DRAFT ENVIRONMENTAL IMPACT STATEMENT
COMBINED OPERATIONAL PLAN

Broward, Miami-Dade, Monroe Counties, Florida

US Army Corps
of Engineers ®
Jacksonville District

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

COMBINED OPERATIONAL PLAN

Broward, Miami-Dade, Monroe Counties, FL

Lead Agency:	**Department of Army** **U.S. Army Corps of Engineers, Jacksonville District**
Cooperating Agency:	**U.S. Department of the Interior, Everglades National Park** **South Florida Water Management District**

Abstract: The purpose of the Combined Operational Plan (COP) is to define operations for the constructed features of the Modified Water Deliveries (MWD) to Everglades National Park (ENP) and Canal 111 (C-111) South Dade project components. This Draft Environmental Impact Statement (EIS) presents a preferred plan, Alternative Q+ (ALTQ+), and examines the environmental consequences of implementation of this alternative. Under the COP, Central and Southern Florida (C&SF) infrastructure would be operated to deliver hydrologic benefits to the environment as defined by ALTQ+. These hydrologic benefits are identified as five specific project objectives: (1) improving water deliveries (timing, location, volume) into ENP given current C&SF infrastructure; (2) maximizing progress toward restoring historic hydrologic conditions in Taylor Slough, the Rocky Glades and the eastern Panhandle of ENP; (3) protecting the intrinsic ecological values associated with Water Conservation Area (WCA) 3A and ENP; (4) minimizing damaging freshwater flows to Manatee Bay/Barnes Sound through the S-197 structure and increasing flows through Taylor Slough and coastal creeks; and (5) include consideration of cultural values and tribal interests and concerns within WCA 3A and ENP. Operations would also support a broad set of defined needs, including: flood control, water supply for agricultural irrigation, municipalities and industry, regional groundwater control and prevention of saltwater intrusion, enhancement of fish and wildlife, and recreation. The COP would supersede the 2012 Water Control Plan for the WCAs, ENP, and ENP to South Dade Conveyance System (SDCS). ALTQ+ was chosen based upon hydrological modeling of system conditions using the Regional Simulation Model. Results of the modeling efforts demonstrate significant enhancements of Northeast Shark River Slough (NESRS) and southern WCA 3A and negligible to minor reductions in hydroperiods in northern WCA 3A. The adaptive management processes supporting ALTQ+ should allow managers the needed operational flexibility to reduce remaining challenges and to help identify what aspects of future Comprehensive Everglades Restoration Plan (CERP) projects can be used to resolve observed challenges. Implementation of the COP is anticipated to increase the availability of water deliveries from WCA 3A to ENP through NESRS and improve hydrologic conditions in Taylor Slough, the Rocky Glades, and the eastern panhandle of ENP.

Send your comments by:
March 16th, 2020

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EXECUTIVE SUMMARY

PURPOSE AND NEED

The purpose of the Combined Operational Plan (COP) is to define operations for the constructed features of the Modified Water Deliveries (MWD) to Everglades National Park (ENP) and Canal 111 (C-111) South Dade project components. Under the COP, Central and Southern Florida (C&SF) project infrastructure would be operated to deliver hydrologic benefits to the environment as defined by Alternative Q+ (ALTQ+) (the preferred plan). These hydrologic benefits are identified as five specific project objectives: (1) improving water deliveries (timing, location, volume) into ENP given current C&SF infrastructure; (2) maximizing progress toward restoring historic hydrologic conditions in Taylor Slough, the Rocky Glades and the eastern Panhandle of ENP; (3) protecting the intrinsic ecological values associated with Water Conservation Area (WCA) 3A and ENP; (4) minimizing damaging freshwater flows to Manatee Bay/Barnes Sound through the S-197 structure and increasing flows through Taylor Slough and coastal creeks; and (5) including consideration of cultural values and tribal interests and concerns within WCA 3A and ENP. Operations would also support a broad set of defined needs, including: flood control, water supply for agricultural irrigation, municipalities and industry, regional groundwater control and prevention of saltwater intrusion, enhancement of fish and wildlife, and recreation.

AUTHORITY

The C-111 South Dade project is a modification to the C&SF project authorized by Section 203 of the Flood Control Act of 1948, Public Law 80-858 as modified by Section 203 of the Flood Control Act of 1968, Public Law 90-483. The modifications are generally described in the “Central and Southern Florida Project, Final Integrated General Reevaluation Report and Environmental Impact Statement, Canal 111, South Dade County, Florida,” dated May 1994 and approved by the Assistant Secretary of the Army (Civil Works) on July 1, 1994.

The MWD project was authorized by Section 104 of the Everglades National Park and Expansion Act of 1989 (Public Law 101-229) as amended in the Consolidated Appropriations Resolution, 2003 (Public Law 108-7). The project features are set forth in the General Design Memorandum entitled "Central and Southern Florida Project, for Flood Control and Other Purposes, Part 1, Agriculture and Conservation Areas, Supplement 54, General Design Memorandum and Environmental Impact Statement, Modified Water Deliveries to Everglades National Park, Florida" dated June 1992. The 8.5 Square Mile Area (SMA) MWD project features were reevaluated in a GRR entitled "Central and Southern Florida Project, Modified Water Deliveries to Everglades National Park, Florida 8.5 Square Mile Area, General Reevaluation Report and Final Supplemental Environmental Impact Statement," dated July 2000, and approved by the Assistant Secretary of the Army (Civil Works) on December 6, 2000. Additionally, the Tamiami Trail features were reevaluated in a revised General Reevaluation Report (GRR) entitled the "Central and Southern Florida Project, Final Revised General Reevaluation Report/Second Supplemental Environmental Impact Statement for the Tamiami Trail Modifications" dated November 2005 and approved by the Assistant Secretary of the Army (Civil Works) on January 25, 2006. The Tamiami Trail features were further evaluated in the “Modified Water Deliveries To Everglades National Park Tamiami Trail Modification Limited Reevaluation Report And Environmental Assessment”, dated June 2008, and its addendum entitled, "Addendum, Tamiami Trail Modifications, Final Integrated Limited Reevaluation Report and Environmental Assessment, 28 July 2008," both approved on August 1, 2008 by the Assistant Secretary of the Army (Civil Works).

PROJECT LOCATION

The MWD to ENP and C-111 South Dade projects affect WCA 3, ENP, and southern portions of Miami-Dade County and is the location of the COP. The water management operation criteria relating to the 2012 Water Control Plan for the WCAs, ENP, and ENP to the South Dade Conveyance System (SDCS) affects an area within the C&SF project located in southern Florida and includes portions of several counties, as well as WCA 3, ENP, Big Cypress National Preserve (BCNP), and adjacent areas. The MWD project is a modification of the C&SF project. Features of the MWD project are located in Miami-Dade County, including portions of ENP and adjacent areas. The 1992 MWD General Design Memorandum (GDM) and Final Environmental Impact Statement (EIS) defines the project boundary as Shark River Slough (SRS) and that portion of the C&SF project north of S-331 to include WCA 3. The C-111 South Dade project is situated within the C-111 Basin which includes approximately 60 square miles of mostly agricultural lands in the Homestead/Florida City area. The C-111 South Dade project is adjacent to ENP to the west and discharges to the eastern panhandle of ENP, Florida Bay, Manatee Bay and Barnes Sound. The project components of the MWD and C-111 South Dade projects are shown in **Figure ES**-1.

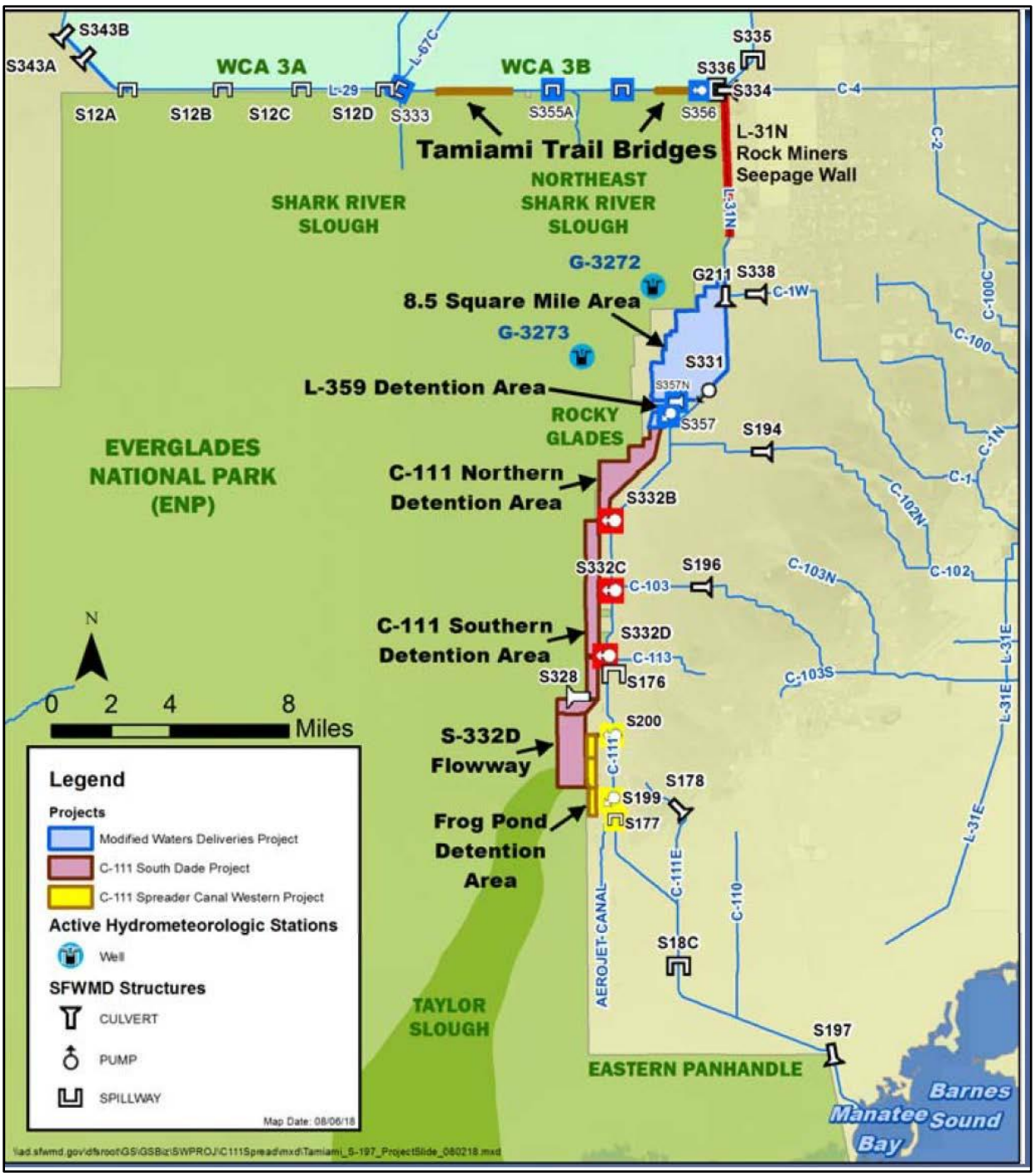

Figure ES-1. Project Location and relevant C&SF features of the MWD and C-111 South Dade projects.

ALTERNATIVE PLANS AND THE PREFFERED PLAN (ALTERNATIVE Q+)

The formulation of the COP was governed by the MWD and C-111 South Dade project objectives and constraints, and lessons learned from a series of MWD Incremental Field Tests conducted under the authority of the MWD project (i.e. Increment 1, Increment 1.1 and 1.2, and Increment 2) to raise the L-29

canal maximum operating limit for the purpose of increasing flows to Northeast Shark River Slough (NESRS) in ENP. The alternative formulation consisted of five iterations using the U.S. Army Corps of Engineers (USACE's) six step planning process to guide the selection of the preferred plan. The five iterations are as follows: initial array, Round 1, Round 2, Round 3, and Round 3 refinement. The formulation process was a collaborative multi-agency effort culminating in the identification of the preferred plan (ALTQ+). The COP is the last step to implement operational changes to convey water from WCA 3A to ENP using the constructed features of the pre Comprehensive Everglades Restoration Program (pre-CERP) foundation projects (i.e. MWD and C-111 South Dade projects) and would result in a change to the 2012 Water Control Plan for the WCAs, ENP, and ENP to SDCS. The COP is also being pursued to address the mandated Reasonable and Prudent Alternative of the July 22, 2016 Everglades Restoration Transition Plan (ERTP) Biological Opinion (BO) which requires the USACE to proceed as scheduled, and as allowable by law, for completing National Environmental Policy Act (NEPA) analysis for the COP by August of 2020.

Alternatives differed based on: (1) modifications to the 1985 WCA 3A Rainfall Plan which currently guides water delivery to NESRS in ENP; (2) operational modifications to ensure flood mitigation within 8.5 SMA and in the C-111 Basin consistent with congressional authorizations; (3) inclusion of operational changes to C-111 canal structure S-197; (4) delivery of supplemental flows to Taylor Slough; (5) additional operational flexibilities during high water conditions in WCA 3A, and; (6) operational modifications to the WCA 3A regulation schedule.

The preferred plan ALTQ+ which is largely based on the Round 3 ALTQ which was modified based on performed sensitivity runs, and to transition from a model simulation to a completed water control plan. In general, ALTQ+ meets all the project objectives and does not violate project constraints. The main component of ALTQ+ that improves water deliveries to ENP is the Tamiami Trail Flow Formula (TTFF). The TTFF replaces the 1985 WCA 3A Rainfall Plan. The TTFF uses information from water stages (WCA 3A and NESRS), rainfall, potential evapotranspiration, and recent structure flows to compute a flow target across Tamiami Trail for the upcoming week. To facilitate increased flows out of WCA 3A, the L-29 canal is operated up to 8.5 feet, National Geodetic Vertical Datum of 1929 (NGVD) which allows for improved water deliveries to ENP via NESRS. However, the maximum duration for operating the L-29 canal stage between 8.3 and 8.5 feet, NGVD is limited to 90 days per water year (May 1 to April 30), which is the interim Florida Department of Transportation (FDOT) constraint until Tamiami Trail Next Steps (additional bridging of Tamiami Trail to improve connectivity and sheetflow between the marshes north and south of the road) construction is completed. Outside the 90-day FDOT limit, the L-29 canal level would be maintained below 8.3 feet, NGVD subject to downstream constraints.

The 2008 MWD Tamiami Trail LRR included recommendations to build a one mile long bridge in the project area's eastern segment and raise the headwater stage constraints in the L-29 canal by one foot from 7.5 feet, NGVD to 8.5 feet, NGVD, which required road mitigation on parts of Tamiami Trail (U.S. Highway 41) located between S-333 on the west and S-334 on the east. To ensure the safety and stability of the roadway sub base infrastructure along this segment of Tamiami Trail, operational constraints [referenced within Section 6 (Recommended Plan) of the 2008 Tamiami Trail LRR] were set forth within the "Contract Between the United States of America and Florida Department of Transportation for Relocation, Rearrangement, or Alteration of Facilities Modified Water Deliveries to Everglades National Park" (Tamiami Trail Modifications Relocation Agreement) dated September 25, 2008. The FDOT allowed the USACE to use a new standard for the Tamiami Trail roadway (adopted in the March 2008 FDOT Flexible Pavement Design Manual) thereby reducing the required separation (Design Base High Water Clearance) between the Design High Water (DHW) and the bottom of the road base. Operational constraints as

outlined within the Relocation Agreement are minimum protective standards that are included in ALTQ+. In coordination with the FDOT, the USACE has expanded hydrologic monitoring of water levels along the section of Tamiami Trail that is of concern. Data collected in accordance with the monitoring plan developed in consultation with the FDOT would help to inform L-29 canal operations in COP.

The requirements of the Relocation Agreement, including any subsequent amendments to this agreement between the USACE and the FDOT, shall remain unchanged until full completion of Tamiami Trail Next Steps roadway construction, currently anticipated for late 2022 or early 2023. ALTQ+ includes the capability to further extend and/or remove the cumulative duration criteria for operating the L-29 canal above 8.3 feet, NGVD (referenced as the FDOT roadway constraint), while continuing to adhere to the maximum operating stage limit of 8.5 feet, NGVD. Implementation of this change would not occur without: (1) written approval from the FDOT to remove the L-29 canal constraint identified in **Appendix A** (**Water Control Plan**), based on a joint evaluation of monitoring data by the USACE and the FDOT (this data evaluation is ongoing with the MWD Increment 2 Field Test); (2) demonstration of the capability of the completed MWD project components to maintain flood mitigation requirements for the 8.5 SMA under the raised L-29 canal maximum operating limit of up to 8.5 feet, NGVD; and (3) consideration of increased low water stages within WCA 3A, including along the western L-29 canal between S-12A and S-333. The requirement for all three pre-conditions to be met may preclude these operations during the implementation period of the COP, since additional inflows of treated water to WCA 3A from the upstream Lake Okeechobee and Everglades Agricultural Area (EAA) basins and/or additional flood mitigation requirements may be necessary.

As part of the MWD Incremental Field Tests, South Dade canal operations for reaches along the L-31N (south of S-331) and C-111 canals were generally lowered with the additional inclusion of seasonal criteria at the S-332 pump stations, compared to the long-term operational paradigms prescribed within the previous Water Control Plans under the Interim Operational Plan (IOP) (2002-2012) and ERTP (2012-2015). The MWD Incremental Field Tests started in 2015, to simultaneously promote both increased deliveries to Taylor Slough and the hydraulic ridge and reduced flood risk for the adjacent agricultural and urban areas. Extensive analyses during the COP iterative modeling rounds, including specifically crafted sensitivity simulations, demonstrated there is no significant trade-off between ecological performance benefits within ENP and the lowering of the normal canal operating ranges with the COP. ALTQ+ promotes increased overland flow to Florida Bay and reduces the use of the S-197. The seasonal closures for the S-12A, S-12B, S-343A and S-343B remain unchanged from the 2016 ERTP BO. However, ALTQ+ includes removal of the seasonal closures at S-344 and includes limited adjustments to the S-332D seasonal pump restrictions. Lifting of S-344 closure dates and extending S-332D full pumping by an additional month, from November 30 to December 31, were based on coordination with the U.S. Fish and Wildlife Service (USFWS).

BENEFITS OF THE PREFFERED PLAN (ALTERNATIVE Q+)

Implementation of ALTQ+ is anticipated to increase the availability of water deliveries from WCA 3A to ENP through NESRS and improve hydrologic conditions in Taylor Slough, the Rocky Glades, and the eastern panhandle of ENP relative to the No Action Alternative (Existing Condition Baseline (ECB19RR)). ALTQ+ is expected to increase annual inflow to ENP by approximately 162,000 acre-feet per year on average, an increase of 28%. ALTQ+ restores NESRS as a functioning component of the Everglades hydrologic system by changing the spatial distribution of the water delivered into ENP across Tamiami Trail, increasing the proportion of the water that enters ENP east of S-333 by 19% (from 58% to 77%). ALTQ+ changes the schedule of water deliveries to ENP so that it fluctuates in consonance with local meteorological

conditions, including providing for long term and annual variation in ecosystem conditions in the Everglades through implementation of a TTFF that determines the volume of flow through S-333 and the S-12s. Furthermore, ALTQ+ maximizes progress toward restoring historic hydrologic conditions in Taylor Slough by increasing annual inflow by approximately 6,000 acre feet per year on average (an increase of 7%) and in the Eastern Panhandle of ENP by increasing annual inflow by approximately 30,000 acre feet per year on average (an increase of 27%). The additional water flowing into ENP would help to restore pre-drainage vegetative communities and habitat for fish and wildlife while providing incremental restoration of natural processes critical for the development of peat soils and tree islands, which are essential features of the Everglades ridge and slough landscape. Discharges to Manatee Bay and Barnes Sound through S-197 are minimized through reduced use of the structure by 41,000 acre-feet per year on average (a decrease of 69%). Average number of days with non-zero deliveries through S-197 would also be reduced by 78% (from 223 to 48 days per year). Increased freshwater flows to Florida Bay would reduce salinities, resulting in better conditions for the diversity of seagrasses and other estuarine plant and animal species that inhabit the bay.

For the 8.5 SMA flood mitigation area, hydrologic conditions are not unchanged for all areas, but circumstances are generally improved. The 8.5 SMA congressionally authorized Flood Mitigation constraint compliance is achieved for all interior 8.5 SMA locations. The 1-2% of the 8.5 SMA Protected Area which indicates a temporary increase in peak stage received a flood risk reduction resultant from reduced inundation duration of 66-74%. Preliminary evaluations for the further extension and/or removal of the 90-day cumulative duration criteria for operating the L-29 canal above 8.3 feet, NGVD (referenced as the FDOT roadway constraint above) are not able to demonstrate compliance with the complete suite of 8.5 SMA flood mitigation constraint metrics for all interior locations. The COP Water Control Plan would incorporate real-time monitoring in an effort to further increase the frequency and duration of L-29 canal operations above 8.3 feet, NGVD, while continuing to balance system-wide performance and maintaining compliance with constraints.

Figure ES-2 provides a depiction of the percent change of the average annual flow volume across overland surface water transects for portions of the study area (Western Shark River Slough (WSS), NESRS, and WCA 3B) for ALTQ+ relative to the No Action Alternative (ECB19RR)). Consistent with the COP objectives, implementation of the preferred plan is expected to provide significant benefits to NESRS in ENP while working within the existing water budget.

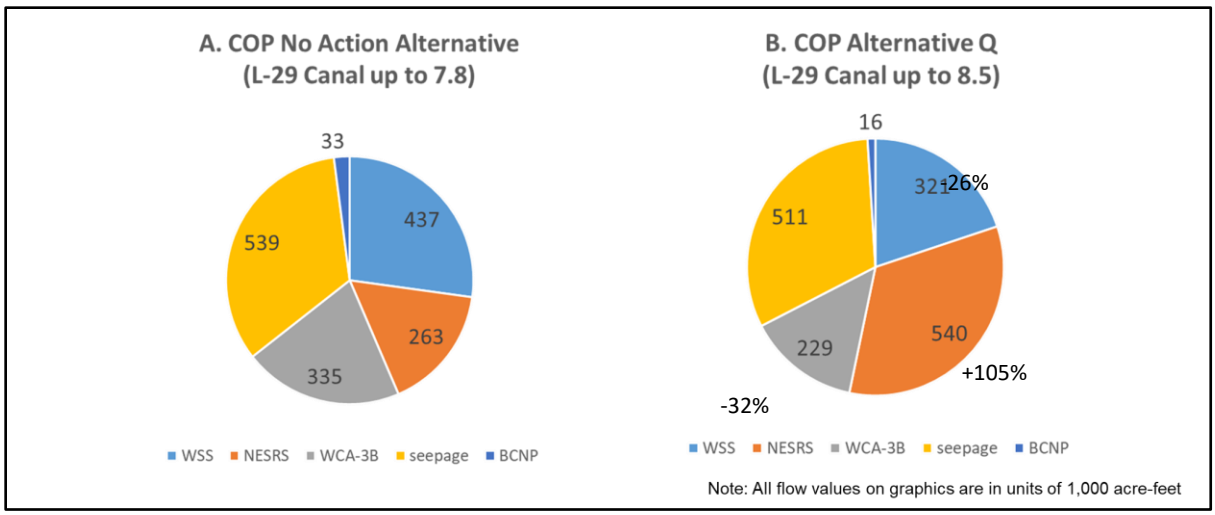

Figure ES-2. Comparison in average annual flow volumes across portions of the study area for the No Action Alternative (ECB19RR) and the preferred plan (ALTQ+).

MEANS TO AVOID OR MINIMIZE ADVERSE ENVIRONMENTAL EFFECTS

ALTQ+ has been identified to be environmentally preferable and the least environmentally damaging practicable alternative. Environmental effects for each resource are discussed in **Section 4** of the Draft EIS. The COP is an operational plan that changes the amount and timing of releases from WCA 3A to ENP. Potential unavoidable adverse effects that may potentially occur as a result of ALTQ+ are summarized below and include: (1) increased risk to accessibility of tree islands for cultural and religious practices by the Miccosukee Tribe; (2) increased risk to soils in WCA 3 due to reduced water levels; (3) increased risk to recreational access in WCA 3 during extremely dry periods; (4) increased risk for phosphorous loading in ENP and exceedance of the Consent Decree's Appendix A Shark River Slough annual phosphorus concentration limit; and (5) potential for high volume discharges through S-197 to Barnes Sound/Manatee Bay associated with the Extreme High Water Line (EHWL).

All practicable means to avoid or minimize adverse environmental effects have been incorporated into ALTQ+. The COP Adaptive Management and Ecological Monitoring Plan (AMMP) has been included in the Draft EIS (**Appendix C**). The primary objective of the COP AMMP is to identify the monitoring necessary to inform decision-makers, partner agencies, and the public on progress towards achieving restoration success, as well as address uncertainties related to potential adverse effects to avoid and/or minimize those effects.

Tribal Concerns: Decreases in water levels in WCA 3A may limit airboat access to tree islands by the Miccosukee Tribe during extremely dry periods. The Miccosukee Tribe maintains a traditional life style that is intricately connected to the Everglades. Traditional practices of hunting, fishing, frogging, trapping, and general living are still maintained, along with modern entrepreneurship with tourism-related businesses (airboat concessionaires) along Tamiami Trail. Tree islands were and still are important places to the Native American populations of Florida. Potential limitations to accessing tree islands may affect the ability of the Miccosukee Tribe to participate in cultural and religious practices that take place on these islands. Independent of implementation of the COP, tribal airboat access is currently limited during the dry season; however durations of limited access would be expected to be extended with the COP

during periods of below average annual rainfall. Access during these times may be limited to walking and/or use of swamp buggies.

WCA 3 Water Levels: A potential increase in dry event severity was observed in portions of WCA 3 which presents an increased risk to soils from oxidation; however the observed results for the majority of WCA 3 were still above the threshold to maintain peat accumulation in the Everglades marsh.

A potential increase in foraging conditions for wading birds is expected to improve in portions of ENP due to increases in the availability of water; however, implementation of ALTQ+ may increase the probability that wading bird colonies in northern WCA 3A would experience drier conditions due to reduced water depths in WCA 3A. Rapid recession rates during the breeding season can result in decreased nest success (through increased predation or decreased forage availability) and decreased juvenile survival (due to decreased forage availability.

Recreational Access: Due to lowering of water levels in WCA 3, the COP may potentially reduce airboat access and recreational fishing within the marsh during extremely dry periods; however access to canals for recreation would not change relative to ECB19RR. Differences in the number of days the Florida Fish and Wildlife Conservation Commission (FWC) considers closure in the Everglades and Francis S. Taylor Wildlife Management Area (EWMA) due to low water stages were observed to be less than a 2% period of record change relative to ECB19RR. ALTQ+ performed equivalent to ECB19RR in the number of low water closures events anticipated. Specific access points along Tamiami Trail west of the L-67 Extension canal face an increased risk of being inaccessible for recreational finishing, air boating, and paddling to an estimated average of 5% period of record change relative to ECB19RR.

Water Quality: The project delivery team (PDT) investigated various adaptive management options that, based on modeling, could help reduce the amount of phosphorus delivered in events where the water concentrations are higher than 8 parts per billion (ppb). Unavoidable potentially adverse impacts on water quality over the next several years could occur with implementation of ALTQ+. However the adaptive management options evaluated by the PDT have determined it is possible to reduce those potential impacts. The water quality adaptive management measures are described in Section 4.4 of this Draft EIS, the COP AMMP (**Appendix C**), and within the COP Water Control Plan (**Appendix A**). Additionally, regardless of any other upstream projects expected to improve water quality, there is a clear decreasing trend for long-term phosphorus concentrations delivered to NESRS. The adaptive management measure, if implemented, has the potential to reduce the quantity of water delivered to ENP. The water quality strategies were developed and designed to avoid any net reduction of water volumes delivered to the ENP during a given water year. The intent is that any temporary reduction in volumes delivered to the ENP due to the implementation of the water quality strategies will be accounted for/tracked and that volume will be made/released to the ENP later in the water year when water is available in the system (typically during the wet season).

The USACE conducted a detailed water quality analysis to determine the potential impacts of operational changes to NESRS on flow weighted mean (FWM) total phosphorous (TP) concentrations and loads to NESRS. Phosphorus is the primary nutrient of concern for the Everglades, which historically has been a phosphorus-limited system. The analysis evaluated potential changes to phosphorus loading, loadings into NESRS above 8 ppb (considered undesirable) and the flow weighted annual mean. Data used included output from the modeling on WCA 3A gauge stages and flows through WCA 3A outflow structures (S-12A, S-12B, S-12C, S-12D, S-333, S-334, and S-356). The PDT used five metrics to evaluate the changes in average annual FWM TP concentrations impacts for 2018 and 2023 compared against the Long Term FWM

(LTFWM). All metrics assumed that changes to the distribution, source, and timing of flows in WCA 3A were minimal for the considered alternatives, relative to ECB19RR, and that such changes would not materially alter water quality conditions. Based upon the PDT water quality analysis, ALTQ+ resulted in a LTFWM (by 2023) similar to ECB19RR and improvements in loadings above 8 ppb by 2023.

The metrics used to evaluate water quality for ALTQ+ predicts an increase in excess TP Load (delivered above 8 ppb) to NESRS. The change in the average FWM concentration delivered to NESRS was 1.2 ppb above ECB19RR for 2018 conditions and 0.5 ppb above ECB19RR under 2023 conditions. When the adaptive management options are employed, the LTFWM is predicted to improve to 0.7 or 0.8 ppb above baseline (sensitivity runs SRQ2 and SRQ3 respectively) under 2018 conditions and improve to 0.2 ppb or 0.1 ppb lower than the LTFWM ECB19RR under 2023 conditions.

Environmental Justice (EJ): An EJ analysis was conducted to determine if there were disproportionate adverse impacts to low-income, minority communities within the study area. The two main risks of adverse impacts within the study area were groundwater stage increases potentially impacting agricultural parcels and the potential for increased dry outs in WCA 3A potentially impacting tribal access to certain lands. Ultimately, ALTQ+ was used as the basis for the EJ analysis since the adverse impacts within the study area for each alternative followed similar spatial patterns (i.e. the same communities were adversely impacted to similar degrees amongst the alternatives). Though the impact analysis did determine that ALTQ+ showed an increased risk of adverse impacts when compared to ECB19RR, these adverse impacts were not shown to be holistically disproportionate to the EJ communities analyzed.

COORDINATION WITH AGENCIES AND THE PUBLIC

The planning process for the COP required extensive coordination with the public and Federal, Tribal, State, and local resource management and regulatory agencies. An interagency project team was formed and met regularly throughout the study, providing Federal, Tribal, State, and local agencies opportunities to comment on planning assumptions, evaluation tools and methods, and alternative plans. Initial public and agency comments received in response to a NEPA scoping letter dated September 22, 2017, were supportive of the project. A Notice of Intent (NOI) to prepare an EIS for the COP was published in the Federal Register (FR Volume 82, Number 173) September 8, 2017. Comments received from the NEPA scoping letter focused on the planning process, operational considerations to be included in the COP, links to other CERP projects and planning constraints. Concerns centered on potential impacts to water supply, flood protection, and water quality. Potential impacts to wetlands, fish and wildlife resources, and known and unknown cultural resources were also of concern. Scoping comments were accepted through October 21, 2017.

Agencies including ENP, the South Florida Water Management District (SFWMD), and the USFWS were asked at the beginning of the planning process to become cooperating agencies under NEPA in correspondence dated September 22, 2017. The SFWMD and ENP formally accepted cooperating agency status on October 20, 2017, and November 1, 2017, respectively. Correspondence requesting cooperating agency status was also provided to the Miccosukee Tribe, the Seminole Tribe of Florida, and the Seminole Nation of Oklahoma on October 13, 2017. No correspondence was received in response to these letters.

AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

Over the lifetime of the MWD and C-111 South Dade projects, considerable interest has been generated among local and regional stakeholders. The USACE continually strives to include all interested parties in

its decision making process and would continue to consider all issues that arise. Concerns and controversies were documented during the planning process. The COP AMMP provides a forum to address the concerns and controversies exacerbated by information gaps. Concerns and controversies are summarized below.

Tribal Concerns: Decreases in water levels in WCA 3A may prohibit access to tree islands by the Miccosukee Tribe during extremely dry periods, who currently use airboats for access. The COP has the potential for beneficial effects to tree islands in the chronically inundated portions of southern WCA 3A. The reduction of water levels within WCA 3A is likely to aid in reducing future tree island degradation due to prolonged inundation and high water depths, and thereby, aid in the preservation of cultural resources by allowing stabilizing growth to occur on the tree islands. The COP is anticipated to be in place until construction of new CERP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and Florida Bay. If new information becomes available through implementation of the COP Water Control Plan and/or the COP AMMP that would necessitate a need to modify water management operations, this information will be incorporated as appropriate in accordance with laws and regulations including the NEPA.

