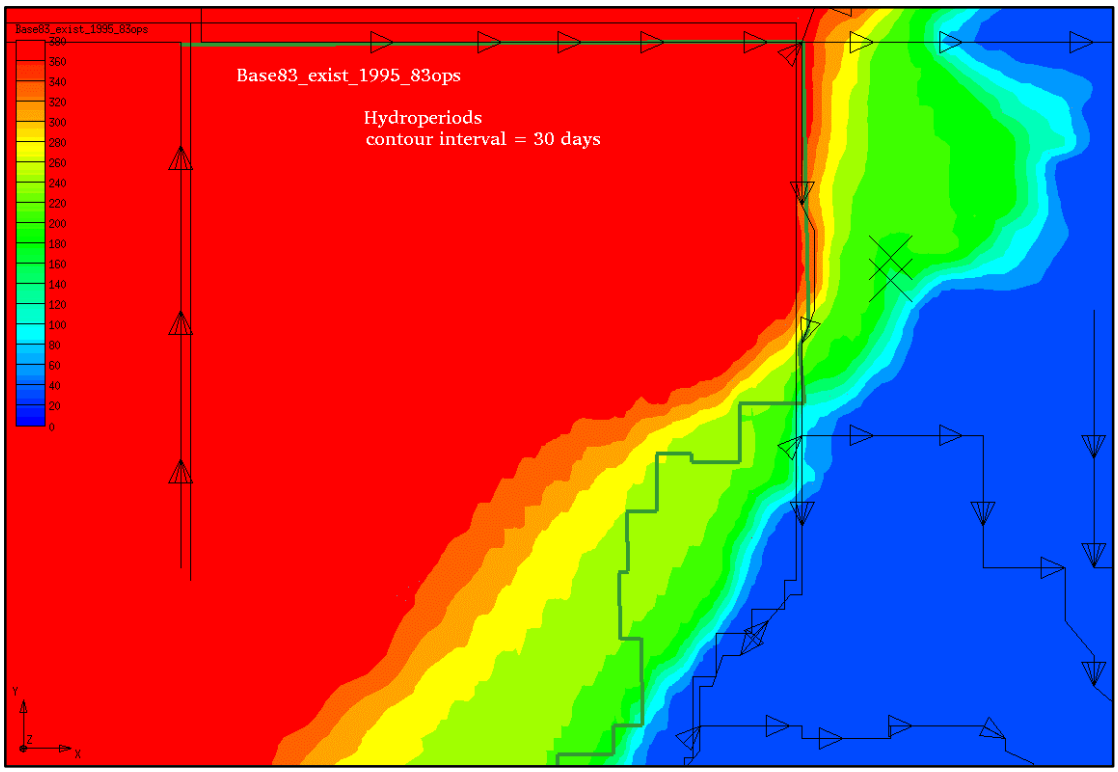


Figure 10 Hydroperiods for Existing Conditions (Base95 Boundary Conditions, 1995 Precipitation, 1983 Operational Conditions)

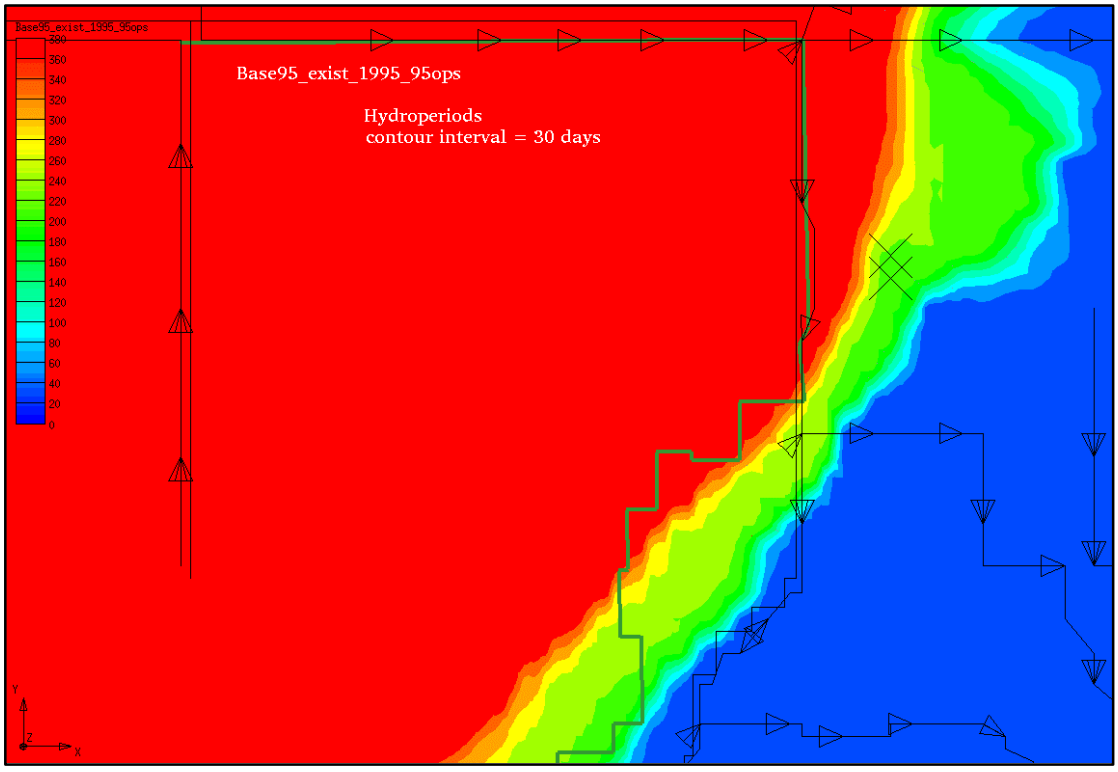
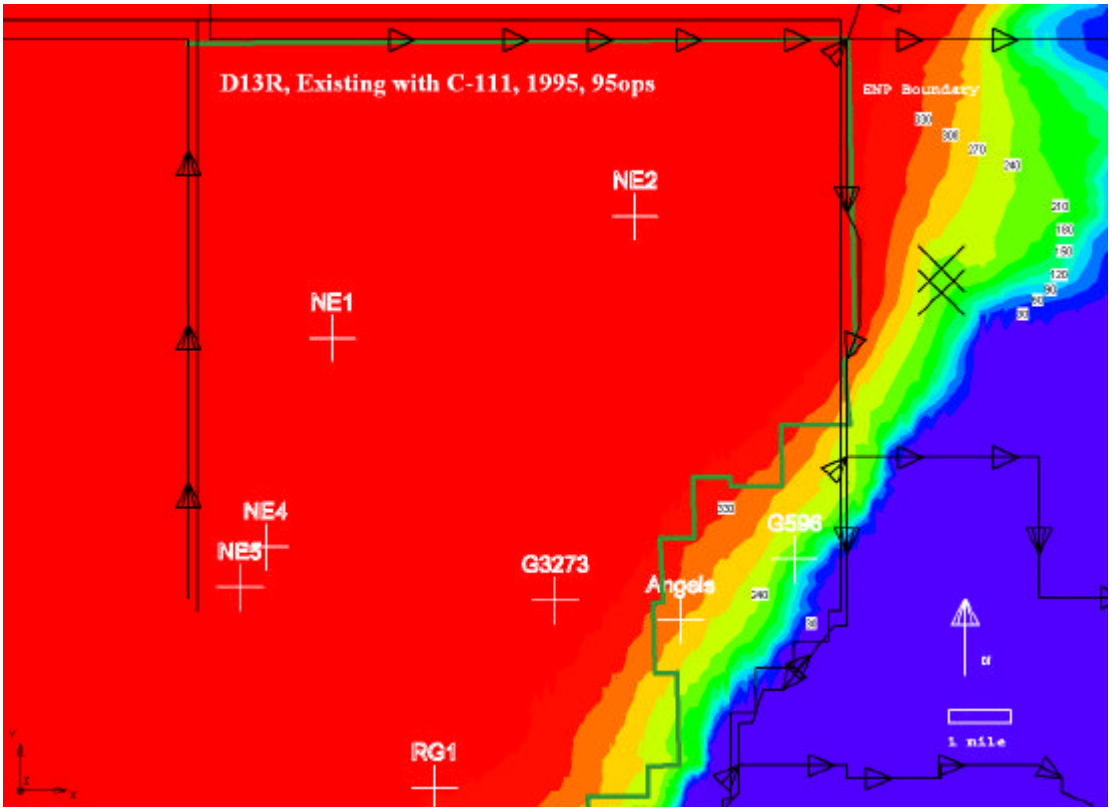
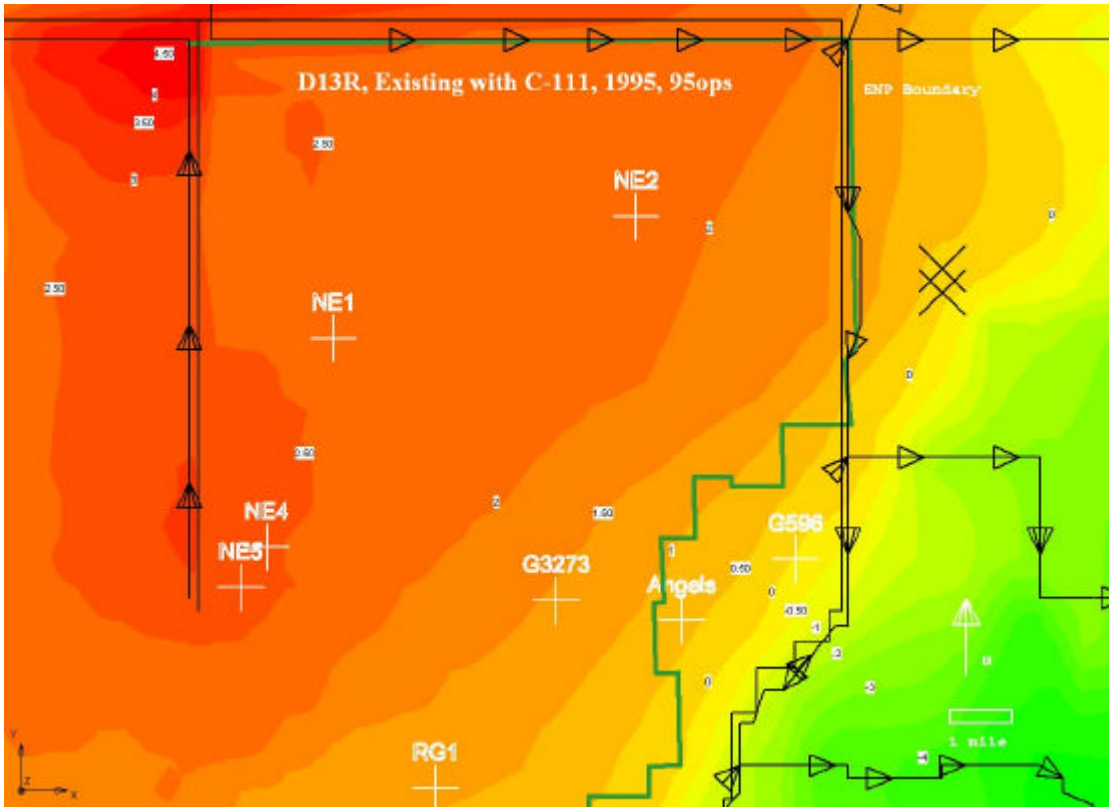


Figure 11 Hydroperiods for Existing Conditions (Base95 Boundary Conditions, 1995 Precipitation, 1995 Operational Conditions)

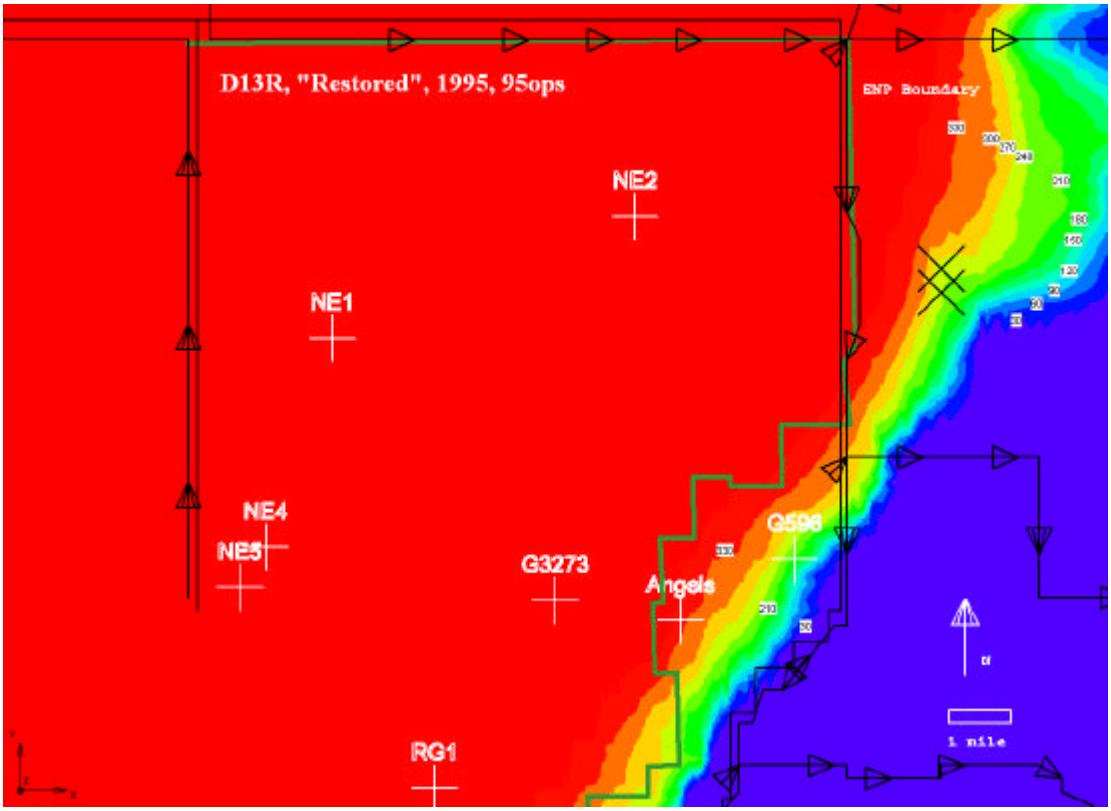


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

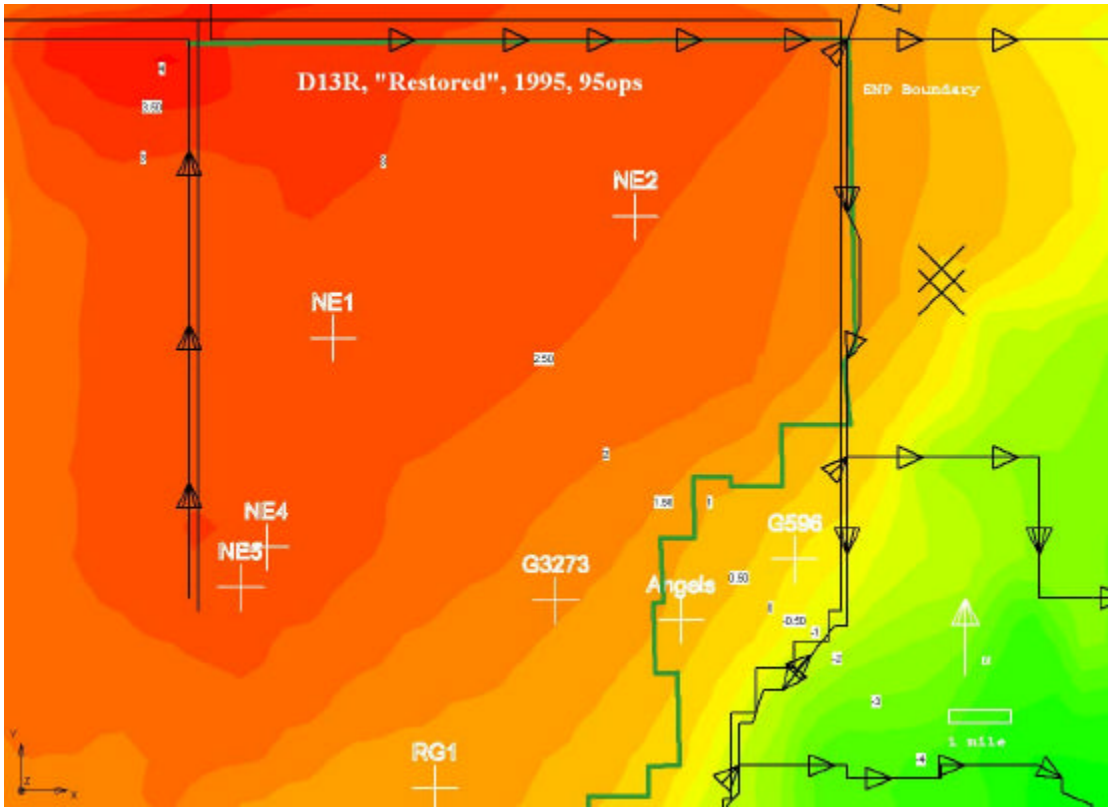


B) Average Depths (2.5 feet deep in NESRS to 1 feet below ground surface in southeastern part of 8.5 SMA)

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

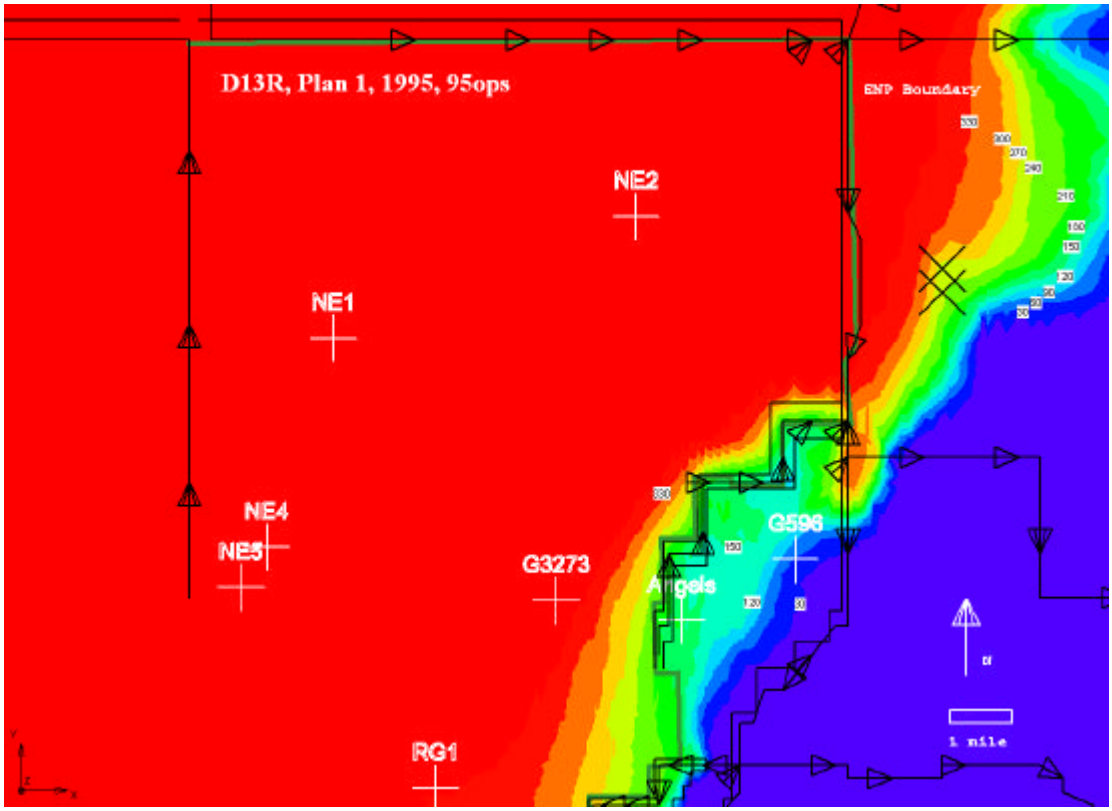


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

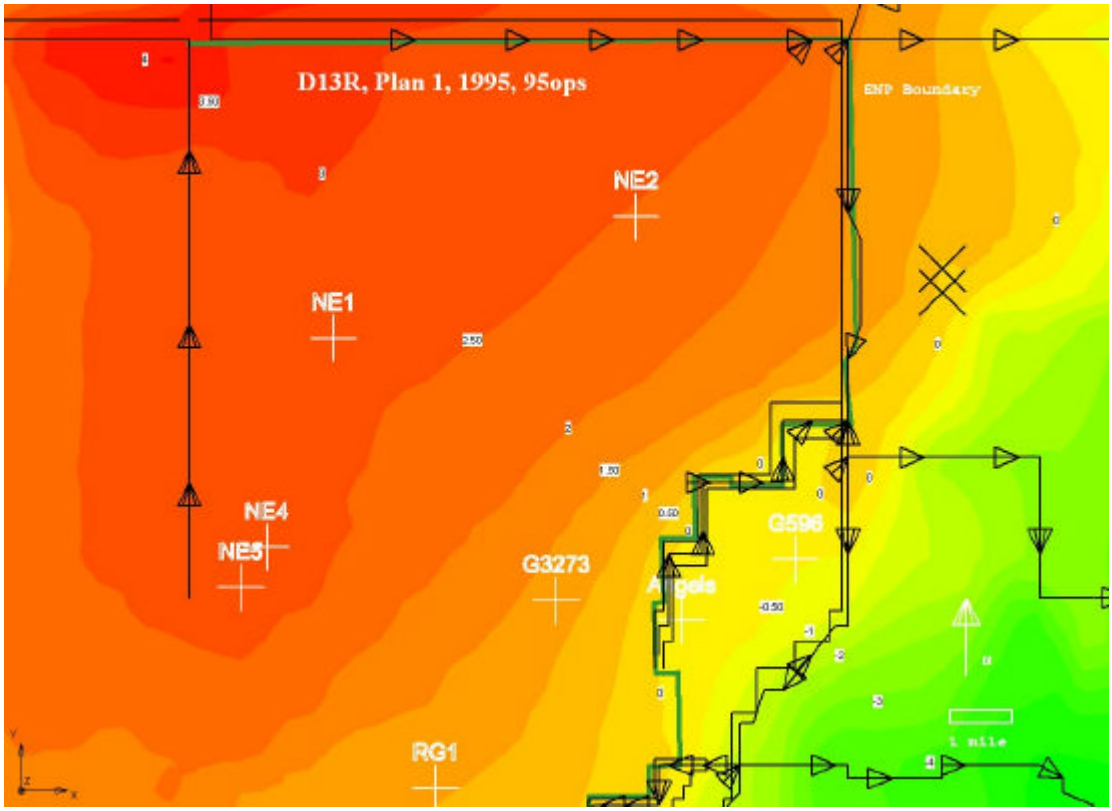


B) Average Depths (2.5 feet deep in NESRS to 1 feet below ground surface in southeastern part of 8.5 SMA)