Regularly scheduled interagency Periodic Scientist Calls (PSCs) allow the USACE to gather input on desired long-term (annual and/or seasonal) conditions within the system. In addition, the PSCs occur on an as needed basis with the frequency of the calls determined based upon ongoing or anticipated conditions within the WCAs, SDCS, and ENP, and provides a forum for consideration of increased low-water stages within WCA 3A, including along the western L-29 canal between S-12A and S-333, that are of concern to the Miccosukee Tribe.

Providing Additional Regional Ecosystem Restoration Needs: ALTQ+ provides a significant increase in freshwater needed for the restoration of NESRS and Taylor Slough (Reference **Benefits of the Preferred Plan** above), however, additional actions are needed such as the completion of CERP components that would increase freshwater flows to achieve Everglades restoration. Concerns expressed by stakeholders included the performance of the TTFF in ALTQ+ during regional droughts in the WCAs, ENP, and Florida Bay. ALTQ+ maximizes progress toward restoring historic hydrologic conditions in Taylor Slough by increasing annual inflow by approximately 7% and in the Eastern Panhandle of ENP by approximately 27%. This is the first time the 1985 WCA 3A Rainfall Plan has been replaced to convey water from WCA 3A to ENP. Uncertainties still exist with respect to the implementation of the TTFF. Adaptive management strategies have been developed to address uncertainty associated with the TTFF and include a structured approach as to how monitoring data may inform implementation of ALTQ+ and/or potential future revisions to the TTFF. Specific operational triggers and operational criteria to address SRS low water conditions have been developed through the COP AMMP process, with technical support from water managers.

EHWL: ALTQ+ includes additional operational flexibility by inclusion of an EHWL for water management operations when extreme high water levels in WCA 3A exist. This operational flexibility is not expected to be triggered frequently and is intended to be available if needed to help reduce risks to the WCA 3A perimeter levee system, a population at risk of 70,600 people, hurricane evacuation routes, and wildlife and tree islands from extreme high water conditions. The EHWL ranges from 11.0 to 12.0 feet, NGVD. When WCA 3A water levels are above the EHWL, this would trigger a thorough evaluation of the C&SF system conditions. The information would be used to decide whether or not to implement all actions authorized by the EHWL which includes routing water from WCA 3A through the SDCS. Concerns expressed by stakeholders include the effects of the EHWL on flood risk in agricultural areas of Miami-

Dade County and potential effects of S-197 discharges to the Eastern Panhandle and Manatee Bay and Barnes Sound. Under this condition discharges at S-197 may be increased up to a maximum of 2400 cubic feet per second (cfs). The S-197 provides a gravity outlet for stormwater runoff, as well as water seepage from ENP, which is conveyed through the SDCS during high water and flood conditions. Releases at S-197 have the potential to decrease flows to Taylor Slough, and subsequently Florida Bay. This operational flexibility is not expected to be triggered frequently. Numerical simulations performed for ALTQ and ECB19RR indicated that the EHWL was exceeded only three times during the 41 year of continuous simulations for both scenarios. Total durations for the exceedances in number of days were 15% less for ALTQ than ECB19RR.

The last three years have required the USACE to seek planned temporary deviations from the current water control plan and has required the State of Florida to issue emergency orders, both of which require a tremendous amount of analysis and coordination. The inclusion of the EHWL in the COP would streamline the process (and the need for additional NEPA) required to implement changes due to extreme high water levels to apply more attention to alleviating future high water condition.

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ACRONYMS

8.5 SMA	8.5 Square Mile Area
A	
ALT	Alternative
AMMP	Adaptive Management and Monitoring Plan
B	
BA	Biological Assessment
BCNP	Big Cypress National Preserve
BMP	Best Management Practices
BO	Biological Opinion
C	
C-111	C-111 South Dade Project
C-111 NDA	Canal-111 North Detention Area
C-111 SDA	Canal-111 South Detention Area
CEQ	Council on Environmental Quality
cfs	Cubic feet per second
CH	Critical Habitat
C&SF	Central and Southern Florida Project
CERP	Comprehensive Everglades Restoration Plan
COP	Combined Operational Plan
CSSS-Ax	Cape Sable seaside sparrow subpopulation A
CSSS-B	Cape Sable seaside sparrow subpopulation B
CSSS-C	Cape Sable seaside sparrow subpopulation C
CSSS-D	Cape Sable seaside sparrow subpopulation D
CSSS-E	Cape Sable seaside sparrow subpopulation E
CSSS-F	Cape Sable seaside sparrow subpopulation F
CSOP	Combined Structural and Operations Plan
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
D	
DOI	Department of Interior
E	
E	Endangered
EA	Environmental Assessment
EAA	Everglades Agricultural Area
EFH	Essential Fish Habitat
EHWL	Extreme High Water Line
EIS	Environmental Impact Statement
EJ	Environmental Justice
ENP	Everglades National Park
EO	Executive Order
EPA	Everglades Protection Area
ERTP	Everglades Restoration Transition Plan
ESA	Endangered Species Act
EWMA	Everglades and Francis S. Taylor Wildlife Management Area
F	
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FR	Federal Register
FSEIS	Final Supplemental Environmental Impact Statement
FWCAR	Fish and Wildlife Coordination Act Report
FWC	Florida Fish and Wildlife Conservation Commission
FWM	Flow Weighted Mean

G

GDM	General Design Memorandum
GIS	Geographic Information Systems
GRR	General Re-evaluation Report

H

HHS	U.S. Department of Health and Human Services
HTRW	Hazardous, Toxic and Radioactive Waste

I

IMC	Interagency Modeling Center
IOP	Interim Operational Plan
ISOP	Interim Structural and Operational Plan
IR	Indicator Regions

K

KAC-FT	Thousand Acre Feet

L

L-31N	L-31 North
LEC	Lower East Coast
LECSA	Lower East Coast Service Area
LTFWM	Long Term Flow Weighted Mean

M

MD-LPA	Miami Dade Limestone Products Association
MDRSM	Miami-Dade Regional Simulation Model
MWD	Modified Water Deliveries

N

NEPA	National Environmental Policy Act
NESRS	Northeast Shark River Slough
NGVD	National Geodectic Vertical Datum of 1929
NRHP	National Register of Historic Places
NMFS	National Marine Fisheries Service
NOA	Notice of Availability
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRFF	New Rainfall Formula
NSM	Natural Systems Model
NSRSM	Natural Systems Regional Simulation Model

O

P

PDT	Project Delivery Team
POR	Period of Record
ppb	Parts per billion
PSC	Period Scientist Calls

Q

R

RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
RSM-GL	Regional Simulation Model Glades Lower East Coast Service Area Application

S

SA	Similarity of Appearance
SAV	Submerged Aquatic Vegetation
SDCS	South Dade Conveyance System
SHPO	Florida State Historic Preservation Officer
SFWMD	South Florida Water Management District
SOM	System Operating Manual
SPF	Standard Project Flood
SRS	Shark River Slough

STA	Storm water Treatment Area

T

T	Threatened
THPO	Tribal Historic Preservation Officer
TMDLs	Total Maximum Daily Loads
TP	Total Phosphorus
TTM	Tamiami Trail Modifications Project

U

USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

V

W

WCA	Water Conservation Area
WRAC	Water Resources Advisory Committee
WY	Water Year

X

Y

Z

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1 PROJECT PURPOSE AND NEED

This section discusses the purpose of, and need for, the project.

1.1 Project Authority

The Combined Operational Plan (COP) is an integrated operational plan for two modifications of the Central and Southern Florida (C&SF) project – known as Modified Water Deliveries (MWD) to Everglades National Park (ENP) and the Canal 111 (C-111) South Dade projects. The C&SF Project is authorized by Section 203 of the Flood Control Act of 1948, Public Law (PL) 80-858, and modified by Section 203 of the Flood Control Act of 1968, PL 90-483.

The purpose of the COP is to define the water management operations for the Water Conservation Area (WCA) 3A, WCA 3B, structures in the L-31N and the C-111 basins constructed as part of the C&SF project and the constructed components of the MWD and C-111 South Dade projects. The COP water management operations will be consistent with their respective project purposes as defined by the authorizing legislation and further refined by subsequent General Design Memoranda (GDM), General Reevaluation Reports (GRR) and Limited Reevaluation Reports (LRR). The proposed operations will also be consistent with the original purposes of the C&SF project as authorized by the Flood Control Act of 1948 (PL 80-858) to provide flood control, water supply for agricultural irrigation, municipalities and industry, and ENP; regional groundwater control and prevention of saltwater intrusion; enhancement of fish and wildlife; and recreation.

1.1.1 C-111 South Dade Project

The C-111 South Dade project was originally authorized in the Flood Control Act of 1962 (PL 87-874) and modified for the C-111 South Dade project by Section 203 of the Flood Control Act of 1968, (PL 90-483).

The Everglades National Park Protection and Expansion Act of 1989 (PL 101-229), which modified the boundaries of ENP and to provide for the protection of lands, waters, and natural resources within the park, also authorized the U.S. Army Corps of Engineers (USACE) in Section 104 to modify the C&SF project to improve water deliveries into the park and shall, to the extent practicable, take steps to restore the natural hydrological conditions within the park. Section 104(j) required the preparation of a GDM for project works within the C-111 Basin area of the east Everglades and directed that it take all measures which are feasible and consistent with the purposes of the project to protect natural values associated with ENP.

The “Final Integrated GRR and Environmental Impact Statement (GRR/EIS) Canal 111, South Dade County, Florida”, dated May 1994, which followed, provided a reformulation and assessment for completing the authorized project within the C-111 Basin in accordance with the 1989 Congressional direction. The GRR was approved by the Assistant Secretary of the Army (Civil Works) on 1 July 1994, These additional project modifications to the C-111 South Dade project were authorized by Section 316 of the Water Resources Development Act (WRDA) of 1996 (PL 104-303). A 2016 LRR served as the Post Authorization Change Report (PACR) that documented prior design refinements to the 1994 GRR/EIS plan that were incorporated into the project construction (Contracts 1 through 8) as well as others since completed construction (Contract 9), as coordinated with the USACE South Atlantic Division (SAD). All C-111 South Dade project constructed features were addressed in previous National Environmental Policy Act (NEPA)

documents. The C-111 South Dade 1994 Integrated GRR/EIS was published in May 1994. This report described a conceptual plan for five pump stations and levee-bounded retention/detention areas to be built west of the L-31N canal, between the proposed S-332B and S-332D pump stations, to control seepage out of ENP while providing flood mitigation to agricultural lands east of C-111 canal. Multiple project features were constructed between 1999 and 2019. As of July 2019, construction of the C-111 South Dade project is functionally complete.

1.1.2 Modified Water Deliveries to Everglades National Park Project

1.1.2.1 Public Law 101-229. 13 December 1989 (Section 104)

The Everglades National Park Protection and Expansion Act of 1989, PL 101-229, authorized the Secretary of the Army, upon completion of a final report (1992 GDM), to modify the C&SF project to improve water deliveries to ENP and to take steps to restore the Park's natural hydrological conditions. Congress directed that the modifications be based on the Experimental Program. The Act states:

> (a) IMPROVED WATER DELIVERIES —
>
> (1) Upon completion of a final report by the Chief of the Army Corps of Engineers, the Secretary of the Army, in consultation with the Secretary, is authorized and directed to construct modifications to the Central and Southern Florida Project to improve water deliveries into the park and shall, to the extent practicable, take steps to restore the natural hydrological conditions within the park.
>
> (2) Such modifications shall be based upon the findings of the Secretary's experimental program authorized in section 1302 of the 1984 Supplemental Appropriations Act (97 Stat. 1292) and generally as set forth in a General Design Memorandum to be prepared by the Jacksonville District entitled "Modified Water Deliveries to Everglades National Park". The Draft of such Memorandum and the Final Memorandum, as prepared by the Jacksonville District, shall be submitted as promptly as practicable to the Committee on Energy and Natural Resources and the Committee on Environment and Public Works of the United States Senate and the Committee on Interior and Insular Affairs and the Committee on Public Works and Transportation of the United States House of Representatives.

Section 104 (b)-(h) also authorized and directed the Secretary to construct a flood protection system for the residential area in the East Everglades and adjacent agricultural areas, if the Secretary determines those areas will be adversely affected by operation of the project. To protect agricultural areas, the Secretary must find that there is a substantial reduction in the areas' present economic utility which is attributable solely to the project modification or the residential flood protection system. The Secretary was directed to review the operation of the modified project within 18 months, and periodically thereafter, to determine whether agricultural areas are being adversely affected and to protect the areas if necessary.

However, any preventive measure shall be implemented in a manner that presents the least prospect of harm to the natural resources of ENP. The Secretary was also directed to coordinate the construction program with the Secretary of the Interior to permit the Park's expansion (land acquisition) program to proceed concurrently.

1.1.2.2 General Design Memorandum and Environmental Impact Statement, Modified Water Deliveries to Everglades National Park. June 1992.

The Central and Southern Florida Project, For Flood Control and Other Purposes, Part I, Agricultural and Conservations Areas Supplement 54, General Design Memorandum and Environmental Impact Statement, Modified Water Deliveries to Everglades National Park, June 1992 (MWD to ENP GDM and Final Environmental Impact Statement (EIS)) was developed in 1992, in response to the Everglades National Park Protection and Expansion Act of 1989, Public Law 101-229. It recommended rain-driven delivery schedules and several structural modifications to the C&SF project.

The following stated objectives of the MWD project were intended to take steps to restore the natural hydrologic conditions within ENP, to the extent practicable, given the identified constraints:

i. Timing: Changing the schedule of water deliveries so that it fluctuates in consonance with local meteorological conditions, including providing for long-term and annual variation in ecosystem conditions in the Everglades;

ii. Location: Restoring WCA 3B as a functioning component of the Everglades hydrologic system and restoration of water deliveries to Northeast Shark River Slough (NESRS), the center of the historic Shark River Slough (SRS);

iii. Volume: Adjusting the magnitude of water discharged to ENP to minimize the effects of too much or too little water.

The MWD Final EIS includes a discussion of the location, capacity, and environmental impacts for the proposed structural modifications, which included structures S-345A, B and C; S-349A, B and C; S-355A and B; S-334 modification, removal of the L-67 Extension Levee and borrow canal filling; and a levee and canal system for flood mitigation in the developed East Everglades area (also referred to as the 8.5 Square Mile Area [8.5 SMA]). The levee and canal system included two pumping stations, S-356 and S-357. The MWD recommended plan provides a system of water deliveries to ENP across the full width of the historic SRS flow-way. Project features of the MWD and C-111 South Dade projects, including amendments to the original project components, are described in **Section 1.3** (**Project Background**).

1.2 Project Location

The water management operation criteria relating to the 2012 Water Control Plan for the WCAs, ENP, and ENP to the South Dade Conveyance System (SDCS) affects an area within the C&SF project located in south Florida and includes portions of several counties, as well as WCA 3, ENP, Big Cypress National Preserve (BCNP), and adjacent areas. The MWD project is a modification of the C&SF project. Features of the MWD project are located in Miami-Dade County, including portions of ENP and adjacent areas. The 1992 MWD GDM and Final EIS defines the project boundary as SRS and that portion of the C&SF project north of S-331 to include WCA 3. The C-111 South Dade project is situated within the C-111 Basin which includes approximately 60 square miles of mostly agricultural lands in the Homestead/Florida City area. The C-111 South Dade project is adjacent to ENP to the west and discharges to the eastern panhandle of ENP, Florida Bay, Manatee Bay and Barnes Sound. The project components of the MWD and C-111 South Dade projects are shown in **Figure 1-1**.

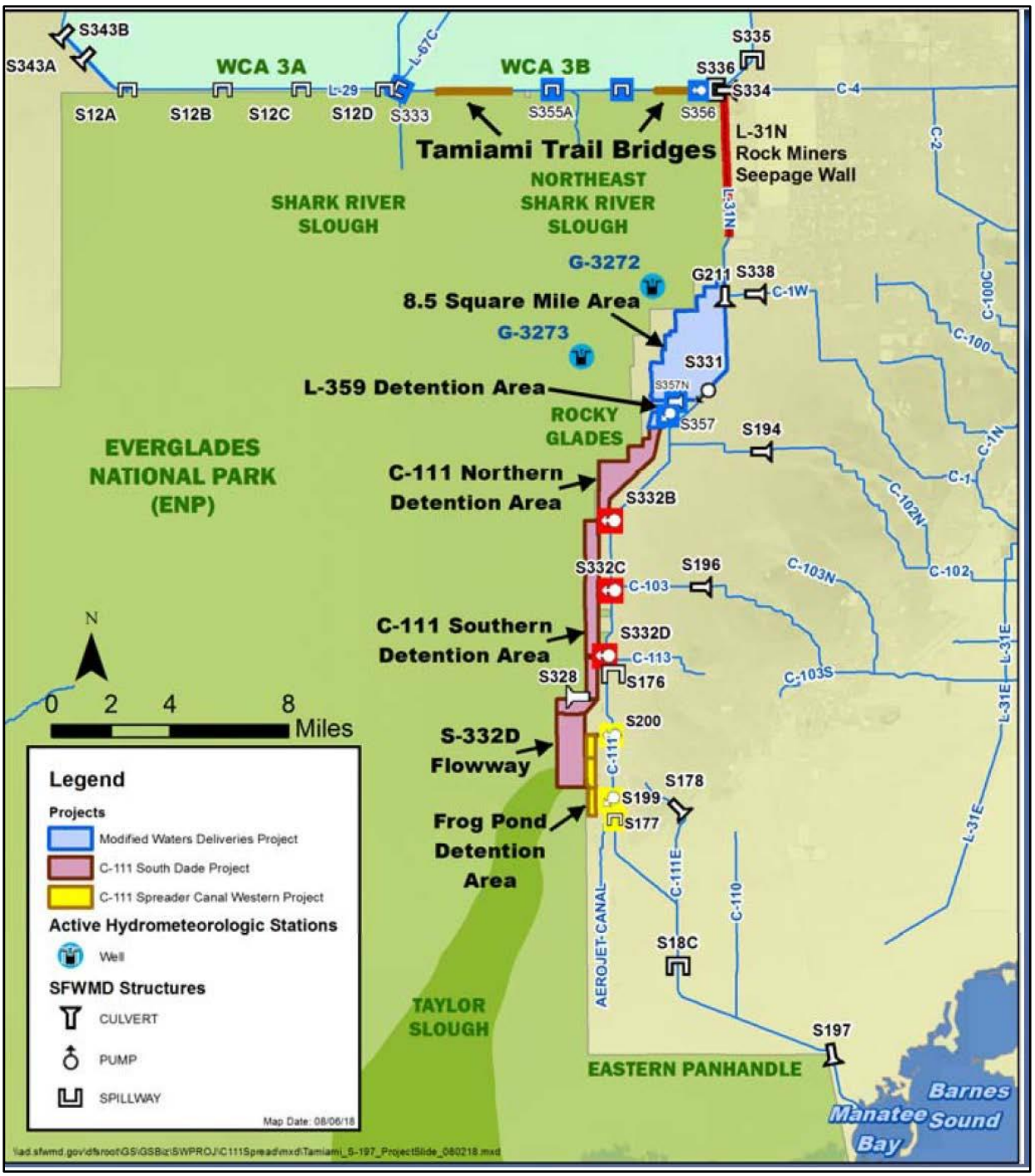

Figure 1-1. Project location and relevant C&SF features of the MWD and C-111 South Dade projects

1.3 Project Background

The C&SF project currently functions and was originally authorized to function as a multi-purpose water management system. The authorized project purposes include flood control; water supply for agricultural irrigation, municipalities and industry, and ENP; regional groundwater control and prevention of saltwater

intrusion; enhancement of fish and wildlife; and recreation. The following sections explain key project and water control plan changes that are relevant to the project.

1.3.1 Modified Water Deliveries Project

The MWD project includes modifications to the C&SF project to provide a system of water deliveries to ENP across the full width of the historic SRS flow way and consists of four main components: (1) conveyance and seepage control features to facilitate flow through the system from WCA 3A to WCA 3B and to limit seepage eastward from WCA 3B and ENP; (2) modifications to Tamiami Trail to facilitate flow under the road to SRS; (3) flood mitigation for the developed east Everglades area (also referred to as the 8.5 SMA); and (4) project implementation support, which includes monitoring and operational changes. The MWD GDM and Final EIS (USACE 1992) includes a discussion of the location, capacity, and environmental impacts for the proposed structural modifications, which included structures S-345A, B and C; S-349A, B and C (hydrologic connections from WCA 3A to WCA 3B); S-355A and B; S-334 modification; removal of the L-67 extension levee and adjacent borrow canal filling; and a levee and canal system for flood mitigation in the 8.5 SMA.

In the MWD GDM and Final EIS (USACE 1992) the GDM 8.5 SMA levee and canal system included reliance on two pumping stations, S-356 and S-357. In the MWD GDM and Final EIS (USACE 1992), the 8.5 SMA flood mitigation project included a perimeter seepage collection canal, with S-357 discharging into the L-31N canal and the seepage returned to NESRS via a larger S-356 pump station. The 8.5 SMA features were constructed to provide flood mitigation to the privately owned lands in the Las Palmas Community located east of ENP, in order to prevent seepage impacts from higher stages within NESRS resulting from the implementation of MWD. A GRR and SEIS for the 8.5 SMA was completed in July 2000 (USACE 2000). The GRR recommended Alternative 6D, consisting of a perimeter levee (Levee 357W [L-357W]), internal levees, an interior seepage collection canal (C-357), a new pump station (S-357), and a detention area that would discharge into the proposed C-111 South Dade Northern Detention Area (NDA) (**Figure 1-1**). The PL for the MWD to ENP Project (PL 101-229) was amended by PL 108-7 (Consolidated Appropriations Resolution, 2003). This statute directed the Corps to "immediately carry out Alternative 6D" (the Selected Alternative in the GRR).

A further design refinement for the 8.5 SMA and Environmental Assessment (EA) was completed in August of 2012 (USACE 2012a). An operational test conducted in 2009 indicated that the S-357 pump station and other 8.5 SMA features may not adequately mitigate impacts from increased flows to the southwest corner of the 8.5 SMA. To ensure capability to use the S-357 pump station at maximum design capacity following completion of the NDA, new hydrologic modeling identified an additional east-west seepage collection canal (C-358) was needed to properly mitigate groundwater stages in the southwest corner (east of L-357W). A gated control structure (S-357N) was constructed in February 2018, and connects the C-358 seepage collection canal to the existing C-357 canal, upstream of S-357. Water management operating criteria for the S-357N and C-358 were initially included in the May 2015 Increment 1 EA and Finding of No Significant Impact (FONSI), (USACE 2015) and criteria were reviewed and refined for the Increment 1.1 and 1.2 EA (USACE 2017a) and Increment 2 EA (USACE 2018) in anticipation of the construction completion (originally scheduled for April 2015).

With regard to the Tamiami Trail Modifications (TTM) component, the original 1992 MWD GDM and Final EIS plan did not include modifications to provide full conveyance capacity under Tamiami Trail for the additional flow volumes of up to 4,000 cubic feet per second (cfs) anticipated during the rainy season (USACE 1992). By 2000, it was known that additional modifications to Tamiami Trail would be required to

prevent damage to the road from increased flows and higher water levels to NESRS. Following an extensive evaluation of a full range of alternatives for Tamiami Trail, the 2008 TTM LRR and EA recommended construction of a one mile bridge in the eastern segment of the roadway, raising the operational water level constraint in the L-29 canal from 7.5 to 8.5 feet National Geodetic Vertical Datum 1929 (NGVD), and reinforcing the roadway in that area to meet Florida Department of Transportation standards (FDOT) (USACE 2008). The TTM construction was completed in 2013.

All construction features for the MWD project were completed by February 2018, including the 8.5 SMA project, construction of S-355A and S-355B, S-333 and S-334 modifications, S-356, Tiger Tail camp raising, removal of four miles of the L-67 extension levee, and Tamiami Trail modifications. However, some features originally included in the 1992 MWD GDM and Final EIS, including features to provide hydrologic connectivity between WCA 3A and WCA 3B and complete degradation of the L-67 extension levee and adjacent canal, have not been completed for various reasons, including operational (water levels) constraints within WCA 3B, lowered MWD maximum operational stages for the L-29 canal (9.7 feet, NGVD was assumed with the 1992 MWD GDM and Final EIS), and potential water quality concerns. NEPA documentation for removal of unconstructed conveyance and seepage control features for the MWD project was completed on May 2, 2017 with signing of a FONSI incorporating an EA (USACE 2017b). Specifically, the components to be removed from the MWD authorized project and associated project Cooperation Agreement (PCA) include: (1) gated culvert structures S-345 A, B, and C through the L-67A; (2) gated concrete headwall structures S-349A, B, and C in the L-67 borrow banal; and (3) degradation of the remaining 5.5 miles of the L-67A extension levee.

1.3.2 C-111 South Dade Project

The C-111 South Dade project is part of the C&SF project authorized by Section 203 of the Flood Control Act of 1948 (PL 80-858), as modified by Section 203 of the Flood Control Act of 1968 (PL 90-483). The C-111 South Dade Integrated GRR and EIS were published in May 1994 (USACE 1994). The 1994 report described a plan to construct five pump stations and a levee-bounded retention/detention area to be built west of the L-31N canal, between the 8.5 SMA and the Frog Pond Area (south of S-332D), to control seepage out of ENP and reduce damaging freshwater discharges to Manatee Bay/Barnes Sound while maintaining flood protection to agricultural lands east of C-111 canal. The 1994 GRR plan also proposed a spreader canal, plugs in the C-109 and C-110 canals, and degradation of the spoil mound south of the C-111 canal to provide overland flow into the ENP Eastern Panhandle towards northeast Florida Bay. The existing and proposed configuration of these structural features are described in detail in the 2006 Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) Final Supplemental EIS (USACE 2006), the 2012 EA for the expansion of the C-111 South Dade NDA (USACE 2012b), the 2016 EA and FONSI for modifications to the C-111 South Dade North and South Detention Areas and associated features (USACE 2016a), and the 2016 C-111 South Dade Final LRR, as depicted in **Figure 1-1** (USACE 2016b).

The remaining features of the C-111 South Dade project recently completed during 2015-2018 include but are not limited to: the NDA which links the C-111 South Dade project to the MWD project 8.5 SMA detention area; two internal flow-way berms (L-360E and L-360W) inside the 8.5 SMA Detention Cell; L-357W Levee crossing at Richmond Drive; modification of the outlet weirs (S-360E and S-360W) for the 8.5 SMA detention area. The C-111 NDA was created by extending the existing L-315 north levee (NDA western perimeter levee) and realigning and extending the L-316 levee (NDA eastern perimeter levee), with both levees connected to the 8.5 SMA detention area perimeter levees. Earthen flow-way berms were constructed within the interior of both the NDA (L-318) and Southern Detention Area (SDAL-321),

which created a narrow interior flow-way along the boundary with ENP to maintain the hydraulic ridge during periods of limited water availability.

Construction of the two internal flow way berms (L-360E and L-360W) inside the 8.5 SMA Detention Cell were completed in May 2017, and the berms were subsequently repaired and raised by the South Florida Water Management District (SFWMD) during February to April 2018 following Hurricane Irma. Construction of the L-357W levee crossing at Richmond Drive was also completed in May 2017. Realignment and extension of the L-316 levee (NDA eastern perimeter levee) was significantly completed in July 2017. Extension of the existing L-315 north levee (NDA western perimeter levee) was significantly completed in July 2017, although additional repairs to the levee section were required following Hurricane Irma. The earthen flow-way berms within the interior of the NDA (L-318) were nearly completed in September of 2017, but additional repairs to the berm were required following Hurricane Irma. Modification of the western outlet weir (S-360W weir and an adjacent section of the L-359 Levee) for the 8.5 SMA detention area was also scheduled for completion in September 2017; however, between September 16 through September 23, 2017, a section of the L-359 north levee adjacent to S-360W was removed by both the USACE' South Florida Operations Office (SFOO) and the USACE contractor to allow S-357 discharges to flow into the NDA in association with the September 2017 Emergency Deviation Post Hurricane Irma. This action was needed to move water out of the 8.5 SMA Detention Cell, minimize return seepage north into the 8.5 SMA interior, and allow a more efficient open channel flow from the S-357 pump station to the NDA. The temporary gap in the L-359 levee was closed in February 2018, to facilitate completion of the post-Hurricane repairs to L-315 and L-318 and for completion of the interior scraping within the NDA. Prior to this Emergency Deviation action, completion of this direct hydraulic connection between the 8.5 SMA S-357 pump station and the C-111 South Dade NDA was an established prerequisite for raising the L-29 canal maximum operating limit above 7.8 feet, NGVD (the limit for MWD Increment 1.2). Following a contract suspension period immediately following Hurricane Irma, the SDA interior berm construction was completed in early August 2018. As of August 2018, the NDA and SDA were both fully functional, and the significant completion status allowed for the L-29 canal maximum operating stage limit to be raised from 8.0 up to 8.5 feet NGVD according to the MWD Increment 2 Field Test criteria (USACE 2018).

An EA and FONSI dated December 7, 2016 for additional modifications to the C-111 South Dade project, other than those noted above, evaluated options for backfill and/or placement of plugs within the existing L-31W canal and modifying existing features, including the gap in the L-31W levee (USACE 2016b). Water drained into the L-31W borrow canal, which is immediately adjacent to ENP, flows as groundwater and surface water to the south and east, raising groundwater and C-111 levels and impeding drainage of lands east of C-111. Partial canal backfill and plugging in the L-31W canal, along with modifications to the L-31W levee gap, are expected to provide additional rehydration benefits to lands in eastern ENP, in addition to the expansion of the NDA and construction of flow-ways in both the NDA and SDA (USACE 2016b). The L-31W borrow canal modifications were completed by the SFWMD between January and September of 2017.

While a preliminary operational plan for the then-proposed C-111 South Dade features was included with the 1994 GRR, the GRR identified a need for a refined operation plan to be developed in coordination with ENP, the U.S. Fish and Wildlife Service (USFWS), the SFWMD and other agencies prior to completion of project construction. The COP will result in a comprehensive integrated water control plan for the operation of the water management infrastructure associated with the MWD and C-111 South Dade projects, including integration of the modified design components which have been constructed as generally described in the December 2016 C-111 South Dade LRR.

1.3.3 C-111 Spreader Canal Western Project

The WRDA of 2000 (PL 106-541), Section 601(b)(1)(A) approved the Comprehensive Everglades Restoration Program (CERP) as a framework for modifications to the C&SF project that are needed to restore, preserve, and protect the south Florida ecosystem while providing for other water related needs of the region, including water supply and flood protection. The C-111 Spreader Canal Western Project is included in the CERP. The C-111 Spreader Canal Western project Final Integrated Project Implementation Report (PIR) and EIS were published in January 2011 (USACE 2011a). The project was authorized in the WRRDA of 2014 (PL 113-121). The C-111 Spreader Canal Western project is located in southern Miami-Dade County, in an area bounded by ENP, the Florida City-Homestead area, and Manatee Bay. Components of the project include construction of a six-mile hydraulic ridge between Taylor Slough and the C-111 canal to reduce seepage loss from Taylor Slough and its headwaters. Implementation of the project is expected to improve the quantity, timing and distribution of water delivered to Florida Bay via Taylor Slough; improve hydroperiods and hydropatterns in the Southern Glades and Model Lands; and return coastal salinities to historical recorded conditions through the redistribution of water that is currently discharged to the Atlantic Ocean and Gulf of Mexico. The hydraulic ridge has been created by constructing a 590 acre above-ground detention area in the Frog Pond area (south of S-332D) and by installing two cfs pump stations (S-199 and S-200), and integrating other C-111 Spreader Canal Western project features (**Figure 1-1**). The completed project will also begin restoration of the Southern Glades and Model Lands with an operable structure in the lower C-111 canal (S-198), incremental operational changes to increase stages upstream of the S-18C structure, a plug just south of the location of structure S-20A within the L-31E canal, operational changes at the S-20 structure, and construction of earthen plugs at the C-110 canal.

The SFWMD implemented features of the C-111 Spreader Canal Western project under the State Expedited Construction program (i.e. Accelerate Everglades Restoration project [Acceler8]) for the purpose of expediting design and construction of a number of critical restoration projects consistent with the CERP. A Department of Army permit (SAJ-2005-9856 [IP-AAZ]) was issued to the SFWMD on October 14, 2009 for the construction and operation of the project. Initial construction of the C-111 Spreader Canal Western project was completed in January 2012 with completion of the Frog Pond Detention Area, partial Aerojet Canal features, plugs in the C-110 canal, and a plug at S-20A. Construction of the remaining two southern weirs along the Aerojet Canal began in November 2014 and was completed in early 2015. Construction of a new water control structure in the lower C-111 canal (i.e. S-198, which would be located south of S-18C) and incremental increases in the open/close stage triggers at S-18C have not yet been implemented.

The SFWMD initiated operation of the C-111 Spreader Canal Western project constructed components in June 2012, in accordance with the project Operating Manual (POM) developed with the PIR. At the request of SFWMD, a revised POM was approved by the USACE Regulatory Division in June 2016. Steps are expected to be taken in the future to incorporate the project into the federally authorized C&SF project once the project's consistency with the 2014 WRRDA authorized project has been documented and approved by USACE, and a project Partnership Agreement (PPA) between the USACE and the SFWMD has been executed. Since a PPA for the C-111 Spreader Canal Western project has not been executed, operation of the C-111 Spreader Canal Western project is not included as part of the 2012 Water Control Plan (USACE 2012c), within the MWD Incremental Field Tests, or within the 2020 Water Control Plan. Concurrent with the MWD Increment 1.1, 1.2, and 2 Field Tests, the SFWMD has continued to operate their expedited C-111 Spreader Canal Western project. Consistent with the requirements of the February 2017 re-issued C-111 Spreader Canal regulatory permit from the USACE, the SFWMD is continuing to

assess south Miami-Dade water conditions and existing operations, including those of the C-111 Spreader Canal Western project, on a quarterly basis for a minimum of five years to ensure project features are constructed and operated not to adversely affect adjacent lands outside and within the C-111 Spreader Canal Western project boundary with regards to water quantity, water quality, and/or flooding. The purpose of the assessment and quarterly reports are to ensure the SFWMD has the best available information to determine what operational system changes, if any, are necessary to avoid adverse water levels on adjacent lands. A summary of the quarterly reporting information is provided by the SFWMD to the COP project delivery team (PDT).

During late 2017 and 2018, the SFWMD completed further modifications to the C-111 Spreader Canal Western project which included increasing the installed pump capacity at S-199 and S-200 by installing an additional 75 cfs electric pump in each of the existing vacant bays (1 per pump station), and connecting the C-200 Header Channel to the L-31W Canal (via the G-737 culvert). Both of these modifications were intended to increase the quantity of fresh water delivered to Florida Bay via Taylor Slough. The G-737 culvert was completed and operational in July 2017. The increased capacity at S-199 and S-200 was completed by the SFWMD in September 2018.

The operations of the SFWMD C-111 Spreader Canal components were included in the hydrologic modeling conducted in support of the COP, but no changes to the current Florida Department of Environmental Protection (FDEP) permitted operations were evaluated with the COP alternatives.

1.3.4 Everglades Restoration Transition Plan

The Everglades Restoration Transition Plan (ERTP) was implemented in October 2012 through the Water Control Plan and included operational guidance for the constructed features of the MWD and C-111 South Dade projects until those projects are fully completed and the COP is implemented (USACE 2012c). The USACE reinitiated ESA consultation on ERTP on November 17, 2014 as a result of an exceedance of an Incidental Take Reinitiation Trigger from the November 17, 2010 ERTP Biological Opinion (BO) for the CSSS. A BO states the opinion of the USFWS as to whether a federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. The USFWS issued a new BO for ERTP on July 22, 2016, developed in formal ESA consultation with the USACE (USFWS 2016). As a result of this consultation, the USFWS determined that current conditions within CSSS habitat threaten the survival of the sparrow, and as a result, the USFWS issued a “jeopardy” BO which explains that unless alternatives to current water operational practices (which then included the 2012 Water Control Plan) are explored and implemented, continued implementation of ERTP is likely to jeopardize the continued existence of the CSSS. The revised BO, issued July 22, 2016 presented a Reasonable and Prudent Alternative (RPA) that would avoid jeopardizing the CSSS. The RPA identified operational modifications and expedited restoration initiatives for some of the structures in the southern portion of the Everglades ecosystem to provide suitable nesting habitat for the endangered CSSS. Main elements of the RPA included: habitat performance targets, actions to move water east, surveys and studies, and adaptive management. These RPA actions included additional seasonal closures to outlet structures within WCA 3A (S-12A, S-12B, S-343A, S-343B, S-344), with the flexibility to open under high water conditions between October and November, and adjustments in operations in the SDCS that will enable additional flows to Biscayne Bay during the dry season as well as increased flows toward eastern ENP to extend hydroperiods during the early dry season. In response to the BO, the USACE committed to taking specific actions to comply with the BO terms and conditions and implementing the RPA.

The 2016 ERTP BO states that the S-12A/S-12B and associated structures currently direct water flows to the north of CSSS-A, resulting in increased hydroperiods within this area. A delay in opening and implementing early closure of the S-12A, S-12B, S-343A, S-343B, and S-344 structures beyond their restrictions under ERTP is needed to limit flow into western SRS and provide drier conditions for this region. Structural closings for S-12A, S-12B, S-343A, S-343B, and S-344 under ERTP were retained under Increment 1 (USACE 2015); however the Increment 1 operational strategy was modified to address the mandated RPA of the July 22, 2016 ERTP BO, to include expanded closure periods for the S-12A, S-12B, S-343A, S-343B, and S-344 structures under Increment 1.1 and 1.2 (USACE 2017a). Increment 2 maintained the required closure periods for these structures and analyzed a set of alternatives to address the mandated RPA of the 2016 ERTP BO to raise the maximum operating limit in the L-29 canal up to a maximum of 8.5 feet, NGVD (USACE 2018).

1.3.5 Increment 1 Field Test

The USACE initiated the Increment 1 Field Test under the authority of the MWD project, to evaluate raising or removing the existing G-3273 stage constraint for inflow into NESRS and operate the S-356 pump station for control of seepage into the L-31N canal in October of 2015. G-3273 lies within eastern ENP, approximately 9.0 miles south of the L-29 canal and 2.5 miles west of the 8.5 SMA (**Figure 1-1**). The G-3273 constraint of 6.8 feet, NGVD was originally established as a flood protection measure. Prior to implementation of the Increment 1 Field Test, a stage of 6.8 feet, NGVD at this gage had been used since 1985 as a trigger to cease S-333 discharges from flowing south into NESRS as a protective measure for residential areas to the east, particularly the 8.5 SMA.

The Increment 1 Field Test was a planned deviation from the 2012 Water Control Plan (USACE 2012c). The 2012 Water Control Plan, which includes the WCA 3A Regulation Schedule, Rainfall Plan, and the Interim Operating Criteria for the 8.5 SMA project continued to govern water management operations during Increment 1, with the exception of operating criteria for S-333, S-334, S-356, S-197, and S-357N (USACE 2015). Increment 1, which was initiated on October 15, 2015, maintained the 2012 Water Control Plan stage maximum operating limit of 7.5 feet, NGVD in the L-29 canal, while relaxing the G-3273 stage constraint and utilized S-356 for the control of seepage to the L-31N canal. During Increment 1, it was anticipated that the combined flows to NESRS through S-333 and S-356 would be more than what would have otherwise been discharged through S-333 under the 2012 Water Control Plan. Additionally, it was anticipated that during implementation of water management operations associated with the Increment 1 Field Test, under typical hydro-meteorological conditions, the combined flows through S-173 and S-331 to the C-111 Basin would be less than what would have been discharged through these features under the 2012 Water Control Plan. Increment 1 also included a testing protocol to assist in defining operating criteria for the new 8.5 SMA S-357N water control structure following completion of construction.

NEPA documentation for Increment 1 was completed on May 27, 2015 with signing of a FONSI incorporating an EA (USACE 2015). Increment 1 duration was planned for approximately two years, with a minimum duration of one year. Implementation of Increment 1 was limited from October 15, 2015 to December 1, 2015, after which the USACE began to proceed with pre-storm drawdown and flood control operations due to very strong El Niño conditions experienced in the WCAs during the 2015-2016 dry season. The pre-storm drawdown and flood control operations were conducted in accordance with the 2012 Water Control Plan, independent of the Increment 1 Field Test. Regional water management operations next transitioned into a temporary emergency deviation to alleviate high water levels within WCA 3 (hereafter referred to as the 2016 Temporary Emergency Deviation). When the Increment 1 EA and FONSI was completed on May 27, 2015, completion of S-357N was anticipated by April 2015, prior to

the initiation of Increment 1 operations. Construction of the S-357N was actually completed in February 2018.

1.3.6 2016 WCA 3 Temporary Emergency Deviation

Due to the very strong El Niño during the 2015 to 2016 dry season, WCA 3A experienced unseasonable high water levels. To protect natural resources within WCA 3A, the USACE initiated a temporary emergency deviation to the stage maximum operating limit of 7.5 feet, NGVD in the L-29 canal on February 15, 2016. The 2016 Temporary Emergency Deviation mediated high water levels within WCA 3A by allowing for the full discharge capacity through S-333 into the L-29 canal and the use of additional WCA 3A discharge structures such as S-152. The 2016 Temporary Emergency Deviation included additional operational flexibility by raising the L-29 constraint up to 8.5 feet, NGVD with corresponding lowering of 8.5 SMA (C-357 and C-358), L-31N, and C-111 canals to compensate for the resulting higher stages and increased groundwater seepage along the eastern boundary of ENP and further expanded utilization of Column 2 operations to convey WCA 3A releases to the SDCS (refer to **Section 3.6** (**Regional Water Management Operations**)). NEPA documentation to support the 2016 Temporary Emergency Deviation was completed on February 12, 2016 with signing of a FONSI, incorporating an EA (USACE 2016c). A Supplemental EA and FONSI were completed on May 10, 2016 (USACE 2016d).

Residents within the 8.5 SMA expressed concern during implementation of the 2016 Temporary Emergency Deviation due to observed increases in ground and surface water. In response to these concerns, the SFWMD constructed temporary measures including the use of temporary pumps and an open channel connection between the C-358 canal and the C-357 canal prior to construction of S-357N to maintain flood mitigation requirements for the 8.5 SMA. The SFWMD also constructed temporary plugs in the drainage swales located north and south of Richmond Drive (SW 168th Street), and a berm around the western end of the C-358 canal, consistent with design refinements associated with the C-111 South Dade project. Design refinements associated with the C-111 South Dade project, which were still under construction in 2016, included the extension of the L-357 W Levee from the 8.5 SMA Detention Cell to the southern limits of Richmond Drive and the completion of the remaining levee segment to cross Richmond Drive, including construction of a ramp over the new levee segment to maintain western access to ENP. Since the 2016 Temporary Emergency Deviation, these features were constructed under the Contract 8 and Contract 8A of the C-111 South Dade project. The SFWMD also installed temporary culverts (subsequently removed) in the southern levee of the 8.5 SMA Detention Cell in an area where the planned degrading of the S-360W weir was anticipated to take place to connect the 8.5 SMA Detention Cell to the future C-111 South Dade NDA under modifications to the C-111 South Dade project (USACE 2016a). This effort was undertaken by the SFWMD in order to limit the increase in water depth in the 8.5 SMA Detention Cell resultant from the additional S-357 pumping coincident with the connection of the C-358 Canal to the C-357 canal.

Due to the critical nature of elevated water levels in WCA 3A, a second emergency NEPA document was prepared to deviate from the 2012 Water Control Plan for S-344 on the L-28 Levee (USACE 2016e). The purpose of S-344 and associated features located along the L-28 levee and borrow canal are to: restore overland flow to an area of BCNP just south of the L-28 Tieback; prevent over drainage of the eastern BCNP under dry conditions; and provide a means of making regulatory releases from WCA 3A into BCNP. The operational criteria during the 2016 deviation included full operational flexibility, subject to downstream constraints, to partially or completely open S-344, allowing up to approximately 200 cfs to be released from WCA 3A into BCNP and the L-28 Canal. The EA and FONSI for that action is dated April 14, 2016 (USACE 2016e).

The 2016 Temporary Emergency Deviation included the relaxation of the L-29 canal stage maximum operating limit up to 8.5 feet, NGVD for a period of 90 days. The temporary emergency deviation also included a 60-day recovery period. The 60-day recovery period was initiated on May 12, 2016 once the L-29 canal constraint was returned to 7.5 feet, NGVD. In June of 2016, the USACE anticipated the likelihood of above average conditions/flows through most of the 2016 wet season. With flora and fauna still recovering from the high water event during the typical dry season months, it was important to prevent, to the extent practicable, another high water event during the 2016 wet season. Therefore the USACE proposed to extend the 60-day recovery period for purposes of maintaining lower canal levels along the L-31N and C-111 canals, as well as to maintain flexibility to address potential 8.5 SMA flood mitigation issues. The lower L-31N canal levels, increased pumping at S-331, and reduced pumping at S-357 into the 8.5 SMA Detention Cell were also expected to benefit and facilitate the continued contractor progress with ongoing construction of the C-111 South Dade project features following weather delays and site-related construction challenges throughout the 2015-2016 El Niño event. The 60-day recovery period was extended on July 11, 2016 and expired on November 30, 2016. A memorandum for record documenting NEPA compliance for the extension of the recovery period was completed on July 8, 2016.

1.3.7 Increment 1 Plus (Increment 1.1 and 1.2)

Upon review of monitoring data associated with Increment 1 and the 2016 Temporary Emergency Deviation, it became apparent that modifications were necessary to the Increment 1 operational strategy to maintain the Congressionally authorized flood mitigation requirements within the 8.5 SMA and to facilitate completion of ongoing construction of the MWD and C-111 South Dade projects. During Increment 1 and the 2016 Temporary Emergency Deviation, the USACE learned information with respect to how 8.5 SMA and the SDCS responded to increased water levels in NESRS prior to the full build out of MWD and C-111 South Dade project features.

The operational strategy for Increment 1 was developed between July 2014 and February 2015. Hence operational flexibility to facilitate the construction of associated features of the C-111 South Dade project was not included within the Increment 1 operational strategy as construction schedules were not available at the time. Furthermore, at the time, a typical wet season was anticipated for 2015, not the extended drought conditions which delayed the initiation of Increment 1 until October 2015, which was then followed by a very strong El Niño during the 2015 to 2016 dry season in which WCA 3A experienced unseasonable high water levels.

The 2016 Temporary Emergency Deviation provided additional operational flexibility to increase WCA 3A discharge by raising the L-29 canal constraint up to 8.5 feet, NGVD with corresponding lowering of the 8.5 SMA (C-357 and C-358), L-31N, and C-111 canals to compensate for the resulting higher stages and increased groundwater seepage along the eastern boundary of ENP and further expanded utilization of Column 2 operations to convey WCA 3A releases to the SDCS. During the 2016 Temporary Emergency Deviation, residents within 8.5 SMA expressed concern due to observed increases in ground and surface water. In response to these concerns, the SFWMD installed several mitigation measures to address conditions related to the deviation. Experience with sustained lower operational ranges from pre-storm operations during Increment 1 and the recent 2016 Temporary Emergency Deviation and extended recovery period which followed, showed that with the existing infrastructure, additional operational constraints were necessary to continue increased inflows to ENP while maintaining the authorized flood mitigation for the 8.5 SMA and to facilitate ongoing construction efforts.

Furthermore, the USACE continued to receive support from Federal and state agencies and members of the general public to continue planning to raise the L-29 canal above 7.5 feet, NGVD and to expeditiously move restoration efforts forward. Aided by new information collected under the 2016 Temporary Emergency Deviation, the USACE proposed to modify the operational strategy defined within the previous May 2015 Increment 1 EA to ensure continued flood mitigation within 8.5 SMA and to be able to continue construction of the MWD and C-111 South Dade project features in order to achieve the needed capacity to deliver restoration flows to NESRS.

The USACE proposed to include additional operational flexibility within the revised Increment 1 Plus operational strategy to operate the L-29 canal to a maximum of 7.8 feet, NGVD subject to downstream constraints. The USACE also modified the Increment 1 operational strategy to address the mandated terms and conditions of the July 22, 2016 ERTP BO, which included expanded closure periods for S-12A, S-12B, S-343A, S-343B, and S-344 as mandated by the RPA. NEPA documentation for Increment 1.1 and 1.2 was completed on February 16, 2017 with signing of a FONSI incorporating an EA (USACE 2017a). During implementation of Increment 1.1 and 1.2, the 2012 Water Control Plan, including the WCA 3A Regulation Schedule and Rainfall Plan, continued to govern water management operations with the exception of operating criteria for S-12A, S-12B, S-328, S-151, S-331, S-333, S-334, S-335, S-337, S-338, S-343A, S-343B, S-344, S-355A, S-355B, S-356, S-357, S-357N, S-332B, S-332C, S-332D, S-194, S-196, S-176, S-177 and S-197. Similar to Increment 1, under Increment 1.1 and 1.2 the water level constraint at G-3273 was not a pre-determined constraint, allowing NESRS to receive more water, relative to the 2012 Water Control Plan. S-356 was also utilized for control of seepage to the L-29 Canal. Under Increment 1.1 and 1.2 the ability to raise the L-29 canal maximum operating limit from 7.5 up to 7.8 feet, NGVD, was contingent upon compliance with downstream constraints including: (1) acquisition of required real estate interest and any associated improvements for the private ownership along Tamiami Trail and receipt of Tamiami Trail Bridge and roadway channel and flowage easements from the FDOT; (2) completion of the C-358 canal (Richmond Drive Seepage Collection Canal) and installation of S-357N (C-358 control structure); and (3) completion of sufficient portions of Contract 8 (construction of the C-111 NDA L-315 western levee, the L-357W extension levee between Richmond Drive and the 8.5 SMA Detention Cell) and completion of the Contract 8A berms inside the 8.5 SMA Detention Cell. Prior to construction completion and operation of the NDA, these constructed features of the MWD and C-111 South Dade projects were deemed necessary in order to raise the L-29 canal maximum operating limit up to 7.8 feet, NGVD while maintaining required water levels in the residential and agricultural areas in southeastern Miami-Dade County.

The combined duration of Increment 1 and Increment 1.1 and 1.2 was anticipated to extend beyond the two calendar years initially envisioned for Increment 1 to compensate for the temporary suspension of the Increment 1 field test during the 2016 Temporary Emergency Deviation and extended recovery period (February-November 2016). Extension of Increment 1 and Increment 1.1 and 1.2 for up to three years was proposed to allow for sufficient time to complete the C-111 South Dade construction components needed to operate the C-111 NDA during subsequent operational field tests of the MWD project (i.e. Increment 2).

Implementation of Increment 1.1 was implemented from February 21, 2017 to June 27, 2017 after which the USACE began to proceed with the 2017 Planned Temporary Deviation from the 2012 Water Control Plan in order to provide relief from high water stages within the WCAs. The June 2017 Planned Temporary Deviation principally provided for increased discharges from WCA 3A. Aside from the allowance for WCA 3A regulatory releases to the SDCS outside of the S-12A seasonal closure period, the operational criteria for the SDCS canals were not otherwise modified for the June 2017 Planned Temporary Deviation (USACE 2017c).

1.3.8 2017 WCA 3 Planned and Emergency Temporary Deviations

The USACE initiated a planned temporary deviation on June 28, 2017 with completion of an EA and FONSI (USACE 2017c) for WCA 3A in response to a series of early wet season storms that occurred in June of 2017 that caused hydrologic conditions within the C&SF project to change rapidly from very dry conditions to very wet conditions. Immediate action was deemed necessary to deviate from permitted water management practices to move floodwater out of the WCAs and mitigate for severe ecologic and economic losses that could result from prolonged high water levels. The 2017 EA consisted of four major components including: (1) opening of S-12A, S-12B, S-343A, S-343B and S-344 structures prior to the official opening date of July 15, 2017;(2) opening of S-152 to discharge water from WCA 3A to WCA 3B; (3) increasing discharges at S-332D from 250 cfs to 500 cfs to increase discharge from WCA 3A to the SDCS using S-333 and S-334, if needed; and (4) increasing discharge at S-197 from 400 cfs to 2,400 cfs to accommodate additional flows from WCA 3A to the SDCS while retaining capacity to manage local basin run off. This deviation was anticipated to remain in effect until the WCA 3A 3-station gage average fell below Zone A of the regulation schedule.

The USACE initiated a second planned temporary deviation on August 1, 2017 with completion of an EA and FONSI (USACE 2017d) for WCA 2A. The 2017 EA for WCA 2A consisted of a deviation from the 1988 Regulation Schedule for WCA 2A to provide additional flexibility in managing the current and expected high water levels in WCA 3A by holding water higher in WCA 2A. The deviation raised the regulation schedule of WCA 2A to accommodate additional storage therefore reducing inflows into WCA 3A through the S-11 structures. This deviation was anticipated to remain in effect until WCA 3A falls below Zone A of the WCA 3A Regulation Schedule, at which point a recovery period would be initiated to reduce the WCA 2A stage to the pre-deviation regulation schedule (normal operations). The deviation, including the recovery period, was approved through April 30, 2018.

Hurricane Irma developed on August 30, 2017 off the Cape Verde Islands and rapidly intensified as it moved west across the Caribbean. The storm caused catastrophic damage on several of the Leeward Islands, and made landfall in Florida on September 10, 2017. In response, the USACE initiated an Emergency Deviation from the 2012 Water Control Plan and Increment 1.1 and 1.2 on September 15, 2017 in order to provide relief from high water stages within WCA 3A and the SDCS due to Hurricane Irma. Emergency water management activities that were implemented included: (1) raising the current 7.5 feet, NGVD maximum operating limit in the L-29 canal up to 8.5 feet, NGVD until the WCA 3A 3-gage average stage fell below Zone A of the WCA 3A Regulation Schedule; (2) use of S-356 (up to 500 cfs) to provide flood relief along L-31N canal between structures S-335 and G-211 along the eastern side of ENP; (3) use of S-357 (up to 575 cfs) to provide flood mitigation to 8.5 SMA due to excessive seepage from high water levels within NESRS; (4) continued implementation of the June 2017 WCA 3A Planned Temporary Deviation; and (5) continued implementation of the July 2017 WCA 2A Planned Temporary Deviation. In addition, the USACE also proposed to initiate a planned temporary deviation to further mitigate for stages within WCA 3A. The planned temporary deviation included delayed closure of the S-12A and S-12B structures and reopening of the S-343A, S-343B, and S-344 structures until the WCA 3A 3-gage average fell below the MWD project Increment Action Line or January 1, 2018, whichever came first. NEPA documentation for the 2017 Emergency Deviation and 2017 Planned Temporary Deviation for S-12A, S-12B, S-343A, S-343B, and S-344 was completed on October 7, 2017 with signing of a FONSI incorporating an EA (USACE 2017e).

1.3.9 Increment 2 Field Test

Implementation of Increment 2 began March 1, 2018 and is expected to continue until the implementation of COP. Increment 2 is the second Field Test post implementation of Increments 1.1 and 1.2 as well as the subsequent approved deviations. Increment 2 modified the operational strategy from the Increment 1.1 and 1.2 that was completed in February 2017 (USACE 2017). Increment 2 raised the maximum operating limit in the L-29 canal up to 8.5 feet NGVD, while replacing the G-3273 stage constraint for S-333 inflows to NESRS with local gages that triggered flood mitigation actions in 8.5 SMA and continued to utilize S-356 for control of seepage into the L-31N canal. During the first year of the Increment 2 operations, L-29 canal stage was raised gradually from 7.5 up to 8.5 feet, NGVD from May 2018 to October 2018 to allow the C-111 South Dade Project to reach its fully constructed completion date, which was September 1, 2018. With the completion of the C-111 South Dade Project, Increment Field Test 2 operations continued in 2019 with L-29 canal raised up to 8.5 feet, NGVD during the wet season and as a result, more water was delivered to NESRS in year 2 of Increment 2 when compared to year 1. The total number of days when L-29 stages were operated between 8.3 and 8.5 feet, NGVD under the Incremental 2 Field Test is 48 and 62 days for 2018 and 2019, respectively. In addition, total volumes of water deliveries to NESRS in 2018 and 2019 are 343,400 and 450,000 acre-feet, respectively. It is reasonable to assume that Increment 2 will continue the trend of increased water deliveries to NESRS and ENP in 2020 and until COP is implemented.

The EA and FONSI state that water management operations would likely result in increased seepage to the L-31N canal as increased flow to NESRS would likely increase stages along the west side of L-31N (USACE 2018). The increase was expected to be fully manageable with operations of the C-111 South Dade NDA. However, there was additional operational flexibility to maintain flood risk management for southeastern Miami Dade County.

For the duration of the MWD Incremental Field Tests from October 2015 through the start of the final Round of COP alternative modeling in April 2019, the water management operations across the collective study area were managed in accordance with the prescribed MWD Incremental Field Test for only approximately one-half (54 percent) of this duration due to the hydrologic, high-water conditions that necessitated the 2016 and 2017 deviations. Construction delays which affected completion of the MWD 8.5 SMA S-357N structure and the C-111 South Dade detention area features, attributable in part to these same high-water conditions, along with unanticipated delays with completion of new monitoring instrumentation identified to complement the Increment 2 Field Test (roadway sub-base monitoring at Tamiami Trail, 8.5 SMA additional monitoring wells, and C-111 South Dade detention area additional monitoring wells), precluded full utilization of the planned monitoring and incremental effects evaluations with field tests. However, these unplanned deviation opportunities, in parallel with the recurrent MWD Incremental Field Test discussions at monthly lead agency meetings and quarterly interagency meetings, afforded further real-time learning opportunities, provided additional information for hydrologic model validation (for example, 8.5 SMA), and also helped inform the COP formulation efforts.

1.3.10 Background on Authority for Water Deliveries to Everglades National Park Project

1.3.10.1 Public Law 91-282. June 19, 1970 (Section 2) ("Minimum Deliveries")

Section 2 of the River Basin Monetary Authorization and Miscellaneous Civil Works Amendments Act of 1970, Public Law 91-282, passed in June 1970, assured the ENP)a minimum supply of water from the C&SF Project which is referred to as 'Minimum Deliveries.' **Section 2** (**Alternatives**) provides that the "delivery

of water from the central and southern Florida project to the Everglades National Park shall not be less than 315,000 acre-feet annually, prorated according to the monthly schedule set forth in the National Park Service letter of October 20, 1967, to the Office of the Chief of Engineers, or 16.5 per centum of total deliveries from the project for all purposes including the park, whichever is less."

1.3.10.2 Public Law 98-181. November 30, 1983 (Section 1302) ("Experimental Program")

Section 1302 of the Supplemental Appropriations Act, 1984, PL 98-181, authorized the Secretary of the Army to conduct an experimental program ("Experimental Program") for delivering water to ENP. This authorization allowed modification of the schedule of water deliveries from the C&SF project. The two-year time limit for the Experimental Program specified in PL 98-181 was extended by Section 115 of PL 99-190 until January 1, 1989. Section 40 of PL 100-676 extended the Experimental Program until January 1, 1992. Section 107 of the Energy and Water Development Appropriations Act, 1992, PL 102-104, amended section 1302 of the Experimental Program, PL 98-181, and allowed the Experimental Program to continue until the modifications to the C&SF project authorized under section 104 of Public Law 101-229, MWD, are completed and implemented.

1.3.10.3 Public Law 101-229. December 13, 1989 (MWD)

The Everglades National Park Protection and Expansion Act of 1989, Public Law 101-229, authorized the Secretary of the Army, upon completion of a final report (1992 GDM), to modify the C&SF project to improve water deliveries to ENP and to take steps to restore the Park's natural hydrological conditions. Congress directed that the modifications be based on the Experimental Program. The Act states:

> (a) IMPROVED WATER DELIVERIES —
>
> (1) Upon completion of a final report by the Chief of the Army Corps of Engineers, the Secretary of the Army, in consultation with the Secretary, is authorized and directed to construct modifications to the Central and Southern Florida Project to improve water deliveries into the park and shall, to the extent practicable, take steps to restore the natural hydrological conditions within the park.
>
> (2) Such modifications shall be based upon the findings of the Secretary's experimental program authorized in section 1302 of the 1984 Supplemental Appropriations Act (97 Stat. 1292) and generally as set forth in a General Design Memorandum to be prepared by the Jacksonville District entitled "Modified Water Deliveries to Everglades National Park". The Draft of such Memorandum and the Final Memorandum, as prepared by the Jacksonville District, shall be submitted as promptly as practicable to the Committee on Energy and Natural Resources and the Committee on Environment and Public Works of the United States Senate and the Committee on Interior and Insular Affairs and the Committee on Public Works and Transportation of the United States House of Representatives.

The MWD GDM recommended rain-driven delivery schedules and several structural modifications to the C&SF project. These operations would allow for greater flexibility than the minimum deliveries proscribed in PL 91-282. MWD GDM at 59. Deliveries to the ENP would be based on rainfall with a regulatory component using three stations in WCA 3A. MWD GDM at 60.

> The minimum delivery requirements of PL 91-282 will no longer be the basis of delivery but will be superseded by the schedules developed by the Secretary of the Army. An initial operating plan for the project features will be developed through a continuing process of studies and coordination. . . . The iterative process will include hydrologic modeling and coordination to develop an acceptable water control plan. . . . If an acceptable operational strategy has not been developed at the end of the iterative process, the Modified Rain-Driven Operational Strategy addressed in this report will be the water control plan implemented when construction of the structural features is complete. MWD GDM at 91.

1.3.10.4 Combined Operational Plan

The COP is the plan for full implementation contemplated under PL 102-104. In authorizing the Experimental Program, Congress allowed for modification of the minimum deliveries required by PL 91-282. Congress specifically authorized the USACE

> to modify the schedule for delivery of water from the Central and Southern Florida project to the Everglades National Park required by Section 2 of the River Basin Monetary Authorization and Miscellaneous Civil Works Amendments Act of 1970 (Public Law 91-282) and to conduct an experimental program for the delivery of water to the Everglades National Park from such project for the purpose of determining an improved schedule for such delivery.

Section 1302, PL 98-181.

Because the COP is the plan for full implementation contemplated under PL 102-104, it does not call for continuation of Minimum Deliveries as identified in PL 91-282, but is aimed at more natural deliveries to ENP that are tied to rainfall and are based on the operations developed under the Experimental Program. Nevertheless, the modeling shows that the COP should far exceed the Minimum Deliveries required under PL 91-282 on an annual basis.

1.4 Project Need or Opportunity

The purpose of the MWD project is to make modifications to the existing C&SF project to improve the natural water flows to SRS enabling the restoration of more natural hydrologic conditions using three dimensions: (1) timing; (2) location; and (3) volume of water. The purpose of the C-111 South Dade project is to address restoration of the ecosystem in Taylor Slough and the eastern panhandle of ENP that were affected by construction of the C&SF project in the C-111 Basin. The COP is a comprehensive operational plan that defines water management operations for the WCA 3A and WCA 3B outlets, structures in the L-31N and C-111 basins constructed as part of the C&SF project, and the constructed features of the MWD and C-111 South Dade projects.

The formulation of the COP was governed by the MWD and C-111 South Dade project objectives and constraints as listed in **Section 1.5** (**Agency Goals and Objectives**). The COP is the last step to implement operational changes to convey water from WCA 3A to the ENP using the constructed features of the pre-CERP Foundation projects (i.e. MWD and C-111 South Dade projects). Development and implementation of the COP is the final action required before both the MWD and C-111 South Dade projects can be considered to be complete. The WRDA of 2000 (CERP authorization) mandates MWD completion prior to appropriation to construct CERP Decompartmentalization features, which would include conveyance

features proposed under the CERP Central Everglades Planning Project (CEPP) to hydrologically connect WCA 3A and WCA 3B.

A socioeconomic analysis was performed on the COP preferred plan in order to satisfy the requirements for C-111 South Dade project closeout. The 2016 LRR for the C-111 South Dade project required that the economic analysis performed during the 1994 GRR development of the C-111 South Dade project operational plan be updated. The socioeconomic analysis performed under the COP satisfied this requirement thus allowing for the completion of the C-111 South Dade project and ultimate project closeout. Reference **Appendix I** (**Socioeconomics**).

The COP balances ecological restoration objectives of the MWD and C-111 South Dade projects completed infrastructure by redistributing the existing WCA 3A and ENP water budget, while remaining forward compatible with future expected flow increases. All of the MWD and C-111 South Dade project features have been constructed. The MWD construction was completed in February 2018 and the C-111 South Dade project construction was completed in September 2018. The USACE is proposing to modify the operational strategy currently in the 2012 Water Control Plan for the WCAs, ENP, and ENP to South Dade SDCS to include operations for these features. Development of the COP has been informed from information and operation criteria from the MWD Incremental Field Tests (Increment 1, Increment 1.1 and 1.2, Increment 2) and condition-driven deviations since 2015 which has provided information on key uncertainties and accrued interim benefits towards restoration by utilizing new features when they were constructed. The myriad of information and data that has informed the COP process included evaluations of monitoring data in accordance with the MWD Incremental Field Tests, information gathered from operational experience under the water management planned and emergency deviations, hydrologic modeling in support of the COP formulation efforts, and information from other parallel CERP project planning efforts (**Table 1-1**Error! Reference source not found.). Continuation of the hydrologic monitoring established to support the MWD Incremental Field Tests was also used to support development of the COP Adaptive Management and Monitoring Plan (**Appendix C**).

The COP is also being pursued to address the mandated RPA of the July 22, 2016 ERTP BO and subsequent coordination between the USFWS and the USACE, which requires the USACE to proceed as scheduled, and as allowable by law, for completing NEPA analysis for the COP by August of 2020. Reference **Section 1.3.4** (**Everglades Restoration Transition Plan**).