Figure 13 Hydroperiods and average depths for restored conditions in ENP following full implementation of MWD with C-111 project Implementation

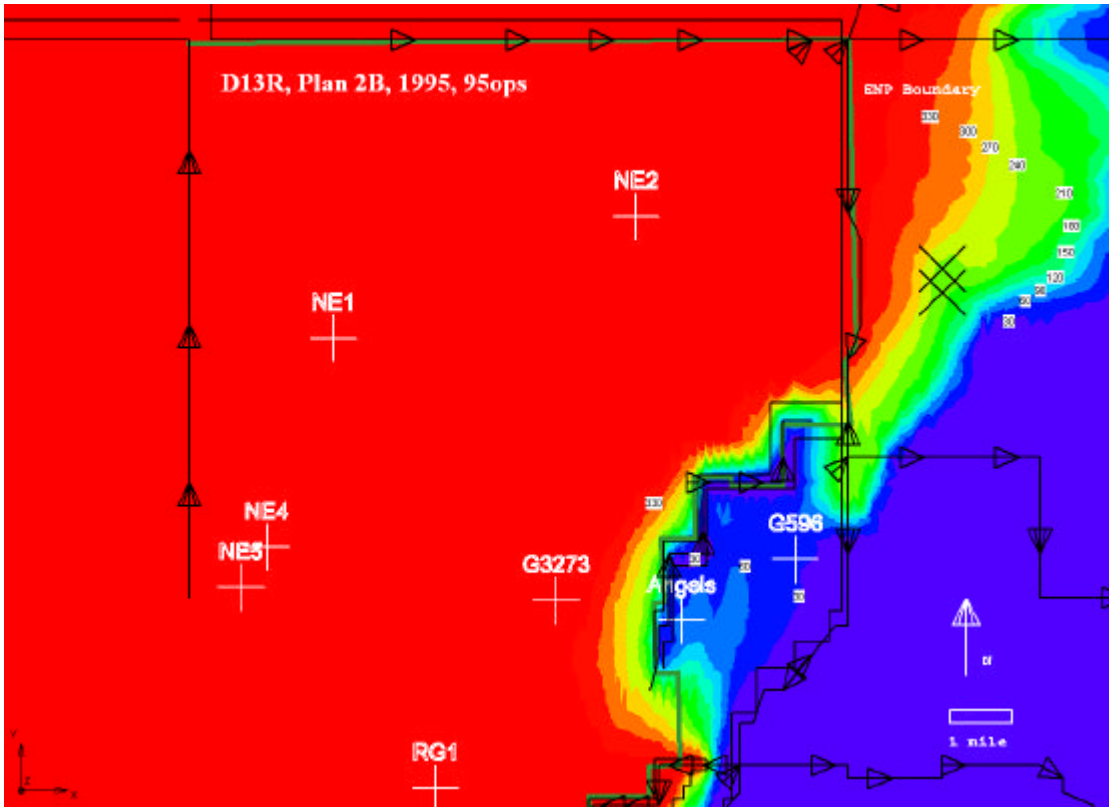


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

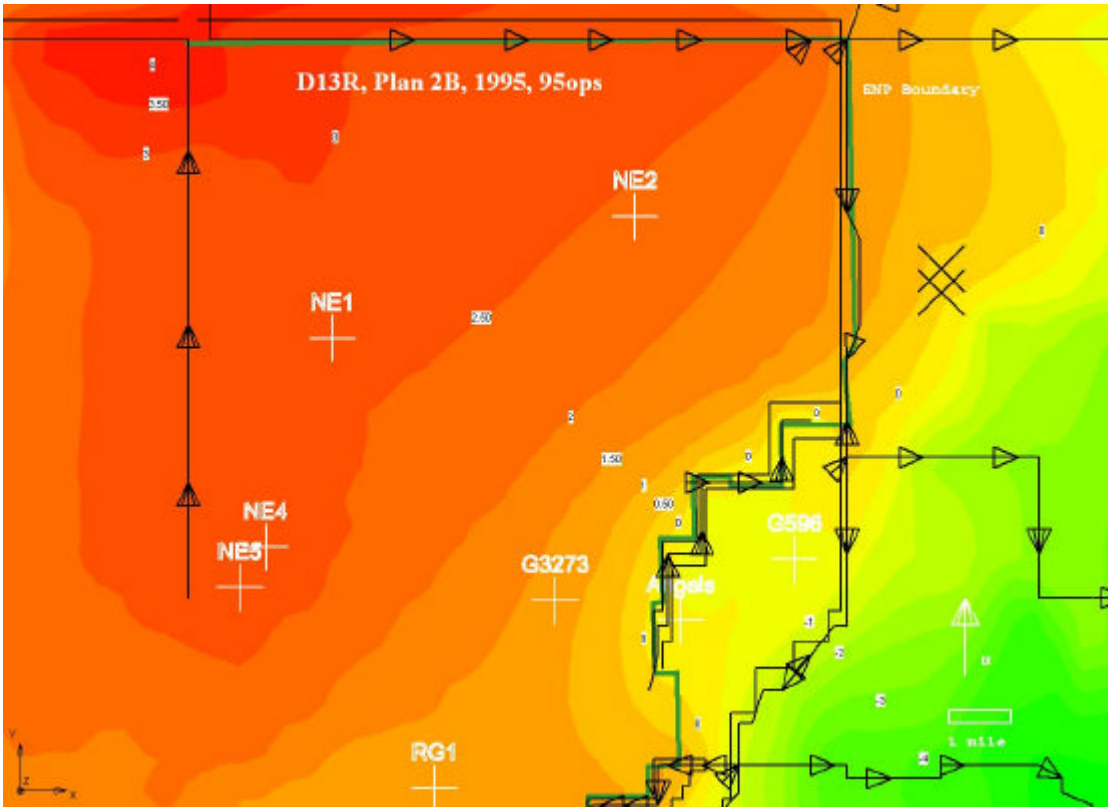


B) Average Depths (2.5 feet deep in NESRS to 1 feet below ground surface in southeastern part of 8.5 SMA)

Figure 14 Hydroperiods and Average Depths for Plan 1

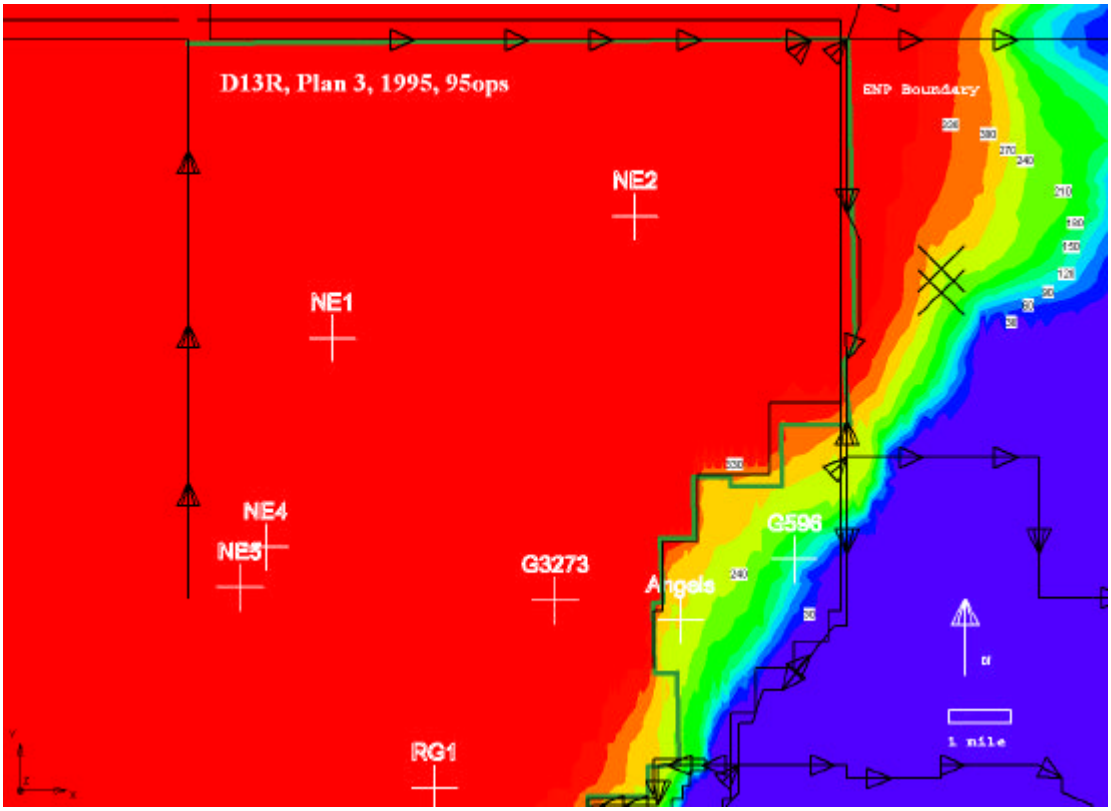


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

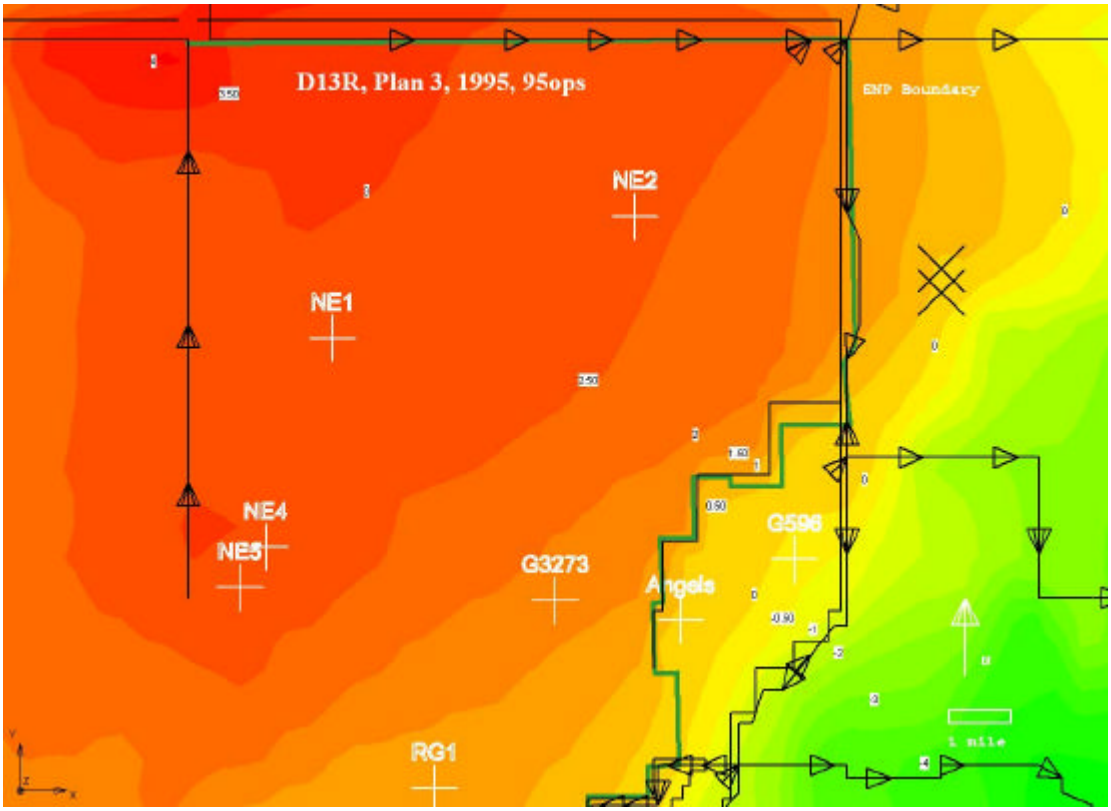


B) Average Depths (2.5 feet deep in NESRS to 1 feet below ground surface in southeastern part of 8.5 SMA)

Figure 15 Hydroperiods and Average Depths for Plan 2B

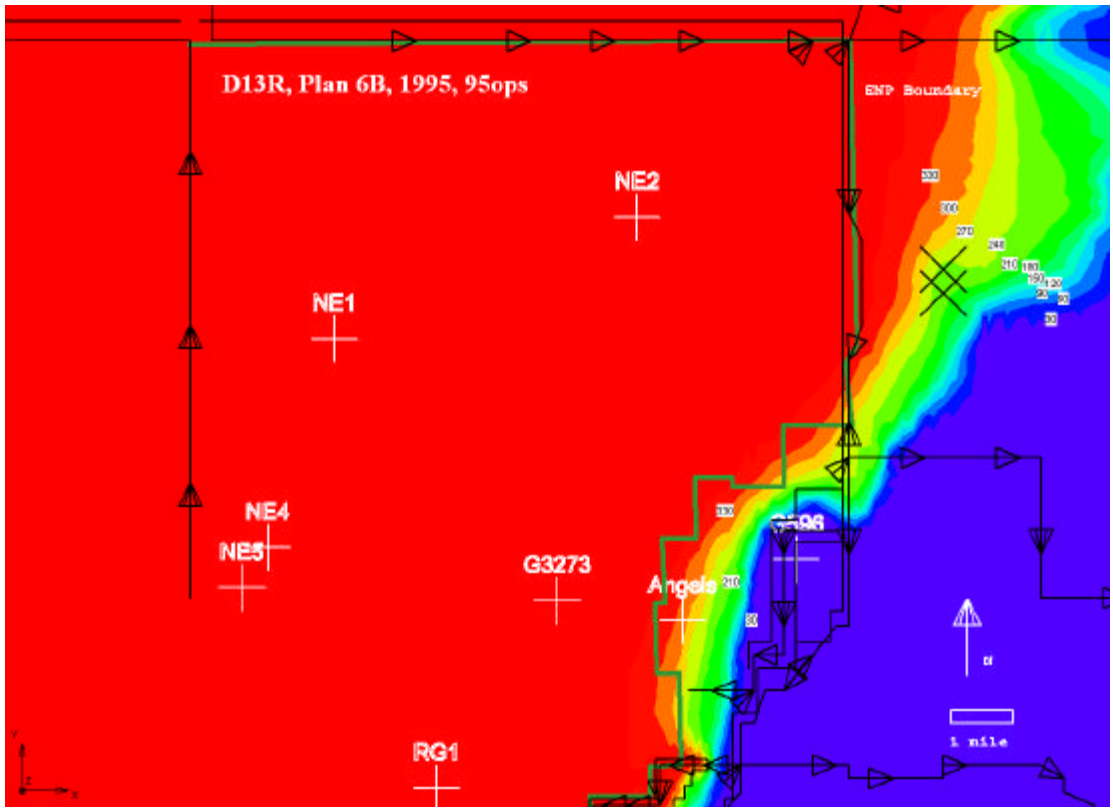


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

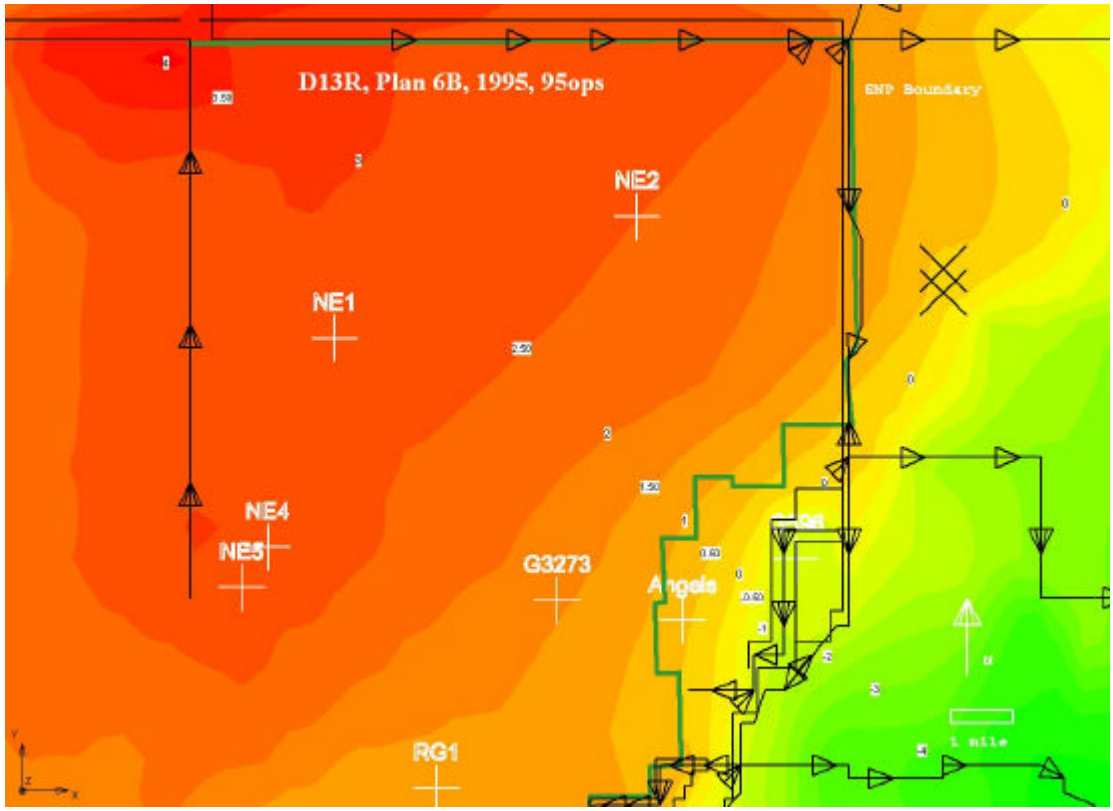


B) Average Depths (2.5 feet deep in NESRS to 1 feet below ground surface in southeastern part of 8.5 SMA)

Figure 16 Hydroperiods and Average Depths for Plan 3

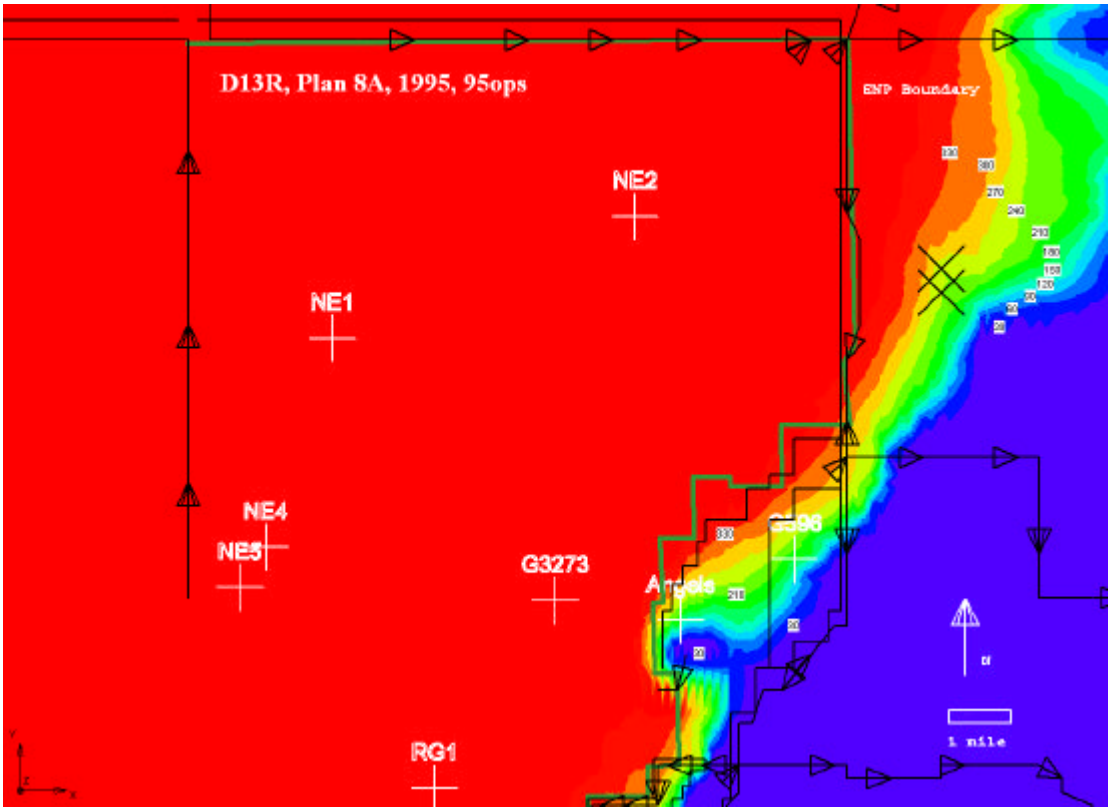


A) Hydroperiods (360 days in NESRS to 0 days in 8.5 SMA)