During the development of the original USACE Master Water Control Manuals (WCMs) for the C&SF project (Engineering Regulation 42 1110-2-8156 Preparation of Water Control Manuals), the south Florida hydrologic system was divided into five interconnected geographical regions. The System Operating Manual (SOM) replaces this existing set of Master WCMs and is included in this Draft EIS as **Appendix J** (SOM) for reference. The SOM provides an integrated system-wide framework for operating the implemented projects of CERP as well as the existing C&SF project. The complete SOM provides explicit guidance and operating criteria for the operational interactions between the system's geographically related regions. The SOM consists of seven volumes, six of which (Volumes 2 through 7) are comprised of the geographically related regions within the original C&SF project. The overall system framework of the SOM is contained in Volume 1, which provides a system-wide operating plan for the implemented projects of the Plan and the C&SF project features. Generally, Volumes 2 through 7 retain the original format of the Master WCMs for the existing C&SF project, with a few modifications to accommodate the CERP POMs. The format of Volume 1 has been modified to provide the framework for system-wide operations. The information from the existing C&SF project Master WCMs has been utilized and modified as necessary for the appropriate volumes of the SOM. The C&SF project "WCAs, ENP, ENP-SDCS Manual" (the original

Volume 5, now SOM-Volume 4) has been updated to include information located in the Water Control Plan developed for the COP (located in **Appendix A** of this Draft EIS). Chapter 7 of the SOM-Volume 4 contains the new Water Control Plan developed from the COP and is also **Appendix A** of the EIS.

This Draft EIS describes anticipated changes to the existing environment including direct, indirect, and cumulative effects as they relate to implementation of the COP and the new Water Control Plan (**Appendix A**, **Chapter 7**) and applicable alternatives developed during plan formulation efforts in support of the COP. Reference **Section 2** (**Alternatives**) and **Section 4** (**Environmental Effects**). The SOM-Volume 4 (Chapters 1-6 and 8-9) are an administrative update required by the 2007 Draft CERP Programmatic Guidance Memoranda, and do not require additional NEPA documentation.

Table 1-1. Information used to inform COP formulation.

COP Spatial Region	*Information Assimilated From: MWD Field-Test Informed*	*Information Assimilated From: Operations Deviations*	*Information Assimilated From: Modeling Informed*	*Information Assimilated From: Other CERP Projects*	Furthered in COP Adaptive Management and/or Hydrologic Monitoring
WCA 3A	-	-	-	-	-
Extreme High Water Line	-	X	X	-	X
Relocation of WCA 3A Floor	-	-	X	X (CEPP modeling)	X
S-344 Removed Seasonal Closure (CSSS)	X	X	X	X (WERP modeling)	X
Reduced Access along Tamiami Trail	-	-	X	-	X
L-29 canal and Northeast Shark River Slough (NESRS)	-	-	-	-	-
Tamiami Trail Flow Formula	-	-	X	X (Ecological targets)	X
Shark River Slough Dry Season Adjustments	-	-	X	-	X
Tamiami Trail Roadway Constraints	X	X		-	X
S-356 Operations	X	-		-	X
Water Quality	X	-	X	-	X
Taylor Slough and Rocky Glades	-	-		-	
Environmental Deliveries (WCA 3A and WCA 3B)	X	-	X	-	X
South Dade and 8.5 SMA Operations	-	-	-	-	-
8.5 SMA Operations (S-357 and S-331)	X	X	X	-	X
S-332B, S-332C, S-332D Pump Operations	X	X	X	-	X
Biscayne Bay South Bay flows	-	-	X	-	X
S-197 Reduced Operations	X	-	X	-	X

1.5 Agency Goals and Objectives

Planning objectives describe what the project is intended to accomplish, and planning constraints describe things the project will avoid doing. Planning objectives are statements of the intended purposes of the planning process. A constraint is a restriction that limits the extent of the planning process. Planning constraints restrict plan formulation. They include legal and policy constraints that are common to most studies. They also include constraints unique to a specific study. Plans should be formulated to meet the study objectives and to avoid violating constraints.

The following lists of planning objectives and constraints are based on the authorizing legislation and prior planning reports for each project. Objectives and constraints may be modified based on identification of new problems and opportunities, interagency input, and public scoping.

The planning objectives for the COP are as follows:

1. Improve water deliveries (timing, location, volume) into ENP and take steps to restore natural hydrologic conditions in ENP given current C&SF infrastructure and features expected to be completed by the time of implementation, to the extent practicable by
    a. Changing schedule of water deliveries so that it fluctuates in consonance with local meteorological conditions, including providing for long term and annual variation in ecosystem conditions in the Everglades (Timing) (P.L. 101-229, Section 101b)
    b. Restoring NESRS as a functioning component of the Everglades hydrologic system (Location) (P.L. 101-229, Section 101b)
    c. Adjusting the magnitude of water discharged to ENP to minimize effects of too much or too little water (Volume) (1992 MWD GDM, Section 44)
2. Maximize progress toward restoring historic hydrologic conditions in the Taylor Slough, Rocky Glades, & eastern Panhandle of ENP.
3. Protect the intrinsic ecological values associated with WCA 3A and ENP.
4. Minimize the damaging freshwater flows to Manatee Bay/Barnes Sound through the S197 structure and increase flows through Taylor Slough and coastal creeks (1994 C-111 GRR, Section 5.2)
5. Include consideration of cultural values and tribal interests & concerns within WCA-3A and ENP.

1.6 Operational Constraints

1. Maintain the authorized purposes of the C&SF project of flood damage reduction, regional water supply for agricultural and urban areas, prevention of saltwater intrusion, preservation of ENP, water supply to ENP, preservation of fish and wildlife resources, recreation, navigation and ecosystem restoration.
2. The Flood Control Act of 1962 (PL 87-874) authorized project Works in South Dade County, in accordance with the recommendations of the Secretary of the Army and the Chief of Engineers in Senate Document Numbered 138, Eighty-seventh Congress.
3. The Flood Control Act of 1968 (PL 90-483) Authorized the SDCS project, including modifications to the existing C&SF project in accordance with Senate Document Numbered 101, Ninetieth

Congress, and in accordance with House Document Numbered 369, Ninetieth Congress, in the interest of improved conservation and distribution of available water and extended flood protection.

4. The Everglades National Park Protection and Expansion Act of 1989 (PL 101-229) authorized the acquisition of 107,600 acres and authorized the Secretary of the Army in consultation with the Secretary of the Interior to construct modifications to the C&SF project "to improve water deliveries into the park and shall, to the extent practicable, take steps to restore the natural hydrological conditions within the park." The modifications were to be based on the 1984 Experimental Program and a GDM prepared by the USACE, Jacksonville District entitled "Modified Water Deliveries to Everglades National Park".

5. The MWD GDM and EIS dated June 19992 consists of four major components: mitigation for project induced flood damages for the 8.5 SMA, the Osceola Indian Camp, and the Tiger Tail Indian Camp; Tamiami Trail Modifications; Conveyance and Seepage Control Features and project Implementation Support.

6. Maintain the level of flood reduction associated with the 1994 C-111 GRR: flood damage reduction project recommended plan.

7. ERTP WCA 3A Regulation Schedule, as identified in the 2012 Water Control Plan for the Water Conservation Areas, Everglades National Park (ENP), and the ENP-South Dade Conveyance System (pending results of the Baseline and Modification Modeling [BAMM]). Maintain Zone A of the WCA 3A Regulation Schedule to not exceed the 1960 WCA 3A 9.5 to 10.5 feet, NGVD Regulation Schedule, as specified within the ERTP Interim Water Management Criteria for WCA-3A Zone A and measured by the 3-gauge average (Sites 63, 64, and 65). (Source: USACE Draft 2011 ERTP EIS, Appendix A-5: Analysis of Standard project Flood, WCA 3A). Additional USACE guidance resultant from the USACE WCA Regional Flood Routing Analysis Study (BAMM) will also be incorporated into the planning constraints if relevant new information from this analysis is available prior to completion of the COP.

8. L-29 canal maximum stage (8.5 feet, NGVD) (2008 MWD Tamiami Trail LRR). Based on coordination between the USACE, the FDOT, and other state agencies conducted for the LRR, while the target stage for the L-29 canal is 8.5 feet, NGVD it is understood that the average October wet season elevation is expected to be approximately 7.89 feet, NGVD based on multiple years (36-year simulated period-of-record). Since this elevation is an average, during some individual years the average October elevation may exceed the 7.89 feet, NGVD stage and other years it would be below 7.89 feet, NGVD. The average elevation will be dependent on the meteorological conditions of that year. However when considering multiple years the October average should be at or below 7.9 feet, NGVD. (Source: 2008 TTM LRR). The LRR additionally specifies operational scenarios during which all inflow structures to the L-29 canal will be closed and all inflows terminated, allowing the canal to naturally recede (the complete excerpt from the 2008 LRR, Section 6.1.3)

9. 2008 Tamiami Trail Modifications Relocation Agreement (FDOT/USA), which set forth operational constraints for the L-29 canal reach between S-333 and S-334 for inclusion in future operational planning studies as minimum protective standards necessary to ensure the safety and stability of the roadway subbase infrastructure along this segment of Tamiami Trail (U.S. Highway 41).

10. Maintain the purposes of the 2000 GRR for the 8.5 SMA. The periodic flooding of landowners east of the 8.5 SMA perimeter levee, before and after MWD project implementation, will remain

unchanged from conditions in existence prior to implementation of the MWD project. Flood mitigation, not flood protection, should be provided by the Preferred Plan and future operational planning studies.

11. 2016 Canal 111 South Dade Final LRR. This LRR describes past and proposed refinements and design changes associated with all construction of the C-111 South Dade project, comparing each design change to the features authorized in the 1994 GRR (USACE 1994). This LRR describes refinements and design changes associated with all construction of the C-111 South Dade project, comparing each design change to the features authorized in the 1994 General Reevaluation Report (USACE 1994). The LRR consolidates and documents previously approved post PACRs and their associated NEPA documents, encompassing numerous design changes were needed on the C-111 South Dade project during construction from 1996 through 2018.

1.7 Planning Considerations

The planning considerations below serve multiple purposes. Some clarify the planning process, some address how key issues will be handled during the process, and some of them describe the position of choice that was followed for selected future actions or conditions where there is some uncertainty.

1. Consideration of Burial Resources Agreement with the Seminole Tribe of Florida.
2. Avoid or minimize adverse effects to cultural resources as per Section 106 of the National Historic Preservation Act of 1966 (Inter alia). Explore opportunities to develop monitoring protocols for "at risk" cultural resources.
3. Water Quality Standards as defined from the CEPP.
4. Maintain multi-species objectives (2012 Water Control Plan) and comply with requirements of the applicable BO from the USFWS to include the July 2016 ERTP BO and the CERP C-111 Spreader Canal Western project.
5. Consider compatibility with future restoration actions including the CEPP. Reasonably connect the planning under this project authority to other near-term changes that are likely to be implemented in the system in the next few years using an adaptive management framework.
6. Explore opportunities for enhancing the recovery of federally and state listed species under the ESA, the USACE's authorities for MWD and C-111 projects and operational considerations.
7. Explore opportunities to enhance flood control and mitigation, consistent with the COP restoration objectives, the USACE's authority for the MWD and C-111 projects, and operational considerations.

1.8 Environmental Documents

The USACE has identified a number of environmental documents relevant to the proposed action. Information contained within the previous NEPA documents listed below is incorporated by reference into this EIS. The listed documents below are available upon request.

- *General Design Memorandum and Environmental Impact Statement, Modified Water Deliveries to Everglades National Park, U.S. Army Corps of Engineers, Jacksonville District, June 1992*

- *C-111, Central and Southern Florida project for Flood Control and Other Purposes, Final General Reevaluation Report and Environmental Impact Statement, U.S. Army Corps of Engineers, Jacksonville District 1994*
- *1998 Emergency Deviation from Test 7 of the Environmental Program of Water Deliveries to Everglades National Park to Protect the Cape Sable Seaside Sparrow, Central and Southern Florida project for Flood Control and Other Purposes, Final Environmental Assessment, U.S. Army Corps of Engineers, Jacksonville District, 1999*
- *Jeopardy and Adverse Modification Biological Opinion on the Modified Water Delivery to Everglades National Park Experimental Program to Everglades National Park and Canal-111 South Dade projects, U.S. Fish and Wildlife Service, Vero Beach, Florida 1999*
- *Comprehensive Review Study of the Central and Southern Florida project, Comprehensive Everglades Restoration Plan Final Integrated Feasibility Report and Programmatic Environmental Impact Statement , U.S. Army Corps of Engineers, Jacksonville District 1999*
- *General Reevaluation Report and Final Supplemental Environmental Impact Statement, 8.5 Square Mile Area, U.S. Army Corps of Engineers, Jacksonville District, July 2000*
- *Central and Southern Florida project for Flood Control and Other Purposes, Interim Structural and Operational Plan, Emergency Deviation from Test 7 of the Experimental Program of Water Deliveries to Everglades National Park for Protection of the Cape Sable Seaside Sparrow Final Environmental Assessment, U.S. Army Corps of Engineers, Jacksonville District, 2000*
- *Interim Operating Plan for the Protection of the Cape Sable Seaside Sparrow Final Supplemental Environmental Impact Statement, U.S. Army Corps of Engineers, Jacksonville District, 2002*
- *Biological Opinion, Final Interim Operating Plan, U.S. Fish and Wildlife Service, Vero Beach, Florida, November 17, 2006*
- *Interim Operational Plan for the Protection of the Cape Sable Seaside Sparrow Final Supplemental Environmental Impact Statement, U.S. Army Corps of Engineers, Jacksonville District, December 2006*
- *C-111 Engineering Documentation Report, U.S. Army Corps of Engineers, Jacksonville District, May 2007*
- *Draft Environmental Assessment, Design Modifications for the Canal 111 project, U.S. Army Corps of Engineers, Jacksonville District, June 2007*
- *Modified Water Deliveries to Everglades National Park Tamiami Trail Modifications Final Limited Reevaluation Report and Environmental Assessment, U.S. Army Corps of Engineers, Jacksonville District, June 2008*
- *Draft Environmental Assessment, Proposed Interim Operating Criteria for 8.5 Square Mile Area project, U.S. Army Corps of Engineers, Jacksonville District, November 2008*
- *Revised Draft Environmental Assessment, Proposed Interim Operating Criteria for 8.5 Square Mile Area project, U.S. Army Corps of Engineers, Jacksonville District, April 2009*
- *Canal-111 Spreader Canal project Implementation Report, U.S. Army Corps of Engineers, Jacksonville District, 2009*

- *Biological Opinion, Canal-111 Spreader Canal, U.S. Fish and Wildlife Service, Vero Beach, Florida, August 25, 2009*
- *Biological Opinion, Everglades Restoration Transition Plan, U.S. Fish and Wildlife Service, Vero Beach, Florida, November 17, 2010*
- *Central and Southern Florida project Comprehensive Everglades Restoration Plan C-111 Spreader Canal Western project Final Integrated project Implementation Report and Environmental Impact Statement, U.S. Army Corps of Engineers, Jacksonville District, January 2011*
- *Environmental Assessment; Proposed Interim Operation Criteria for 8.5 Square Mile Area project, U.S. Army Corps of Engineers, Jacksonville District, June 2011*
- *Environmental Assessment; Design Refinement for the 8.5 Square Mile Area, U.S. Army Corps of Engineers, Jacksonville District, August 2012*
- *Environmental Assessment for Expansion of C-111 Detention Area and Associated Features South Miami-Dade County, U.S. Army Corps of Engineers, Jacksonville District, May 2012*
- *Everglades Restoration Transition Plan Final Environmental Impact Statement, U.S. Army Corps of Engineers, Jacksonville District, October 19, 2012*
- *Environmental Assessment; G-3273 Constraint Relaxation/S-356 Field Test and S-357N Operational Strategy, U.S. Army Corps of Engineers, Jacksonville District, May 2015.*
- *Environmental Assessment and Finding of No Significant Impact; Modifications to the C-111 South Dade North and South Detention Areas and Associated Features, U.S. Army Corps of Engineers, Jacksonville District, December 2016.*
- *Environmental Assessment; Modifications to the C-111 South Dade project, L-31W, U.S. Army Corps of Engineers, Jacksonville District, December 2016.*
- *Canal 111 (C-111) South Dade County, Florida: Final Limited Reevaluation Report, U.S. Army Corps of Engineers, Jacksonville District, December 2016.*
- *Environmental Assessment; L-29 Canal and South Dade Conveyance System Temporary Emergency Deviation to Affect Relief of High Water Levels within Water Conservation Area 3A, U.S. Army Corps of Engineers, Jacksonville District, February 2016*
- *Supplemental Environmental Assessment; L-29 Canal and South Dade Conveyance System Temporary Emergency Deviation to Alleviate High Water Levels in Water Conservation Area 3A, U.S. Army Corps of Engineers, Jacksonville District, May 2016.*
- *Environmental Assessment Temporary Emergency Deviation to Alleviate High Water Levels in Water Conservation Area 3A (S-344 Deviation), U.S. Army Corps of Engineers, Jacksonville District, April 2016.*
- *Environmental Assessment Temporary Emergency Deviation to Alleviate High Water Levels in Water Conservation Area 3A (S-344 Deviation), U.S. Army Corps of Engineers, Jacksonville District, February 2016.*
- *Supplemental Environmental Assessment G-3273 Constraint Relaxation/S-356 Field Test and S-357N Revised Operational Strategy: Increment 1 Plus (Increment 1.1 and 1.2), U.S. Army Corps of Engineers, Jacksonville District, February 2017.*

- *Environmental Assessment Modified Water Deliveries to Everglades National Park project: Removal of Unconstructed Conveyance and Seepage Control Features, U.S. Army Corps of Engineers, Jacksonville District, May 2017.*
- *Environmental Assessment Planned Temporary Deviation to Affect Relief of High Water Levels within Water Conservation Area 3A, U.S. Army Corps of Engineers, Jacksonville District, June 2017.*
- *Environmental Assessment Planned Temporary Deviation from the 2012 Water Control Plan for Water Conservation Area 2A, U.S. Army Corps of Engineers, Jacksonville District, July 2017.*
- *Environmental Assessment Emergency Deviation to Affect Relief of High Water Levels within Water Conservation Area 3A and the South Dade Conveyance System Post Hurricane Irma and Planned Deviation to Affect Relief of High Water Levels within Water Conservation Area 3A¸U.S. Army Corps of Engineers, Jacksonville District, October 2017.*
- *2018 L-29 Canal and G-3273 Constraint Relaxation including the Northern Detention Area (Revised operational strategy Increment 2), U.S. Army Corps of Engineers, Jacksonville District, February 2018.*

1.9 Decisions to be Made

Selection of an alternative is the primary decision that must be made. The USACE is considering implementation of Alternative Q+ (ALTQ+). ALTQ+ would supersede the 2012 Water Control Plan and approved deviations thereto. Reference **Section 2** (**Alternatives**) for additional information on alternatives considered.

1.10 Scoping and Issues

A Notice of Intent (NOI) to prepare an EIS for the COP was published in the Federal Register (FR Volume 82, Number 173) September 8, 2017. A NEPA scoping letter dated September 22, 2017 was used to invite comments from Federal, State, and local agencies, affected Indian Tribes, and other interested private organizations and individuals. Scoping comments were accepted through October 21, 2017. A copy of the scoping letter, NOI, scoping letters received and a comment response matrix are located in **Appendix D** (**Pertinent Correspondence**). Reference **Section 6** (**Public Involvement**) for additional information on public involvement during plan formulation for the COP including PDT meetings. Comments received in response to the NEPA scoping letter are briefly summarized below.

- Ability to maximize ecosystem benefits to ENP by increasing the L-29 canal maximum operating limit to 8.5 feet, NGVD
- Ability to maximize ecosystem benefits to Florida Bay and potential for opportunities to improve coastal fisheries
- Ability to maintain existing water supply in the study area
- Ability to maintain flood protection in the study area
- Ability to meet water quality standards in the study area
- Potential concerns related to flood mitigation for the developed east Everglades area (also referred to as the 8.5 SMA)
- Potential concerns related to flood protection to agricultural lands east of the C-111 canal.

- Potential concerns related to the use of Column 2 operations to convey WCA 3A regulatory releases to the SDCS as defined in the 2012 Water Control Plan. Column 2 operations generally require the increased use of pumping stations S-331, S-332B, S-332C, and S-332D. During Column 2 operations, the control stages along the L-31N canal are also lowered to help maintain existing flood risk management along the SDCS and also to provide the necessary downstream gradient for the S-334 releases to reach the S-332B, S-332C, and S-332D pump stations. Column 2 operations were established under the IOP 2002 to mitigate for potential adverse effects on WCA 3A related to actions taken to protect CSSS-A within western ENP.
- Operational considerations to address high water events within WCA 3 and the use of an Extreme High Water Action Line (EHWL) within the scope of the COP. An EHWL has been used in prior deviations to the 2012 Water Control Plan as a means to provide additional operational flexibility to allow for a rapid response to extreme high water levels in WCA 3A that have the potential to be harmful to fish and wildlife resources.
- Potential concerns related to the use of S-197 and the reduction of discharges to Manatee Bay and Barns Sound. S-197 maintains optimum water control stages in the C-111 canal and prevents saltwater intrusion during high tides. S-197 is typically closed, diverting discharge from S-18C overland to the Eastern Panhandle of ENP. Releases at S-197 have the potential to decrease flows to Taylor Slough, and subsequently Florida Bay.
- Request for inclusion of incremental increases at S-18C consistent with the C-111 Spreader Canal Western project to maximize ecosystem benefits to Taylor Slough, the headwaters of Florida Bay
- Ability to incorporate lessons learned from prior MWD Incremental Field Tests conducted under the authority of the MWD project and emergency and planned temporary deviations to the 2010 Water Control Plan
- Regulation schedule changes to WCA 3 within the scope of the COP and potential changes considered
- Request for inclusion of potential regulation schedule changes to WCA 1, WCA 2, and WCA 3B within the scope of the COP

1.11 Permits, Licenses and Entitlements

The USACE has coordinated a consistency determination pursuant to the Coastal Zone Management Act (CZMA) through the circulation of this Draft EIS. The USACE has determined that the proposed action is consistent to the maximum extent practicable with the enforceable policies of the Florida Coastal Zone Management Program (CZMP). Reference **Appendix B** (**Coastal Zone Consistency Determination**) for a Florida CZMP federal consistency determination. Final concurrence of consistency with the CZMP will be determined during environmental permitting processes, as applicable. All required permits and/or modifications to existing permits would be acquired prior to implementation of the proposed action.

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2 ALTERNATIVES

2.1 Introduction

The Combined Operational Plan (COP) alternative formulation consisted of five iterations using the U.S. Army Corps of Engineers' (USACE) six step planning process to guide the selection of the preferred plan. The five iterations are as follows: initial array, Round 1, Round 2, Round 3, and Round 3 refinement. The formulation process was a collaborative multi-agency and public process which incorporated input throughout each step. The multi-agency team was comprised of members from USACE, Everglades National Park (ENP), the South Florida Water Management District (SFWMD), the U.S. Fish and Wildlife Service (USFWS), the Florida Fish and Wildlife Conservation Commission (FWC), the Florida Department of Environmental Protection (FDEP), the Florida Department of Agriculture and Consumer Services (FDACS), and Miami-Dade County Department of Environmental Resource Management (DERM). Representatives from the Miccosukee Tribe of Indians (Miccosukee Tribe), the Seminole Tribe of Florida (STOF), and the Seminole Nation of Oklahoma participated in the multi-agency team as well through government-to-government consultations with the USACE. Alternatives were formulated based on project objectives, constraints, planning considerations, benefits identified in planning based simulations, and lessons learned from the Modified Water Deliveries (MWD) Incremental Field Tests (Increment 1, 1.1, 1.2, and 2). The initial array of alternatives were screened through a detailed screening process which led to the three action alternatives that comprised Round 1. Modeling was performed on Rounds 1, 2, and 3. The preferred plan was selected based on the Round 3 model results, sensitivity runs and refinement. The following subsections will describe the objectives and constraints that guided the alternative selection process.

2.1.1 Alternative Formulation – COP Objectives

In order to achieve the project objectives, USACE in conjunction with the interagency project delivery team (PDT), identified a list of performance measures for purposes of evaluating the systems response to alternative plans. Project performance measures were applied to evaluate a project objective(s) and are quantitative tools that have numerical targets related to restoration objectives. Several of the project performance measures for the planning effort were derived from those performance measures approved for use in the Comprehensive Everglades Restoration Plan (CERP) by **RE**storation, **CO**ordination and **VER**ification (RECOVER). RECOVER is an interagency and interdisciplinary scientific and technical team that provides essential support to the CERP. RECOVER performance measures identify hydrologic and ecological indicators expected to respond to implementation of CERP and were developed from Conceptual Ecological Models that identify the major anthropogenic drivers and stressors on natural systems, the ecological effects of these stressors, and the best biological attributes or indicators of these ecological responses. Performance indicators were also identified. Performance indicators were used to evaluate potential impacts to the current system by evaluating a given alternative relative to the existing condition baseline (ECB19R/ECB19RR). Ecological planning tools developed by the Joint Ecosystem Modeling group (JEM) were applied to evaluate habitat suitability for fish and wildlife resources, in addition to indicators developed under Endangered Species Act (ESA) consultation from the 2016 Everglades Restoration Transition Plan (ERTP) Biological Opinion (BO). **Appendix E.1** (**Ecological Evaluation of Round 1, Round 2, and Round 3 Alternatives**) provides a summary of how this information was utilized to evaluate Round 1, Round 2, and Round 3 alternatives and documents trends in alternative performance with respect to ecosystem benefits.

The COP modeling strategy, which was developed in coordination with the COP interagency PDT prior to the start of modeling analyses, describes the suite of hydrological models that were applied through the iterative rounds of modeling, the modeling sequence and scenarios for planning alternatives, and the review process for the applied tools; refer to the Hydraulics and Hydrology Appendix (**Appendix H**), **Annex 1**. Regional hydrologic models used to support the analysis included the South Florida Regional Simulation Model (Glades-LECSA Implementation (RSM-GL)) and the Miami Dade Regional Simulation Model (MD-RSM). RSM-GL was used as the primary tool for the hydrologic simulations of the baseline and each alternative. The newly-developed sub-regional MD-RSM was also used to provide greater detail on flood risk assessment than can be performed with the RSM-GL output alone. **Appendix H** provides a comprehensive documentation record of the COP hydrologic modeling efforts, including the following information: detailed documentation of the hydrologic modeling tools and modeling sequence (**Annex 1** and **Annex 2**); comprehensive documentation of the operational criteria and modeling assumptions for the base conditions (**Annex 3**); a detailed record of the operational criteria developed by the formulation team for the alternatives and sensitivity runs through the three rounds of modeling (**Annex 3** and **Annex 4**); a representative selection of RSM-GL and MD-RSM modeling output that was used to support plan formulation (**Annex 5**); hydrologic analyses for the 8.5 Square Mile Area (SMA) (**Annex 6**) and the C-111 South Dade Basin design storms (**Annex 7**) that were used to confirm compliance with project constraints; and lastly, a detailed record of the processes, data, tools and outcomes of the effort to identify a new and robust Tamiami Trail Flow Formula (TTFF) to implement real-time "rainfall driven operations" that are constrained to existing system limitations and are geared towards more scientifically-based ecological targets than the current Water Conservation Area (WCA) 3A Rainfall Plan.

2.1.2 Alternative Formulation – COP Constraints

The modeling tools mentioned above were also pivotal in ensuring that the flood mitigation constraints of the COP were met. There were two primary constraints (i.e. base conditions) to consider for two separate geographic areas modeled in the impact analysis, the 8.5 SMA and the agricultural and residential parcels east of the L-31 canal in the South Dade area[1]. The 1994 C-111 South Dade General Reevaluation Report (GRR) planning condition, hereafter referred to as the Base94 or 1994 GRR base condition, defines the minimum level of flood mitigation required for the South Dade area, consistent with Congressional authorization in the Water Resources and Development Act (WRDA) of 1996 (Public Law (PL) 104-303) for the USACE to implement the 1994 GRR recommended plan of improvement. This base condition was modeled with the sub-regional MD-RSM model beginning in Round 2 and each round thereafter to confirm that no alternative had an aggregate increase in flood risk based on defined economic impact reaches as modeled in the MD-RSM wet, dry, and average years[1].

The 1983 base condition (also referred to as Base 83) represents the Congressionally authorized flood mitigation performance standard for all the 8.5 SMA locations within the interior of the protective levee, consistent with the methodology applied for the 2000 MWD 8.5 SMA GRR/Environmental Impact Statement (EIS). This planning condition represents the authorized canal levels and operations prior to the Experimental Water Deliveries Program, consistent with the pre-project baseline used for analysis of the 8.5 SMA performance within the 1993 MWD General Design Memorandum (GDM) and the 2000 MWD 8.5 SMA GRR/ EIS. The Record of Decision for the 2000 MWD 8.5 SMA GRR/EIS identifies the plan for

[1] Refer to **Appendix I** (**Socioeconomics**) for the methodology, assumptions, and results pertaining to the COP impact analysis and constraint check.

providing flood mitigation to the 8.5 SMA and mandates implementation guidance that "the periodic flooding of landowners east of the proposed levee, before and after project implementation, will remain unchanged from conditions in existence prior to implementation of the MWD project except where flowage easements are required." Consistent with the sub-regional modeling evaluation methodology from the 2000 MWD 8.5 SMA GRR/EIS, the COP flood mitigation analysis will assess rainfall accumulation and durations, post-event peak stage and recession rates, inundation duration, and antecedent conditions.

2.2 Description of Alternatives

2.2.1 No Action Alternative/Existing Condition Baseline

The existing conditions baseline is intended to represent conditions assumed in place at the time of implementation of the COP Water Control Plan in 2020. The National Environmental Policy Act (NEPA) requires that the lead federal agency define a No Action Alternative, or the conditions that will exist in an analysis year if a proposed action is not implemented. Under the USACE, planning principles, the No Action Alternative is referred to as the Future Without Project Condition. In this instance there are no differences between ECB19RR and the No Action Alternative or the Future Without Project Condition; therefore a single baseline was used for planning purposes. The existing conditions baseline, referred to as ECB19RR, included the following assumptions:

(1) MWD Increment 1.1 and 1.2 (operational changes required under the July 2016 ERTP BO and in response to new information gained during the 2016 Temporary Emergency Deviation);

(2) existing Central and Southern Florida (C&SF) project infrastructure and Regulation Schedules (including 2008 Lake Okeechobee Regulation Schedule);

(3) MWD Tamiami Trail Modifications 1-mile bridge and raised roadway;

(4) Tamiami Trail Next Steps 2.6 mile Western Bridge;

(5) Full construction of C-111 South Dade project to include Contracts 8, 8A and 9;

(6) 8.5 SMA project features to include C-358 and S-357N;

(7) Miami-Dade Limestone Products Association (MD-LPA) 5 mile Seepage Cutoff wall along L-31 North;

(8) current permitted operations for the SFWMD C-111 Spreader Canal project components (includes G-737 and S-199/S-200 at expanded 300 cubic feet per second (cfs) each);

(9) the expanded capacity at S-333 completed by the SFWMD component of the Central Everglades Planning Project (CEPP), with operations as prescribed by the July 2018 permit issued by the FDEP to the SFWMD;

(10) the Department of Interior (DOI) plug installed at the junction of old Tamiami Trail Roadway and ENP Shark Valley Tram Road south of WCA 3A; and

(11) assuming operations of the S-152, Decompartmentalization (Decomp) Physical Model.

It should be noted that Round 1 alternatives were compared to ECB19R which is the same as ECB19RR except S-333N operations differed as prescribed by the FDEP operational permit (note that the Round 1 modeling was completed prior to issuance of the FDEP permit to the SFWMD). Reference **Section 1** (**Purpose and Need**) for further information on these projects. Detailed modeling assumptions for

ECB19RR can be found in **Appendix H**, **Annex 3**. Increment 1.2 was assumed for ECB19RR since the associated operational criteria are compliant with the Reasonable and Prudent Alternative (RPA) from the 2016 ERTP BO (Increment 2 is also compliant with the RPA however, the 2012 Water Control Plan is not), and since the L-29 maximum operating limit of 7.8 feet National Geodectic Vertical Datum of 1929 (NGVD) is consistent with both the 2008 Florida Department of Transportation (FDOT) Relocation Agreement and requirements to maintain the federally-authorized flood mitigation for the 8.5 SMA.

Since the No Action Alternative includes operation of the L-29 canal as prescribed in the MWD Increment 1.1/1.2 Field Test, for which the L-29 canal maximum operating stage limit was up to 7.8 feet, NGVD with relaxation of the pre-MWD G-3273 stage constraint, a portion of hydrologic and ecological benefits to North East Shark River Slough (NESRS) attributed to raising the L-29 canal stage limit under implementation of the MWD Incremental Field Test are already incorporated within the No Action Alternative. The COP EIS documents additional hydrologic and ecological benefits that may be realized with implementation of the COP following completion of the MWD and C-111 South Dade projects.

2.2.2 Initial Array

In order to develop implementable alternatives for the Round 1 evaluations, the USACE, the SFWMD, and ENP conducted a series of workshops which leveraged the collective technical expertise of senior agency staff, including plan formulation, policy, hydrology, ecology, flood risk management, and water management. These workshops started from a comprehensive inventory of water control structures associated with the MWD and C-111 South Dade Project operations and extensive technical briefings of pertinent information assimilated from previous agency planning efforts. Operational options for each structure were developed along a continuum that ranged between bookends which maximized environmental restoration across the areas identified within the project objectives and bookends which maximized flood risk management. The development of operational options began with the No Action Alternative (Increment 1.2) and with the MWD Increment 2 Field Test occupying the center of the range between the bookends. For the MWD combinations, one extreme of the combinations gave priority to WCA 3A while the other extreme of the combinations provided priority to NESRS.