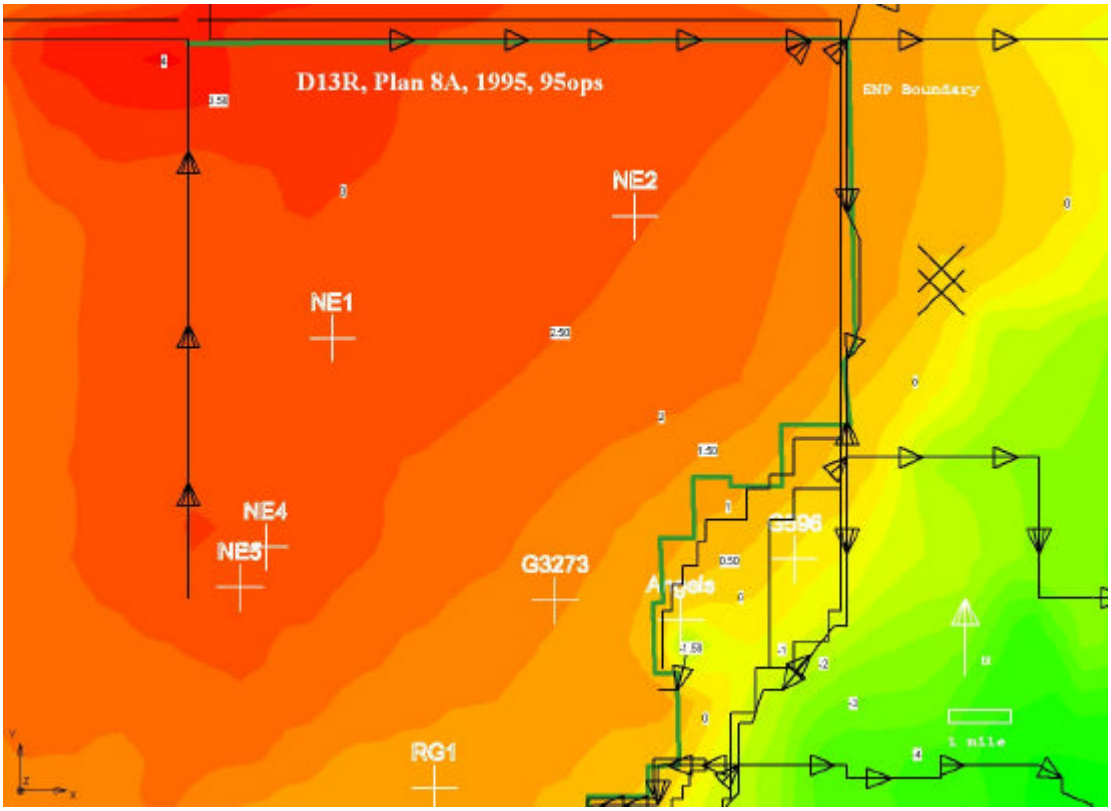


B) Average Depths (2.5 feet deep in NESRS to 1 feet below ground surface in southeastern part of 8.5 SMA)

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 (2.5 feet deep in NESRS to 1 feet below ground surface in southeastern part of 8.5 SMA)

Figure 18 Hydroperiods and Average Depths for Plan 8A

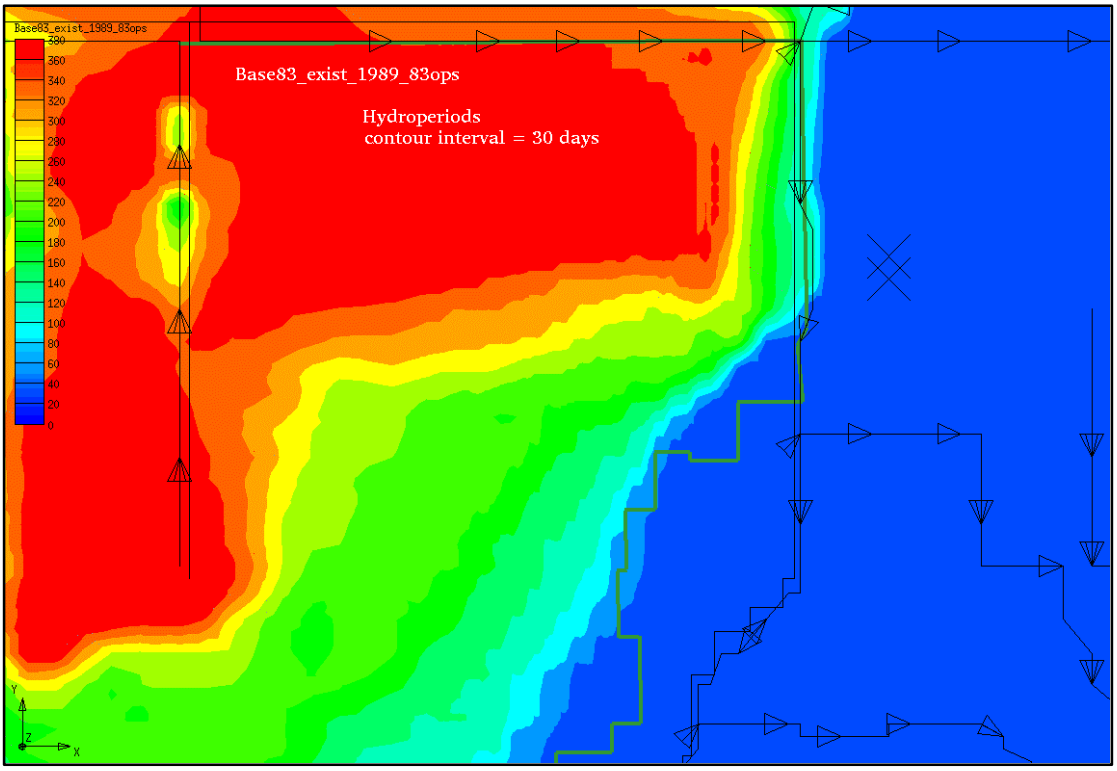


Figure 19 Hydroperiods for Existing Conditions (for the dry year, hydroperiods for existing conditions (Base83) range from 360 days in the northern part of NESRS to 0 days in the 8.5 SMA)

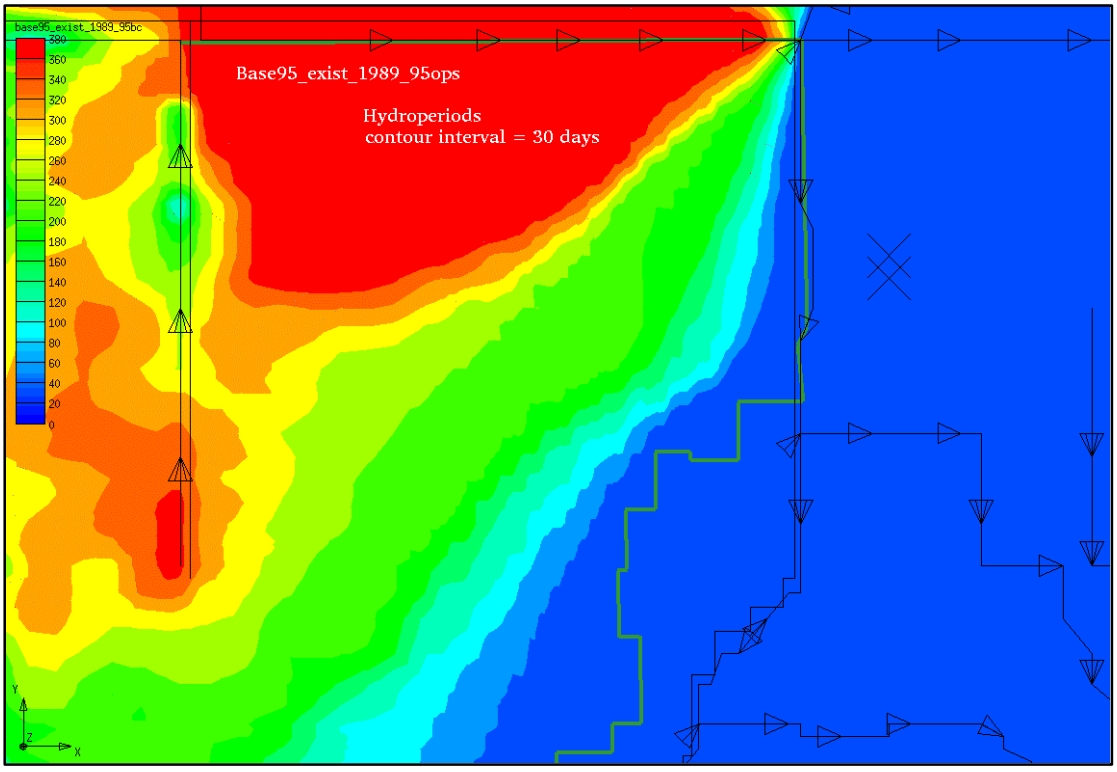


Figure 20 Hydroperiods for Existing Conditions (for the dry year, hydroperiods for existing conditions (Base95) range from 360 days in the northern part of NESRS to 0 days in the 8.5 SMA)

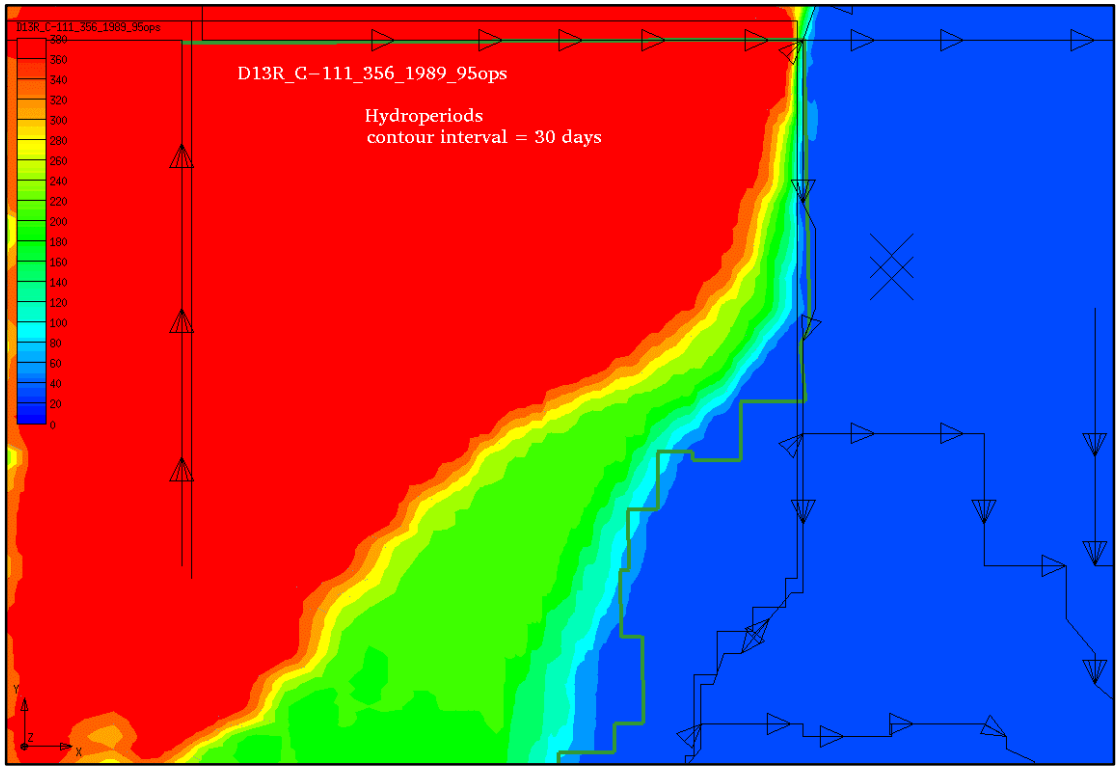


Figure 21 Hydroperiods for Restored Conditions (360 days of inundation in northern part of NESRS to 0 days of inundation in 8.5 SMA)

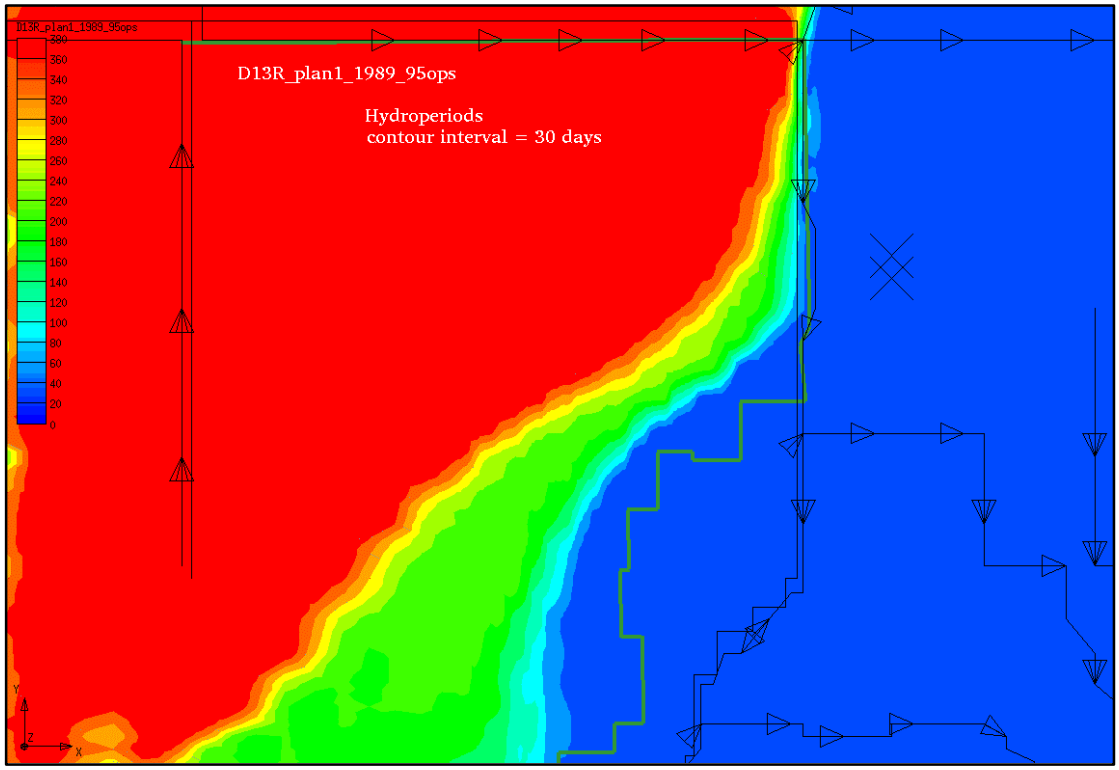


Figure 22 Hydroperiods for Plan 1 (360 days of inundation in northern part of NESRS to 0 days of inundation in southeastern part of NESRS)

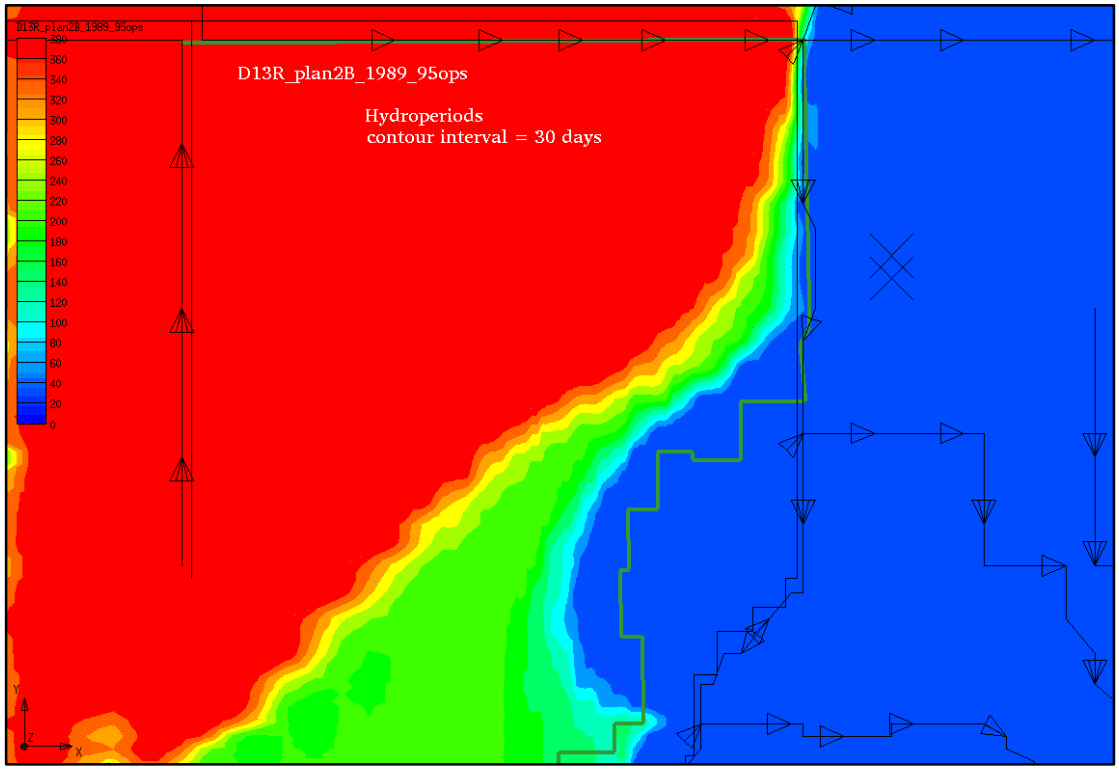


Figure 23 Hydroperiods for Plan 2B (360 days of inundation in northern part of NESRS to 0 days of inundation in the southeastern part of NESRS)

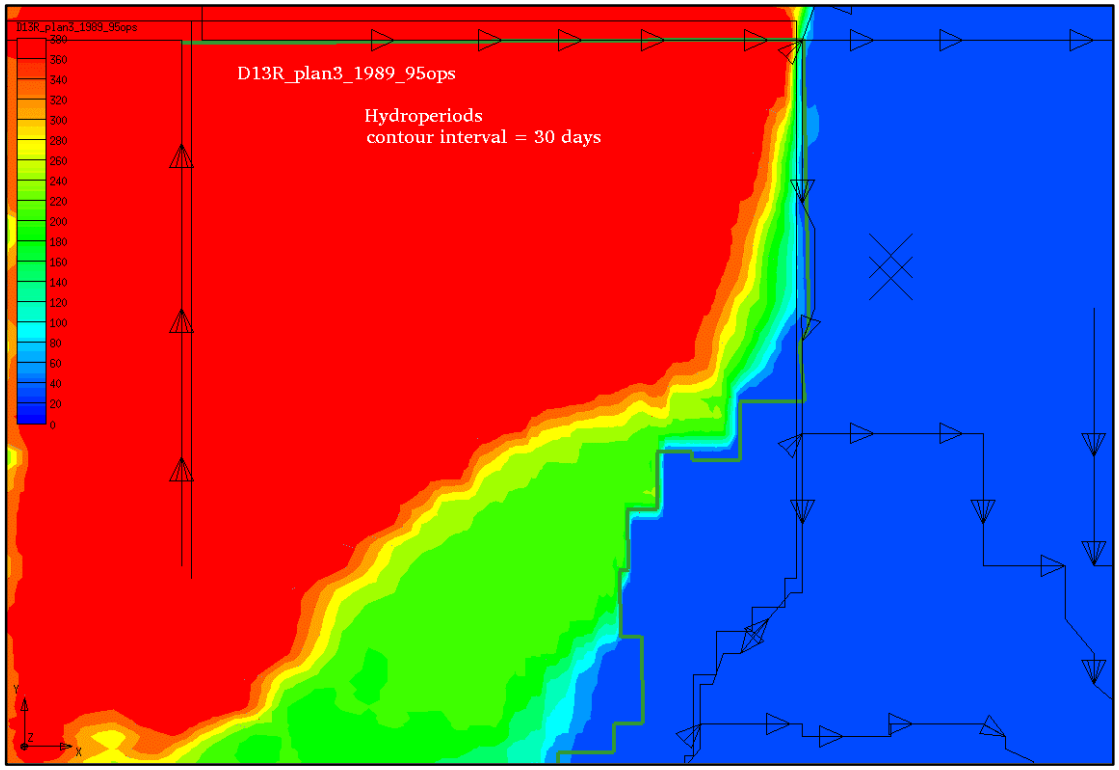


Figure 24 Hydroperiods for Plan 3 (360 days of inundation in northern part of NESRS to 0 days of inundation inside slurry wall at ENP boundary)

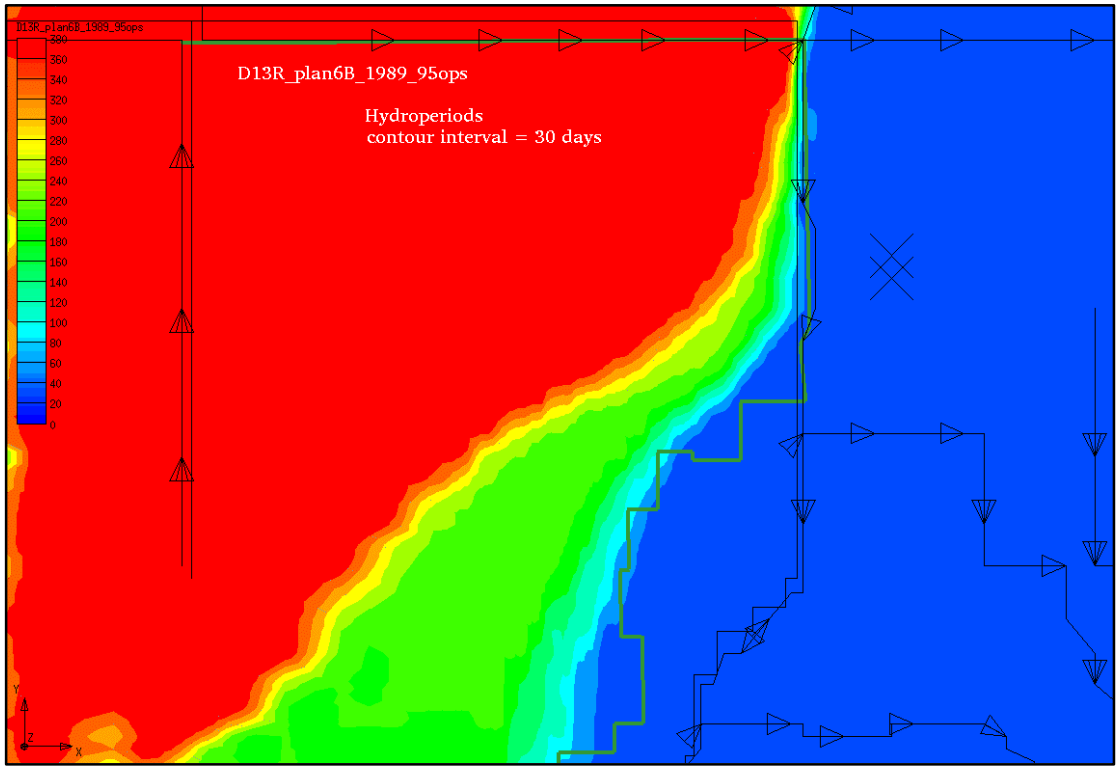


Figure 25 Hydroperiods for Plan 6B (360 days of inundation in northern part of NESRS to 0 days of inundation outside ENP boundary)