The MWD combinations extremes are as follows:

- Combination 1: No Action – Increment 1.1/1.2
- Combination 2: Priority to WCA 3A
- Combination 3: Priority to WCA 3A with water supply and flood control constraints
- Combination 4: Priority for WCA 3A with water supply, flood control constraints, and sparrow constraints
- Combination 5: Increment 2
- Combination 6: Increment 2 plus with changes to the Rainfall Plan and the regulation schedule
- Combination 7a: Priority to NESRS with water supply, flood control, and sparrow constraints
- Combination 7b: Priority to NESRS with existing sparrow constraints only
- Combination 8: Priority to NESRS with sparrow constraints
- Combination 9: Priority to NESRS

For the C-111 South Dade combinations, one extreme gave priority to South Dade flood risk management and the other extreme gave priority to Taylor Slough, Rocky Glades, and the restoration of the Eastern Panhandle restoration.

The C-111 South Dade combinations are as follows:

- Combination 1: No Action – Increment 1.1/1.2 assumes C-111 South Dade construction complete
- Combination 2: Priority for South Dade to ensure flood protection without sparrow constraints
- Combination 3: Priority for South Dade to ensure flood protection plus sparrow constraints
- Combination 4: Priority for South Dade to ensure flood protection sending combination west/south
- Combination 5: Increment 2 – assumes C-111 South Dade construction complete
- Combination 6: Increment 2 raised to 2012 WCP water levels
- Combination 7: Priority to Taylor Slough, Rocky Glades, the Panhandle, and BBCW with flood control and the sparrow constraints
- Combination 8: Priority to Taylor Slough, Rocky Glades, and the Eastern Panhandle with sparrow constraints
- Combination 9: Priority to Taylor Slough, Rocky Glades, and the Eastern Panhandle

There was also a third combination spreadsheet that was utilized which captured the items that didn't necessarily fall under the MWD or C-111 South Dade projects. Combinations of the MWD, C-111 South Dade and the "Other" spreadsheet operational options were developed into alternatives and screened by evaluating the alternatives against project objectives, constraints, and planning considerations.

Screening criteria was then set up for the objectives, assigning a value of 0 for "No/Does Not Occur", 5 for "Partially occurs", and 10 for "Yes/Definitely Occurs". The MWD objectives were scored for the MWD project features while the C-111 South Dade objectives were scored for the C-111 South Dade project features. These scores were used for combining the MWD combinations and the C-111 South Dade combinations into functioning alternatives with potential to address the COP objectives. The constraints and planning considerations were then used to score the alternatives further, which allowed for the highest and lowest scoring alternatives to be screened out for violating the constraints and/or the planning considerations. This allowed for a Top 8 of Preliminary Alternatives. The Top 8 were then narrowed down further to 4 Alternatives, screening out the ones that were very similar in the formulation rationale and quantitative scoring results. In order to facilitate completion of the COP hydrologic modeling with a limit of three rounds of modeling and maintain schedule commitments, the USACE, the SFWMD, and ENP had originally agreed to move forward with 3 alternatives plus the No Action Alternative to Round 1 modeling. The plan formulation and screening process and outcomes were briefed to the COP interagency PDT and integrated minor changes in response to review comments. The formulation process moved forward with Alternatives K (ALTK), L (ALTL), and N (ALTN) to the Round 1 modeling with the understanding and agreement that those 3 alternatives captured the wide array of project, agency and public interests while adhering to the project objectives and constraints.

2.2.3 Round 1

The Round 1 set of alternatives includes the No Action Alternative, ALTK, ALTL and ALTN. All three Round 1 action alternatives applied the 2006 New Rainfall-Flow Formula (NRFF) with appropriate scale factor that produces improved hydropatterns in Shark River Slough (SRS) without over-draining WCA 3A. The 2006 NRFF was developed during the formulation of the previous Combined Structural and Operations Plan for the MWD and C-111 South Dade projects (CSOP) in order to provide more natural timing for deliveries to ENP, with reduced mandatory regulatory discharges in accordance with the WCA 3A Regulation Schedule. Based on review of hydrologic modeling results across a range of NRFF scaling percentages of 40 to 70%, the USACE, the SFWMD, and ENP, reached a consensus to use a 45% scaling factor for the COP Round 1 modeling. All scaling scenarios delivered significant volumes of water to ENP, consistent with the intent of the COP formulation, but the higher percentage of rainfall formula (above 50 %) clearly identified risks to WCA 3A and water supply well fields in southern Miami Dade County. Opportunities to further increase deliveries to ENP were deferred to be further investigated during the Round 2 alternative modeling using the iModel to balance attainment of prescribed ecological stage targets within WCA 3A and ENP. All alternatives also maintained the S-12A/S12B closure criteria in accordance with 2016 ERTP BO and high-water exit strategy. During the formulation of alternatives the team looked at the 2015-2016 South Dade Investigation Study as a source of data to inform the planning process. The South Dade Investigation Study was conducted by the SFWMD to look at opportunities to convey more water to Biscayne Bay when regional water and canal capacity is available.

ALTK was more focused on the southern part of the system below the S-331 structure with lowered canal levels providing an opportunity for enhanced flood protection for South Dade agriculture. Key assumptions of ALTK were as follows:

- Increment 2 Field Test operations for WCA 3A,
- WCA 3B and ENP which include the extreme high water (EHW) action line,
- Priority operations at S-356 over S-333 under all conditions to maintain L-31N at 5.5-5.8 feet (NGVD) and the S-334 prescribed use regulatory releases from WCA 3A based on the EHW;
- A revised Zone E1 for WCA 3A (reference **Figure 2-1**);
- An additional constraint for NESRS inflows with G-3273 constraint at 7.4 feet, NGVD, targeted to ensure 8.5 SMA flood mitigation;
- Half a foot higher operational range for S-331 and S-357 as compared to Increment 2 operational range, targeted to avoid over-drainage of ENP wetlands adjacent to the 8.5 SMA;
- Seasonal flows for S-332s which match the SFWMD recommendation from the South Dade Investigation Study;
- S-176 and S-177 with lower operational range up to 200 cfs consistent with Increment 1.1/1.2 operations;
- Taylor Slough Supplemental delivery was limited from October through February, to provide managed recessions in Taylor Slough with limited risk to WCA 3A water supply users; and
- Simplified (compared to Increment 2) operating criteria for S-197.

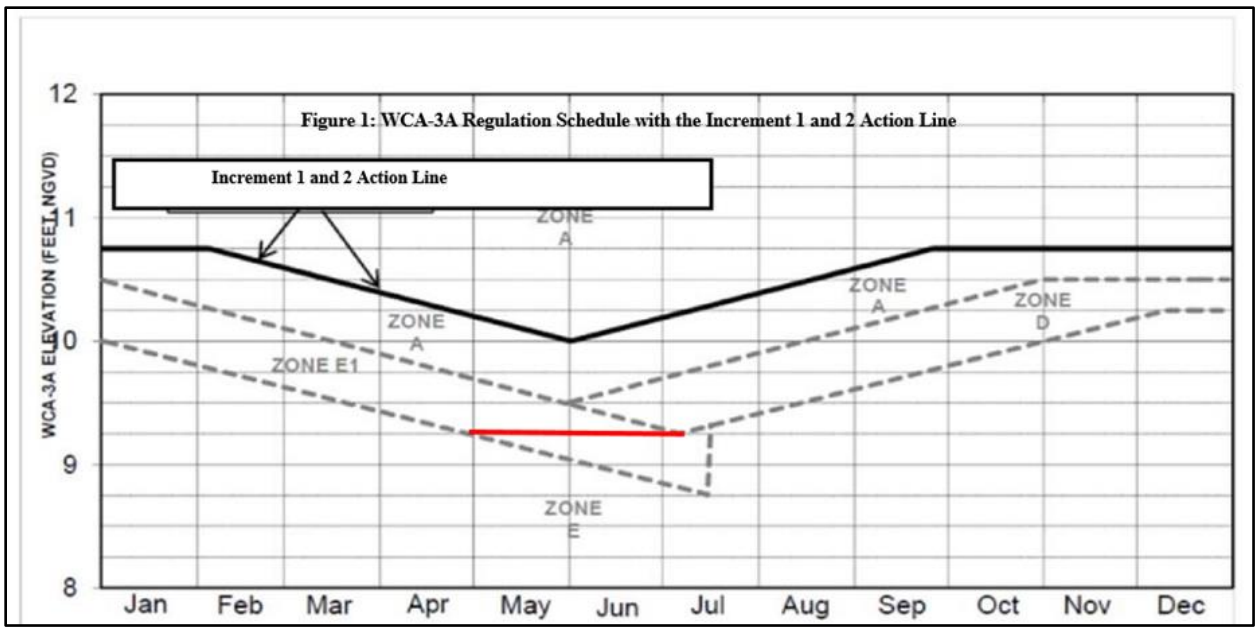

Figure 2-1. Revised Zone E1 for WCA 3A

ALTL was more focused on the northern portion of the project area providing the most flows into NESRS and into ENP.

Key assumptions for ALTL were as follows:

- 2012 Water Control Plan for WCA 3A, WCA 3B, and ENP with no Increment 1 action line or an EHW;
- no G-3273 constraint for S-333;
- no column 2 operations (regulatory releases from WCA 3A to the South Dade Conveyance System);
- S-356 has full priority over S-333 and maintains L-31N at 5.5-5.8 feet, NGVD;
- S-335 and S-337 used for water supply only, targeted to retain seepage water in the WCA 3B and NESRS basins versus discharging south to the South Dade basin;
- operational range for S-331 of 4.5-5.0 feet, NGVD with no dependency on 8.5 SMA (changed from the Incremental Field Test);
- an operational range for S-357 of 5.7-6.2 feet, NGVD;
- no ramp up operations for S-332s (structures opened at top of range and continue operating until floor of range is crossed);
- S-176 and S-177 operating range is consistent with the 2012 Water Control Plan;
- S-199 and S-200 operations per the 2011 C-111 Spreader Canal Western Project Implementation Report (PIR), incrementally higher than the existing FDEP operating permit issued to the SFWMD;
- Taylor Slough Supplemental Deliveries limited to October – February (same as ALTK);
- and S-197 operated per the 2012 Water Control Plan, dialing back the increased low-volume releases at S-197 that were included in the Incremental Field Test.

ALTN was formulated to provide flood protection to the South Dade Agriculture and provides increased flows to NESRS and ultimately ENP.
Key assumptions for ALTN are as follows:

- Increment 2 operations for WCA 3A, WCA 3B, and ENP which includes the EHW action line;
- S-356 priority over S-333, and the S-334 update based on the EHW (same as ALTK);
- the revised Zone E1 for WCA 3A (reference **Figure 2-1**);
- the operational range for S-331 and S-357 were per the Increment 2 operations;
- the S-176 and S-177 operating range is consistent with the 2012 Water Control Plan;
- Taylor Slough Supplemental deliveries limited to November-December only (further limited than ALTK and ALTL);
- and the S-197 operations are limited to level 1 operations with a maximum capacity limited to 400 cfs (no Level 2 or Level 3 releases), targeted to test the sensitivity of South Dade Basin flood risk management on S-197 operations.

The Round 1 alternatives were modeled using the RSM-GL and the results were further analyzed by the PDT team (see **Appendices E.1** (**Ecological Evaluation of Round 1, Round 2, and Round 3 Alternatives**) and **Appendix I** (**Socioeconomics**) for details). Reference **Table 2-1** for high level details regarding the Round 1 alternatives.

Table 2-1: High-level overview of the Round 1 Alternatives K, L, and N.

Structures	Increment 1.2 with completed C-111 South Dade Construction	ALTK	ALTL	ALTN
S-356	Operating Range from 5.5 to 5.8 feet, NGVD (under Condition 1 & 2)	Additional Flexibilities Conditional Priority	Additional Flexibilities Priority over S-333	Additional Flexibilities Conditional Priority
G-3273	Relax constraint (previously 6.8 feet, NGVD)	Constraint replaced with G-3272 constraint of 7.4 feet NGVD (intent to maximize stage limit, subject to meeting 8.5 SMA flood mitigation)	Constraint Removed	Constraint Removed
S-357N	Limit to 100 cfs	Limit to 100 cfs	Limit to 100 cfs	Limit to 100 cfs
L-29	7.8 feet, NGVD	8.5 feet, NGVD with FDOT Constraint	8.5 feet, NGVD with FDOT Constraint	8.5 feet, NGVD with FDOT Constraint
ESA	New S-12s Operational Window (closed 01 OCT – 14 JUL, subject to high-water exit strategy in OCT-NOV); S-343A/B and S-344 closed 01 OCT – 14 JUL	Maintain 2016 ERTP BO Closures, aside from S-344 Reduced Cape Sable Seaside Sparrow (CSSS) Seasonal Closures	No Change. Maintain 2016 ERTP BO Closures	No Change. Maintain 2016 ERTP BO Closures
Increment 1 Action Line	Increment 1 Action Line: 10.0 feet to 10.75 feet, NGVD	Increment 1 Action Line:	No Action Line	Increment 1 Action Line: 10.0

Structures	Increment 1.2 with completed C-111 South Dade Construction	ALTK	ALTL	ALTN
		10.0 feet to 10.75 feet, NGVD		feet to 10.75 feet, NGVD
Extreme High Water Action Line	No EHW Action Line	Increment 2 EHW Action Line	No EHW Action Line	Increment 2 EHW Action Line
Rainfall Plan	1985 Rainfall Plan as modified in 2012 Water Control Plan	2006 Rainfall Plan *Everglades Rain Driven Operations (ERDO) Round 2	2006 Rainfall Plan *ERDO Round 2	2006 Rainfall Plan *ERDO Round 2
C-111 South Dade	Maintain local flood risk management Slightly Lower canal elevations than 2012 Water control Plan, consistent with Increment 1.1 and 1.2 after completed C-111South Dade construction: 4.2 to 4.8 feet, NGVD Stage Constraint in NDA/SDA: 2.5 feet, NGVD	South Dade Investigation Study with CSSS seasonal constraints Similar to Increment 1.1 and 1.2: 4.0 to 4.8 feet, NGVD with seasonal variability (minor decrease from 2012 Water Control Plan) No Stage Constraint in NDA/SDA	Minimize S-176 openings (intent is to keep S-176 closed as often as possible) Similar to 2012 Water Control Plan: 4.7 to 4.9 feet., NGVD (minor decrease from 2012 Water Control Plan) No Stage Constraint in NDA/SDA	2012 Water Control Plan (Water Control Plan) Operating Ranges: 4.7 to 5.0 (Column 1) feet, NGVD 4.5 to 4.8 (Column 2) feet, NGVD No Stage Constraint in NDA/SDA
S-333 (includes S-333N/S-334)	Operated per WCA 3A Regulation Schedule (2012 Water Control Plan), including priority to NESRS. Additional increase governed by L-29 stage.	Further reduce Column 2 discharges as compared to the Field Test; Operated above EHW Action Line; short-term availability in accordance with FDOT constraints	No Column 2 S-334 short-term availability in accordance with FDOT constraints	Further reduce Column 2 discharges as compared to the Field Test; Operated above EHW Action Line; short-term availability in accordance with FDOT constraints
S-197	Increased low-volume discharges, based on S-18C HW, S-176/S-177 flows; Moderate to High flows dependent on S-177/S-18C HW stage: Level 1 discharges limited to 500 cfs;	Simplified Increment 2 with EHW Action Line: Level 1 criteria at 800 cfs	2012 Water Control Plan including Level 1 (800 cfs), Level 2 and Level 3 criteria	Limit releases to 400 cfs and Remove Level 2 and 3 Criteria

Structures	Increment 1.2 with completed C-111 South Dade Construction	ALTK	ALTL	ALTN
	Level 2 and Level 3 discharges unchanged from 2012 Water Control Plan			
Supplemental Flows to Taylor Slough	Up to 250 cfs for up to 8 weeks of the year	Up to 250 cfs	Up to 250 cfs	Up to 250 cfs with constraints for a max of 8 weeks
S-357	S-357 discharges into C-111South Dade NDA. Dependency on S-331 to provide 8.5 SMA flood mitigation, with S-357 as secondary. Operations maintain consistency with Increment 1.1 and 1.2 following assumed operation of the C-111 South Dade NDA: C-357 range 3.5-6.0 feet, NGVD (limit to 500 cfs)	Operating range similar to Increment 2 raising S-331 criteria by 0.5 feet: C-357 range 4.0 to 6.0 feet, NGVD; no limit (575 cfs) Priority at S-357 over S-331	Operating range similar to Increment 1 (8.5 SMA): 5.7 to 6.2 feet, NGVD; no limit (575 cfs) Priority at S-357 over S-331	Operating range of Increment 2: 3.5 to 6.0 feet, NGVD; No limit (575 cfs) Priority at S-357 over S-331

2.2.4 Round 2

The Round 2 alternatives consisted of Alternatives N2 (ALTN2) and O (ALTO) that were developed based on performance evaluations of the Round 1 alternatives. The input that was given by the public at the PDT meeting regarding the alternative that they proposed was taken by the team and reviewed, the operational intent was incorporated into ALTN2 and ALTO. As ALTN was generally recognized in the first round of modeling as the best overall performer across all regions relative to the COP objectives, ALTN2 represented a minor tweaked version of the Round 1 ALTN with adjustments to improve the areas of performance concern for South Dade and the S-197 structure and generally leverages the 2012 Water Control Plan and the MWD Increment 2 Field Test operations. ALTO is a hybrid of Round 1 ALTK and ALTL, specifically the preferred flood risk reduction performance observed with the L-31N (south of S-331) and C-111 canal operations from ALTK, combined with a slightly modified version of the operations for WCA 3A, WCA 3B and ENP from ALTL. ALTO generally adopts the SFWMD's South Dade Investigation Study operations combined with a less aggressive WCA 3A schedule than used in ALTL. After combining the selected features from ALTK and ALTL, the preliminary draft ALTO was then reviewed by the DOI, the SFWMD, and the USACE water managers and hydrologists to determine whether ALTO was implementable and if the structure operations could be combined based on the structural dependencies.

ALTO and ALTN2 both incorporated updates to the Everglades Rain-Driven Operations (ERDO) informed by the iModel that mostly affects the Tamiami Trail, S-335 and the S-332 B/C/D pump station operations and replaces the 45% placeholder NRFF that was used in Round 1. A summary of the iModel and the tool application for the COP is provided in the Hydraulics and Hydrology (**Appendix H**), **Annex 1** and **Annex 8**. **Appendix E.2** (**Supporting Information**) presents the targets (i.e. stage hydrographs) utilized within WCA 3 and ENP for purposes of informing ERDO. The COP Eco sub-team prioritized stage targets at 24 "Marsh" equally weighted locations in WCA 3A, WCA 3B and ENP (including SRS and Taylor Slough), with the targets largely based on RECOVER efforts and consistent with previous planning efforts including the development of the CERP Central Everglades Planning Project (CEPP).

The iModel emulates the hydrologic response characteristics of the RSM-GL and unlike traditional hydrologic models, the iModel is "inverse" in that inputs to the iModel are hydrologic targets (water depths and durations) and outputs are the optimized operations of structures that provide the overall best fit to the hydrologic targets. The iModel domain includes WCA 3A, WCA 3B and ENP, as well as WCAs 1 and 2. Considering the importance of seepage dynamics, water supply and flood risk management in the COP, additional areas were included in the COP iModel version along the natural/developed boundary, including the headwater of structures along the L-30, L-31N, and C-111 Canals. Both alternatives updated S-197 to allow flexibility to handle the high rainfall events but would minimize the overall discharges.

In addition to the common inclusion of ERDO-informed operations for ENP inflows along Tamiami Trail and to Taylor Slough, there were common key assumptions within both Round 2 ALTSN2 and O, as follows:

- the S-12A/S-12B Seasonal Closure Criteria in accordance with the 2016 ERTP BO and high-water exit strategy, same as ECB19RR;
- the L-29 canal operating limit up to 8.5 feet, NGVD with the FDOT constraint (up to a maximum of 90 days per water year with stages above 8.3 fee, NGVD);
- no constraint at G-3273;
- the S-152 Decomp Physical Model Structure operated per the 2016 Phase 2 criteria, same as the ECB19RR;
- the C-111 South Dade NDA/SDA emergency weir elevation used to allow inflows up to an average depth of 3.5 feet, if needed (the ECB19RR assumed a limit of 2.5 feet depth);
- the secondary structure releases to tide at S-148 (C-1W), S-167/S-179(C-103), S-165 (C-102), and S-178 (C-111E) operations remain the same as ECB19RR;
- CEPP S-333N operations remain the same as ECB19RR (the FDEP permit issued to the SFWMD)
- C-111 Spreader Canal S-200, S-199, and G-737 operations remain the same as ECB19RR (the FDEP permit issued to the SFWMD);
- the operational range for the S-357 is the same as the Increment 2 operations of 3.5 feet-6.0 feet NGVD (as informed by Field Test development and real-time monitoring); and
- the 8.5 SMA S-357N operations remain the same as ECB19RR.

ALTN2 was formulated to balance additional inflows to ENP with potential dry-out concerns within WCA 3A and WCA 3B, given consideration of the existing ECB19RR water budget limitations, and to maintain the Taylor Slough flow volumes observed with ALTN (Taylor Slough flows were reduced versus ECB19RR for the other Round 1 alternative). As with ALTN, the WCA 3A Regulation Schedule for ALTN2 retained Zone A, Zone D, and Zone E1 (with the raised floor elevation from Round 1) from the 2012 Water Control Plan, in addition to conditional priority for S-333 and the EHWL that was incorporated during the MWD Increment 2 Field Test. South Dade canal operations for reaches along the L-31N (south of S-331) and C-111 Canals were built around the long-term operational paradigms prescribed within the previous Water Control Plans under the Interim Operational Plan (IOP) (2002-2012) and ERTP (2012-2015), which preceded the MWD Incremental Field Tests starting in 2015. L-31N Canal levels north of S-331 were adjusted downward compared to ALTN in response to performance evaluations conducted by the Flood Risk sub-team. Flood risk sub-team evaluations of the lower C-111 Basin also led to addition of Level 3 (full gate opening) criteria for S-197, while retaining the Level 1 low-volume release cap of 400 cfs from ALTN.

ALTO was formulated to provide increased flexibility under the WCA 3A Regulation Schedule to provide deliveries to ENP in response principally to the science-based, ecological stage targets used with the iModel by retaining only Zone A of the schedule as a requirement for up to maximum releases, with Zone D, Zone E1, and the Field Test action line removed and no inclusion of the EHWL. S-356 pump station operations were not dependent on WCA 3A water stages, promoting the maximum return of ENP seepage losses and reduced potential discharges to the southern reaches of the South Dade Conveyance System. L-30 canal operational criteria were lowered compared to ECB19RR and ALTN2 to promote additional deliveries to the SDCS to increase water availability for the Taylor Slough, the C-111 South Dade hydraulic ridge operations, and opportunistically, to Biscayne Bay. The ECB19RR and ALTN2 dependency of S-331 pump station based on 8.5 SMA stages was removed, and the canal operational range was correspondingly lowered based on the performance evaluations conducted by the Flood Risk sub-team during Round 1. South Dade canal operations for reaches along the L-31N (south of S-331) and C-111 canals were generally consistent with the South Dade Investigation Study recommendations and lowered (with the additional inclusion of seasonal criteria at the S-332 pump stations), compared to ECB19RR and ALTN2 to simultaneously promote both increased deliveries to Taylor Slough and the hydraulic ridge and reduced flood risk for the adjacent agricultural and urban areas. A hybrid approach was used to prescribe S-197 operations, based on the Round 1 performance evaluations by the Flood Risk sub-team and including consideration of ALTN low-flow operations. ALTO operations removed ECB19RR stage trigger criteria at S-177 (only retaining S-18C headwater trigger criteria) and includes two tiers of low-flow operations (Level 1 at 200 cfs, and Level 2 at 800 cfs) formulated to limit potential damaging estuary flows; Level 3 (full gate opening) criteria were also retained to manage flood risk following extreme rainfall events, which were carefully isolated during the Round 1 performance reviews.

The environmental effects evaluations of the COP Round 2 alternatives are detailed in **Section 4** (**Environmental Effects**) of the EIS. Additional model simulations were conducted to investigate the effects of other operational criteria not included in Round 2 alternative scenarios, based on consideration of interagency PDT input during the Round 1 evaluations. These sensitivity runs were structured to include changes in minimum number of variables (informed by previous model runs) so that the project performance from these changes can be effectively distinguished. Each sensitivity run was developed starting from the RSM-GL Round 2 alternatives. A total of four RSM-GL sensitivity runs were completed in Round 2, as further detailed in **Section 2.3.2** (**Round 2**).

2.2.5 Round 3

The intention of Round 3 modeling was to further optimize the alternative selected after Round 2 to address specific performance short-comings, to improve attainment of project objectives, to achieve compliance with project constraints, and to opportunistically explore enhancements around the planning considerations. The Round 3 modeled alternative was also followed by a design storm analysis in order to assess potential effects for the C-111 South Dade project area during extreme rainfall events beyond those historical events modeled in the RSM-GL and MD-RSM. The design storm analysis was required to close out the C-111 South Dade project since this analysis was conducted with the originally authorized 1994 GRR Plan. As the team progressed to the Round 3 alternative, the information provided from the PDT and stakeholders was taken into the formulation of the Round 3 alternative, Alternative Q (ALTQ). Some key assumptions that were made for the Round 3 alternative was that it was derived from ALTO as that alternative was clearly the preferred alternative following sub-team and interagency PDT evaluations conducted during Round 2.

Based on the input received during the plan formulation process the following adjustments to ALTO are included in ALTQ:

- ALTQ incorporates a "real time" TTFF (reference **Appendix H**, **Annex 8**) to identify weekly operational target flows in place of the previous 2006 Rainfall Plan which was utilized for Round 1 and use of the iModel flow distribution results as internal model boundary conditions during Round 2;
- Incorporates the EHWL, which was a component from ALTN2;
- retains regulatory Zone A as the only WCA 3A regulatory discharge zone (consistent with ALTO);
- Eliminates regulatory Zones D, E, and E1, and adds Zone B (to define the Zone below Zone A) for WCA 3A;
- Updates were made to the WCA 3A floor reference location to incorporate use of the 3-69W gage (in addition to the S-333 headwater stage of 7.5 used in the ECB19RR) as envisioned in the CEPP;
- Incorporates operational changes to S-332C and S-18C as was recommended in the public feedback, following review of the Round 2 alternatives.
- Incorporates operational modifications to promote flow to Biscayne Bay consistent with Round 2 sensitivity run SR4 (reference **Section 2.2.4**).

Following completion of the Round 2 modeling, during development of the operational refinements for the Round 3 modeling, the COP modeling team identified an error with the RSM-GL simulation of ALTO which influenced the volume of flows through S-12C. Assumptions for each alternative were defined during development of the plan formulation process. Since the simulated performance of ALTO was identified by the COP PDT as the preferred starting point for development of the optimized alternative in the subsequent Round 3 modeling, including the development of the new TTFF targets for water deliveries from WCA 3A to ENP, the USACE, the SFWMD, and ENP determined that this error correction would be appropriately addressed during the Round 3 modeling rather than through a schedule delay that would ultimately delay later implementation of the COP. During the Round 3 modeling, an incorrect closure criteria which was applied to the S-12C in the Round 2 ALTO scenario was corrected. Specifically, for the RSM-GL simulation S-12C was inadvertently operated for ALTO with a seasonal closure period from December 01 through July 14 of every year. The seasonal closure prevented maximum releases from S-12C when WCA 3A stages were above Zone A of the Regulation Schedule; for comparison, ALTN2 releases from S-12C during this time period ranged from 300 to 600 cfs during moderate wet conditions and from 1000 to 1800 cfs during extreme wet conditions. Since all WCA 3A output structures are operated up to maximum capacity when stages are above Zone A, the other output structures are not able to make-up for the S-12C releases held back during the S-12C closure period; the end result of this modeling error is that ALTO retained additional water at the end of the wet season (typically 0.1 – 0.2 feet higher stages for WCA 3A), compared to ALTN2; ALTN2 also includes the EHWL, providing additional storage for WCA 3A releases to NESRS further into the dry season months. Although the RSM-GL regional hydrologic model for Round 2 ALTO was not re-run to address the error, a correction to the identified error in S-12C operations was not anticipated to result in a significant change in performance for WCA 3 and ENP, and is not responsible for the subtle differences in dry condition performance that led to the development of the dry conditions Field Test described in **Appendix C** (**COP Adaptive Management and Monitoring Plan [COP AMMP]**). In addition, ALTO performance was ultimately selected as the basis for the Round 3 ALTQ, which provided the opportunity to maintain the majority of the desirable performance characteristics for WCA 3A and ENP during the subsequent development of the TTFF.

2.2.6 Round 3 Refinement

Additional model simulations were conducted to investigate the effects of other operational criteria not included in Round 3 ALTQ scenario, based on consideration of interagency PDT input during the Round 2 evaluations. The team utilized the information that had been provided by the PDT and the public to inform the sensitivity runs that were performed on ALTQ. A total of six RSM-GL sensitivity runs were completed in Round 3 based on the same two general categories established with the Round 2 sensitivity runs:

- EIS Support - Assess uncertainties with an implementable plan, and/or for inclusion in adaptive management (for example, existing FDOT/USACE high-water constraints for the L-29 canal)
- Non-EIS Support - Not considered in the implementable plan or for inclusion in adaptive management, but provides valuable near future information (for example, additional seepage barrier construction, WCA 1/WCA 2A Regulation Schedule changes, and raising the L-29 canal maximum operating limit up to 9.7 feet, NGVD)

The six sensitivity runs were SRQ1, SRQ2, SRQ3, SRQ4, SRQ5, and SRQ6. SRQ1 has the L-29 FDOT constraint of L-29 canal stages operated above 8.3 feet, NGVD for 90 days per water year lifted to year-round when water is available to deliver to ENP. SRQ2 and SRQ3 has operations that tried to improve timing for water quality of SRS inflow. SRQ4 has conditional opening for S-344 and removal of seasonal CSSS constraints at S-332D. SRQ5 and SRQ6 included a WCA 3A Low-Water Action Line, based on requests from the COP Water Supply sub-team evaluations during Round 2. From the six sensitivity runs and their respective key components, parts of SRQ4, such as the conditional opening for S-344 and removal of the CSSS constraint at S-332D in the month of December, was carried forward in to Alternative Q+ (ALTQ+). Information gained from SRQ2 and SRQ3 were used to identify a more-limited set of conditional operational criteria to provide additional protection for water quality of inflows to ENP, and these criteria are included in the COP AMMP(**Appendix C**) and ALTQ+. ALTQ+ also incorporates the ability to extend the duration for stages in the L-29 canal above 8.3 feet, NGVD, if supported by further data evaluations and coordination with the FDOT. ALTQ+ is very similar to ALTQ with respect to the expected hydrologic and ecological performance, as further detailed in **Section 4** (**Environmental Effects**) of the EIS.

Table 2-2 provides a high level overview of ALTs N2, O, Q, and Q+. Modeling assumptions for ALTs N2, O, and Q are included in **Appendix H, Annex 3** (**Baseline and Alternative Modeling Evaluation**). Reference **Appendix A** (**Water Control Plan**) for a complete description of ALTQ+.

Table 2-2: High level overview of the ALTS N2, O, Q and Q+

Structures	ECB19RR (Increment 1.2 with completed C-111 South Dade Construction)	ALTN2 (Round 2)	ALTO (Round 2)	ALTQ (Round 3)	ALTQ+
L-29 Canal	7.8 feet, NGVD	8.5 feet, NGVD with FDOT Constraint L-29 may be operated above 8.3 feet, NGVD for 90 days per calendar year, with the opportunity to increase based on real time monitoring of the US41 Subbase (interim until Tamiami Trail Next Step [TTNS]) construction) and 8.5 SMA flood mitigation criteria.	8.5 feet, NGVD with FDOT Constraint L-29 may be operated above 8.3 feet, NGVD for 90 days per calendar year, with the opportunity to increase based on real time monitoring of the US41 Subbase (interim until TTNS) construction) and 8.5 SMA flood mitigation criteria.	8.5 feet, NGVD with FDOT Constraint. L-29 may be operated above 8.3 feet, NGVD for 90 days per calendar year, with the opportunity to increase based on real time monitoring of the US41 Subbase (interim until TTNS) construction) and 8.5 SMA flood mitigation criteria.	8.5 feet, NGVD with FDOT Constraint. L-29 may be operated above 8.3 feet, NGVD for 90 days per calendar year, with the opportunity to increase based on real time monitoring of the US41 Subbase (interim until TTNS construction) and 8.5 SMA flood mitigation criteria. And consideration of increased low-water stages within WCA 3A including along Western L-29 canal between S-12A and S-333.
G 3273	Relax constraint (previously 6.8 feet, NGVD)	Constraint Removed	Constraint Removed	Constraint Removed	Constraint Removed
Rainfall Plan	1985 Rainfall Plan as modified in 2012 Water Control Plan	ERDO targeted to meet ecological stage targets in WCA 3A, SRS, and Taylor Slough with existing water budget (iModel optimization)	ERDO targeted to meet ecological stage targets in WCA 3A, SRS, and Taylor Slough with existing water budget (iModel optimization)	TTFF (Derived equation fit to optimum performance signal in ALTO; depends on: stage in WCA 3A and ENP; Tamiami Trail	TTFF (Derived equation fit to optimum performance signal in ALTO; depends on: stage in WCA 3A and ENP; Tamiami Trail

Structures	ECB19RR (Increment 1.2 with completed C-111 South Dade Construction)	ALTN2 (Round 2)	ALTO (Round 2)	ALTQ (Round 3)	ALTQ+
				structure flows; WCA 3A contributing basin Rainfall; and ET).	structure flows; WCA 3A contributing basin Rainfall; and ET). TTFF adjustments for ENP drought years and water quality considerations will be developed through COP AMMP
S-356	Operating Range from 5.5 to 5.8 feet, NGVD (under Condition 1 & 2)	Operating Range 5.5 to 5.8 feet, NGVD. Conditional Priority (under all Conditions 1-4 as defined in Increment 2)	Operating Range 5.5 to 5.8 feet, NGVD. Priority over S-333	Operating Range 5.5 to 5.8 feet, NGVD. Priority over S-333 except when WCA3A is above the EHWL	Operating Range 5.5 to 5.8 feet, NGVD. Priority over S-333 except when WCA3A is above the EHWL
ESA	New S-12s Operational Window (closed 01 OCT – 14 JUL, subject to high-water exit strategy in OCT-NOV); S-343A/B and S-344 closed 01 OCT – 14 JUL	No Change. Maintain 2016 ERTP BO Closures	No Change. Maintain 2016 ERTP BO Closures	Maintain 2016 ERTP Closures for S-12A, S-12B, S-343A, and S-343B.	Maintain 2016 ERTP BO Closures for S-12A, S-12B, S-343A, and S-343B. S-344 open when WCA 3A > Zone A (no seasonal closures at S-344) Removal of S-332D Seasonal Pump Restrictions during December
Inc. 1 Action Line	Increment 1 Action Line: 10.0 feet to 10.75 feet, NGVD	Increment 1 Action Line: 10.0 feet to 10.75 feet, NGVD	No Action Line	No Action Line	No Action Line
EHW Action Line	No EHW Action Line	Increment 2 EHW Action Line	No EHW Action Line	COP EHWL: Varies Seasonally from 11.0	COP EHWL: Varies Seasonally from 11.0

Structures	ECB19RR (Increment 1.2 with completed C-111 South Dade Construction)	ALTN2 (Round 2)	ALTO (Round 2)	ALTQ (Round 3)	ALTQ+
				feet to 12.0 feet, NGVD (tiered operations for releases to SDCS and S-197)	feet to 12.0 feet, NGVD (tiered operations for releases to SDCS and S-197)
S-333	Operated per WCA 3A Regulation Schedule (2012 Water Control Plan), including priority to NESRS. Additional increase governed by L-29 stage.	Operated per ERDO, as informed by iModel	Operated per ERDO, as informed by iModel	Operated per TTFF targets.	Operated per TTFF targets.
S-334		Operated above EHW Action Line; short-term availability in accordance with FDOT constraints. Further reduce Column 2 discharges as compared to the Field Test	No Column 2 discharges. S-334 short-term availability in accordance with FDOT constraints	S-334 Operated above EHWL if available capacity in SDCS; short-term availability in accordance with FDOT constraints. Further reduce Column 2 discharges as compared to the Field Test;	S-334 Operated above EHWL if available capacity in SDCS; short-term availability in accordance with FDOT constraints Further reduce Column 2 discharges as compared to the Field Test;
S-335	Operating Range for Flood Control is 6.5 to 7.5 feet, NGVD May be used to provide Supplemental Deliveries to Taylor Slough, Florida Bay, and Manatee Bay (up to 250 cfs) (note: in the absence of specific criteria, these operations were not	Operating Range for Flood Control is 7.0 to 7.5 feet, NGVD S-335 operations suspended when Tail water (TW) stage equals or exceeds 6.0 feet, NGVD	Operating range for Flood Control is 6.5 to 7.5 feet, NGVD S-335 operations suspended when TW stage equals or exceeds 6.1 feet, NGVD	Operating range for Flood Control is 6.5 to 7.5 feet, NGVD S-335 operations suspended when TW stage equals or exceeds 6.1 feet, NGVD	Operating range for Flood Control is 6.5 to 7.5 feet, NGVD S-335 operations suspended when TW stage equals or exceeds 6.1 feet, NGVD

Structures	ECB19RR (Increment 1.2 with completed C-111 South Dade Construction)	ALTN2 (Round 2)	ALTO (Round 2)	ALTQ (Round 3)	ALTQ+
	included in the hydrologic modeling)	To supplement flows toward Taylor Slough and downstream systems from 01 Aug through 14 Feb, S-335 should release up to 400 cfs when S-335 HW stages are 5.3 to 5.5 feet, NGVD subject to downstream constraints: (a) L31S stage (S-176 HW) of 4.4 feet NGVD; (b) flow limits based on total S-332s pumping, consistent with S-334 (Column 2) criteria defined in the Increment 2 Operational Strategy: up to 400 cfs if combined S-332B/C/D pumping is less than 1,000 cfs; up to 250 cfs if combined pumping is less than 1,125 cfs.	To supplement flows toward Taylor Slough and downstream systems from 01 Aug through 14 Feb, S335 should: * Release up to 400 cfs when S335 HW stages are 5.3 to 5.5 feet, NGVD * Release up to full capacity when S335 HW stages are 5.5 to 6.5 feet, NGVD * Subject to HW constraint at S-176 Additionally, WCA 3A may provide a separate source of water to maintain the hydraulic ridge along the C-111 detention areas and/or provide deliveries to Taylor Slough under limited circumstances (note: in the absence of specific criteria, these operations were not included in the hydrologic modeling).	To supplement flows toward Taylor Slough and downstream systems from 01 Aug through 14 Feb, S335 should: * Release up to 400 cfs when S-335 HW stages are 5.3 to 5.5 feet, NGVD * Release up to full capacity when S-335 HW stages are 5.5 to 6.5 feet, NGVD Subject to HW constraint at S-176 Additionally, WCA 3A may provide a separate source of water to maintain the hydraulic ridge along the C-111 detention areas and/or provide deliveries to Taylor Slough under limited circumstances (note: in the absence of specific criteria, these operations were not included in the hydrologic modeling)	To supplement flows toward Taylor Slough and downstream systems from 01 Aug through 14 Feb, S335 should: * Release up to 400 cfs when S-335 HW stages are 5.3 to 5.5 feet, NGVD * Release up to full capacity when S-335 HW stages are 5.5 to 6.5 feet, NGVD Subject to HW constraint at S-176 May be Subject to Pennsuco stage limit Additionally, WCA 3A may conditionally provide a separate source of water to maintain the hydraulic ridge along the C-111 detention areas and/or provide deliveries to Taylor Slough under limited circumstances

Structures	ECB19RR (Increment 1.2 with completed C-111 South Dade Construction)	ALTN2 (Round 2)	ALTO (Round 2)	ALTQ (Round 3)	ALTQ+
C-111 South Dade (S-332B/C/D)	Maintain local flood risk management Slightly Lower canal elevations than 2012 Water Control Plan, consistent with Increment 1.1 and 1.2 after completed C-111 South Dade construction: 4.2 to 4.8 feet NGVD Stage Constraint in NDA/SDA: 2.5 feet, NGVD	2012 Water Control Plan with 0.25' lower S-332D operating range. Operating Ranges: 4.25 to 5.0 feet, NGVD No Stage Constraint in NDA/SDA	South Dade Investigation Study with CSSS seasonal constraints Similar to Increment 1.1 and 1.2: 3.8 to 4.8 feet, NGVD with seasonal variability (minor decrease from 2012 Water Control Plan) No Stage Constraint in NDA/SDA	Informed by SFWMD 2016-2017 South Dade Investigation Study with CSSS seasonal constraints Similar to Increment 1.1 and 1.2: 3.8 to 4.8 feet, NGVD with seasonal variability (minor decrease from 2012 Water Control Plan) No Stage Constraint in NDA/SDA	Informed by SFWMD 2016-2017 South Dade Investigation Study with CSSS seasonal constraints Similar to Increment 1.1 and 1.2: 3.8 to 4.8 feet, NGVD with seasonal variability (minor decrease from 2012 Water Control Plan) No Stage Constraint in NDA/SDA
Supplemental Flows to Taylor Slough	Up to 250 cfs for up to 8 weeks of the year	Up to 250 cfs	Up to 300 cfs	Up to 300 cfs	Up to 300 cfs
S-357	S-357 discharges into C-111 South Dade NDA. Dependency on S-331 to provide 8.5 SMA flood mitigation, with S-357 as secondary. Operations maintain consistency with Increment 1.1 and 1.2 following assumed operation of the C-111 South Dade NDA: C-357 range 3.5-6.0 feet, NGVD (limit to 500 cfs)	Operating range of Increment 2: 3.5 to 6.0 feet, NGVD; No limit (575 cfs) S-357 is Primary water control structure for flood mitigation in the 8.5 SMA. S-331 can be used to support S-357 to ensure 8.5 SMA flood mitigation.	Operating range of Increment 2: 3.5 to 6.0 feet, NGVD; No limit (575 cfs) S-357 is Primary water control structure for flood mitigation in the 8.5 SMA.	Operating range of Increment 2: 2.3 to 6.0 feet, NGVD; No limit (575 cfs) S-357 is Primary water control structure for flood mitigation in the 8.5 SMA. S-331 can be used to support S-357 to ensure 8.5 SMA flood mitigation.	Operating range of Increment 2: 2.3 to 6.0 feet, NGVD; No limit (575 cfs) S-357 is Primary water control structure for flood mitigation in the 8.5 SMA. S-331 can be used to support S-357 to ensure 8.5 SMA flood mitigation.

Structures	ECB19RR (Increment 1.2 with completed C-111 South Dade Construction)	ALTN2 (Round 2)	ALTO (Round 2)	ALTQ (Round 3)	ALTQ+
S-331	Operating range from 3.5 to 5.0 feet, NGVD, dependent on LPG-2 stage condition (when LPG-2 > 5.5 feet, NGVD); when LPG-2 < 5.5, minimum operating range is 5.0 feet, NGVD	Operating range of Increment 2: 3.5 to 6.0 feet, NGVD; No limit (575 cfs) S-357 is Primary water control structure for flood mitigation in the 8.5 SMA. S-331 can be used to support S-357 to ensure 8.5 SMA flood mitigation.	Operating Range from 4.5 to 5.0 feet, NGVD (14 Feb to 31 July). Operating Range from 4.3 to 4.6 feet, NGVD (01 Aug to 01 Jan), with transition operations. Independent of stages within 8.5 SMA.	Operating Range from 4.5 to 5.0 feet, NGVD (14 Feb to 31 July). Operating Range from 4.3 to 4.6 feet, NGVD (01 Aug to 01 Jan), with transition operations. May be used to assist with 8.5 SMA flood mitigation when G-3273 > 7.5 feet, NGVD and LPG-2 > 6.7 feet, NGVD for more than the maximum flood mitigation criteria.	Operating Range from 4.5 to 5.0 feet, NGVD (14 Feb to 31 July). Operating Range from 4.3 to 4.6 feet, NGVD (01 Aug to 01 Jan), with transition operations. May be used to assist with 8.5 SMA flood mitigation when G-3273 > 7.5 feet, NGVD and LPG-2 > 6.7 feet, NGVD for more than the maximum flood mitigation criteria.
S-197	Increased low-volume discharges, based on S-18C HW, S-176/S-177 flows; Moderate to High flows dependent on S-177/S-18C HW stage: Level 1 discharges limited to 500 cfs; Level 2 and Level 3 discharges unchanged from 2012 Water Control Plan	2012 Water Control Plan with level 1 limited to 400 cfs (Alt N criteria), with additional full open criteria remove level 2 and retain level 3 Level 1: If S-18C HW > 2.6 feet NGVD OR S-177 HW > 4.1: S-197 flows 400 cfs	Only use S-18C to trigger opening of S-197 When S-18C > 2.6 feet, open S-197 up to 200 cfs When S-18C > 2.8 feet, operate S197 up to 800 cfs	Only use S-18C to trigger opening of S-197. (a) When S-18C HW > 2.7 feet NGVD, open S-197 up to 200 cfs; close when S-18C HW < 2.5 feet NGVD. Flow may be adjusted from 0 to 200 cfs within the range. (b) When S-18C HW > 2.9 feet NGVD, operate S197 up to	S-18C to trigger opening of S-197 Level 1. When S-18C HW > 2.7 feet NGVD, open S-197 up to 200 cfs; close when S-18C HW < 2.5 feet NGVD. Flow may be adjusted from 0 to 200 cfs within the range. Level 2. When S-18C HW > 2.9 feet NGVD, operate S197 up to 800 cfs; reduce to

Structures	ECB19RR (Increment 1.2 with completed C-111 South Dade Construction)	ALTN2 (Round 2)	ALTO (Round 2)	ALTQ (Round 3)	ALTQ+
		Level 3: If S-18C HW > 3.3 feet NGVD OR S-177 HW > 4.3: S-197 is open fully (2400 cfs).	When S-18C > 3.3 feet, operate S197 up to 2400 cfs	800 cfs; reduce to 200cfs when S-18C HW < 2.4 feet NGVD. (c) When S-18C HW > 3.3 feet, operate S197 up to 2400 cfs; reduce to 800 cfs when S-18C HW < 2.4 ft. Operating intent is to transition down to lower flows holding S-18C < 2.4 feet NGVD. When S-331 is operating below S-331 normal operating range to assist in providing drainage to 8.5SMA then up to 200cfs can be routed to S-197 as long as S-18C HW > 2.3 feet. Priority would be to utilize available capacity at S-332B/C/D, S-199, S-200 prior to opening S-197.	200cfs when S-18C HW < 2.4 feet NGVD. Level 3. When S-18CHW > 3.3 feet, operate S197 up to 2400 cfs; reduce to 800 cfs when S-18C HW < 2.4 feet. Operating intent is to transition down to lower flows holding S-18C < 2.4 feet NGVD. When S-331 is operating below S-331 normal operating range to assist in providing drainage to 8.5SMA then up to 200cfs can be routed to S-197 as long as S-18C HW > 2.3 feet. Priority would be to utilize available capacity at S-332B/C/D, S-199, and S-200 prior to opening S-197.

2.3 Issues and Basis for Choice

The three rounds of modeling results and formulation was analyzed by the PDT, public and the following sub-teams: Eco, Flood Risk, Water Quality, and Water Supply. Selection of the preferred plan included the elimination of Round 1 and Round 2 alternatives through the planning process as detailed above and for the following reasons:

Round 1: Based on PDT and public input ALTK was the worst performer for meeting project objects overall but the operations south of S-331 were preferred. ALTL was the best performer for WCA 3B and the operations were preferred north of S-331. The preferred operations of ALTK and ALTL were combined to create the Round 2 ALTO. ALTN was the best overall performer and was used as a basis ALTN2 but the identified areas of concern, Northern WCA 3A and the Everglades Complex of Wildlife Management Areas (EWMA) closures, were tweaked in Round 2. During the formulation process the authority to use structures for flood mitigation was brought up for the S-331 and S-334 structures. The S-331 has been modified throughout various GDMs and other reports in accordance with the Chief's discretionary authority and subsequent Congressional authorizations. Flood mitigation for S-331 is discussed within the Final Integrated GRR and EIS, C-111, South Dade County, Florida, May 1994, authorized in Water Resources Development Act (WRDA) of 1996, PL 104–303, October 12, 1996. Because this report was authorized by Congress, S-331 is authorized for flood mitigation.

The S-334 has been modified throughout various GDMs and other reports in accordance with the Chief's discretionary authority and subsequent Congressional authorizations.

Everglades National Park Protection and Expansion Act of 1989, PL 101-229, December 13, 1989, is "[a]n Act, to modify the boundaries of the Everglades National Park and to provide for the protection of lands, waters, and natural resources within the park, and for other purposes." This Act changed both the 1968 plan for the water supply to the Everglades National Park (Modified Water Deliveries to Everglades National Park) as well as the C-111 South Dade Project.

As a result of PL 101-229, the Corps of Engineers prepared the GDM and EIS, Modified Water Deliveries to Everglades National Park, June 1992, which modified S-334.

Because this GDM was authorized by the Chief of Engineers, in accordance with the Chief's discretionary authority under Section 203 of the Flood Control Act of 1954, S-334 is authorized to be used for flood control.

Round 2: Based on PDT and public input for meeting project objectives, ALTO was the best performer overall and was therefore used as the base to carry forward to Round 3 modeling. ALTN2 when compared to ALTO did not fully meet project objectives and did not provide enough flows to NESRS and resulted in unacceptable ecological impacts due to dry events in WCA 3A.

Round 3: The Round 3 ALTQ was analyzed by the PDT, sub-teams and the public. Input was also provided by the PDT and the public which aided in the generation of the sensitivity runs that were modeled off of ALTQ. All of the team input and sensitivity run models assisted in the refinement of ALTQ which ultimately led the team to the preferred plan, ALTQ+. ALT Q+ best meets the project objectives, constraints, and the project purpose.

2.3.1 Round 1

The ecological evaluation utilized RECOVER approved performance measures that have been used in prior South Florida Planning studies. **Table 2-3** presents a cross-walk between the project objectives and project performance measures. Project performance measures were identified as being able to evaluate a project objective, if a score from the regional hydrologic model was available for a given area (i.e. indicator region (IR) or transect). **Table 2-4** provides a brief description of each performance measure. The Eco sub-team concluded that each Round 1 alternative provides benefits to NESRS, Central Shark River Slough and Taylor Slough respective to the No Action Alternative (existing condition). There was similar performance of ALTs K, L, and N for several performance measures and performance indicators. However, ALTN was the best overall performer by increasing flows to NESRS and Taylor Slough and increased the risk in dry downs to portions of WCA 3A and WCA 3B relative to ALTL, ALTK and the No Action. ALTN also shifts the flows eastward and restores the historic flow path to NESRS. ALTN increased the hydration of Taylor Slough, showed an increase in average annual overland flow volume across the ENP's panhandle, and showed a decrease in high volume discharges to Manatee Bay and Barnes Sound.

Table 2-3: Cross walk of project performance measures and project objectives.

Performance Measures	1i. Improve water deliveries – timing	1ii. Improve water deliveries – location	1iii. Improve water deliveries – volume	2i. Restore hydrologic conditions in Taylor Slough	2ii. Restore hydrologic conditions in Rocky Glades	2iii. Restore hydrologic conditions in eastern panhandle of ENP	3. Protect the intrinsic ecological values associated with WCA 3A and ENP	4. Minimize damaging flows to Manatee Bay/Barnes sound and increase flows through Taylor Slough and coastal
Inundation Duration in the Ridge and Slough Landscape	X	X	X	X	X	-	X	X
Number and Duration of Dry Events in Shark Slough	X	X	X	-	-	-	X	-
Slough Vegetation Suitability	X	X	X	X	-	-	X	X
Soil Oxidation	X	X	X	X	-	-	X	X
Florida Bay Salinity	X	X	X	-	-	-	X	X

Table 2-4: Project performance measures.

Area	Performance Measure	Description
WCA 3 & ENP	**Inundation Patterns** • Percent Period of Record (PPOR) of Inundation	**Above Ground Water Levels** - Measure of the duration of inundation over the period of record within WCA 3 and ENP. Desired restoration condition is to restore pre-drainage patterns of multi-year hydroperiods. Target: based on Natural System Model (NSM)*.
WCA 3 & ENP	**Hydrologic Surrogate for Soil Oxidation** • Drought Intensity Index	**Below Ground Water Levels** - Measure of cumulative drought intensity below ground to reduce exposure to peat within WCA 3 and ENP. Desired restoration condition is to restore processes that result in soil accretion. Target: based on NSM.
ENP (Northeast Shark River Slough)	**Dry Events in Shark River Slough** • Number of Dry Events • Duration of dry Events • Percent Period of Record (PPOR) of Dry Events	**Below Ground Water Levels** - Measure of number of times and mean duration in weeks that water drops below ground in NESRS. Desired restoration condition is to restore pre-drainage patterns of multi-year hydroperiods. Target: based on NSM.
WCA 3 & ENP	**Slough Vegetation Suitability** • Hydroperiod • Drydown • Dry Season Average Depth • Wet Season Average Depth	**Above & Below Ground Water Levels -** Measure to evaluate the hydrologic suitability for vegetation communities within WCA 3A and ENP. Desired restoration condition is to restore pre-drainage water patterns suitable for white water lily and slim spikerush. Target: based on NSM.
Florida Bay	**Southern Coastal Systems** • Dry Season Regime Overlap • Wet Season Regime Overlap • Dry Season High Salinity • Wet Season High Salinity	**Salinity** - Measure to evaluate suitability for flora and fauna in Florida Bay based on salinity envelopes. Target: paleo-adjusted NSM.

* Several of the performance measure targets listed within this table are based on output from the Natural Systems Model (NSM) which simulates the response of a pre-drained Everglades. Additional documentation of the NSM is available at the following web location: https://www.sfwmd.gov/science-data/nsm-model .

The Round 1 alternatives were also evaluated by the Flood Risk sub-team. The area of focus for the Flood Risk sub-team was on the South Dade Agriculture. A comprehensive evaluation of the 8.5 SMA performance compared to the flood mitigation constraint was not able to be conducted during Round 1

due to the limited resolution of the RSM-GL model to represent the 8.5 SMA features, and further analysis for the 8.5 SMA was deferred until the Round 2 modeling that included the higher resolution MD-RSM hydrologic model. The evaluation was performed on the agriculture impacts measured across three land use types: Row Crops, Fruit Crops and Container Crops – each of which has a unique ground water stage and duration of thresholds at which point damage was calculated. The row crops have four distinct thresholds: 2 inches, 12 inches, 18 inches and 24 inches. For the 2 inch threshold the damaging event occurs within 24 hours while the other three thresholds the damaging event occurs within 48 consecutive hours. The fruit crops have a 24 inch threshold of 24 consecutive hours. And the container crops have a 0 inch threshold for 48 consecutive hours. The most susceptible crop type was used for establishing the thresholds. Residential impacts were calculated at an 18 inch threshold for 24 hours. A damaging event was counted as soon as any of the thresholds were exceeded. The hydrologic model used for Round 1 evaluation was the RSM-GL. As with the Eco sub-team the alternatives were compared to the Existing Condition/No Action baseline. The results of the Round 1 modeling showed that no single alternative performed best throughout the system. ALTs K and ALTL had a few areas that had higher risk of constraint violation. ALTK specifically included a trigger to reduce flows to NESRS that is only a slight departure from the historical strategy of limiting releases into NESRS with the intent of limiting flood risk to Miami Dade County. The flood risk analysis indicated that maintaining this trigger did not produce an enhancement of flood risk across all of the agricultural areas of Miami Dade County. There was very little risk to residential indicator cells from the Round 1 modeling.

Agency and public stakeholder input is an integral part of the formulation process and was collected after the results of the Round 1 modeling were presented. A PDT meeting was held where all the results from the Modeling, Eco, and the Flood Risk sub-teams were presented. The agencies were provided comment sheets with a map of the average annual hydroperiod difference (reference **Figure 2-2**). Along with, large print outs of the system and structures map. The agencies were asked to fill out the comment sheets with notes next to the region highlighting something that worked well with the respective alternative or something that did not work. The comment sheets provided were for the No Action/Existing Condition, Alternatives ALTK, ALTL and ALTN.

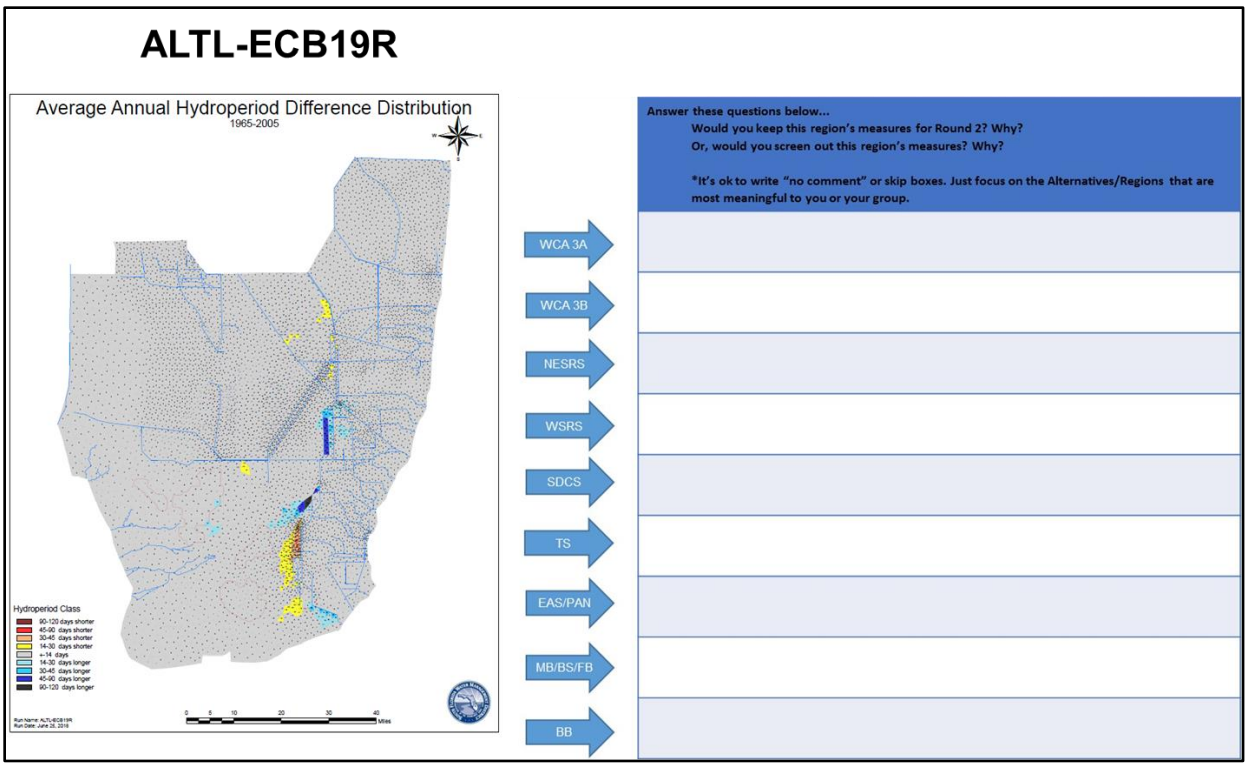

Figure 2-2: Example of comment sheet.

The agencies were asked to participate in a "sticky dot" exercise which utilized the large system and structure maps. Each agency was given a set of colored sticky dots, orange represented ALTN, blue represented ALTK, and green represented ALTL. The team was asked to place the corresponding alternative/color sticky dot on the map where they liked the performance best. See **Figure 2-3**.

Figure 2-3: Sticky dot exercise results

The results of the sticky dot exercise revealed the general consensus was that ALTN was the overall best performer throughout the system. However it also showed that ALTL performed quite well in the northern portion of the system, north of S-331, while ALTK was preferred in the South Dade agriculture area, south of S-331. Based on these results ALTN was carried forward to Round 2 and a hybrid of ALTK and ALTL was generated for Round 2. The operations that were preferred in ALTL in the northern portion of the system were carried forward while the operations in the southern portion of the system for ALTK were also carried forward, this combination created ALTO. Based on PDT feedback from the comment sheets and input from the public PDT meeting, minor tweaks to "fix" the areas of concern (for example: Northern WCA 3A and the EWMA closures) were made to ALTN which generated ALTN2. Therefore the alternatives that were carried forward to Round 2 were ALTN2 and ALTO.

The general comments received from the stakeholders and the PDT were to:

- increase flow to Taylor Slough/Florida Bay,
- consider water quality,
- fix the areas at risk for the South Dade agriculture,
- closures of the S-12s/ESA/ CSSS,
- reduce hydroperiods in western SRS,

- use caution with the use of the S-197 structure,
- retain the action line and emergency high water action line in WCA 3A, and a comment from the FDACS was that one of the Round 2 alternatives needs to include operations in South Dade as defined by the SFWMD's South Dade Investigation Study.

2.3.2 Round 2

As was with Round 1 alternatives, the Round 2 alternatives were evaluated by the Eco sub-team and the Flood Risk sub-team. The results were presented at a public PDT meeting and input informing the formulation for the Round 3 refinement was gathered.

To evaluate the Round 2 alternatives the Eco sub-team looked at the performance measures and used a suite of ecological planning tools that are developed by a joint ecosystem modeling group. These are the Marl Prairie habitat suitability model, the CSSS helper, the Apple Snail population model, the WADEM (Wading Bird Distribution Evaluation Model) which is a wading bird model, the small fish density and the alligator suitability model. Reference **Appendix E.1** (**Ecological Evaluation of Round 1, Round 2, and Round 3 Alternatives**) for further details. The same performance measures analyzed in Round 1 were utilized throughout the plan formulation process to maintain consistency of analysis. The inundation duration in the ridge and slough landscape performance measure showed that ALTN2 and ALTO increased the water stages in ENP on average while the stages in Taylor Slough increased to a lesser extent on average. However, the stages were slightly higher for ALTO. Both ALTN2 and ALTO performed similarly for the number of duration of dry events in SRS. With regards to the soil oxidation performance measure there were slight differences among the alternatives in WCA 3A, ALTO was preferred for WCA 3B, within ENP ALTN2 performed slightly better for NESRS and central SRS while ALTO performed slightly better in southeast Taylor Slough. The slough vegetation suitability performance measure indicated that ALTO performed best for WCA 3 and ENP both alternatives showed slight additional drying risks in WCA 3B. The Florida Bay Salinity performance measure showed that ALTO yielded higher flows down Taylor Slough and the ENP panhandle. There was a very slight difference between ALTN2 and ALTO with regards to the EWMA potential closures. And as for the use of the S-18C and the S-197 structures ALTO was the overall best performer allowing for the most overbank flow and the least days of daily flow distribution from the S-197.

The hydrologic models used for the Round 2 alternatives flood risk evaluation were the RSM-GL and the MD-RSM. A detailed overview of the COP hydrologic modeling tools, including the RSM-GL, MD-RSM, and iModel, and modeling sequence is included in the COP Modeling Strategy in **Appendix H, Annex 1**, consistent with briefings provided to the interagency PDT. The Miami-Dade sub-regional application of RSM is a model designed to investigate current and future operational alternatives for flood control and water supply in South Miami Dade County. MD-RSM was designed to overcome some of the limitations of the RSM-GL model to simulate at a sub-daily time-step water supply and flood control operational strategies considered in the South Dade Conveyance System and the C-111 Spreader Canal Project. The model development and calibration for the MD-RSM was completed by SFWMD and reviewed by the CERP Interagency Modeling Center concurrent with the COP Round 1 modeling. The MD-RSM model allows for comparing alternatives to the 1994 C-111 South Dade GRR base condition in addition to ECB19RR. The MD-RSM simulation period include individual wet, dry and average years using a sub-hourly time step. This additional degree of model resolution allowed the Flood Risk sub-team to verify that the constraints are not being violated by any of the alternatives (i.e. conditions for flood risk management are not worse than the 1994 C-111 South Dade GRR performance for the South Dade basins and not worse than the 1983 base condition for the 8.5 SMA). Also with the use of the MD-RSM a greater level of detail is possible

for the specific ground water stage thresholds to demonstrate a more detailed difference map amongst the alternatives. For further details regarding the evaluation methodology for the Flood Risk sub-team reference **Appendix I** (**Socioeconomics**). The flood risk analysis showed that ALTN2, ALTO and ECB19RR all satisfy the 1994 C-111 South Dade GRR constraint. ALTO provided significant improvements in flood risk as compared to the 1994 C-111 South Dade GRR operations. The bedding height increases can dramatically reduce flood risk in most areas even when compared to ECB19RR. This analysis not only was utilized for informing plan formulation for the COP, but also satisfied the requirements for assisting with ultimately closing out the authorities for the MWD to ENP and the C-111 South Dade foundation projects. A detailed evaluation of the 8.5 SMA flood mitigation constraint using the MD-RSM simulation results (refer to **Appendix H**, **Annex 6**, **Section H-6.5**) indicated that the 8.5 SMA Congressionally-authorized Flood Mitigation constraint compliance is achieved for all interior 8.5 SMA locations, consistent with methodology applied for the 2000 8.5 SMA GRR. However, during the subsequent Round 3 alternative modeling for ALTQ, an error with the Round 2 MD-RSM modeling was identified where only the WCA 3A releases associated with the TTFF were delivered into NESRS via the S-333 gated spillway. WCA 3A Regulatory discharges, which supplement the TTFF environmental deliveries when WCA 3A stages exceed Zone A of the Regulation Schedule under both ALTN2 and ALTO, were correctly included in the RSM-GL Round 2 modeling but these supplemental inflows to NESRS were not included in the MD-RSM modeling of the Round 2 alternatives. The result of this error correction was an average stage increase of approximately 0.3 feet for NESRS across the entire 2005-2006 wet year, with a more localized increase of approximately 0.5 feet within the L-29 canal prior to the significant rainfall event associated with Hurricane Katrina in late August 2005; correction of this error with the Round 3 modeling resulted in a revised performance assessment for the 8.5 SMA flood mitigation constraint, as fully documented in **Appendix H**, **Annex 6**, **Section H-6.6**.