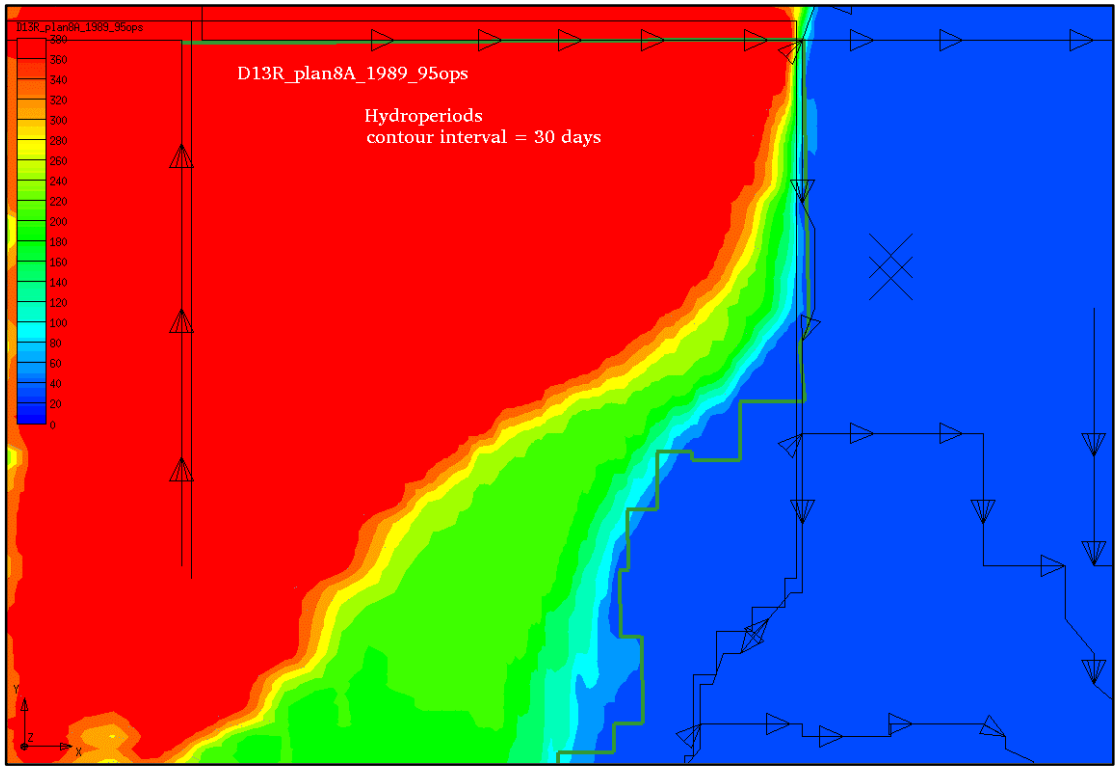


Figure 26 Hydroperiods for Plan 8A (360 days of inundation in northern part of NESRS to 0 days outside ENP boundary)

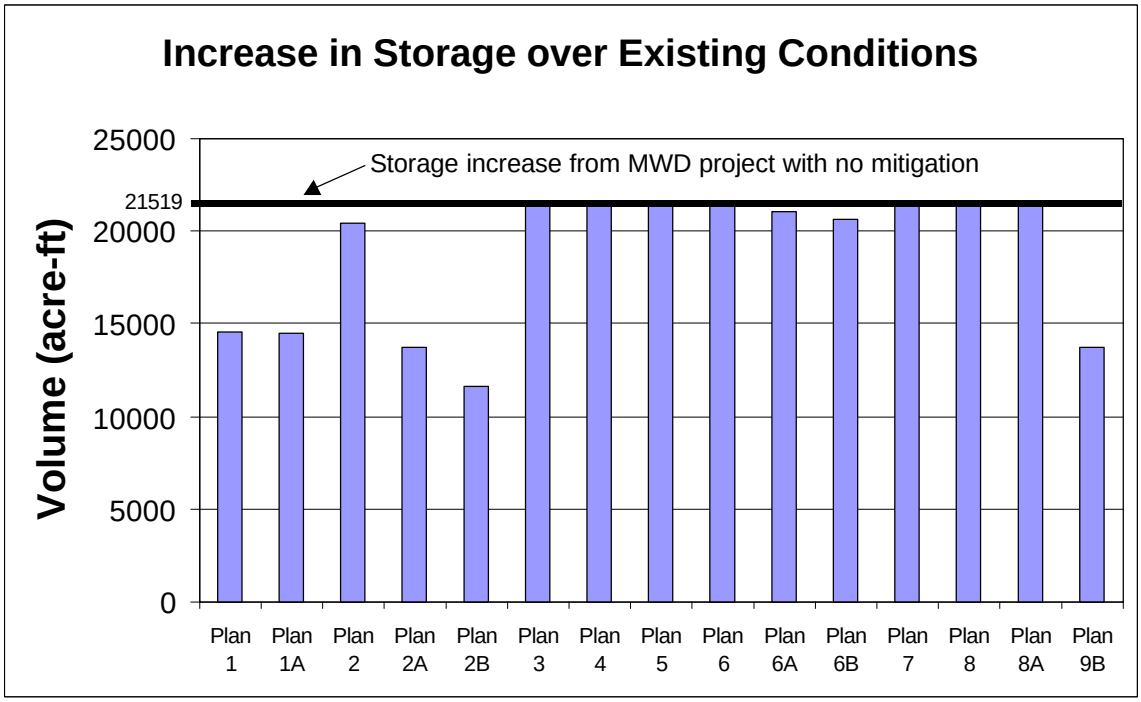


Figure 27 Increase in Storage (Water Volume) over Existing Conditions

Table 4 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)
C–111	0	21,042	0
Plan 1	0	6,979	33.2
Plan 1A	0	7,032	33.4
Plan 2	232	1,061	5.0
Plan 2A	0	7,808	37.1
Plan 2B	0	9,912	47.1
Plan 3	2,626	0	0
Plan 4	0	0	0
Plan 5	0	0	0
Plan 6	74	88.5	0.4
Plan 6A	0	455	2.2
Plan 6B	0	868	4.1
Plan 7	0	0	0
Plan 8	0	0	0
Plan 8A	0	117	0.6
Plan 9	0	9,912	47.1

Flood Mitigation and Flood Protection

Flood mitigation was evaluated in terms of both increases in hydroperiod and average depth. The results are presented in Table 3. Plan 1 provides flood mitigation to the entire 8.5 SMA except for a small portion. There would be 102 acres with increased surface water depths and 263 acres with increased hydroperiod. Plan 2B would provide full flood mitigation in all of the 8.5 SMA, both in terms of hydroperiod and depth. Plans 3 and 8A fail to mitigate in more than 3,000 acres of the 8.5 SMA. Plan 6 does not provide flood protection. However, in plan 6A water is pumped further south, still not providing flood protection, but allowing for flood mitigation.

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 flood protection if the water surface was below the ground surface during week 26 (the week in which peak flows occurred in the model). These results are presented in Table 5. The flood protection zone for all plans except 6B is the entire 8.5 SMA (6,909 acres). For plan 6B, the flood protection zone is limited to the area east of the canal (1,992 acres).

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 1A	6,323	586	91.5	8.5
Plan 2	6,323	586	91.5	8.5
Plan 2A	6,264	645	90.7	9.3
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 6	540	1,452	27.1	72.9
Plan 6A	40	1,952	2	98.0
Plan 6B	0	1,992	0	100
Plan 7	6,323	586	91.5	8.5
Plan 8	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 1,192 acres, leaving 5,201 acres unprotected.

Plans 2B and 9 would provide flood protection to 188 acres, leaving 6,205 acres unprotected. For all of the structural plans except 6B, more than 95 percent of the 8.5 SMA would be flooded during a ten-year event. Under existing conditions, 98 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.

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.

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 on the western edge of the 8.5 SMA (Figure 28). The presence of muhly grass noted by WRAP members confirmed these results, which are presented in Table 6. 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 long hydroperiod wetlands. Under plans 2B and 9B, 1204 acres of marl forming wetlands would remain in the 8.5 SMA and 3,675 acres would be created by draining long hydroperiod wetlands in ENP. Under plan 2,002 additional acres of marl forming wetland would be added to the 8.5 SMA. Under plan 6B, all of the 1,294 acres of marl forming wetlands in the study area would be lost. Plan 8A loses 834 acres of marl forming wetlands. Under plans 4, 5, and 7, 1,397 acres of marl forming wetlands would be retained, 1,289 in the 8.5 SMA.

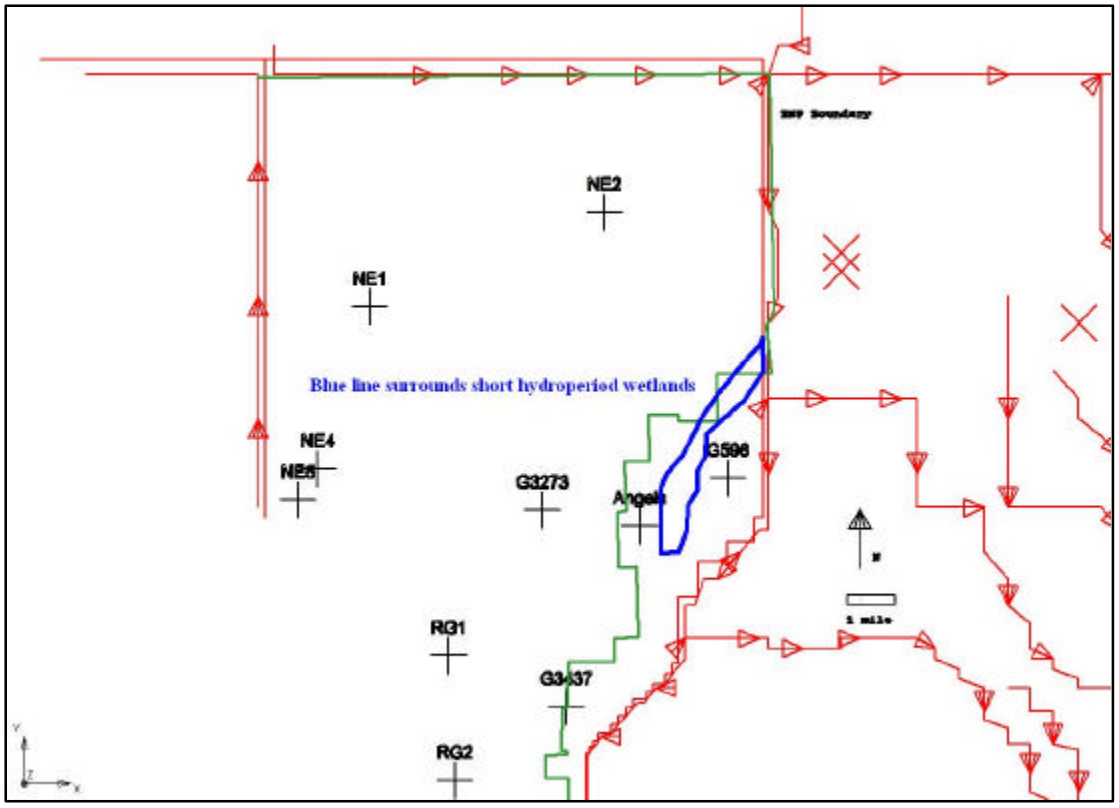


Figure 28 Existing Short Hydroperiod Wetlands from Modeled Performance Measures

Table 6 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:		
Restored Conditions	1,397	1,289
Plan 1	2,428	1,387
Plan 2B	3,675	1,204
Plan3	2,110	2,002
Plan 6B	591	483
Plan 8A	1,051	943
Plan 9B	3,675	1,204

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.

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 plan 2b 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. 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 30). However, it is these exact same perimeter zones that are needed to complete the landscape and restore ecological function. The future of a healthy

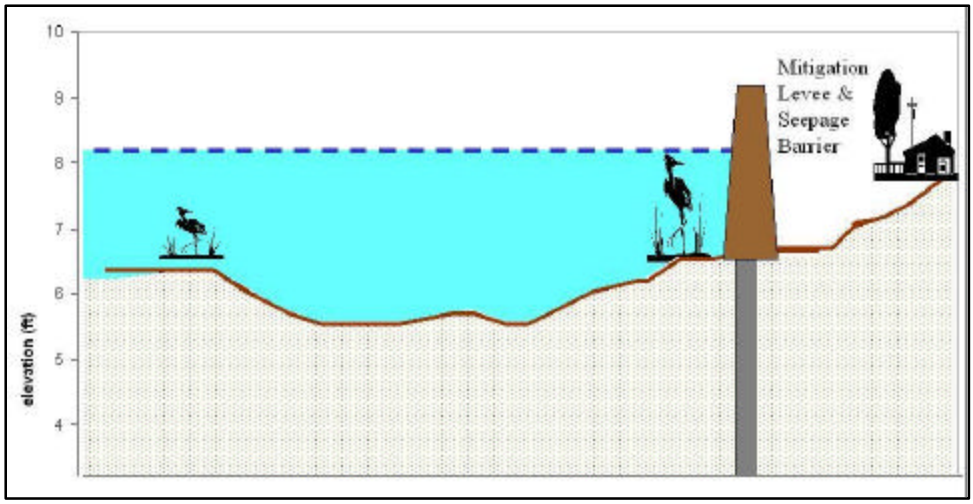


Figure 29 Effect of Canals, Levees, and Seepage Barriers on Water Level Gradients

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 least consistent with the long-term goal of restoring Everglades ecological function. Plans involving levees and canals (1, 2b, 3, 6b, and 9) are the least 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.

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 nine 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). An interagency WRAP Team was established in October 1999 and included representatives from the FWS, Corps, ENP, SFWMD, Florida Department of Environmental Protection, DERM, and the Miccosukee Tribe of Florida. These representatives were experienced biologists, ecologists, and botanists who have applied the WRAP procedure on numerous occasions and are knowledgeable of wetland ecology in South Florida.

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 acreage of each wetland habitat type (polygon) is then multiplied by the acreage of that habitat type to derive "functional units" 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 convened to calculate the "with-project" wetland functional projections for the nine alternatives proposed for the project.

Best professional judgment in combination with hydrologic model outputs (MODBRANCH, U.S. Army Corps of Engineers), which quantified spatial hydroperiod projections developed for construction 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 graminiod 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. **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.

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

4. **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.

5. **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.

6. **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.

7. **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.

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

9. **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 31.

Everglades National Park

As shown on Table 7, 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).

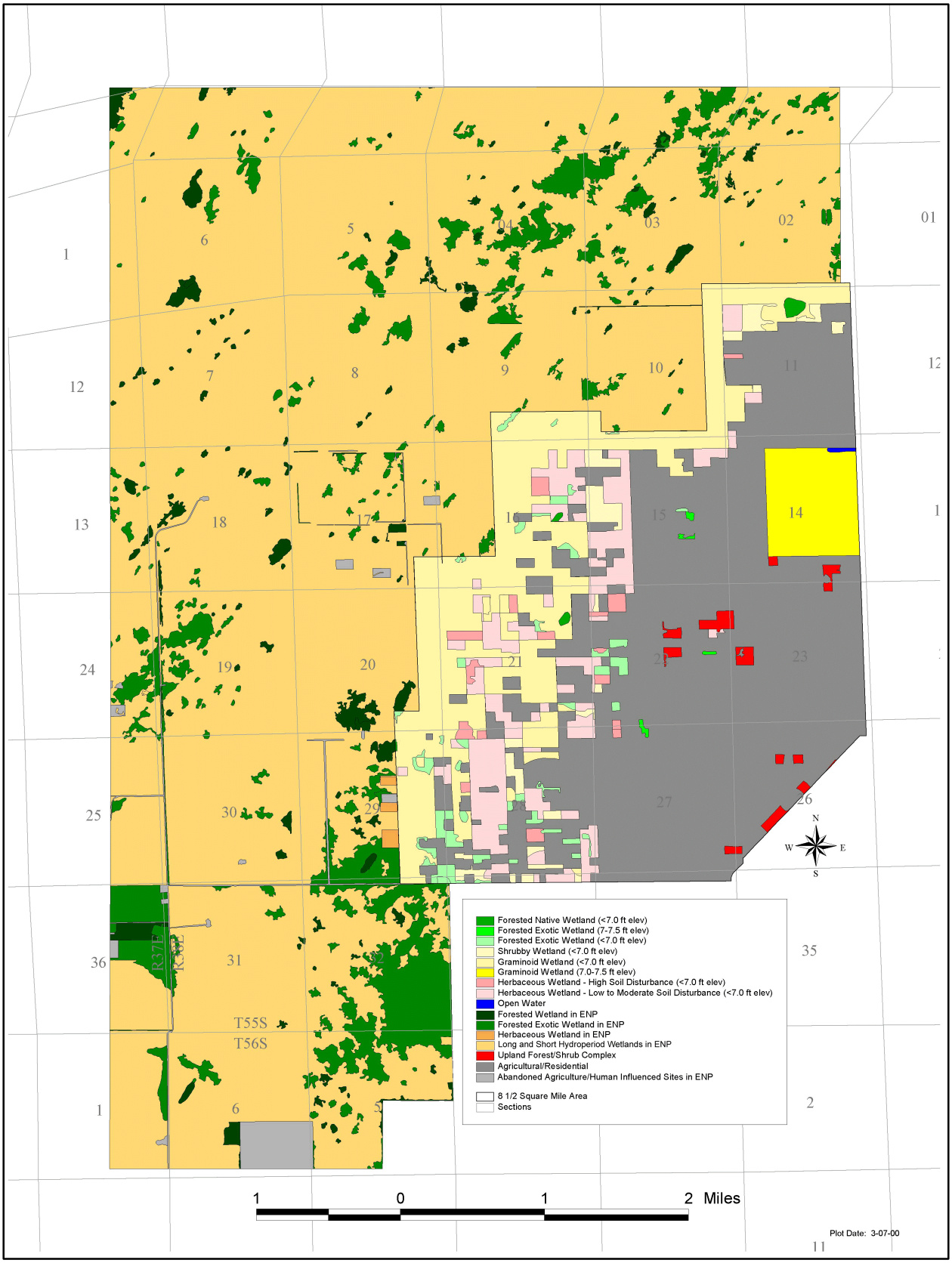


Figure 30 Distribution of Wetlands in the Study Area

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 continuing 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 = 0.72); 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 past and present agricultural land uses. The degree of disturbance appears to be adequately reflected in their respective scores (Table 7).

Table 7 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 7). 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 FAA's 300-acre 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 were 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 flood 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's 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;

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

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

10) **Habitat Management**: It was assumed that all public lands in the 8.5 SMA that are not flood protected, 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 8 lists the with-project WRAP results, by polygon scores, acreages, and functional units, for Alternatives 1, 2 and 9. The highest WRAP scores calculated were for the Forested Wetland Systems (0.82) and Long Hydroperiod Wetlands (0.82) 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 units score by habitat type.

Table 8 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 9 lists the with-project WRAP results, by polygon scores, acreages and functional units, 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 9 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 10 lists the with-project WRAP results, by polygon scores, acreage, and functional units, 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 10 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 6

Alternative 6 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 6 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 11 With-project Condition WRAP Polygon Scores, Acreages, and Functional Units for Alternative 6 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, no 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 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 (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 extent, 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, the WRAP Team assumed that overall existing conditions of the 8.5 SMA wetlands could prevail. However, anthropogenic dynamics could likely result in trade-offs between activities that cause wetland functional losses as well as improved hydrology throughout project life. Table 12 describes the best case wetland conditions for Alternative 7.

Alternative 8

This alternative, is a 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 12 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 Graminoid Wetland >7.0 feet on the FAA's tract 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 would decrease water levels within a 0.5-mile radius during pumping operations. Wetland losses from construction of the containment levee would be similar to Alternative 6. 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 13 lists the with-project WRAP results, by polygon scores, acreage, and functional units, for Alternative 8.

Table 13 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 Agrictultural/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 functional units relative to existing condition functional units. Table 14 presents comparisons of wetland functional units among the project alternatives and existing conditions. Figure 31 graphically displays functional gains and losses for the nine alternatives compared to the existing condition wetland function.

The WRAP analysis suggests construction and operation of Alternatives 1, 2, 3, and 9 would result in wetland losses when compared to the existing condition. A total loss of 2,765 functional units (1,290 in ENP and 1,475 within the 8.5 SMA) is associated with Alternatives 1, 2, and 9, whereas construction and operation of

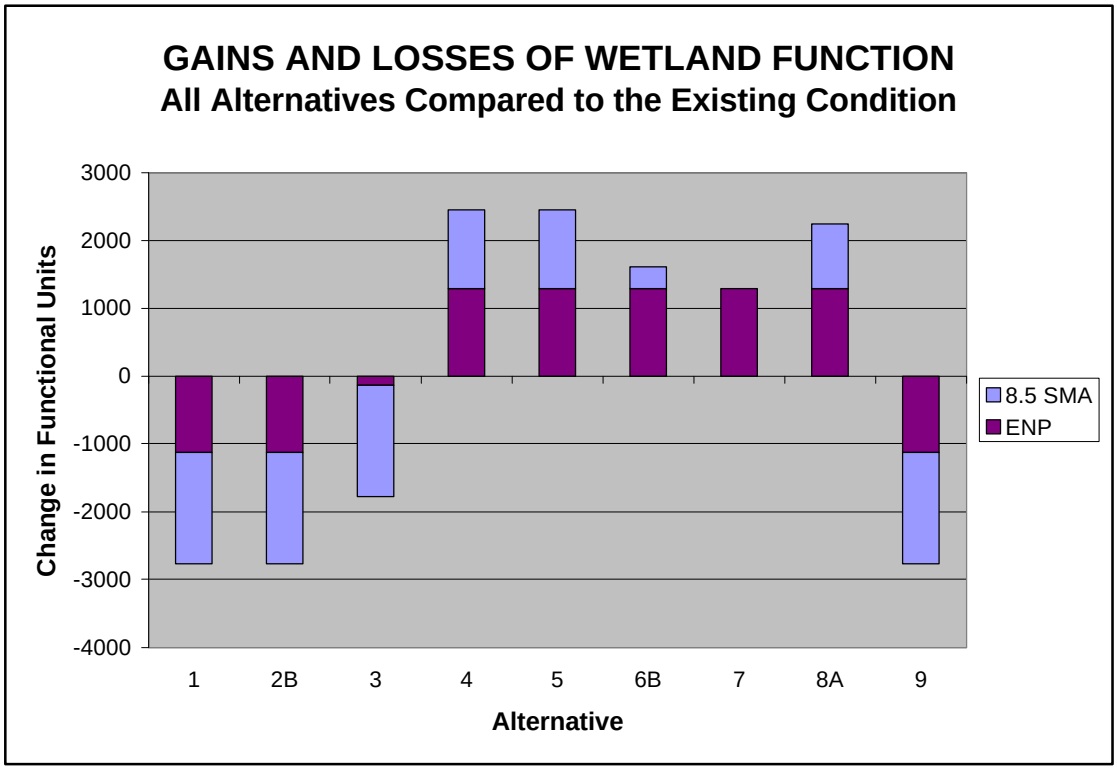


Figure 31 Gains and Losses in Wetland Function from the Existing Condition for the Nine 8.5 SMA Alternatives

Alternative 3 would result in a loss of 1,775 functional units (137 in ENP and 1,638 within the 8.5 SMA). This significant difference (990 functional units) 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.

A gain in wetland function should be realized by predicted hydrologic and ecological improvements from the implementation of Alternatives 4, 5, 6, 7, and 8. Alternatives 4, 5, and 7 are non-structural, whereas both Alternatives 6 and 8 involve the construction of levees. Alternative 6 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 6 would improve existing wetland function by 1,606 functional units (1,290 in ENP and 316 within the 8.5 SMA), whereas the implementation of Alternative 8 would result in an increase of 2,240 functional units (1,290 in ENP and 950 within the 8.5 SMA).

Table 14 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	6	7	8	9
Everglades National Park										
Forested Wetland	809	729	729	791	836	836	836	836	836	729
Forested Exotic	1,701	1,701	1,701	2,054	0	0	0	0	0	1,701
Long Hydrp Gram	6,325	5,894	5,894	6,469	6,469	6,469	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	2,865	2,865	2,157
Herbaceous Wetland	na	na	na	na	2,728	2,728	2,728	2,728	2,728	Na
Subtotal	11,608	10,481	10,481	11,471	12,898	12,898	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	1,043	1,138	0
Graminoid Wetland > 7.0 ft	159	159	159	159	159	159	99	159	159	159
Herb. Wetl. low-mod. Disturb. < 7.0 ft	395	0	0	0	595	595	592	395	532	0
Herb. Wetl. high Distub. <7.0 ft.	46	0	0	0	191	191	180	46	166	0
Shrubby Wetland	73	0	0	0	0	0	0	73	0	0
Forested Exotic Wetl. 6.5–7.0 ft	65	0	0	0	0	0	0	65	0	0
Forested Exotic Wetl. >7.0 ft	3	0	0	0	0	0	0	3	0	0
Forested Native Wetl.	13	0	0	0	14	14	14	13	14	0
Restored Agricultural/ Residential	0	0	0	0	765	765	0	0	738	0
Subtotal	1,797	159	159	159	2,955	2,955	2,113	1,797	2,747	159
Total	13,405	10,640	10,640	11,630	15,853	15,853	15,011	14,695	15,645	10,640

na = not available

The difference between these two structural alternatives is found in each plan's potential to restore agricultural and residential lands to natural wetlands. Both alternatives provide equal 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's tract by eliminating the hydrologic edge effect associated with the seepage canal; a prominent feature of Alternative 6. Seepage losses to adjacent lands (generally along the levee alignment) would preclude restoration of those lands to functional wetlands.

Alternative 7 would improve existing wetland function by 1,290 functional units, 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 functional units: 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 comparisons of Alternatives 2 through 9 to the No Action Alternative.

Alternative 2 — No difference

Alternative 3 — This alternative represents an improvement of 990 functional units compared to the No-Action Alternative. All functional units 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 functional units compared to the No-Action Alternative. ENP wetlands would realize an improvement of 2,796 functional units, 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 functional units by optimization of existing wetlands (2,031 functional units) and restoration of existing agriculture/residential lands within the 180-day hydroperiod (765 functional units).

Alternative 5 — Same as Alternative 4.

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

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

Alternative 8 — This alternative represents an improvement of 5,005 functional units compared to the No Action Alternative. ENP wetlands would realize an improvement of 2,417 functional units due to restoration flows as described for Alternatives 4, 5, 6, and 7. Wetland function within the 8.5 SMA would be 2,588 functional units 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 FWS' 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 FWS personnel involved in making recommendations to protect or conserve fish and wildlife resources. The policy is needed to: (1) ensure consistent and effective FWS recommendations, (2) allow Federal and private developers to anticipate FWS recommendations and plan for mitigation needs early, and (3) reduce FWS 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 15).

Table 15 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 FWS 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 FWS established the following resource categories for the twelve habitat types listed in Table 16. Based on these habitat types, the FWS 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;

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;

Table 16 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.

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.

(Note: *Fish and Wildlife Resource Mitigation will be developed pending selection of a federally preferred alternative*).

Fish and Wildlife Enhancement Features

A substantial body of literature exists on the design of wetland construction projects (Kusler and Kentula 1989). However, designing a functional wetland project and actually constructing a successful wetland project are two different matters. The following presentation of Fish and Wildlife Enhancement Features (features) utilizes literature, expert opinion, and best professional judgment based on years of designing, implementing, and monitoring wetland compensatory mitigation and wetland restoration in South Florida. These features 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 water. 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 vegetated nesting islands, fish refugia, littoral shelves, and foraging sloughs, inside water storage areas. Outside the water storage areas, it is envisioned that vegetated buffer zones be established to screen these features from urban areas and disturbances. It is envisioned that material for construction of these features would be available on-site. For example, material for the construction of nesting islands could come from the excavation of fish refugia and foraging sloughs, which would minimize costs.

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. The FWS envisions littoral shelves that are constructed at different elevations along canals to maximize shelf performance. For example, shelf 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 primarily to move water, the flow-through wetland shelves should remain wetted for maximum water quality benefits. If canal stages are designed to drop more than three feet for significant periods of time, then the littoral shelf design would have to be adjusted to meet this target.

On the other hand, large water fluctuations in any proposed water storage areas 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.

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 vegetation planting plan in sufficient detail to facilitate this effort should be developed.

Information needed to further refine the fish and wildlife enhancement features include hydrologic operational plans for impoundments and canals, potential seepage issues, availability of suitable soils for revegetation, and plans to control exotic/nuisance species. Finally, a wildlife management plan is needed for managing and monitoring the response of fish and wildlife resources to these features.

Overall, the FWS envisions that these features would be compatible with hydrologic operational scheduling and could always be adjusted to accommodate new operational schedules as need be.

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. Pending the selection of a federally preferred alternative, DOI would apply the wetland functional results (WRAP) to develop a wetland compensatory mitigation plan, if necessary.

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, 6, 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, 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, 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 16.

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 requirements of a given civil works project.

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 functional unit. 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 17.

Table 17 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
6	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 also has significant mitigation costs, but is $34.7 million less than Alternative 1. Implementation of either Alternative 4, 5, 6, 7, or 8 would not incur any mitigation costs because no wetland functional losses would occur under these alternatives.

(*Note: A final Compensatory Mitigation Plan will be developed pending the selection of a federally preferred alternative*)

Chapter 7 — Federally Listed Threatened or Endangered Species

This chapter presents DOI's evaluation of potential effects of the nine 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, wood stork, and Cape Sable seaside sparrow. Evaluation of the project regarding potential impacts to the Florida panther and eastern Indigo snake has been deferred until selection of the federally preferred alternative, at which time complete evaluations for these species will be done.

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 (FWS 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. Bennetts and Kitchens (1997) conclude in their study of the snail kite that the goals of 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 18.

Table 18 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
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 6B, 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.

Ogden (1996) notes that 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 prenesting 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 from one place to another on 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 found in Appendix D and determining from each graph if there was sustained habitat availability with a minimum of disruption (abrupt changes) to that availability. Rankings are as follows:

1. Alternatives 4 & 5
2. Alternative 6b
3. Alternative 8a
4. Alternative 7
5. Alternatives 2b & 9
6. Alternative 1
7. 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 (see Chapter 4 for description of the alternatives and Appendix D for Wood Stork Habitat under Restored Conditions).

Alternative 6b provides similar conditions; however, it 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 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.

Cape Sable Seaside Sparrow

Sub-population F of the Cape Sable Seaside Sparrow is located south of the 8.5 SMA and west of the proposed C–111 S-332 B pump (Figure 32). The model simulations included the C–111 Project with the S–332 A and B pumps delivering most of the C–111 Project's water that is returned to ENP. This pumping at S–332 A and B would cause increased water levels for sparrow sub-population F. However, when the final design for the C–111 Project is developed, it is likely that these impacts can be avoided by pumping more water at S–332C and S–332D. Therefore, it is not appropriate to gage impacts to sparrow sub-population F based on the current model runs.

In addition to the C–111 Project's impacts, the model simulations also included a synthetic 1-in-10 year storm event from May 15 to May 24. This would occur in the middle of the sparrow's breeding season and would cause water levels to be artificially high in the sparrow's habitat. Further analysis will be needed to verify that removal of the effects of the C–111 Project's pumps and the synthetic 1-in-ten year event do not cause detrimental impacts to sparrow breeding.

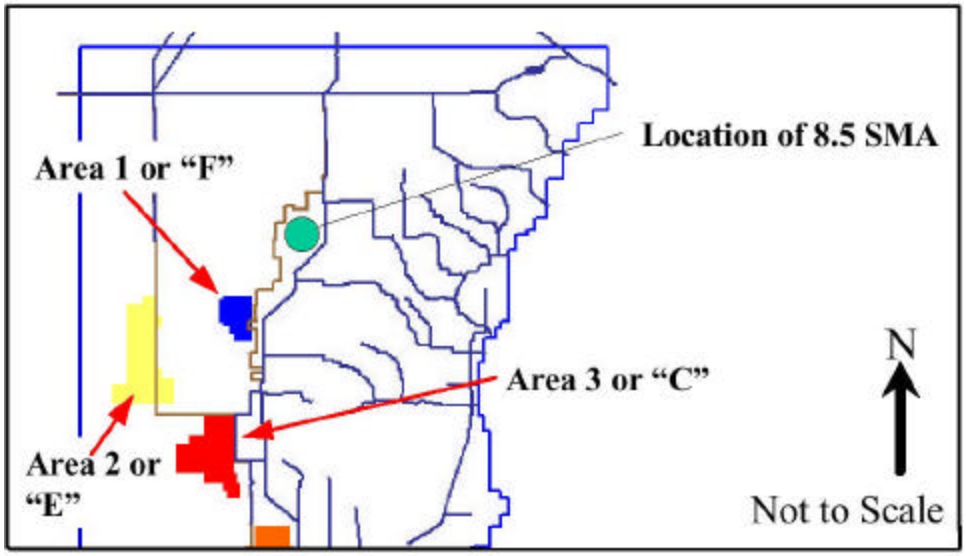


Figure 32 Location of Cape Sable Seaside Sparrow Sub-population F

Chapter 8 — Preliminary 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 restored water levels. 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. Positive numbers (greens) represent areas where the restored water level is higher than the alternative and negative numbers (pinks) represent areas where the alternative caused higher water levels than restored conditions.

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 33) 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. The plan performed poorly for wood storks and snail kites and had a WRAP score that reflected a loss of 2,765 functional units 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. The plan provided full structural mitigation. In essence, the plan mitigates for increased water levels by reducing water levels in both the 8.5 SMA and NESRS (Figure 34). 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 functional units from existing conditions. Thus, as with Alternative 1 Alternative 2 would result in a loss of functional wetlands if implemented.

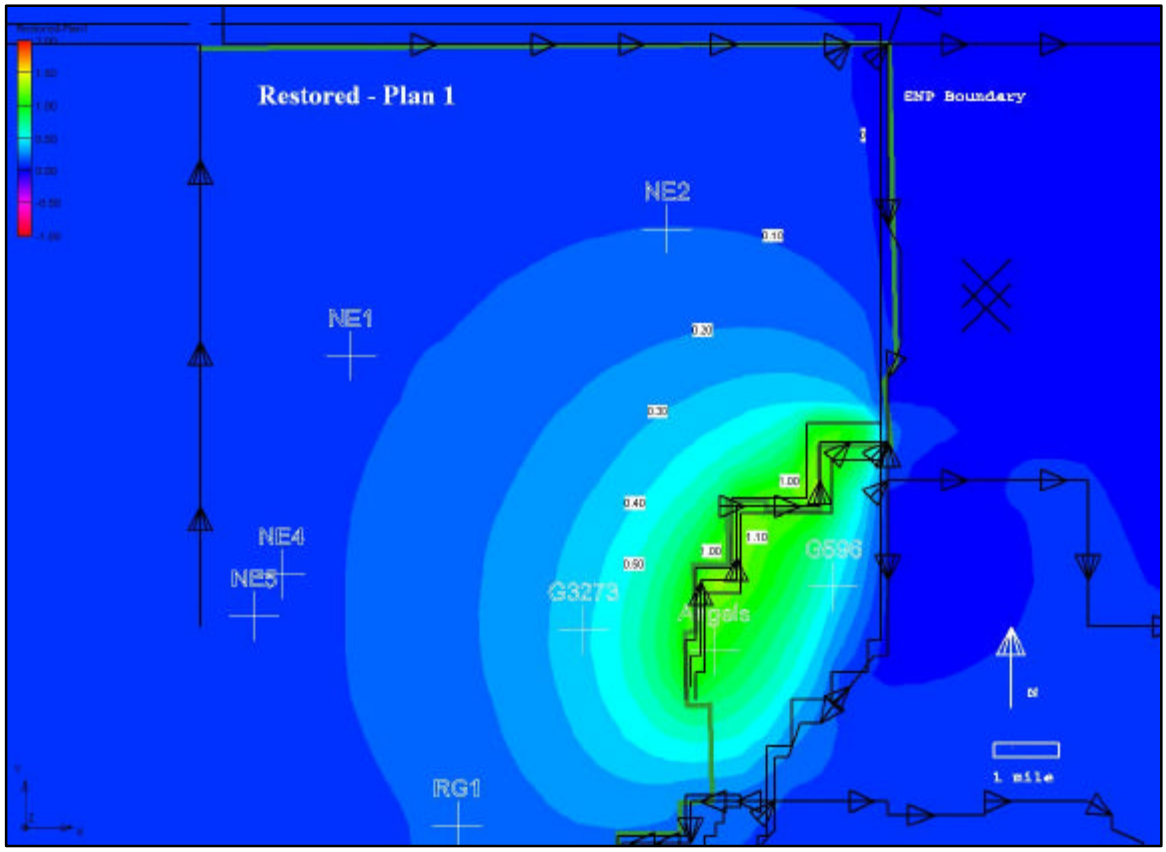


Figure 33 Difference in average water depths between the restored condition following full implementation of MWD and Alternative 1 (lowered water depths in NESRS by 0.1–1.0 feet relative to restored conditions in ENP following full implementation of MWD)

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 35) 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 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 functional units from existing conditions.

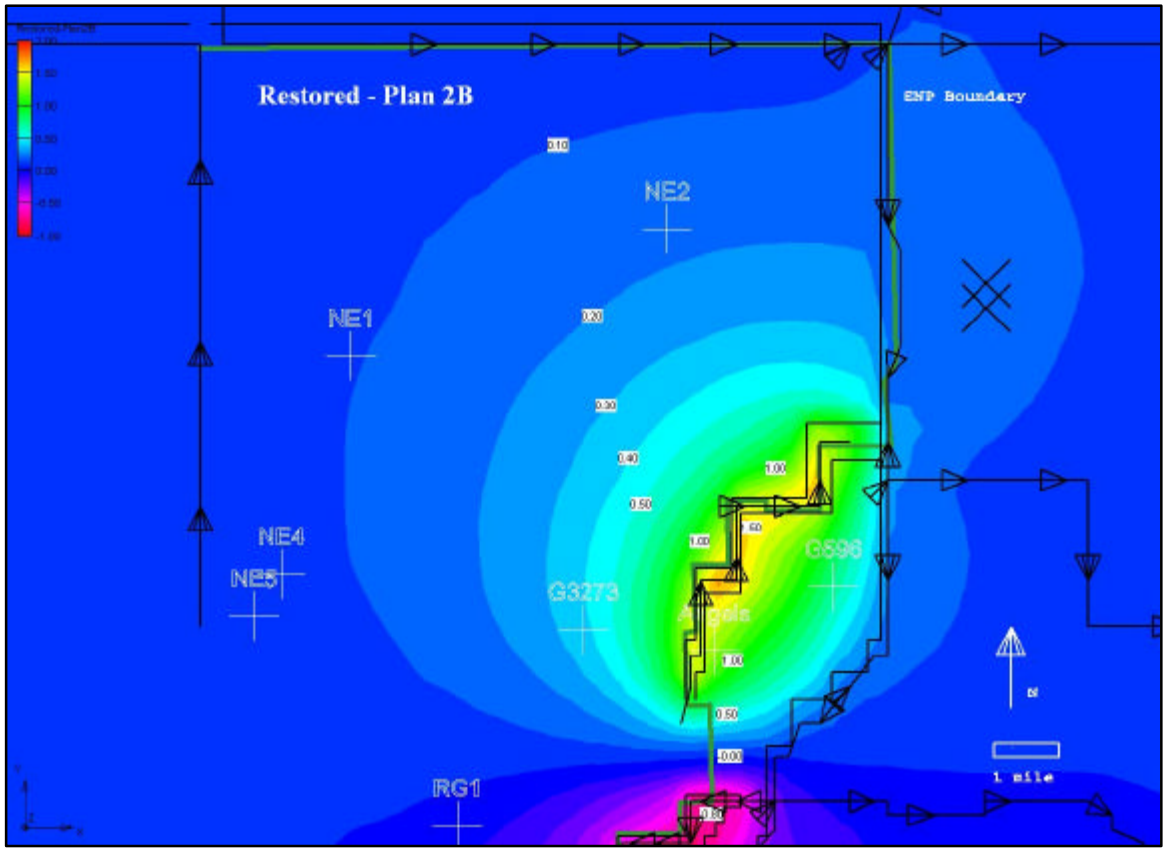


Figure 34 Difference in average water depths between the restored condition following full implementation of MWD and Alternative 2B (Alternative 2B lowered water depths in NESRS by 0.1 to 1.5 feet and increased depths to the south by 0.8 feet relative to the restored condition following full implementation of MWD)

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 functional units from existing conditions.

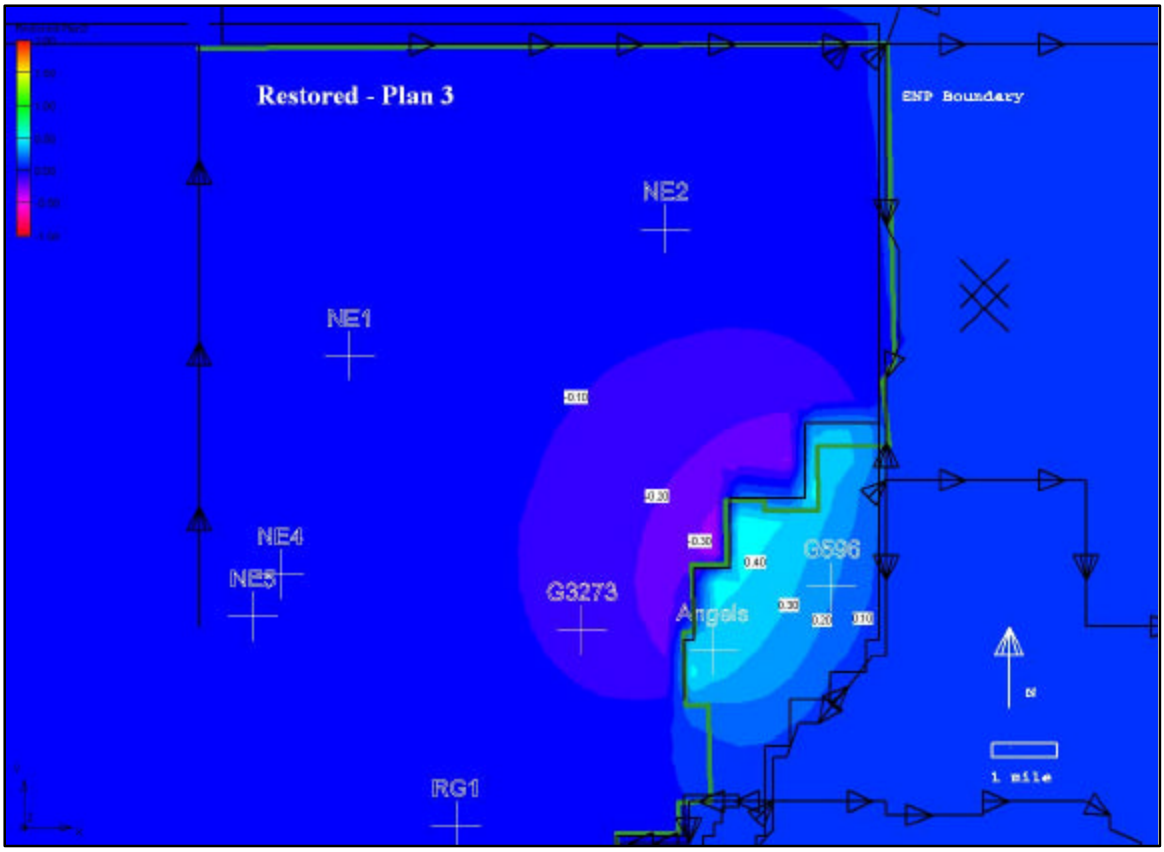


Figure 35 Difference in average water depths between the restored condition following full implementation of MWD and Alternative 3 (Alternative 3 increased water depths in eastern NESRS by as much as 3 feet and decreased depths in the 8.5 SMA by as much as 0.4 feet relative to the restored condition following full implementation of MWD)

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 functional units 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 36). Limiting the protected area to the higher elevations in the 8.5 SMA would allow attainment of full flood protection. In providing 1-in-10 year flood protection to the residents, 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 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 snail kites. The WRAP score for Alternative 6B suggests implementation of this alternative would result in a net gain of 1,606 functional units.