In order to gather stakeholder and PDT input with regards to the performance of ALTN2 or ALTO, the comment cards with maps were provided as was done for Round 1. Not only was everyone asked to provide feedback for which alternative performed best in each region but they were also asked to provide feedback of the overall best performing alternative. Input provided by the PDT and the stakeholders was that ALTO was better overall, a step in the right direction, needs to provide further flow to Taylor Slough and there is still room to do more. However, ALTN2 performed better for Biscayne Bay. ALTO was carried forward to Round 3 as the best performer based on the PDT input. General comments provided by the PDT were to:

- Increase flows to Florida Bay,
- Florida Bay is dying and it needs more freshwater,
- Florida Bay is very important to the economy, Florida Bay needs fresh water specifically in the dry season, and fresh water is needed in Central Bay.
- Increase clean, fresh water into Taylor Slough.
- There are concerns with water quality.
- Need to consider sea level rise.
- Consider water supply/salt water intrusion/and the economic impact.
- There are agricultural concerns with the economic analysis.
- And to consider S-18C incremental testing.

SENSITIVITY RUNS

The team conducted a round of sensitivity runs to complement the Round 2 alternatives analysis and inform the formulation for the Round 3 alternative. The RSM-GL was applied to this set of sensitivity runs. The Round 2 sensitivity runs were included to address input provided by the PDT and stakeholders, which were not included in the Round 2 alternatives, and were presented to the overall PDT for potential inclusion to the Round 3 alternatives. Documentation of the sensitivity run scope and rationale is provided in **Appendix H, Annex 4**. This analysis was presented to the PDT along with the sub-team analysis results. Two general categories of sensitivity runs were defined for the COP: (1) EIS Support — scenarios which assess uncertainties with an implementable plan, and/or for inclusion in adaptive management; and (2) Non EIS Support — not considered in the implementable plan or for inclusion in adaptive management but provides valuable near future information.

The list of four sensitivity runs included:

(1 & 2) Conditional Closures for the S-12s to be applied to both ALTN2 (SR1) and ALTO (SR2).

(3) Lower Canal Levels in South Dade, applied to ALTN2 only as SR3.

(4) Refinement of operational criteria for coastal divide structures to opportunistically provide improved timing and spatial distribution of flows to Biscayne Bay, applied only to ALTO as SR4.

SR1 and SR2 utilized targets from the iModel (reference **Appendix E.2** (**Supporting Information**) for further details regarding the iModel) versus the prescribed seasonal closure dates at the S-12A/B, S-343 A/B, and S-344 which are currently required through the 2016 ERTP BO. The iModel applied spatial targets for the CSSS performance derived from analysis that was performed by the Eco sub-team. Based on an analysis performed by the Eco sub-team SR1 and SR2 increased the risk of reduced hydroperiods and stages within portions of central WCA 3A and northern WCA 3B, while increasing hydroperiods and stages within the vicinity of the CSSS-Ax population.

SR3 revised operational criteria for structures between S-331 and S-177 to match lower canal levels as was modeled in ALTO for the South Dade Canals. This sensitivity run was in response to stakeholder input received as well as the planning consideration to explore opportunities to enhance flood control and mitigation. Based on an analysis performed by the Flood Risk sub-team, SR3 and ALTN2 performed very similarly.

SR4 was developed in response to recommendations from the Eco sub-team to better balance existing flows to Biscayne Bay. Under the existing condition, flows to Biscayne Bay predominantly enter the northern part of the Bay and occur during storm events when large volumes of water from WCA 3 are routed down the Miami Canal to reduce flooding risks. The COP identified the opportunity to better balance flows across Biscayne Bay, by setting a goal to increase the volumes delivered to the southern portion of the Bay while decreasing the volumes delivered to the northern portion of the Bay. ALTO was selected to apply this sensitivity run to because it did not include supplemental regulatory deliveries from WCA 3A to the SDCS. Due to the limited scope of the Round 2 sensitivity runs, additional sensitivity run placeholders were also carried forward for later consideration for the Round 3 modeling. The analysis performed by the Eco sub-team showed that SR4 increased flows to the South Bay of Biscayne Bay; however flows to NESRS and Taylor Slough were slightly decreased relative to ALT O.

Along with ALTO, SR4 as described above was also carried forward to be included in the slight modification of ALTO to form the Round 3 alternative, ALTQ.

2.3.3 Round 3

As was with the previous rounds, the Round 3 alternative was evaluated by the COP sub-teams. The sub-teams that evaluated the Round 3 alternative consisted of the Eco sub-team, the Flood Risk sub-team, the Water Supply sub-team, and the Water Quality sub-team. The Eco sub-team utilized the same performance measures utilized in the previous rounds to do their analysis along with a set of sensitivity runs performed to address ecological questions. The sensitivity runs are described below. The Round 3 ALTQ results were compared to ALTN2, ALTO and ECB19RR, for further details reference **Appendix E.1 Ecological Evaluation of Round 1, Round 2, and Round 3 Alternatives** and **Section 4** (**Environmental Effects**). For the soil oxidation performance measure ALTQ decreased the risk for soil oxidation within NESRS and central SRS, decreased the cumulative drought intensity duration within Taylor Slough, and had mixed results within WCA 3A and 3B showing somewhat higher risk than the existing condition. ALTN2 decreased inundation to the greatest extent relative to ALTO and ALTQ. For the slough vegetation suitability performance measure there were very slight differences between the alternatives but with certain indicator regions ALTO was slightly better than ALTQ. The Florida Bay Salinity performance measure had very minor differences between ALTO and ALTQ as was the situation with the EWMA potential closures. ALTQ utilized S-197 only slightly more than ALTO and was slightly less than the ECB19RR with regards to flows to Biscayne Bay. Reference **Table 2-2** for high level operational details regarding the alternatives from Rounds 2 and 3 and the Round 3 refinement.

As was mentioned above in **Section 2.1** (**Introduction**), alternative development and preliminary preferred alternative (PPA) selection was constrained by flood mitigation requirements set forth by the 83Base and 94Base conditions. There was also a planning consideration to enhance flood mitigation as compared to ECB19RR so long as ecosystem restoration benefits were not compromised. During Round 2, ALTO and ALTN2 were compared to these base conditions and ALTO was determined to be a better performer than ALTN2. Both alternatives satisfied the constraint condition but ALTO had a slightly greater decrease in flood risk compared to ALTN2. Both alternatives in this round increased risk in certain economic reaches as compared to ECB19RR, but ALTO had a lesser increase. These results are demonstrated in **Section 4** (**Environmental Effects**) as well as more thoroughly detailed in the Socioeconomic (**Appendix I**).

ALTQ showed a systematic and significant reduction of flood risk as compared to the constraint base conditions and also showed a general reduction of risk compared toECB19RR. However, significant hydro-period extensions were evidenced at the ENP buffer locations immediately west of the 8.5 SMA (governed by the 83Base). There is uncertainty with the MD-RSM model predictions and topography which warranted further constraint checks at the LPG-2 gage. Continued assessment was required for the Round 3 alternative. However, it was important to note that the economic impact analysis indicated that structure first-floor elevations (FFEs) were not impacted by any increases in peak stage condition and therefore there was no increase in structural damages by any of the alternatives.

<u>SENSITIVITY RUNS</u>

Following completion of the formulation for the Round 3 ALTQ and review of the comments provided by the PDT, stakeholders and public; a limited number of sensitivity runs were identified to complement the

Round 3 ALTQ. The RSM-GL was applied for this set of sensitivity runs, with one additional sensitivity run also conducted using the MD-RSM.

(1) SRQ1, relax the L-29 FDOT constraint. Based on the Increment 2 operational strategy limit of 90 days per water year with stages above 8.3 feet, NGVD, all of the COP action alternatives limited the L-29 canal maximum operating limit to 8.5 feet, NGVD during October through February and 8.25 feet NGVD for the remaining 8 months of each year. The maximum L-29 stage constraint is limited to 8.5 feet, NGVD, consistent with the prescribed constraint. The same sensitivity run was also conducted with the MD-RSM, to support the 8.5 SMA flood mitigation evaluation, referred to as SRQm1. The Eco sub-team analysis of SRQ1 showed that it provided additional hydrologic benefit to portions of ENP, including NESRS and Taylor Slough by removing the L-29 canal constraint that limits the duration at which the maximum operating limit can be held at 8.5 feet, NGVD. The SRQm1 showed very similar flood risk results to ALTQ with very little difference. The constraint conditions were satisfied by SRQm1 and most economic impact reaches showed reduced risk as compared to ECB19RR.

(2 & 3) SRQ2 and SRQ3, operational scenarios recommended by the COP Water Quality sub-team. These sensitivity runs were proposed to evaluate whether water quality performance could be improved (lower total phosphorus concentrations in the ENP inflows). Both of the sensitivity runs are a combination of concepts to reduce dry out conditions in the WCAs and defer some of the dry-season deliveries to ENP until the following wet season. SRQ2 has a minimum flow of 150 cfs, defers flow releases to S-12 and S-333 primarily in the late dry season and early wet season in dry years when phosphorus spikes at the SRS inflow structures are typically observed. SRQ3 has a minimum flow of 150 cfs, potentially being implemented on 1 December if the three gage average is at 10 feet or below, which reduces the dry-season recession rates in WCA 3A to reduce the frequency of low-stage conditions associated with phosphorus spikes in dry years. Each of the sensitivity runs shifted approximately 25% of the ALTQ flows from S-12D (representative of canal flow) to S-12C (representative of marsh sheet flow). There was no net reduction in the average total volume of inflows delivered to NESRS or SRS as a whole due to the implementation of these water quality strategies. The SRQ2 and SRQ3 water quality sensitivity runs indicated improved water deliveries to the SRS as compared to ALTQ for the 2018 (modeled for that specific year) and 2023 (modeled for that specific year) scenarios and provided potential water quality improvements over ECB19RR for the 2023 scenario. Specifically the annual flow weighted mean (FWM) for total phosphorus (TP) was decreased by .4 parts per billion (ppb) and .3 ppb annual FWM TP for SRQ2 and SRQ3 respectively as compared to ALTQ for the 2018 scenario. Additionally the excess TP above 8 ppb delivered to the ENP SRS was reduced by 578 kg TP for SRQ2 and 393 kg TP relative to ALTQ for the 2018 scenario. SRQ2 and SRQ3 provided small improvements over ECB19RR for the 2023 scenario with regards to annual flow weighted (0.2ppb/0.1 ppb FWM less for the SRQ2 and SRQ3 run respectively). Additionally the excess TP load above 8 ppb relative to ECB19RR was reduced by 368 kg TP and 188 kg TP for SRQ2/SRQ3 respectively for the 2023 scenario.

(4) SRQ4. SRQ4 is a conditional opening for S-344 and removal of the seasonal CSSS constraints at S-332D. SRQ1 and SRQ4 decreased structure flow through the S-197 relative to ECB19RR but they both performed similarly to ALTQ. SRQ4 decreased the structure flow to a greater degree, 1,000 acre feet per year less than ALTQ. Relative to ALTQ, SRQ4 showed increased flow toward and higher stages in Taylor Slough. The Eco sub-team analysis showed that SRQ4 provided additional hydrologic benefit to portions of Taylor Slough by removing the S-332D constraint that currently restricts pumping capacity during the CSSS nesting season.

(5 & 6) SRQ5 and SRQ6. These are two operational scenarios which include a low water action line recommended by the COP Water Supply sub-team. The Water Supply sub-team presented to the PDT that when stages in WCA-3A decline below pre-defined stages, water supply deliveries are at an increased risk and additional recession management measures could be warranted. Therefore, these two sensitivity runs explored if the proposed operations substantively increased water deliveries to ENP as was shown in ALTO without creating additional risk to water supply beyond the existing base condition. SRQ5 used the low water action line and the TTFF including flows to ENP not exceeding 100 cfs. SRQ6 used a different low water action line and the TTFF and maintained 100 cfs to ENP. The Water Supply sub-team determined that ALTQ mirrored the base condition at the previous areas of concern and no change was evident for the sensitivity runs. Based on the ALTQ results, it was decided by the Water Supply sub-team that the low water action line did not need to be formally implemented for the COP.

SRQ1 and a modified SRQ4 which maintained the conditional opening for S-344 but does not remove the CSSS constraint at S-332D was carried forward into the refinement of ALTQ to the preferred plan (ALTQ+) and SRQ2 and SRQ3 were carried forward to the consideration in the COP AMMP (reference **Appendix C**).

The SFWMD performed a sensitivity model run based on ALTQ which looked into the feasibility of refining the WCA 1 and WCA 2A regulation schedules. The goal was to confirm the robustness of ALTQ if some of the upstream sources of water flows changed and to provide insight into the potential to refine the regulation schedule in the future. Current regulation schedules for WCA 1 and WCA 2A have hydrologic induced challenges resulting in documented impacts to the observed system and that have also been identified in planning studies over the last several years (Sklar et al. 2002). Changes to the WCA 1 and WCA 2A regulation schedules, as modeled in sensitivity run based on ALTQ are outside the scope of this EIS and therefore were not incorporated into the proposed action. In the future, a more thorough planning study will need to be conducted to refine one or both WCA 1 and WCA 2A regulation schedules. This includes coordination with Federal and state agencies as well as Tribal partners, stakeholders and interested parties of the public. Additional NEPA will need to be conducted to implement a future change to the Water Control Plan to incorporate proposed regulation schedule changes for WCA 1 and WCA 2. A plan to conduct such a study (how, when, who, etc.) has not been identified.

2.4 Alternatives Eliminated from Detailed Evaluation

ALTs K, L, and N were eliminated from detailed evaluation for the reasons outlined above. ALTs N2, O, Q, and Q+ were carried forward through the environmental effects analysis in **Section 4** (**Environmental Effects**).

2.5 Preferred Alternative

Three rounds of hydrologic modeling of all possible variations and combinations were conducted during development of the COP, consistent with the COP hydrologic modeling strategy that was vetted through the COP interagency PDT. Given consideration of the purpose and limitations of the hydrologic modeling tools applied for the COP, it is not feasible nor practical to conduct hydrologic modeling of all variations and combinations of the COP operational criteria. Water managers additionally require some degree of latitude to evaluate real-time hydrologic conditions and forecast information to effectively operate the complex C&SF System, based on adherence to the established objectives and constraints which govern the COP implementation. The level of detail included in the operational criteria table for ALTQ was appropriate for distinguishing between alternatives evaluated during the hydrologic modeling phase of project development. In addition to ALTQ, Round 3 sensitivity runs were conducted with both RSM-GL

and MD-RSM to investigate other potential operational components for considerations within the Preliminary Preferred Alternative; information gained from these sensitivity runs was leveraged to develop ALTQ+. No additional hydrologic modeling was conducted for the COP, aside from the MD-RSM design storm analysis (conducted starting from the MD-RSM representation of ALTQ, including high water operations using S-331 for 8.5 SMA flood mitigation – simulation ALT Qm) to support the socio-economic evaluation of the South Dade Basin.

Throughout the interagency alternative formulation process and hydrologic modeling efforts, the USACE had recognized and communicated to the PDT the need to translate operational criteria appropriate for distinguishing between modeled alternatives into more refined operational criteria suitable for inclusion in the COP Water Control Plan. Due to the wide breadth of alternatives that were evaluated during the COP, the prerequisite for further development of the COP Water Control Plan was the formal identification of the preliminary preferred alternative based on consideration of evaluation results and interagency PDT review comments. Starting from the ALTQ+ preliminary preferred Alternative (refer to **Appendix H, Annex H-3** (**Modeling Assumptions**) (reference pages 1-5), which was briefed to the PDT throughout May and June 2019, further development of the operational table and associated Water Control Plan was conducted with additional technical input from the COP Modeling sub-team and the COP Water Management sub-team, while maintaining the operational intent and operational priorities established with the ALTQ+, the preliminary preferred plan.

ALTQ+ includes the following additions, compared against the modeling simulations of ALTQ conducted during the Round 3 modeling:

(1) Capability to further extend and/or remove the 90-day annual cumulative duration limitation for operating the L-29 canal above 8.3 feet, NGVD (referenced as the FDOT roadway constraint), while continuing to adhere to the maximum operating stage limit of 8.5 feet, NGVD (included in RSM-GL Round 3 sensitivity simulation SRQ1).

(2) Removal of seasonal closures for S-344 (included in RSM-GL Round 3 sensitivity simulation SRQ4).

(3) Removal of seasonal pumping capacity restriction for S-332D during the month of December (included in RSM-GL Round 3 sensitivity simulation SRQ4, which additionally removed S-332D seasonal pumping capacity restrictions during January through 14 July).

(4) Additional operational flexibility within the COP Water Control Plan to address uncertainties identified in the COP AMMP regarding: (a) water quality inflows to SRS (included in RSM-GL Round 3 sensitivity simulations SRQ2 and SRQ3); and (b) TTFF dry season operations for SRS (dry season Field Test criteria developed based on technical evaluation of RSM-GL ALT O versus ALTQ hydrologic responses within WCA 3A and ENP).

(5) Operational criteria and operational flexibility developed by the COP Water Management sub-team (and vetted through the COP PDT), as needed to effectively translate the operational intent and operational priorities established with the ALTQ+ preliminary preferred plan for inclusion in the COP Water Control Plan (the ALTQ+ table specifically identified which structures would require "further details to be developed thru the Operational sub-team."

Item 1 relates to the up-front decision by the COP formulation and modeling team that throughout the COP alternative modeling Rounds 1, 2, and 3 (ALTQ) and to ensure the safety and stability of the Tamiami Trail (US-41) Highway, the L-29 canal maximum operating stage limit was constrained to 8.5 feet, NGVD, with a maximum cumulative duration of 90 days per water year (May through April) for stages above 8.3 feet, NGVD. These operational restrictions are consistent with the coordination between the USACE and

the FDOT regarding implementation of the "Contract between the United States of America and the FDOT for Relocation, Rearrangement, or Alteration of Facilities Modified Water Deliveries to Everglades National Park Project," which was prescribed in the operational strategy for the MWD Increment 2 Field Test. For the alternative modeling simulations, the representation of this constraint assumed an L-29 canal stage constraint of 8.5 feet at the end of the wet season, for a maximum duration of 123 days from 01 October through 31 January; for the remaining months of the year, the L-29 canal stage constraint was 8.25 feet, NGVD. The four month duration (rather than 90 days) and late wet season timing was assumed for the hydrologic modeling since specific condition-based rules were not established by the COP formulation team and to ensure the ability to check whether the 90 day limit was restrictive during any specific simulated event in the modeling period-of-record.

ALTQ+ includes the capability to further extend and/or remove the cumulative duration criteria for operating the L-29 canal above 8.3 feet, NGVD (referenced as the FDOT roadway constraint), while continuing to adhere to the maximum operating stage limit of 8.5 feet, NGVD. Implementation of this change would not occur without: (1) written approval from FDOT to remove the L-29 canal constraint identified in **Appendix A** (**Water Control Plan**), based on a joint evaluation of monitoring data by the USACE and the FDOT (this data evaluation is ongoing with the MWD Increment 2 Field Test); (2) demonstration of the capability of the completed MWD project components to maintain flood mitigation requirements for the 8.5 SMA under the raised L-29 canal maximum operating limit of up to 8.5 feet, NGVD; and (3) consideration of increased low-water stages within WCA 3A, including along the western L-29 canal between S-12A and S-333. The requirement for all three pre-conditions to be met may preclude these operations during the initial implementation period of the COP, since additional inflows of treated water to WCA 3A from the upstream Lake Okeechobee and EAA basins and/or additional flood mitigation requirements may be necessary.

Independent of the COP, as Phase 2 of the Tamiami Trail Next Steps Project, the DOI is partnering with the State of Florida to re-construct the non-bridged roadway sections and to install additional bridges along the remaining portions of the Tamiami Trail roadway between S-333 and S-334 (L-29 canal reach) to accommodate the design high water stage of 9.7 feet, NGVD that is planned for full implementation of the CERP. Design efforts are ongoing concurrent with the COP, and construction completion is currently anticipated by early 2023. Completion of the roadway modifications would allow for written approval from the FDOT to remove the L-29 canal constraint identified in **Appendix A** (**Water Control Plan**), independent of the joint evaluation of monitoring data for the existing roadway by the USACE and the FDOT under the MWD Increment 2 Field Test. Since the potential raising of the L-29 canal maximum operating stage limit will not be completed prior to implementation of the COP Water Control Plan in 2020, consistent with the up-front plan formulation assumptions, the higher L-29 stage limit was not considered, modeled, or evaluated during development of the COP; regional operational changes to utilize an L-29 canal maximum operating limit above 8.5 feet, NGVD will be further evaluated during CERP implementation, given that CERP also provides additional inflows to the WCA 3A.

The Water Control Plan, reference **Appendix A**, documents the operational criteria and necessary guidance for water managers to implement the COP ALTQ+. The preferred plan promotes full utilization of completed MWD, C-111 South Dade and available CERP projects (Decomp Physical Model S-152; C-111 Spreader Canal; CEPP S-333N). The TTFF governs WCA 3A to ENP target flows, developed based on 'un-weighted' ecological restoration stage targets in WCA 3A and ENP. The L-29 canal maximum operating stage limit of 8.5 feet, NGVD (MWD), per FDOT criteria (90d/yr.), will continue to be monitored and evaluated for additional opportunities to increase the duration of these elevated stage levels In accordance with the requirements identified earlier in this section. Regulatory releases from WCA 3A to

South Dade are removed from the Water Control Plan, except during Extreme High Water Levels in WCA 3A (varies 11.0-12.0 feet, NGVD) which will occur with reduced frequency following implementation of the COP and the associated TTFF operations. The plan includes the capability to supplement local basin flows to Taylor Slough and the Rocky Glades from the L-30 canal and the adjacent WCA 3B, including conditional low-volume deliveries from WCA 3A. South Dade Canal levels are maintained consistent with MWD Incremental Field Test (0.2-0.3 lower than 2002-2015 operating levels), with full usage of completed C-111 detention areas and the SFWMD CERP C-111 Spreader canal project to function as a hydraulic ridge along the eastern boundary of ENP. Discharges at S-197 to Manatee Bay are significantly reduced with removal of S-177 criteria and use of low-volume releases. The 8.5 SMA and C-111 South Dade Basins are operated to maintain authorized flood risk management, consistent with the established project constraints.

The COP AMMP (**Appendix C.2**) was developed with the primary objective of identifying the monitoring necessary to inform decision-makers, the COP partner agencies, and the public on progress towards achieving restoration success, as well as address uncertainties related to project performance. The USACE, the SFWMD, and ENP will establish an interagency collaborative forum (referenced within the COP AMMP as the "PDT+") that succeeds the COP interagency PDT, consisting of the COP implementing agencies, oversight agencies, and stakeholder groups that will meet 1-2 times per year during implementation of the COP. Additional technical sub-teams will also be established to oversee hydrologic monitoring, coordinate data evaluations, and prepare data reports, consistent with the commitments identified in the COP AMMP. Established meetings (e.g., WCA 3 Periodic Scientists Calls (PSCs)) may also support evaluation of the COP AMMP and/or provide additional forums for periodic updates on the monitoring and assessment results. The adaptive management options associated with each uncertainty may be classified into one or more of the following categories depending on whether additional NEPA permitting and review will be required:

1. <u>Adaptive Management Options Defined in Water Control Plan and supported by EIS</u>: proposed management options in the COP AMMP are defined within the COP Water Control Plan and supported in the environmental effects analysis contained in the EIS.
2. <u>Adaptive Management Options Not Defined in Water Control Plan and not supported by EIS</u>: proposed management options in the COP AMMP are not defined within the COP Water Control Plan and are not supported in the environmental effects analysis contained in the EIS. Proposed management option may require supplemental NEPA permitting and review.
3. <u>Adaptive Management Options Not in the Authority of COP</u>: management options in COP AMMP are proposed as a subsequent planning effort and do not currently fall under the authority of the COP (i.e. would require subsequent authorization/study). May require supplemental NEPA, permitting and review

Table C.2-23 in **Appendix C.2** (**COP AMMP**) provides a cross walk of the uncertainties identified in the COP AMMP and where they fall within the above categories. Two adaptive management options have been identified as being defined within the 2020 COP Water Control Plan and supported by the Draft EIS and are as follows:

- AM Uncertainty ID #12b (Tamiami Trail Flow Formula (TTFF) and Drought): Is there an opportunity to deliver water to NESRS in a specific manner such that the delivery enhances freshwater flows to Florida Bay by delivering more water during the dry season without harming the ecological condition of WCA 3? Reference **Appendix C.2**, **Section C.2.2.4**.

- AM Uncertainty ID #16b (Water Quality in NESRS): Will there be downstream biogeochemical effects associated with modifying inflows and hydrologic conditions in ENP, that result in detrimental effects on nutrient movement, availability, and ecological responses? Reference **Appendix C.2**, **Section C.2.4.2**.

The proposed management options for uncertainty ID#12b are short duration, event-based operations in which operational constraints were developed to ensure that potential environmental effects to WCA 3 and ENP did not exceed that which was simulated under ALTO, and ALTQ, as discussed below. The TTFF Field Test was developed based on the differences in modeled performance between ALTO and ALTQ in response to stakeholder concerns regarding the timing of flow to NESRS during a transition from the wet season to the dry season. **Appendix C.2** (**COP AMMP**), **Section C.2.2** describes the criteria for the TTFF Field Test, including prerequisite triggers indicative of conditions within central SRS which support consideration of the TTFF Field Test and prescribed constraints in which the TTFF Field Test would be stopped due to concerns related to drought intensity (i.e. risk for soil consuming peat fires) in WCA 3. Implementation of the TTFF Field Test is not self-executing. At each TTFF technical sub-team meeting and the associated PDT+ meetings, the participating agencies will identify if the TTFF Field Test is possible in the upcoming wet-dry season transition as described in **Appendix C.2 (COP AMMP**), **Section C.2.2.** Although the hydrologic modeling conducted for ALTO and ALTQ provided the performance basis for the design of the TTFF Field Test, the actual implementation of the action must be done in the specific context that occurs, with specific physical limits and constraints imposed upon the test. The TTFF Field Test would be limited in duration to 6-8 week intervals.

The proposed management options for uncertainty ID#16b are short duration, event-based operations to help manage potential water quality concerns for water delivered to ENP. The quality of the water delivered to ENP has been historically affected by lower stages in WCA 3A. Water quality delivered to ENP can be influenced under some conditions by the timing of water deliveries and the location of deliveries to SRS. When stages are low in WCA 3A, S-333 HW is less than 8.5 feet, NGVD, typically phosphorus levels delivered to ENP are higher than are protective of the wetland. Additionally when the three gage average in WCA 3A stages is below 10 feet, NGVD starting Dec 1st, water quality delivered to ENP in the upcoming wet season historically had higher phosphorus concentrations than protective of the receiving marsh. To help manage potential water quality concerns for water delivered to ENP before the expected upstream water quality improvement measures are fully implemented (CEPP and Restoration Strategies) there are a few water quality strategies that were evaluated. The strategies to reduce water quality concerns are: (1) limited delays/flow reductions in releases to ENP during the dry season to wet season transition; (2) shifting S-12D flows to S-12C temporarily (as S-12C water quality is typically lower in total phosphorus (TP) versus S-12D water quality); and (3) reducing dry season recession rates in WCA 3A by reducing releases from WCA3A when the three gage average is at or below 10 feet starting Dec 1st. Based on the sensitivity analysis of the modeled flows for the 40 year ALTQ simulation, these strategies were generally implemented for less than 8 weeks (mean 6 weeks) in about 75% of the years, relative to 45% during the ECB. These actions are expected to reduce high nutrient pulses to ENP during the dry season to wet season transition. The implementation of these strategies will be limited as much as practical given the needs of ENP and other stakeholders. Execution of these strategies require the tracking of water volumes that would have been delivered without implementation of these strategies with the intent to make up any temporary flow reductions during the temporary flow reduction delivery period. The need to continue the implementation of these water quality strategies is expected to no longer be necessary when certain conditions are in place. These conditions for increasing S-333/S-12D flows above 150 cfs levels after the low stage trigger of 8.2 feet, NGVD has been reached and adaptive management strategies have been

implemented for water quality are: (1) S-333_Headwater stage increases to 9.2 feet NGVD or higher or (2) S-333_Headwater stage increases 1.0 feet NGVD above the May 15th stage.

Once the WCA 3A stages decline to or below 8.5 feet NGVD at the S-333 Headwater during the dry season to wet season transition and/or the WCA 3A three gage average is at 10 feet or below on Dec 1, a water quality group (the DOI, the SFWMD, the FDEP and other agencies with expertise in water quality led by the USACE will evaluate conditions for potential recommendations to implement the above strategies. This group shall then further coordinate these recommendations to determine suitability for implementation. These strategies will only be implemented on a case by case basis and will include evaluation of the near real time water quality conditions provided by the SFWMD (preliminary water quality data from the S-333, S-152, S-12's and other appropriate structures), weather forecasts, water supply conditions etc. Recommendations from the water quality team will be shared with the USACE water managers and then brought forth to the periodic scientist meeting for WCA 3A prior to implementation of these water quality strategies. USACE, after receiving input, shall make the operational decision whether or not to implement the water quality strategy in consideration of water quality and all authorized project purposes.

The water quality adaptive management measure, if implemented, has the potential to reduce the quantity of water delivered to ENP. The water quality strategies were developed and designed to avoid any net reduction of water volumes delivered to the ENP during a given water year. The intent is that any temporary reduction in volumes delivered to the ENP due to the implementation of the water quality strategies will be accounted for/tracked and that volume will be made/released to the ENP later in the water year when water is available in the system (typically during the wet season). There is a potential that the implementation of the water quality strategies could result in a net reduction in volume delivered to the ENP during a given year if dry season conditions continued throughout the entire water year, but all efforts were made during development of the water quality management options to avoid this condition for a normal water year. During a drought year, in the absence of increased future inflows to WCA 3A, there is no means or strategy to avoid dry out conditions in the ENP or the upstream WCAs.

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3 AFFECTED ENVIRONMENT

This section describes the relevant resources of the study area that would may be affected by the alternatives described in **Section 2** (**Alternatives**) and evaluated in **Section 4** (**Environmental Effects**).

A complete description of the affected environment with respect to the Modified Water Deliveries (MWD) and C-111 South Dade projects are discussed within the Everglades Restoration Transition Plan (ERTP) Environmental Impact Statement (EIS) (USACE 2012c), the 2015, 2017, and the 2018 Environmental Assessments (EAs) for the MWD Incremental Field Tests (Increment 1, Increment 1.1 and 1.2, and Increment 2), respectively (USACE 2015, USACE 2017a, USACE 2018). Further information regarding 8.5 Square Mile Area (SMA) can be found within the July 2000 8.5 SMA General Re-evaluation Report and Final Supplemental Environmental Impact Statement (GRR/FSEIS) (USACE 2000), and 2012 design refinement for the 8.5 SMA EA (USACE 2012a). The above-mentioned projects are described in **Section 1** (**Project Purpose and Need**). Project documents are provided at the following links:

http://www.saj.usace.army.mil/About/DivisionsOffices/Planning/EnvironmentalBranch/EnvironmentalDocuments.aspx#

http://www.saj.usace.army.mil/Missions/Environmental/EcosystemRestoration/G3273andS356PumpStationFieldTest.aspx#

Information contained within these National Environmental Policy Act (NEPA) documents is hereby incorporated by reference within this Draft EIS.

The following link also provides an overview of Central and Southern Florida (C&SF) project infrastructure (pump stations, gated culverts, etc.) referenced throughout this section:

https://www.sfwmd.gov/document/facility-and-infrastructure-map-overview.

3.1 General Environmental Setting

The current extent of the Greater Everglades wetlands includes a mosaic of interconnected freshwater wetlands and estuaries located primarily south of the Everglades Agricultural Area (EAA). A ridge and slough system of patterned, freshwater peat lands extends throughout the Water Conservation Areas (WCAs) into Shark River Slough (SRS) in Everglades National Park (ENP). The ridge and slough wetlands drain into tidal rivers that flow through mangrove estuaries into the Gulf of Mexico. Higher elevation wetlands that flank either side of SRS are characterized by marl substrates and exposed limestone bedrock. Those wetland areas located to the east of SRS include the drainage basin for Taylor Slough, which flows through mangrove forests into northeast Florida Bay. The Everglades wetlands merge with the forested wetlands of Big Cypress National Preserve (BCNP) to the west of WCA 3 (**Figure 3-1**).