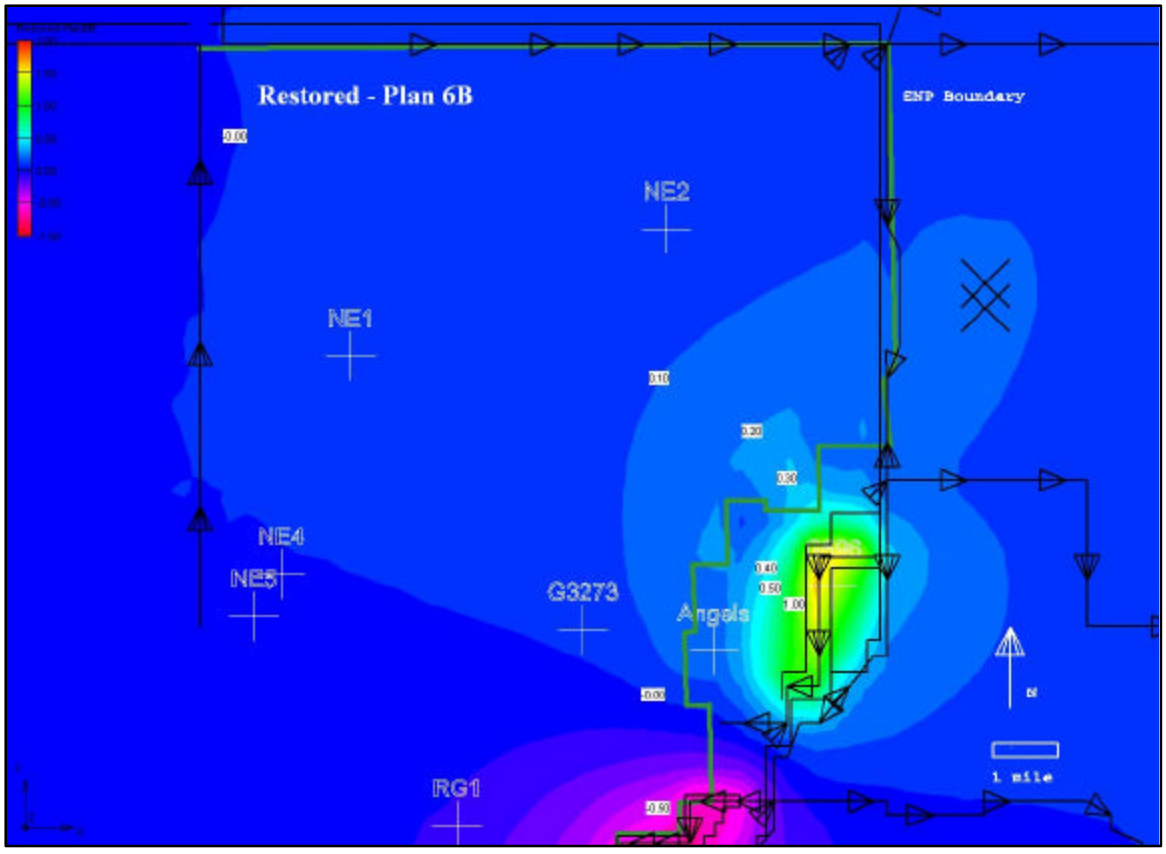


Figure 36 Difference in average water depths between the restored condition following full implementation of MWD and Alternative 6B (Alternative 6B lowered water depths in eastern NESRS by 0.1 to 0.3 feet and increased depths to the south by 0.5 feet relative to the restored condition following full 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 functional units 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. The WRAP score for Alternative 6B suggests implementation of this alternative would result in a net gain of 1,209 functional units.

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 37). 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 functional units 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.

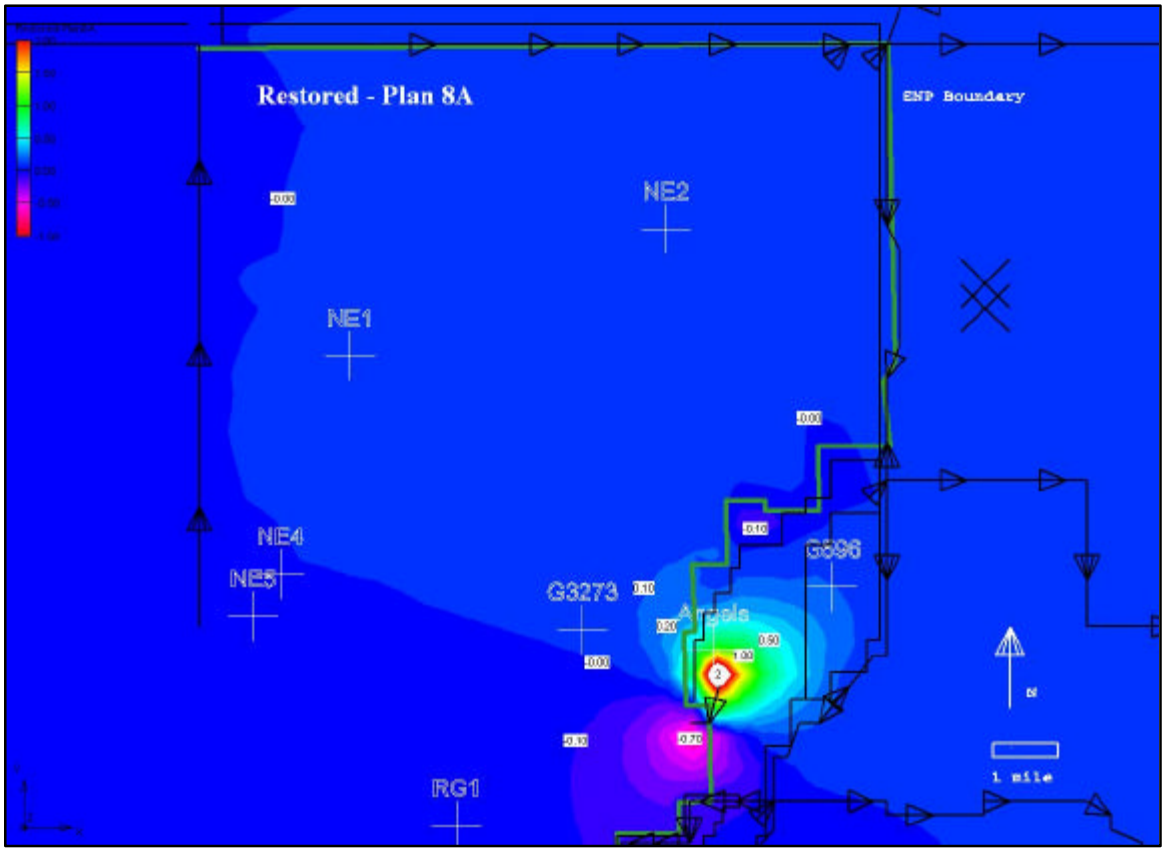


Figure 37 Difference in average water depths between the restored condition following full implementation of MWD and Alternative 8A (Alternative 8 had little effect on water depth in NESRS and lowered depths near the pump by up to 2 feet)

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 series of three spreadsheets. The first spreadsheet (Table 19) contains the raw data for each of the performance measures as presented in the previous chapters. The second spreadsheet (Table 20) 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 20 is provided in Table 22.

The third spreadsheet (Table 21) summarizes the performance for all objectives and renders a preliminary score. Table 21 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:

Table 19 Performance Measures Evaluation and Scoring Matrix (Raw Data)

Performance Measure	data units	Unweighted Raw Data-Wet Year (1995) Raw Data Alt1	Alt2B	Alt3	Alt4	Alt5	Alt6B	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	Relative to restored condition
1B-NESRS decrease in spatial distribution of hydroperiod	acres	3,158	3,275	0	0	0	294	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	Relative to restored condition
1D-NESRS decrease in spatial distribution of water depth	acres	27,173	36,640	0	0	0	6,035	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	5,976	3,934	0	Relative to exisiting condition
2B-8.5 SMA damages due to increase in surface water depth	acres	102	0	3,669	0	0	0	5,059	3,796	0	Relative to exisiting 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	Requires additional COE modeling output
3B-Nesting habitat suitability changes	days	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Requires additional COE modeling output
Snail Kite											
3C-Habitat suitability changes	acres	54,847	53,700	60,367	58,286	58,286	57,400	58,286	57,832	53,700	
Wood Stork											
3D-Habitat suitability changes	rank (1-9)	2	4	1	9	9	7	5	6	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	0	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	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	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	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	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	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	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	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	1,290	2,240	-2,765	Change from existing condition
6-Measure compatibility with CERP and C-111 Projects; maintain flood protection east of											
6A-Retrofitting of project features	Score (1-5)	1	2	1	3	5	3	3	3	2	(1=retrofitting high; 5=retrofitting minimal)
6B-Potential to re-establish historical flow regimes	Score (1-5)	1	1	1	4	5	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 (1-9)	9	9	9	9	9	9	9	9	9	
7B-Ability to meet implementation schedule	Rank (1-9)	9	9	9	9	9	9	9	9	9	
7C-Construction delays	Rank (1-9)	9	9	9	9	9	9	9	9	9	
7D-Administrative requirements of alternatives	Rank (1-9)	9	9	9	9	9	9	9	9	9	

N/A= Information Not Available

Table 20 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**	**Alt7**	**Alt8A**	**Alt9**
LEGISLATIVE REQUIREMENTS AND PERFORMANCE MEASURES										
1-Evaluate effects on hydropatterns in NESRS										
1A-NESRS increase in spatial distribution of hydroperiod	1-9	1	1	9	1	1	1	1	1	1
1B-NESRS decrease in spatial distribution of hydroperiod	1-9	3	1	9	9	9	4	9	5	1
1C-NESRS increase in spatial distribution of water depth	1-9	1	1	9	1	1	1	1	1	1
1D-NESRS decrease in spatial distribution of water depth	1-9	3	1	9	9	9	4	9	5	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	1-9	4	9	2	9	9	9	1	3	9
2B-8.5 SMA damages due to increase in surface water depth	1-9	4	9	3	9	9	9	1	2	9
3-Evaluate effects to federal and state listed endangered species survival										
Cape Sable Seaside Sparrow										
3A-Nesting opportunity changes	1-9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3B-Nesting habitat suitability changes	1-9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Snail Kite										
3C-Habitat suitability changes	1-9	3	1	9	8	8	4	8	5	1
Wood Stork										
3D-Habitat suitability changes	1-9	2	4	1	9	9	7	5	6	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	1-9	1	5	1	9	9	9	1	6	5
Socio-economic Factors										
2D-Impacts to business	1-9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2E-Residents relocated	1-9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2F-Lost Agricultural lands	1-9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2G-Unwilling Sellers	1-9	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	1-9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4B-Local secondary costs	1-9	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	1-9	6	9	7	4	4	1	4	5	9
5B-Wetland Rapid Assessment Procedure (WRAP)	1-9	1	1	4	9	9	6	5	7	1
6-Measure compatibility with CERP and C-111 Projects; maintain flood protection east of L-31N										
6A-Retrofitting of project features	1-9	1	4	1	8	9	8	8	8	4
6B-Potential to re-establish historical flow regimes	1-9	1	1	1	8	9	1	6	8	1
7-Analyze impacts and costs associated with time delays in implementation of alternatives										
7A-Environmental and cultural resources	1-9	9	9	9	9	9	9	9	9	9
7B-Ability to meet implementation schedule	1-9	9	9	9	9	9	9	9	9	9
7C-Construction delays	1-9	9	9	9	9	9	9	9	9	9
7D-Administrative requirements of alternatives	1-9	9	9	9	9	9	9	9	9	9

N/A= Information Not Available

Table 21 Performance Measures Evaluation and Scoring Matrix (Weighted Score)

Performance Measure		PM Weight	Weighted Scores-Wet Year (1995) Weighted Score Alt1	Alt2	Alt3	Alt4	Alt5	Alt6	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	9	1	1	1	1	1	1
1B-NESRS decrease in spatial distribution of hydroperiod		Critical	3	1	9	9	9	4	9	5	1
1C-NESRS increase in spatial distribution of water depth		Desirable	1	1	9	1	1	1	1	1	1
1D-NESRS decrease in spatial distribution of water depth		Critical	3	1	9	9	9	4	9	5	1
	Objective Subtotal Score	**Mean**	**2**	**1**	**9**	**5**	**5**	**2,5**	**5**	**3**	**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	9	2	9	9	9	1	3	9
2B-8.5 SMA damages due to increase in surface water depth		Critical	4	9	3	9	9	9	1	2	9
	Objective Subtotal Score	**Mean**	**4**	**9**	**2.5**	**9**	**9**	**9**	**1**	**2.5**	**9**
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
3B-Nesting habitat suitability changes		Critical	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	9	8	8	4	8	5	1
Wood Stork											
3D-Habitat suitability changes		Desirable	2	4	1	9	9	7	5	6	4
	Objective Subtotal Score	**Mean**	**2.5**	**2.5**	**5**	**8.5**	**8.5**	**5.5**	**6.5**	**5.5**	**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	4	1	9	9	9	1	6	4
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
2E-Residents relocated		Important	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
2G-Unwilling Sellers		Important	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Objective Subtotal Score	**Mean**	**1**	**4**	**1**	**9**	**9**	**9**	**1**	**6**	**4**
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
4B-Local secondary costs		Important	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**
5-Analyze effects to ecological function											
5A-Spatial distribution of functional marl forming wetlands		Important	6	9	7	1	1	1	1	5	9
5B-Wetland Rapid Assessment Procedure (WRAP)		Critical	1	1	4	9	9	6	5	7	1
	Objective Subtotal Score	**Mean**	**3.5**	**5**	**5.5**	**5**	**5**	**3.5**	**3**	**6**	**5**
6-Measure compatibility with CERP and C-111 Projects; maintain flood protection east of L-31N											
6A-Retrofitting of project features		Important	1	4	1	8	9	8	8	8	3
6B-Potential to re-establish historical flow regimes		Important	1	1	1	8	9	1	6	8	1
	Objective Subtotal Score	**Mean**	**1**	**2.5**	**1**	**8**	**9**	**4.5**	**7**	**8**	**2**
7-Avoid impacts and costs associated with time delays in implementation of alternatives											
7A-Environmental and cultural resources		Desirable	9	9	9	9	9	9	9	9	9
7B-Ability to meet implementation schedule		Desirable	9	9	9	9	9	9	9	9	9
7C-Construction delays		Desirable	9	9	9	9	9	9	9	9	9
7D-Administrative requirements of alternatives		Desirable	9	9	9	9	9	9	9	9	9
	Objective Subtotal Score	**Mean**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**
Aggregate Mean Scores for all Objectives			**23**	**33**	**33**	**53.5**	**54.5**	**43**	**32.5**	**40**	**32.5**
Final Rank Based on Aggregate Mean Scores			**9**	**5**	**8**	**2**	**1**	**3**	**7**	**4**	**6**
			Alt1	**Alt2B**	**Alt3**	**Alt4**	**Alt5**	**Alt6B**	**Alt7**	**Alt8A**	**Alt9**

Table 22 Ranking criteria for each performance measure

Legislative Requirement/ ProjectObjective	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)

1. Decrease in hydroperiod in NESRS (Table 21, 1B)
2. Decrease in water depths in NESRS (Table 21, 1D)
3. Damages in 8.5 SMA by increases in hydroperiod (Table 21, 2A)
4. Damages in 8.5 SMA by increases in surface water depths (Table 21, 2B)
5. Cape Sable Seaside Sparrow (CSSS) nesting opportunity changes (Table 21, 3A)
6. CSSS Nesting habitat suitability changes (Table 21, 3B)
7. Wetland Rapid Assessment Procedure or WRAP (Table 21, 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 21, 2D)
2. Residents relocated (Table 21, 2E)
3. Lost agricultural lands (Table 21, 2F)
4. Unwilling sellers (Table 21, 2G)
5. Project costs (Table 21, 4A)
6. Local secondary costs (Table 21, 4B)
7. Spatial distribution of functional short hydroperiod wetlands (Table 21, 5A)
8. Retrofitting of project features (Table 21, 6A)
9. Potential to reestablish historical flow regimes (Table 21, 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 21, 1A)
2. Increase in water depths in NESRS (Table 21, 1C)
3. Snail kite habitat suitability changes (Table 21, 3C)

4. Wood stork habitat suitability changes (Table 21, 3D)
5. Damages in 8.5 SMA by not providing flood protection (Table 21, 2C)
6. Environmental and cultural resources (Table 21, 7A)
7. Ability to meet implementation schedule (Table 21, 7B)
8. Construction delays (Table 21, 7C)
9. Administrative requirements of alternatives (Table 21, 7D)

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 22 and the weights as stated above (and included in Table 21), 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 38 (using unweighted values) and Figure 39 (using weighted values).

From the results presented in Figures 38 and 39, 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

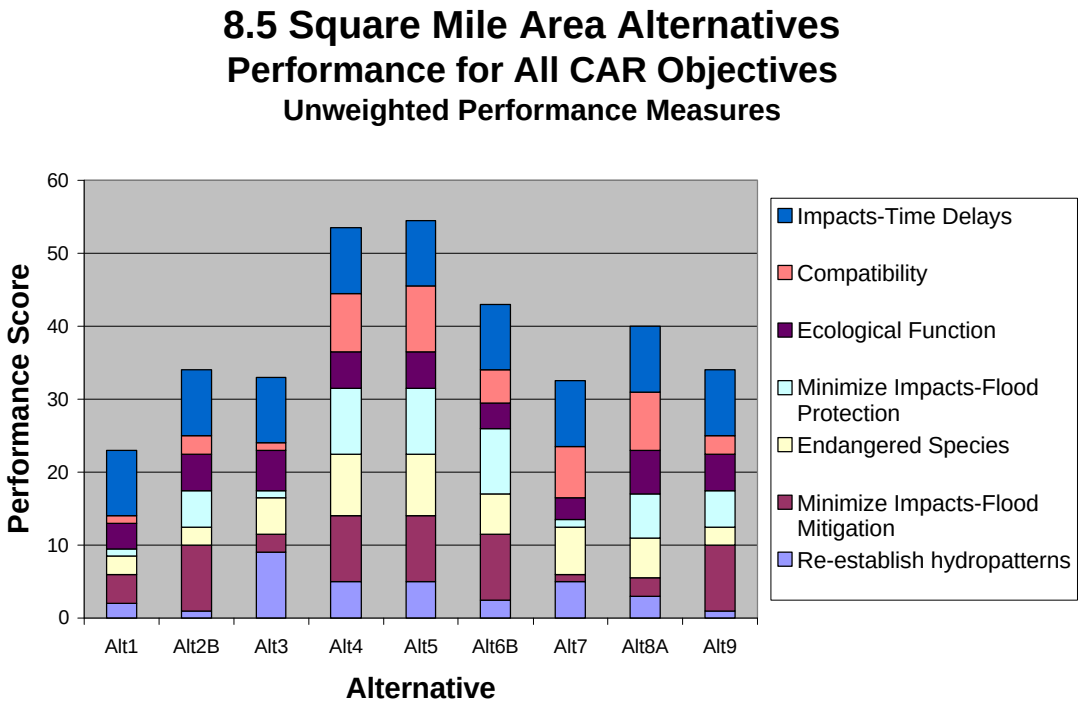


Figure 38 8.5 SMA Performance Scores (Unweighted)

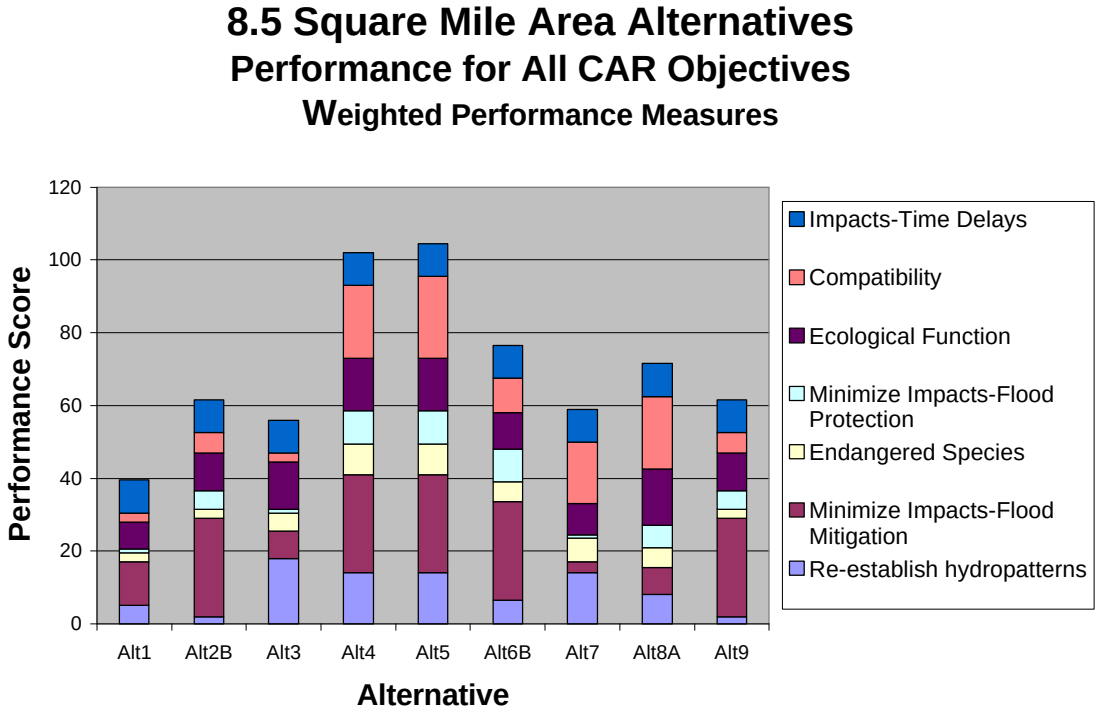


Figure 39 8.5 SMA Performance Scores (Weighted)

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. Alternative 6B, 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 Alternative 6B when the Corps addresses the following concerns:

1. That the decrease in water storage in restored NESRS following implementation of the final design of Alternative 6B 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 Alternative 6B.

3. That adequate water quality is provided for 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 SEIS additional hydrologic modeling investigating the feasibility of realigning the levee in Alternative 6B to allow the wetlands in the FAA's tract to be included within the buffer region.

Chapter 9 — Preliminary Review of Supplemental Benefits and DOI Recommendations

As indicated in Chapter 1, DOI could elect to provide additional funding for the 8.5 SMA component of the MWD Project if an alternative could demonstrate a level of performance that would result in appreciable supplemental benefits to the Everglades ecosystem, in general, and ENP, in particular.

For purposes of the CAR, DOI will only quantify the supplemental benefits associated with the alternatives when compared to the SEIS No Action Alternative or, for this evaluation, Alternative 1. The No Action Alternative, according to the Corps, would be the alternative implemented should no other alternative be selected as a result of the SEIS analysis.

For purposes of supplemental benefits, DOI only considered the critical performance measures; this suite of measures quantifies the performance of the project in meeting the MWD Project's purposes of restoration of NESRS while providing a sustainable solution for the project-induced flooding of the 8.5 SMA. These performance measures are as follows:

NESRS hydropatterns

1. Decrease in restored hydroperiod in NESRS
2. Decrease in restored water depths in NESRS

8.5 SMA Flood Mitigation

1. Damages in 8.5 SMA by increases in hydroperiod
2. Damages in 8.5 SMA by increases in surface water depths

CSSS Nesting

1. CSSS nesting opportunity changes
2. CSSS nesting habitat suitability changes

Wetland Function

1. Wetland Rapid Assessment Procedure or WRAP

As stated earlier, the CSSS nesting critical performance measures could not be assessed for this version of the CAR. These data are required under Section 7 of the ESA by DOI to evaluate impacts on the CSSS and its habitat. Therefore, the only critical performance measures reviewed by DOI for purposes of supplemental benefits were NESRS hydropatterns, 8.5 SMA flood mitigation, and wetland function.

Summary of Alternative 1 Impacts

The technical analyses detailed in Chapters 5 through 7 consistently identified Alternative 1 as the alternative exhibiting the poorest performance for most performance measures evaluated in the CAR. While Alternative 1 does provide for flood mitigation of much of the 8.5 SMA, the analysis conducted by DOI indicates more than 200 acres of the 8.5 SMA would still not receive flood mitigation should Alternative 1 be implemented.

The major problem with Alternative 1, from the perspective of DOI, is the extensive impact this alternative has on the water levels and hydroperiods in NESRS. More than 28,000 acres of NESRS would experience water levels below the restoration targets should this alternative be implemented. Moreover, this alternative would reduce the amount of water storage in the NESRS by approximately 7,000 acre-feet (see Table 4, Chapter 5), which DOI interprets as in direct conflict with the intended purposes of the MWD Project.

Comparisons of all alternatives to Alternative 1 for the critical performance measures of NERSR hydropattern restoration, 8.5 SMA flood mitigation, and wetland function are presented below.

Changes in NESRS Hydropatterns

For each of the hydropattern parameters, hydroperiod and water depth, the quantities obtained from and presented in Table 19 were subtracted from the values obtained for Alternative 1. The results of the comparison are summarized in Figure 40.

As seen in this figure, Alternatives 2B and 9 performed worse than Alternative 1 for changes in hydroperiod. Only minor changes were noted for the water depth comparison for these two alternatives. For this reason, it is the opinion of DOI that Alternatives 2B and 9 provide no supplemental benefits for the ecosystem in general or ENP in particular.

For both hydroperiod and water depth performance measures, Alternatives 3, 4, 5, 6B, 7, and 8A showed improved performance when compared to Alternative 1, with Alternative 6B exhibiting the least amount of relative performance increase when compared to the remaining alternatives.

Changes in Flood Mitigation

Each alternative was compared to Alternative 1 for the performance measures associated with flood mitigation, hydroperiod, and water depth in the 8.5 SMA. The results of this comparison are presented in Figure 41.

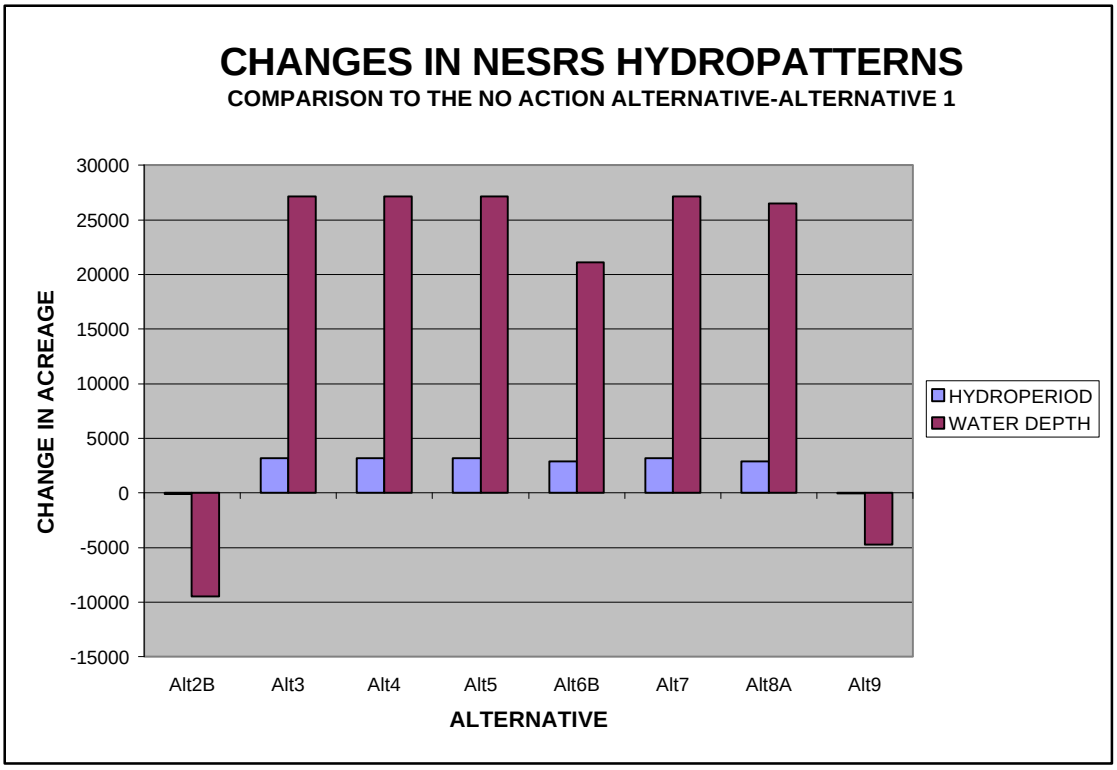


Figure 40 Changes in Water Depths and Hydroperiods When all Alternatives Were Compared to the No Action Alternative (Alternative 1)

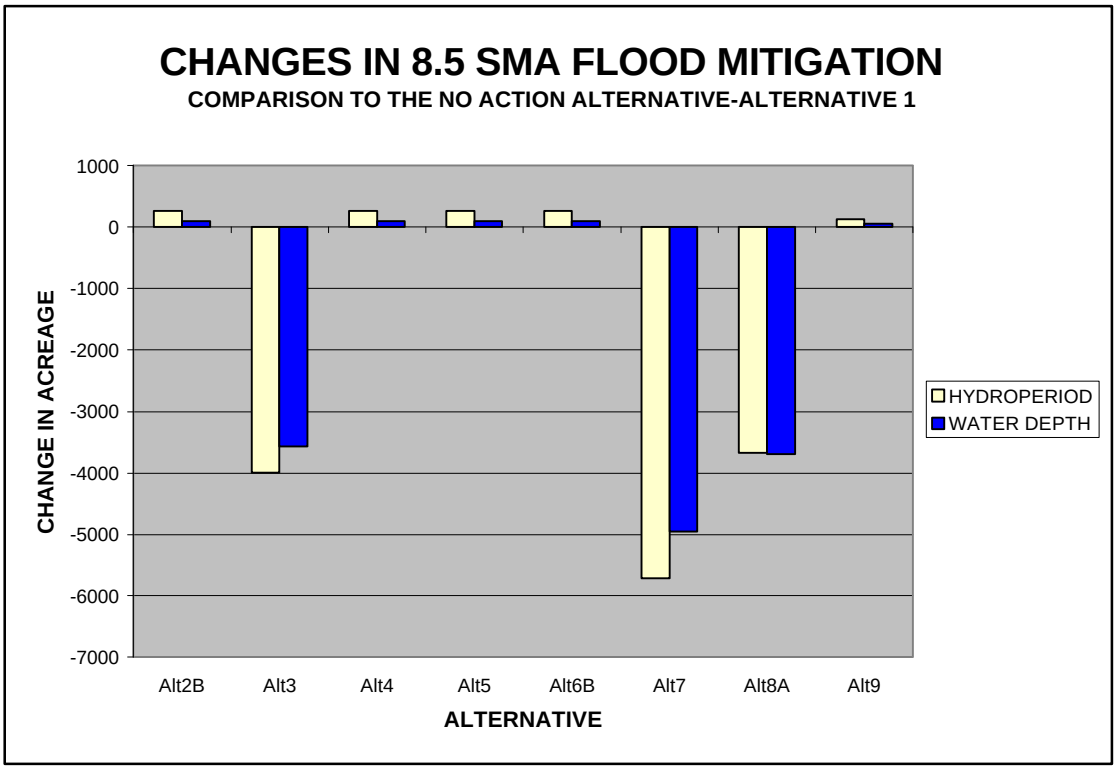


Figure 41 Changes in Flood Mitigation Parameters When all Alternatives Were Compared to the No Action Alternative (Alternative 1)

In contrast to the NESRS hydropattern parameters, Alternatives 3, 7, and 8A all would have diminished performance in the area of flood mitigation when compared to Alternative 1. For these reasons, Alternatives 3, 7, and 8A also would provide no supplemental benefits for the ecosystem or ENP, in that the marked decrease in performance for flood mitigation would not meet one of the legislative requirements of the MWD Project. It should also be noted that Alternative 7 would provide no flood mitigation to the 8.5 SMA because this alternative would only raise the existing road surface elevations. It is the opinion of DOI that this would result in a worsening of conditions when compared to the existing condition.

Based on these results, DOI finds no supplemental benefits would be accrued by the ecosystem, in general, or ENP, in particular, if Alternatives 2B, 3, 7, 8A, or 9 are selected by the Corps for implementation. As depicted in figures 40 and 41, Alternatives 4, 5, and 6B provided incremental improvements in the performance for both NESRS hydropattern restoration as well as 8.5 SMA flood mitigation. For this reason, only Alternatives 4, 5, and 6B were considered for further evaluation of potential supplemental benefits. Each of these alternatives would involve the acquisition of significant portions of the 8.5 SMA to act as a buffer between the developed areas to the east and the restored wetlands to the west.

Changes in Wetland Function

Use of the wetland function analysis as the basis for the determination of supplemental benefits has several advantages. First, the WRAP integrates a number of potentially disparate wetland characteristics (e.g., hydrology, vegetation, and soils) into a single wetland function unit. This allows for a more direct comparison of alternatives. Second, the protocol for the WRAP analysis is based on input from a number of different agencies and organizations. This has the advantage of providing a widely accepted technique to the decision-making process. Third, the procedure has been documented in a publication used by the SFWMD, the local sponsor for the project (Miller and Gunsalus 1997).

Based on information presented in Chapter 6, wetland functional units for both ENP and the 8.5 SMA for Alternatives 4, 5, and 6B were subtracted from the wetland functional units for Alternative 1. Figure 42 depicts the expected increases in wetland function for each of alternative compared to the No Action Alternative (Alternative 1). As seen in this figure, the increases in wetland function for wetlands within ENP and the 8.5 SMA are improved considerably when compared to the wetland function associated with Alternative 1.

It is the opinion of DOI that this increase in wetland function is representative of the supplemental benefits that are accrued by both the NESRS in ENP and by the wetlands within the 8.5 SMA. For all alternatives, the supplemental benefits accrued by ENP are the same, 2,417 functional units, or approximately one-half of the total benefit accrued by the combined areas of NESRS and the 8.5 SMA. The potential increase in wetland function within the 8.5 SMA ranges from 1,954 functional units for Alternative 6B to 2,796 functional units for Alternatives 4 and 5. Increases in wetland function for both areas combined indicate an increase in wetland function due to Alternative 6B to be 4,371 functional units while

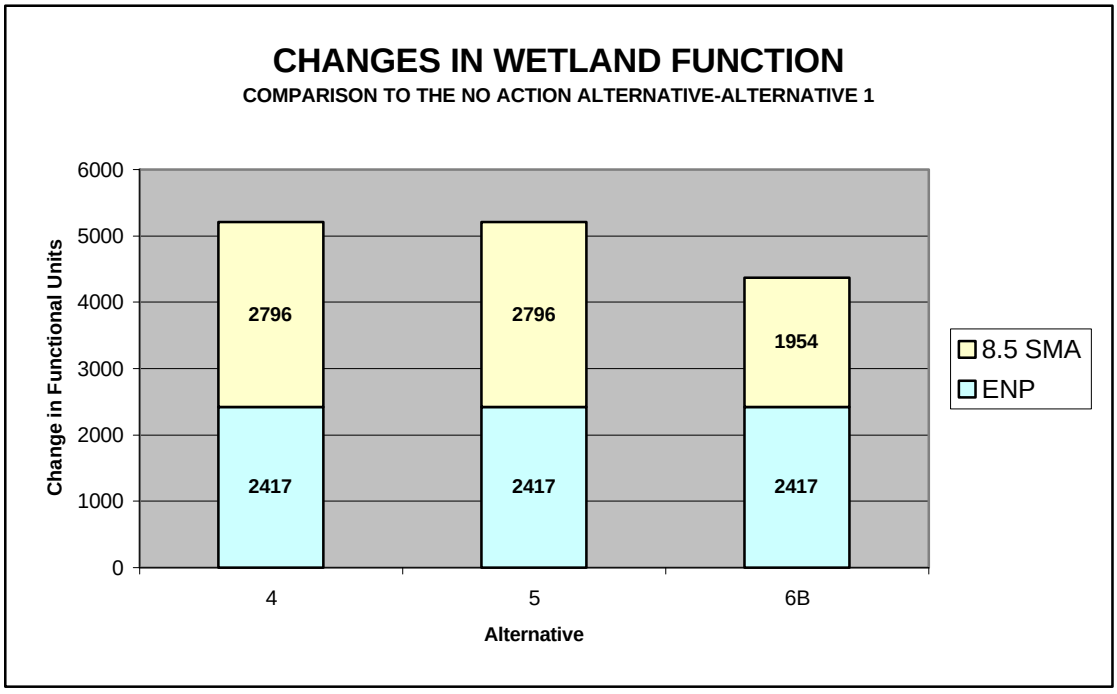


Figure 42 Changes in Wetland Function within the NESRS and the 8.5 SMA when Compared to the No Action Alternative (Alternative 1)

Alternatives 4 and 5 provide a larger lift of 5,213 functional units. The total increase in wetland function associated with Alternative 6B (4,371) represents only approximately 80 percent of the gain in wetland function over Alternative 1, when compared to either Alternative 4 or 5 (5,213). Therefore, selection of Alternative 6B as either the LPA or the federally preferred alternative would result in 20 percent fewer supplemental benefits being accrued by the Everglades ecosystem than under either Alternative 4 or 5. This level of benefit could potentially result in a reduced level of supplemental funding from the DOI sources identified in Chapter 1, should this alternative be selected over either Alternatives 4 or 5.

Recommendations

The FWS and ENP, as DOI agencies, continue to review and analyze ongoing hydrologic modeling information critical to effective planning and design for this project. As new or additional modeling becomes available, results presented herein will be updated and would potentially replace previously analyzed data used to prepare this draft report. Therefore, the FWS and ENP must emphasize that recommendations made at this time are subject to modification.

Based on analysis performed on the nine project alternatives as described and presented to DOI staff, the DOI makes the following preliminary recommendations based on the analyses contained in this version of the CAR:

1. Alternative 5 is the most environmentally preferred alternative. The DOI unequivocally and without reservation supports this alternative as the most

consistent with overall goals and objectives of the MWD Project. The DOI firmly believes that public acquisition of these flood-prone wetlands would best serve the National interest regarding protection of people and property from hazardous flooding conditions (Executive Order 11990) as well as goals and objectives regarding preservation of wetlands (Executive Order 11988). Although Alternative 4 performs well, it is the opinion of DOI that full acquisition provides more opportunity for wetland restoration and greater flexibility in post-project management. Alternative 6B meets performance criteria evaluated in this version of the CAR. DOI will consider supporting the implementation of Alternative 6B when the Corps satisfactorily addresses DOI's concerns regarding NESRS storage impacts, the C–111 Project's operations, the quality of water originating in the 8.5 SMA, C–111 Project's water quality treatment capabilities, and the wetlands in the FAA's tract, as detailed in Chapter 8.

2. In DOI's opinion alternatives 1, 2B, 3, 7, 8A, and 9 performed poorly for one or more legislative requirements as well as the critical DOI performance criteria evaluated in this version of the CAR. Upon interpretation of all the available data analysis presented to date, we find any structural solution, other than potentially Alternative 6B, would result in impacts on the wetlands within ENP.

3. The Corps should adopt the performance measures used by DOI in evaluating the 8.5 SMA alternatives. DOI also specifically requests that the performance measures used to assess the re-establishment of hydropatterns in NESRS be spatially based and evaluated with respect to the restored hydrologic condition. It is the opinion of DOI that the 8.5 SMA is a component of the MWD Project and; therefore, must be evaluated in accordance with the purposes and goals of the MWD Project. It must not be narrowly evaluated based solely on flood mitigation/flood protection.

4. Ecological and hydrologic monitoring should be planned and performed to adaptively assess project function throughout the project's life (50 years). Parameters measured should be consistent with the MWD Project's goals and objectives and fully coordinated with DOI's staff.

5. Upon the selection of a federally preferred alternative, the Corps should expeditiously make a determination of effects and initiate appropriate consultation under the ESA, providing thorough analysis of the alternative's potential to impact listed species and/or their habitats.

6. The Department recommends that pending the selection of a federally preferred alternative, the Corps develop a Fish and Wildlife Resource Mitigation Plan to fully off-set fish and wildlife resource impacts in accordance with the FWS' Mitigation Policy described in Chapter 6. The Fish and Wildlife Enhancement Features described in this report and in the Planning Aid Letter (PAL) dated January 11, 2000, provide specific design features for this purpose. This plan will be integrated into the 8.5 SMA project during the Detailed Design and Engineering Phase as a project feature. The cost of implementing this plan, including monitoring and adaptive assessment, shall be a construction cost borne by the project.

7. The Department recommends that the Corps develop a Wetland Compensatory Mitigation Plan to ensure "no net loss" of wetland function, as described in Chapter 6. This plan should be integrated into the 8.5 SMA project during the Detailed Design and Engineering Phase as a project feature. The cost of implementing this plan, including monitoring and adaptive assessment, should be a construction cost borne by the project.

Chapter 10 — Preliminary 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 this version of the CAR. When this information is made available, the CAR, and potentially the DOI's position, will be modified accordingly. 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:

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.

Supplemental Benefits

- Alternative 5 provides an additional 2,417 functional units (effective wetland acreage) in NESRS.
- Alternative 5 provides an additional 2,796 functional units (effective wetland acreage) in the 8.5 SMA.

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.

Supplemental Benefits

- Alternative 4 provides an additional 2,417 functional units (effective wetland acreage) in NESRS.
- Alternative 4 provides an additional 2,796 functional units (effective wetland acreage) in the 8.5 SMA.

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.

Supplemental Benefits

- Alternative 6B provides an additional 2,417 functional units (effective wetland acreage) in NESRS.

- Alternative 6B provides an additional 1,954 functional units (effective wetland acreage), or approximately 30 percent less than the supplemental benefits associated with either Alternatives 4 or 5, in the 8.5 SMA.

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.

Supplemental Benefits

- Alternative 1 does not meet the legislative requirements and therefore provides no supplemental benefits as defined in the CAR.

Compensatory Mitigation

- Will require significant compensatory mitigation for wetlands (2,765 functional units) 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.

Supplemental Benefits

- Alternative 2B does not meet the legislative requirements and therefore provides no supplemental benefits as defined in the CAR.

Compensatory Mitigation

- Will require significant compensatory mitigation for wetlands (2,765 functional units) 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 existing 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.

Supplemental Benefits

- Alternative 3 does not meet the legislative requirements and therefore provides no supplemental benefits as defined in the CAR.

Compensatory Mitigation

- Will require significant compensatory mitigation for wetlands (1,775 functional units) 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.

Supplemental Benefits

- Alternative 7 does not meet the legislative requirements and therefore provides no supplemental benefits as defined in the CAR.

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.

Supplemental Benefits

- Alternative 8A does not meet the legislative requirements and therefore provides no supplemental benefits as defined in the CAR.

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.

Supplemental Benefits

- Alternative 9 does not meet the legislative requirements and therefore provides no supplemental benefits as defined in the CAR.

Compensatory Mitigation

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

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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 which will no longer be available for agricultural uses.	Number of acres of agriculture lands lost from PMs 2a. and 2b. above.	B, C
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.	(1) No. of consecutive days from 3/1 through 7/15 with water levels below ground surface (2) Total no. of days w/ water levels above ground for model year (3) 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 constructa-bility (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 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 – 16: Hydroperiods and Average Depths

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_plan8A_1995_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_plan1A_1995_95ops
D13Rbc_plan2_1995_95ops
D13Rbc_plan2A_1995_95ops
D13Rbc_plan2B_1995_95ops
D13Rbc_plan3_1995_95ops
D13Rbc_plan6_1995_95ops
D13Rbc_plan6A_1995_95ops
D13Rbc_plan6B_1995_95ops
D13Rbc_plan8_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_plan1A_1995_95ops
D13Rbc_plan2_1995_95ops
D13Rbc_plan2A_1995_95ops
D13Rbc_plan2B_1995_95ops
D13Rbc_plan3_1995_95ops
D13Rbc_plan6_1995_95ops
D13Rbc_plan6A_1995_95ops
D13Rbc_plan6B_1995_95ops
D13Rbc_plan8_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_plan1A_1995_95ops
D13Rbc_plan2_1995_95ops
D13Rbc_plan2A_1995_95ops
D13Rbc_plan2B_1995_95ops
D13Rbc_plan3_1995_95ops
D13Rbc_plan6_1995_95ops
D13Rbc_plan6A_1995_95ops
D13Rbc_plan6B_1995_95ops
D13Rbc_plan8_1995_95ops

D13Rbc_plan8A_1995_95ops

Figure 17 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_plan1A_1995_95ops
D13Rbc_plan1B_1995_95ops
D13Rbc_plan2_1995_95ops
D13Rbc_plan2A_1995_95ops
D13Rbc_plan2B_1995_95ops
D13Rbc_plan3_1995_95ops
D13Rbc_plan6_1995_95ops
D13Rbc_plan6A_1995_95ops
D13Rbc_plan6B_1995_95ops
D13Rbc_plan8_1995_95ops
D13Rbc_plan8A_1995_95ops

Table 6 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_plan8A_1989_95ops
D13Rbc_plan8A_1995_95ops

Appendix C — U.S. Fish and Wildlife Service's Land Management Guidance for Exotic Species

Invasive Exotic Plant Removal and Control

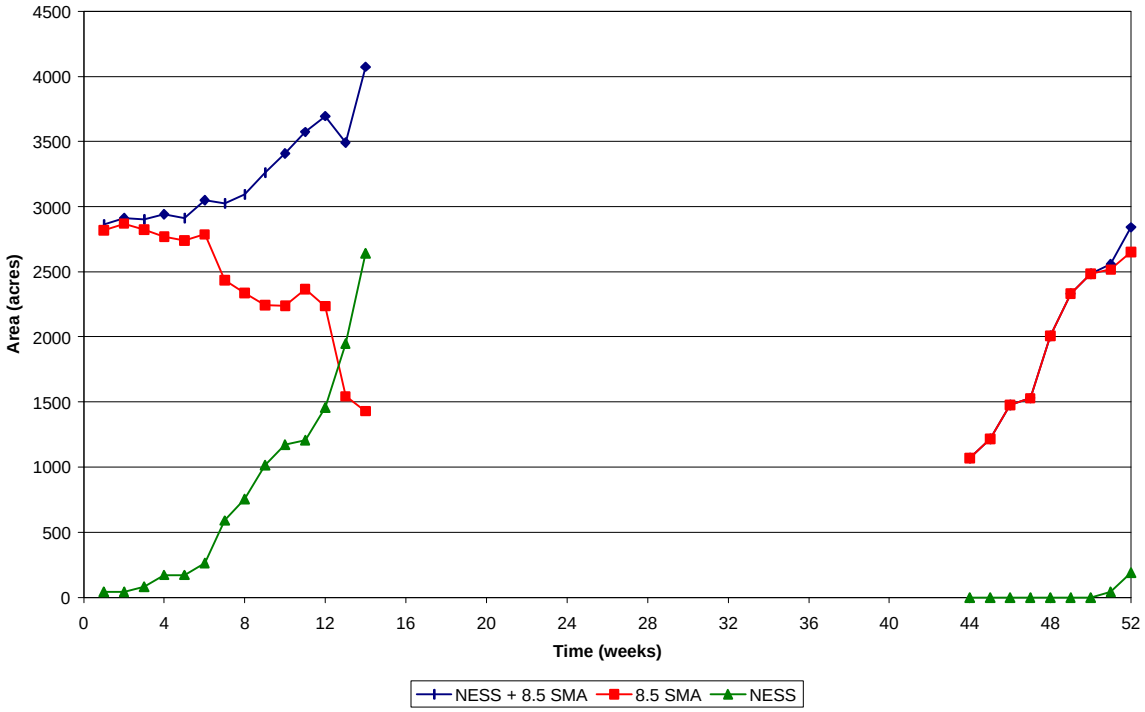
Removal of invasive exotic plant species can be accomplished through proven chemical and mechanical techniques based on plant morphology (herbaceous versus woody) and density of the species present. Typically, exotic grasses, such as *Neyraudia reynaudiana* and *Pennisetum purpureum*, must be treated 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.

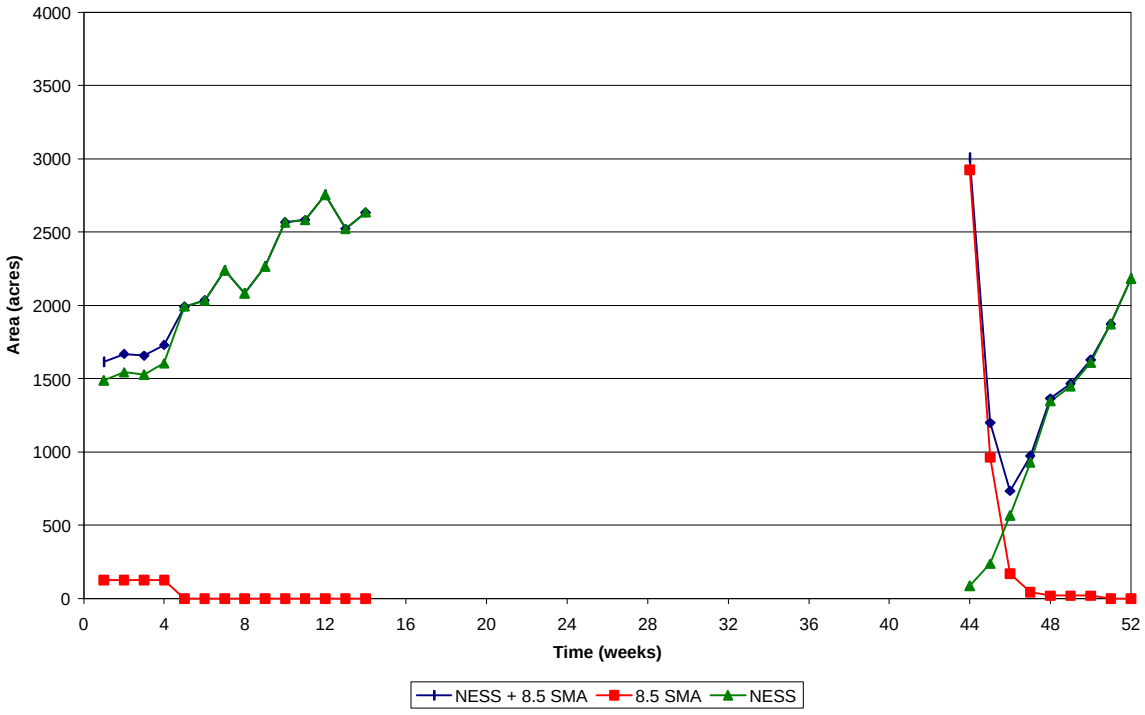
In the 8.5 SMA, it is suggested that the final grade of the area be less than 6.5 feet to recreate, as a minimum, a short hydroperiod prairie. To achieve this final elevation any overlying artificial (rock-plowed) or natural soil or geologic feature be removed using currently available scrapping techniques. 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.

Appendix D — Wood Stork Analysis Results

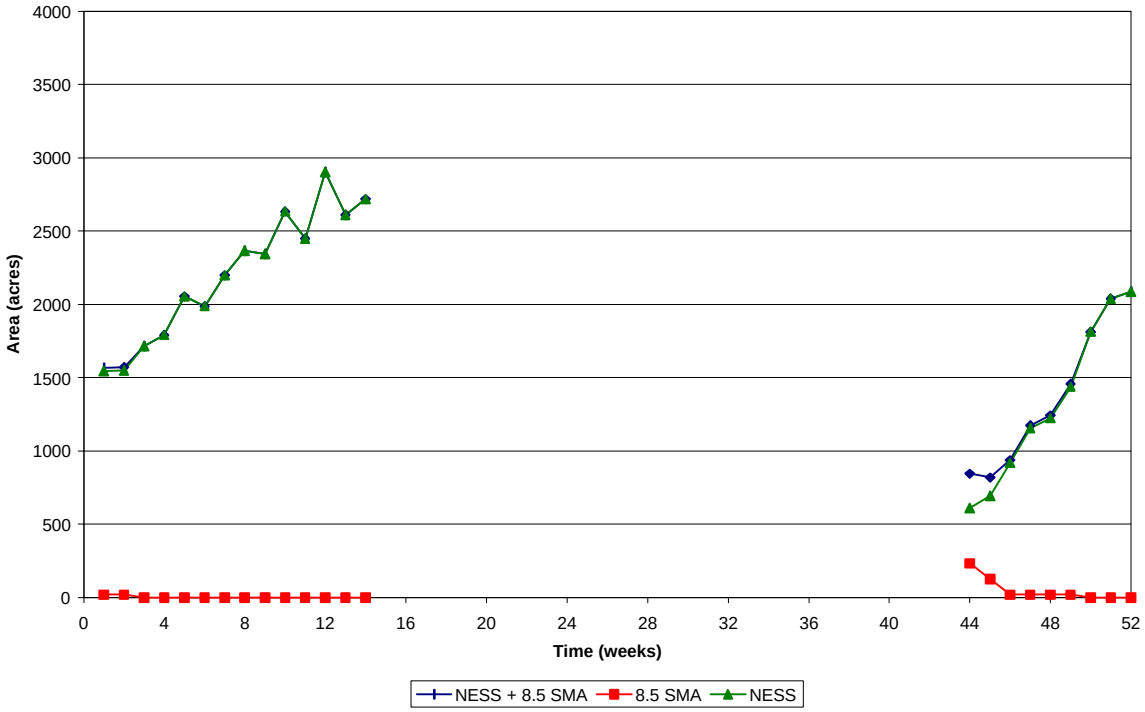
Wood Stork Habitat under Restored Conditions: Wet Year



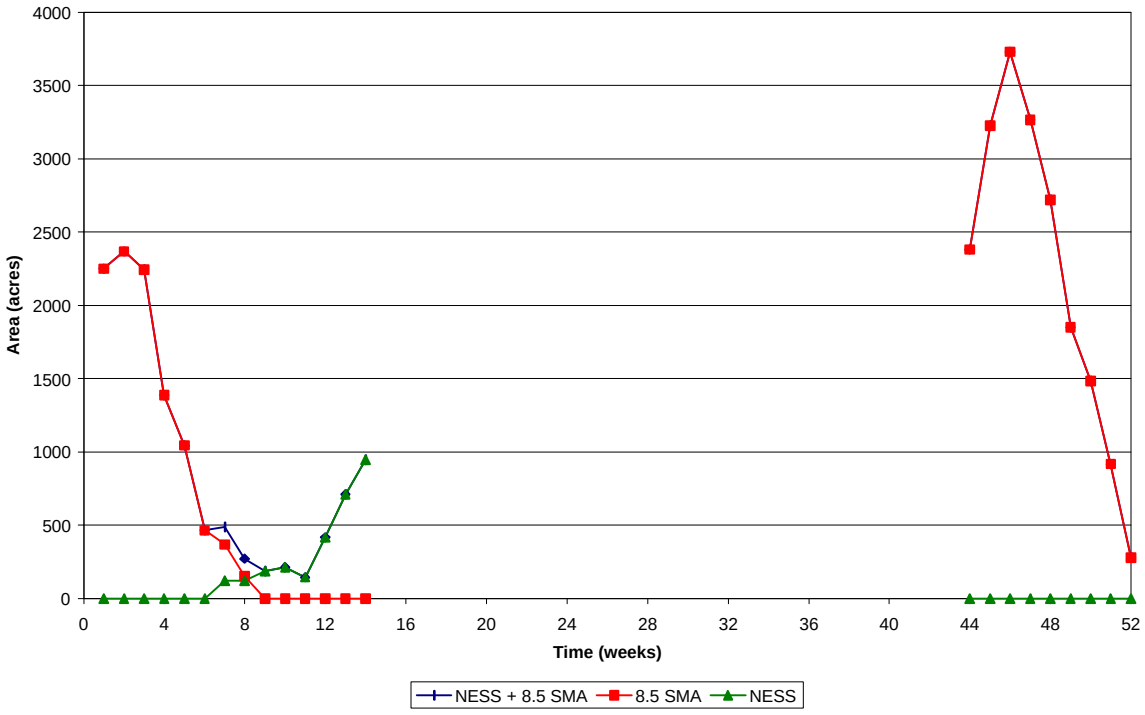
Wood Stork Habitat under Plan 1: Wet Year



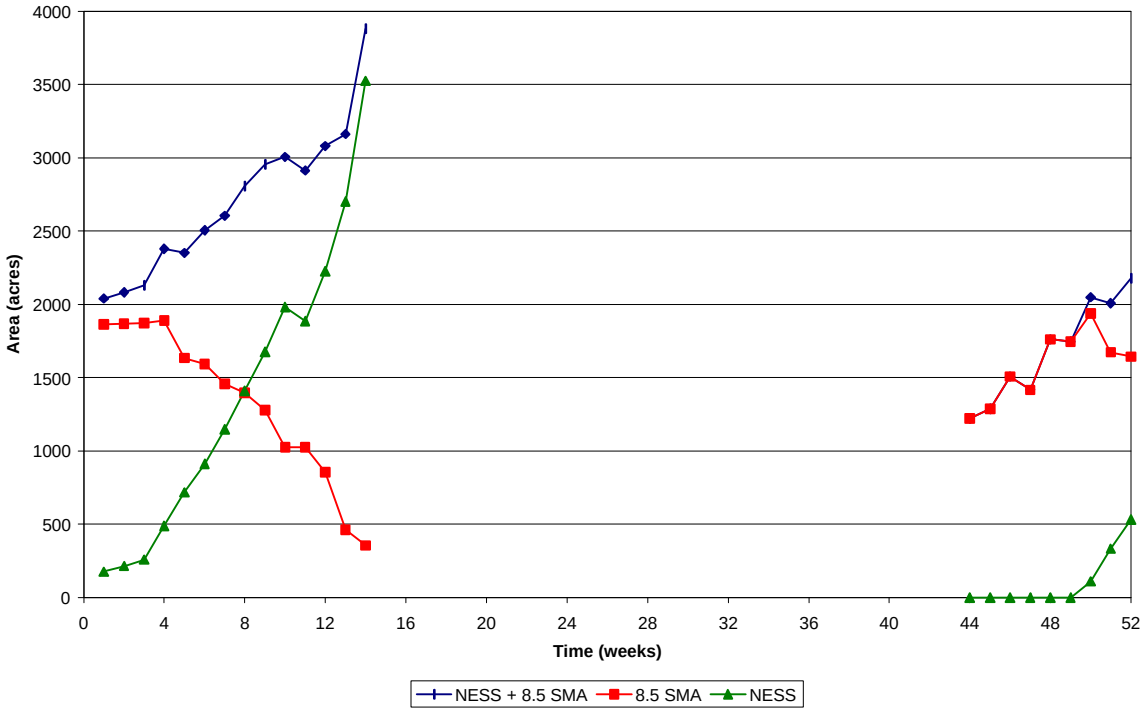
Wood Stork Habitat under Plan 2B and 9B: Wet Year



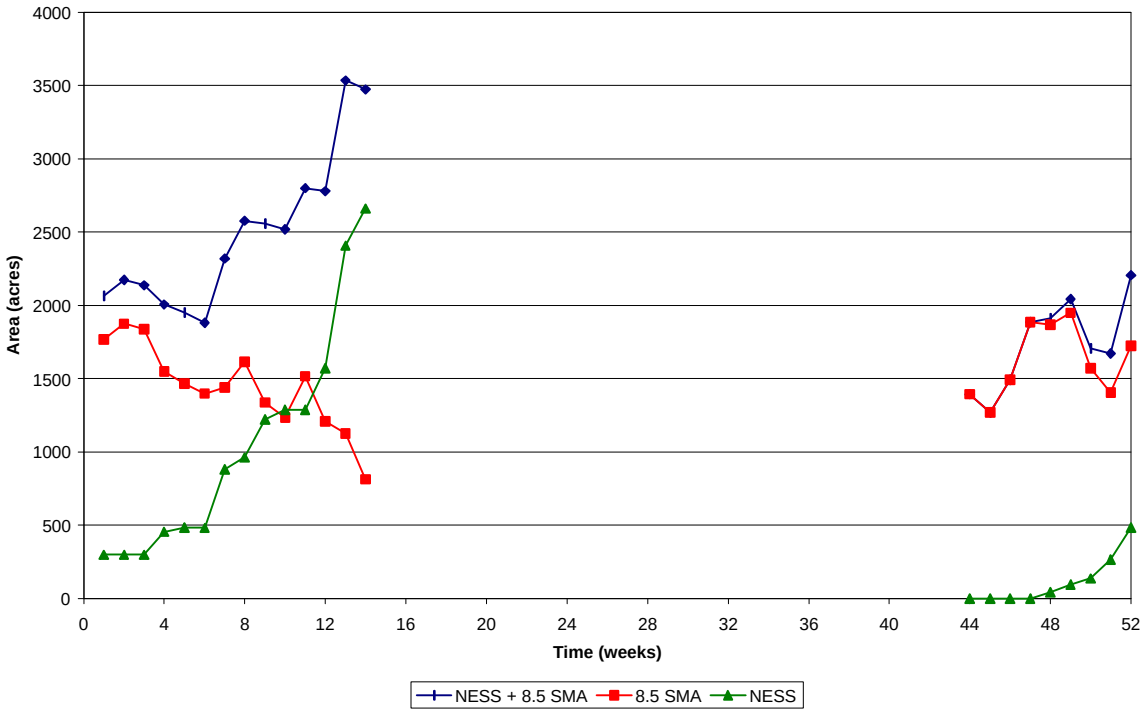
Wood Stork Habitat under Plan 3: Wet Year



Wood Stork Habitat under Plan 6B: Wet Year



Wood Stork Habitat under Plan 8A: Wet Year



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.

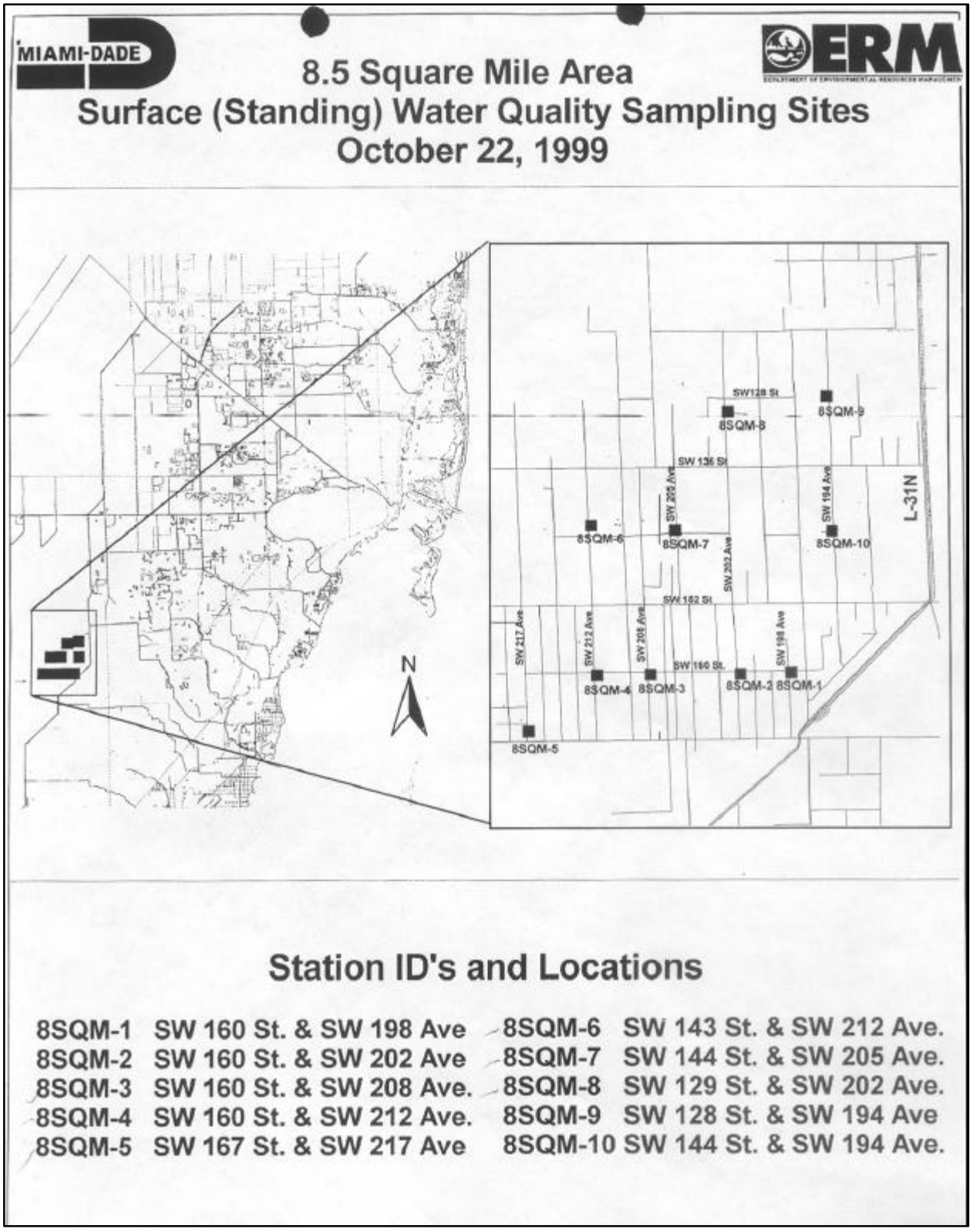


Figure E-1 Location of Sampling Stations

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 Froms" – 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.