Declines in ecological function of the Everglades have been well documented. Construction of canals and levees by the Central and Southern Florida (C&SF) project has resulted in the creation of artificial impoundments and has altered hydroperiods and depths within the project area. The result has been substantially altered plant community structures, reduced abundance and diversity of animals, and spread of non-native vegetation.

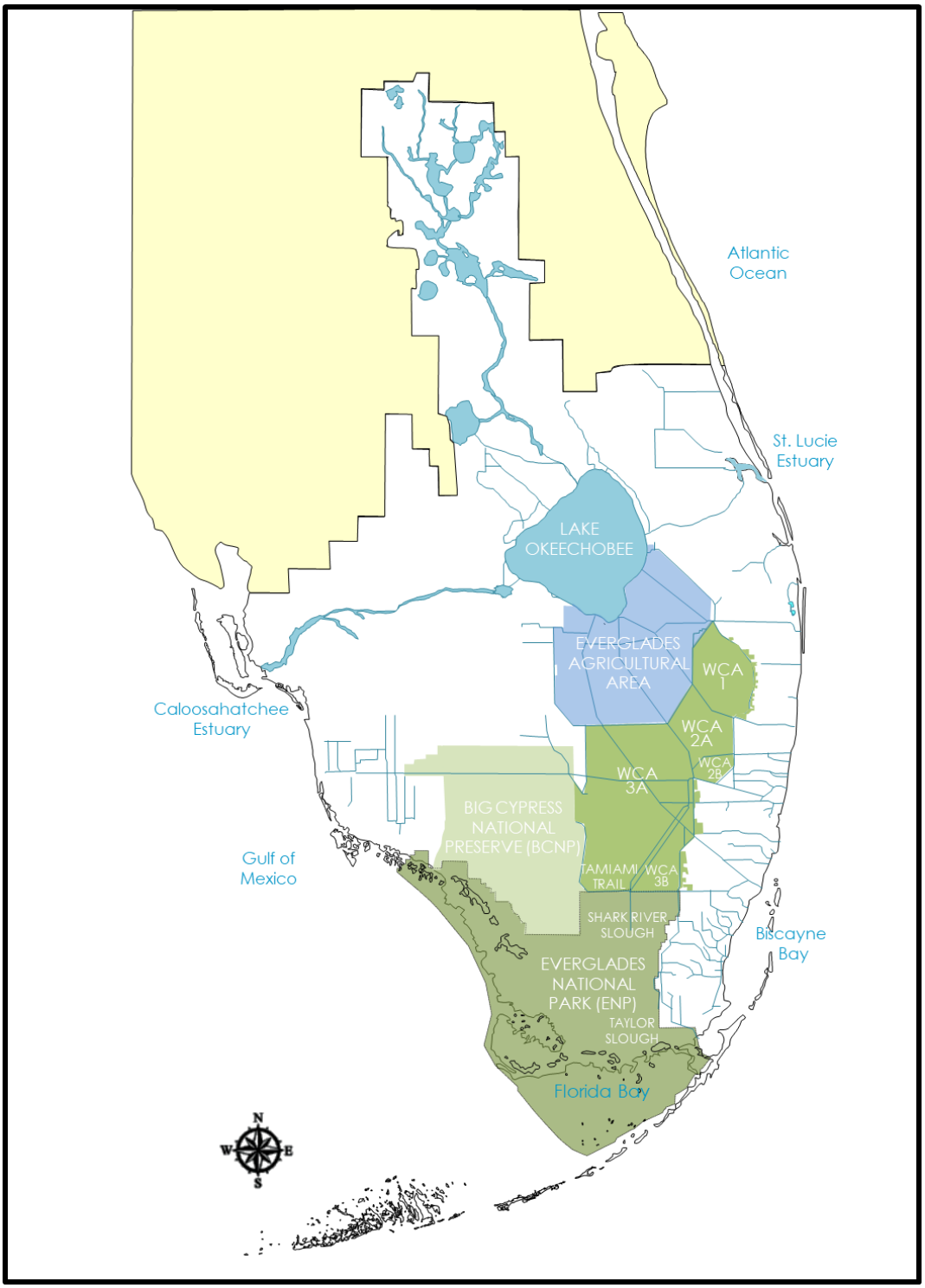

Figure 3-1. General environmental setting.

3.2 Climate

The climate of south Florida is subtropical. Seasonal rainfall patterns in south Florida resemble the wet and dry season patterns of the humid tropics more than the winter and summer patterns of temperate

latitudes. Of the 53 inches of rain that south Florida receives on average annually, 75% falls during the wet season months of May through October. Tropical storms and hurricanes also provide major contributions to wet season rainfall. During the dry season (November through April), rainfall is governed by large-scale winter weather fronts that pass through the region approximately weekly. However, due to the variability of climate patterns (La Niña and El Niño), dry periods may occur during the wet season and wet periods may occur during the dry season. High evapotranspiration rates in south Florida roughly equal annual precipitation. Mean annual temperature for the south Florida ecosystem ranges from 72° Fahrenheit (F) (22° Celsius [C]) in the northern Everglades to 76 ° F (24 °C) in the southern Everglades (Thomas 1974). There is now evidence of anthropogenic changes to global climate patterns that will likely have an impact on south Florida in terms of rainfall, evapotranspiration, temperature, and salt-water intrusion due to sea level rise.

3.3 Geology and Soils

The geology and soils of South Florida represent many of the opportunities, constraints, and impacts of regional water management. The high transmissivity of the Biscayne Aquifer allows rapid recharge of lower east coast well fields while it sets the stage for water competition between the Everglades and Biscayne Bay regarding the issue of seepage control. The loss of peat soils of the Everglades provides an indicator of ecosystem change due to drainage activities. Peat soils were predominate in previously flooded areas. Peat soils have subsided as a result of oxidation due to drainage, which has affected local topography and hydroperiods.

The lower east coast on the Atlantic Coastal Ridge is mostly underlain by thin sand and Miami Limestone that are highly permeable and moderately to well drained. To the west of the coastal ridge, soils of the lower east coast contain fine sand and loamy material and have poor drainage. Rockland areas on the coastal ridge in Miami-Dade County are characterized by weathered limestone surfaces and karst features such as solution holes and sinkholes. Higher elevation marshes of the southern Everglades on either side of SRS are characterized by calcitic marl soils deposited by calcareous algal mats and exposed lime rock surfaces with karst features such as solution pits and sinkholes.

3.4 Study Area Land Use

The existing land use within the study area varies widely from agricultural to high-density multi-family and industrial urban uses. Much of the land use change occurring in south Florida over the past several years can be categorized as either the creation of new developments in previously natural or agricultural areas, or the change in the types of agriculture practiced.

According to the 2017 Census of Agriculture[1], produced by the United States Department of Agriculture's (USDA) National Agricultural Statistics Service, Miami-Dade County is home to 2,752 individual farms operating on 78,543 acres of land. Of those acres 55,206 are cropland and, more specifically, 50,488 acres are harvested cropland. The market value of all agricultural products sold is $837.7 million, about 95% of which are from crops.

In addition to agricultural parcels, the study area has a large contingent of land under use for residential and commercial purposes. Generally, urban development is concentrated along the Lower East Coast

[1] This census is conducted every five years, making 2017 the most recent year in which the data is available.

(LEC) from Palm Beach County to Miami-Dade County. In the specific modeling domain of the Combined Operational Plan (COP) there are over 43,000 parcels of single-family residential, multi-family residential and commercial property.

WCA 3, located directly north of ENP, is part of the Everglades Complex of Wildlife Management Areas (EWMA) which are managed by the Florida Fish and Wildlife Conservation Commission (FWC). WCA 3 is used heavily for a variety of cultural practices by the Miccosukee Tribe of Florida as well as providing abundant recreational opportunities. Several airboat concessionaires are setup along the Tamiami Trail along the southern border of WCA 3.

3.5 Hydrology

The major characteristics of south Florida's hydrology are: (1) local rainfall; (2) evapotranspiration; (3) canals and water control structures; (4) flat topography; and (5) the highly permeable surficial aquifer along a thirty to forty mile-wide coastal strip. Local rainfall is the source of all of south Florida's fresh water. The surface water that is not removed from the land by evapotranspiration and seepage to the underlying aquifer is drained to the Atlantic Ocean, Florida Bay, or the Gulf of Mexico by very slow, shallow sheetflow through wetlands or relatively quickly through man-made canals.

Levees and canals constructed during the last 60 years under the C&SF project have divided the former Everglades into areas designated for development and areas for fish and wildlife benefits, natural system preservation, and water storage. The natural areas consist of the three WCAs located north of Tamiami Trail and ENP located south of Tamiami Trail. The WCAs provide detention storage for water from Lake Okeechobee, the EAA, and parts of the east coast region. Detention of water helps prevent floodwaters from inundating the east coast urban areas; provides water supply and detention for east coast urban and agricultural areas and ENP; improves the water supply for east coast communities by recharging underground freshwater aquifers; reduces seepage; and provides control for saltwater intrusion in coastal aquifers. While the WCAs may reduce the severity of the drainage of the Everglades caused by the major canal systems, thus reducing impacts to fish and wildlife caused by the major drainage systems, the levees surrounding the WCAs still function to impound the Everglades, precluding the historic flow patterns. The C&SF project infrastructure, combined with operational constraints, makes it difficult to provide natural timing, volume, and distribution. In wet periods, water is impounded in the WCAs and then discharged to ENP or coastal canals for eventual release to tide. During dry periods, water can flow through the canals to coastal areas and bypass the ENP wetlands.

3.5.1 Water Conservation Areas 3A and 3B

The largest WCA is WCA 3, which is divided into two parts, 3A and 3B. It is approximately 40 miles long from north to south and covers approximately 915 square miles. Ground elevations slope southeasterly one to three feet in ten miles ranging from 13 feet, National Geodetic Vertical Datum of 1929 (NGVD) in northwest WCA 3A to 6 feet, NGVD in southeast WCA 3B. The area is enclosed by approximately 111 miles of levees, of which 15 miles are common to WCA 2. An interior levee system across the southeastern corner of the area reduces seepage into an extremely pervious aquifer.

The upper pool, WCA 3A, provides an area of approximately 752 square miles for storage of excess water from the following sources: regulatory releases from WCA 2A; rainfall excess from approximately 750 square miles in Collier and Hendry counties (through Mullet Slough); flood control inflows from 71 square miles of the former Davie agricultural area lying east of pump station S-9 in Broward County; and excess

water from a 208 square mile agricultural drainage area of the Miami canal and other adjacent EAA areas to the north. WCA 3A provides water supply to the lower east coast, as well as the South Dade Conveyance System (SDCS), in accordance with the WCA 3A Regulation Schedule, and WCA 3A provides water deliveries to ENP in accordance with the Rainfall Formula and the WCA 3A Regulation Schedule, collectively referred to as the Rainfall Plan (USACE 2006). Due to its limited discharge capacity compared to the spatial extent of the watershed from which it receives water, consecutive rainfall events have the potential to quickly utilize potential storage within WCA 3A and result in discharges from WCA 3A to SRS and/or the SDCS via the S-12 structures and/or S-333 and S-334.

South of WCA 3 and within ENP, the northern portion of SRS is also partially divided by the remaining 5.5 miles of the L-67 extension levee, which extends south from the southern terminus of L-67A at Tamiami Trail. Outflows from WCA 3A to ENP are regulated according to the WCA 3A Regulation Schedule, with some additional WCA 3A outflows to ENP from groundwater seepage across Tamiami Trail and seasonal surface water flows through the L-28 gaps, which then continue south along the L-28 borrow canal towards the Tamiami Trail bridges west of S-12A.

Stage variability within WCA 3 typically follows an annual cycle; the levels vary from high stages in the late fall and early winter to low stages at the beginning of the wet season (typically late May or early June). Water stages within WCA 3A typically exceed the top of the WCA 3A Regulation Schedule during the months of August through October, with this duration extended to earlier in the wet season (May) and/or later into the dry season (November and December) during wet years. Above-normal rainfall patterns associated with El Niño conditions during the dry season months (November through May) may also result in water stages which exceed the top of the WCA 3A Regulation Schedule. Overall, water stage decreases from northwest to southeast within WCA 3, consistent with the general direction of surface water flow and prevailing topography within WCA 3. Water depth is typically between one to two and a half feet, with the shallower waters in the higher elevation northwestern portion of WCA 3. Water stages and depths in WCA 3B are typically much lower than water stages and depths in WCA 3A, due to limited surface water inflows into WCA 3B and the reduction of seepage from WCA 3A to WCA 3B consistent with the design purpose of the L-67A and L-67C levees. Water levels in WCA 3B are affected by seepage losses to the east towards the L-30 borrow canal and seepage losses to the south towards the L-29 canal.

Water supply deliveries from the C&SF project (also known as the Regional system) to coastal canals are utilized to recharge coastal well fields and to prevent saltwater intrusion into the Biscayne aquifer. When canal levels drop below adequate recharge levels due to a combination of well field drawdowns, evaporation, and lack of rainfall, water supply deliveries are typically made from the Regional system. When canal levels drop in Miami-Dade County, regional water supply is delivered from WCA 3A through one of two delivery routes. Depending on system conditions, both routes may be utilized concurrently. For the northern delivery route from WCA 3A, water supply deliveries are either released from S-151 to the Miami canal within WCA 3B (C-304), followed by downstream releases to either Miami-Dade County's SDCS by utilizing S-337 and/or by utilizing S-31 to release into the C-6 canal. For the southern delivery route from WCA 3A, water supply deliveries are released from S-333 (from the upstream L-67A canal), passed through the L-29 canal, and are released to the SDCS by utilizing S-334.

The most important component of the groundwater system within the study area is the Biscayne aquifer, an unconfined aquifer unit underlying an area of approximately 3,000 square miles in southeast Florida, from southern Palm Beach County southward through Broward County to South Miami-Dade County. Groundwater in WCA 3 generally flows from the northwest to the southeast, with extensive seepage across the eastern and southern levees, L-30 (southeast corner of WCA 3B) in particular. However, the

direction of groundwater flow may be locally influenced by rainfall, drainage canals, or well fields. Fluctuations in groundwater levels are seasonal. Groundwater levels within WCA 3 are influenced by water levels in adjacent canals. The Biscayne aquifer and surface water canals are hydraulically connected and therefore groundwater levels are influenced by changes in surface water canal levels. Where there is no impermeable formation above the aquifer, surface water recharges the system and the groundwater level can rise freely. In times of heavy rainfall, the aquifer fills and the water table rises above the land surface, contributing to seasonal inundation patterns throughout the area.

3.5.2 Northeast Shark River Slough

Northeast Shark River Slough (NESRS) is a complex area located in the northeast corner of ENP. It is currently the northern terminus of SRS, which is aligned from the northeast to southwest across ENP. Tamiami Trail is the northern boundary, the L-31N canal the eastern boundary, and the L-67 extension canal the western boundary of the NESRS. Prior to construction and operation of the C&SF project, NESRS would have been characterized as wet most of the year, but regional developments have reduced freshwater flow through the region. The consequence of reduced flows has been increased severity of seasonal drought and corresponding ecological risks of fire and soil loss. In addition, if historic levels are not maintained through the end of the wet season, significant reductions in surface water can occur during the dry season, below historic dry season levels.

Water enters NESRS primarily from WCA 3A via S-333, and then to the L-29 canal and subsequent passage through several sets of culverts, the one mile eastern Tamiami Trail bridge (completed as part of the MWD project in 2013), and the 2.3 mile western Tamiami Trail bridge (completed as part of the Department of Interior (DOI) Tamiami Trail Next Steps project in early 2019) under Tamiami Trail. S-355A and S-355B may also be used to deliver water from WCA 3B to the L-29 canal for subsequent passage through the bridge openings and culverts to NESRS, under conditions with a positive head between WCA 3B and the L-29 canal. The discharges made from WCA 3A through the S-12 structures and S-333 are target flows determined from the Rainfall Plan (USACE 2012c). Under the Rainfall Plan, water deliveries are computed and operations adjusted weekly, if necessary, based on the sum of two components: a rainfall response component and a WCA 3A regulatory component. When flows through the S-12 structures are determined necessary by the WCA 3A Regulation Schedule and the Rainfall Plan, water managers prioritize flow through the easternmost S-12 structures as capacity allows, in order to minimize flow through the S-12A and S-12B structures. The historical operational target flow distribution of 55% through S-333 into NESRS and 45% through the S-12 structures into ENP west of the L-67 extension levee is no longer used as a constraint governing water management operations of WCA 3A and northern ENP under the 2012 Water Control Plan (ERTP). Weekly WCA 3A water management release decisions are coordinated with ENP. Eastern portions of the ENP are also influenced by the system of canals and structures that provide flood control and water supply for the LEC urban and agricultural areas. Water management operations within NESRS have continued to change in response to the successive increments of the MWD Incremental Field Test, as discussed in **Section 3.6** (**Regional Water Management Operations**).

3.5.3 Western Shark River Slough

Western SRS located to the west of L-67 extension levee and bounded on the north by Tamiami Trail, is primarily influenced by rainfall and water management operations at the S-12 structures (A, B, C and D). Under the 2012 Water Control Plan (ERTP), the utilization of the S-12 structures and the seasonal sequential closure periods beginning from the west at S-12A (November 1 through July 15) and S-12B (January 1 through July 15) is meant to move water from WCA 3A into SRS while providing conditions for

Cape Sable seaside sparrow Subpopulation-A (CSSS-A) nesting and breeding. Releases from WCA 3A are specified by the Rainfall Plan, which includes the regulation schedule for WCA 3A and the Rainfall Formula. This Rainfall Based Management Plan consists of a rainfall-based delivery target and a supplemental regulatory component that specifies the total amount of water to be delivered to ENP in weekly volumes through the S-333 and S-12 structures; additional details for the Rainfall Plan are provided in **Section 3.6** (**Regional Water Management Operations**).

3.5.4 Rocky Glades and Taylor Slough

The Rocky Glades and Taylor Slough is in the southeast quadrant of ENP. The area through the Rocky Glades and Taylor Slough is higher in elevation compared to ground levels north, south, or west. Because of this characteristic, the area is normally drier than other areas in the ENP. The Rocky Glades and Taylor Slough are somewhat like an island or a peninsula extending from the canals into the ENP. Under the 2012 Water Control Plan (ERTP), specified C-111 Basin canal water levels/ranges and S-332D pump station operations have resulted in Taylor Slough being provided water from the C-111 Basin mainly during the wet season. During the dry season, under the 2012 Water Control Plan (ERTP), water deliveries to Taylor Slough were limited to provide conditions conducive to CSSS Sub-population C (CSSS-C) nesting (325 cubic feet per second (cfs) from December 1 – January 31; 250 cfs from February 1 – July 14).

Since completion of the S-332D Detention Area in 2003, maximum surface water flows observed at the Taylor Slough Bridge (approximately 1.8 miles downstream of the existing L-31W gap and the remnant S-332/S-332I pump stations) typically range between 250 and 550 cfs during the wet season months of June to October. The flow at Taylor Slough includes contributions from the S-332D Detention Area and flow-way, southerly flow within the remnant L-31W canal (including significant seepage inflows from the S-332D Detention Area), and drainage from the adjacent ENP wetlands. The S-332D Detention Area includes the High Head Cell (a portion of the S-327 weir was degraded by the South Florida Water Management District (SFWMD) in August 2016, as part of the C-111 South Dade project), the Cell 1 detention area, the Cell 2 detention area, and the flow-way cell.

Figure 3-2 and **Figure 3-3** provides an overview of the S-332D Detention Area and the northern reaches of the L-31W canal, including prevalent surface water flow pathways (indicated by green arrows) and seepage/groundwater flow pathways (indicated by blue arrows). Partial canal backfill and plugs within the remnant segments of the L-31W canal, which were completed by the SFWMD as part of the C-111 South Dade project in 2017, were constructed to reduce seepage losses from the S-332D Detention Area to the L-31W canal, reduce drainage of the adjacent ENP wetlands by the L-31W canal, and promote increased sheetflow to Taylor Slough. Plug locations for the northern-most 8 plugs are shown on **Figure 3-2** and **Figure 3-3** (refer to yellow boxes); 2 additional plugs are located along the southern reach of L-31W.

The Comprehensive Everglades Restoration Plan (CERP) C-111 Spreader Canal Western project components include construction of a six-mile hydraulic ridge between Taylor Slough and the C-111 canal to reduce seepage loss from Taylor Slough and its headwaters. The hydraulic ridge has been created by constructing a 590-acre aboveground detention area in the Frog Pond area (south of S-332D) and by installing two 300 cubic feet per second (cfs) pump stations (S-199 and S-200; capacity increased from 225 cfs at each pump station during 2018), and integrating other C-111 Spreader Canal Western project features. The SFWMD initiated operation of the C-111 Spreader Canal Western project constructed components in June 2012. As part of the SFWMD Florida Bay Initiative to increase freshwater flows from Taylor Slough to Florida Bay, the G-737 culvert was completed in July 2017 to connect the C-200 Header Channel (with inflows from the S-200 pump station) to the L-31W canal (refer to **Figure 3-3**).

The operations of the SFWMD C-111 Spreader Canal components were included in the hydrologic modeling conducted in support of the COP, but no changes to the current FDEP permitted operations were evaluated with the COP alternatives.

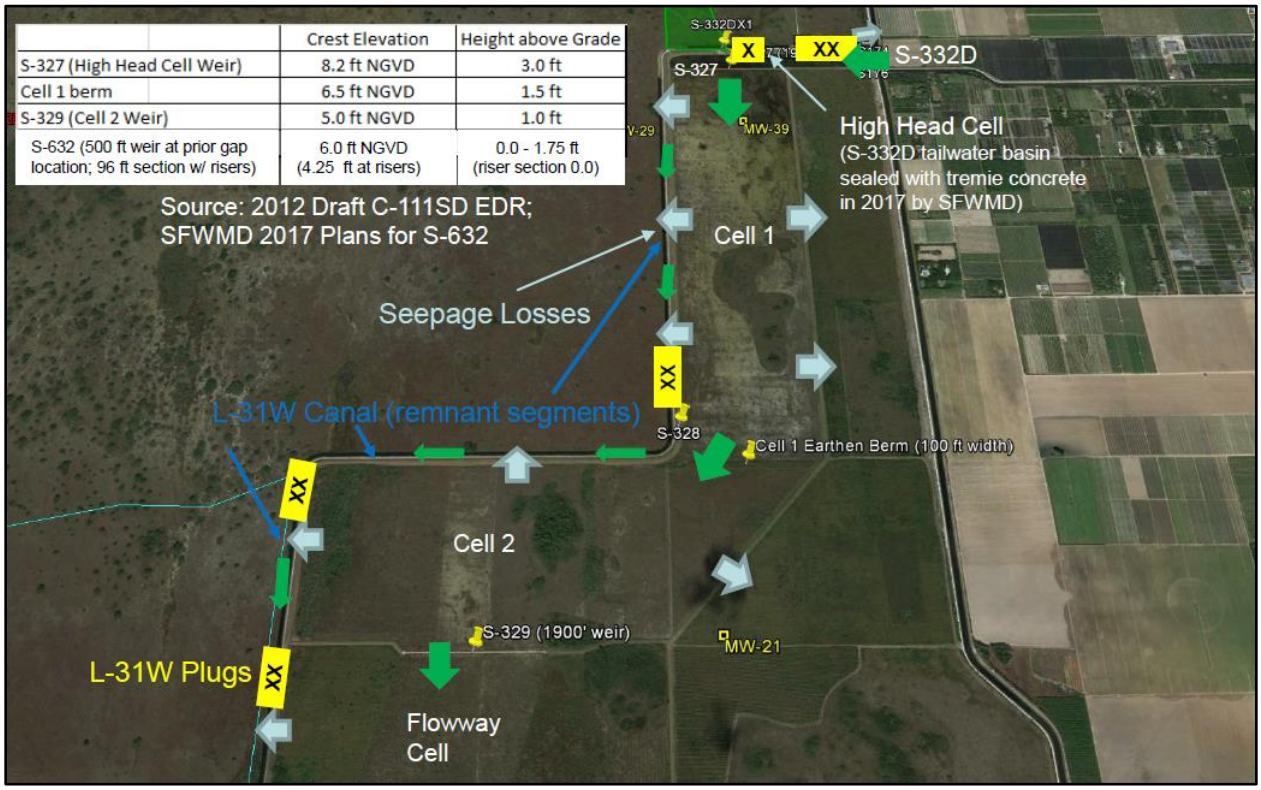

Figure 3-2. Northern S-332D Detention Area.

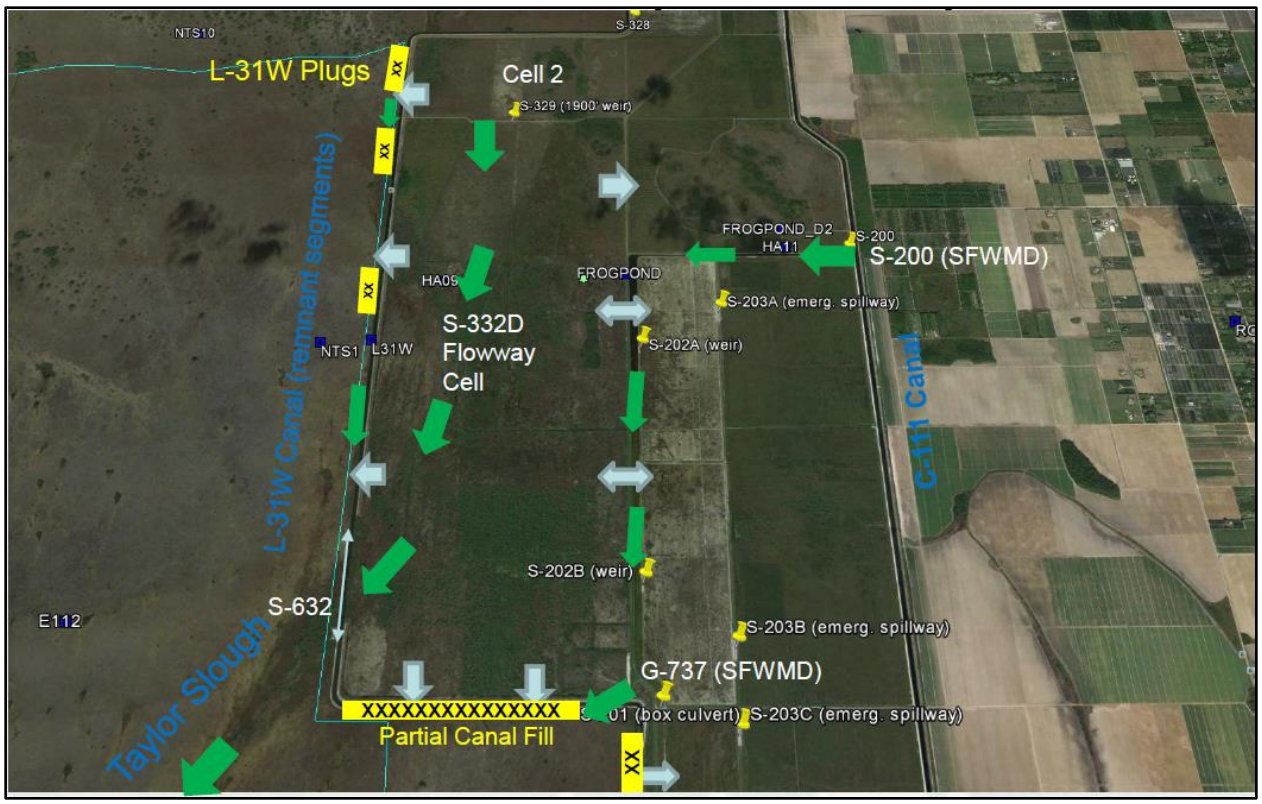

Figure 3-3. Southern S-332D Detention Area

3.5.5 Lower East Coast Area

The LEC area is located to the east of the L-31N, L-31W, and C-111 canals. Under current water management operations, specified canal water levels/ranges are meant to provide flood protection, water supply, and prevention of saltwater intrusion for the LEC. The LEC can be provided water supply from WCA 3A and Lake Okeechobee according to their respective regulation schedules. In wet conditions, the excess water from the LEC is discharged to tide.

3.5.6 8.5 Square Mile Area

The 8.5 SMA is a primarily residential area adjacent to, but west of, the L-31N canal (**Figure 3-4** and **Figure 3-5**). The 8.5 SMA, which is also known as the Las Palmas community, is bordered on both the west and north by NESRS. In 2000, the USACE prepared the MWD GRR/SEIS to assist in the selection of a Recommended Plan for providing flood mitigation to the 8.5 SMA while allowing for restoration of the NESRS as authorized by the MWD project. Consistent with the 1992 MWD General Design Memorandum (GDM) analysis, it was a requirement of the reevaluation to analyze alternatives that provided no increase in flooding above and beyond what existed prior to the authorization of the MWD project. As a result of the USACE implementing the 8.5 SMA flood mitigation project, the Las Palmas community has water management infrastructure consisting of a perimeter levee, a seepage collection canal, a pump station (S-357), and a southern detention area meant to collectively provide flood mitigation as part of the MWD project (USACE 2000). An additional seepage collection canal along Richmond Drive (C-358) has been operational since April 2016 to manage water stages within the southwest corner of the 8.5 SMA. The gated water control structure (S-357N) at the junction of the C-358 and C-357 canals was completed in

February 2018, which replaced the temporary by-pass culverts used during the first two years of the MWD Incremental Field Tests to maintain C-358 canal stages.

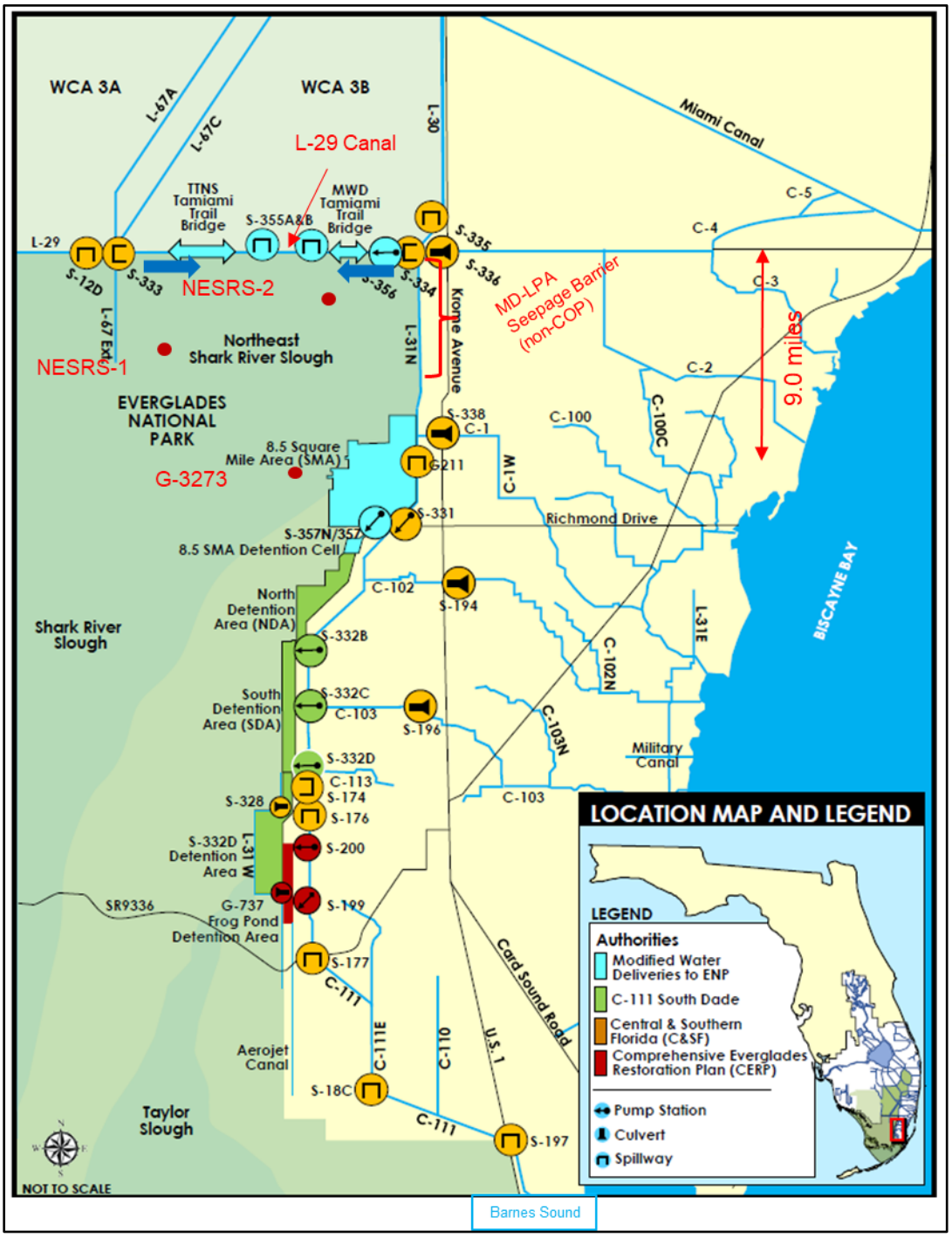

Figure 3-4. Major components of the MWD and C-111 South Dade projects.

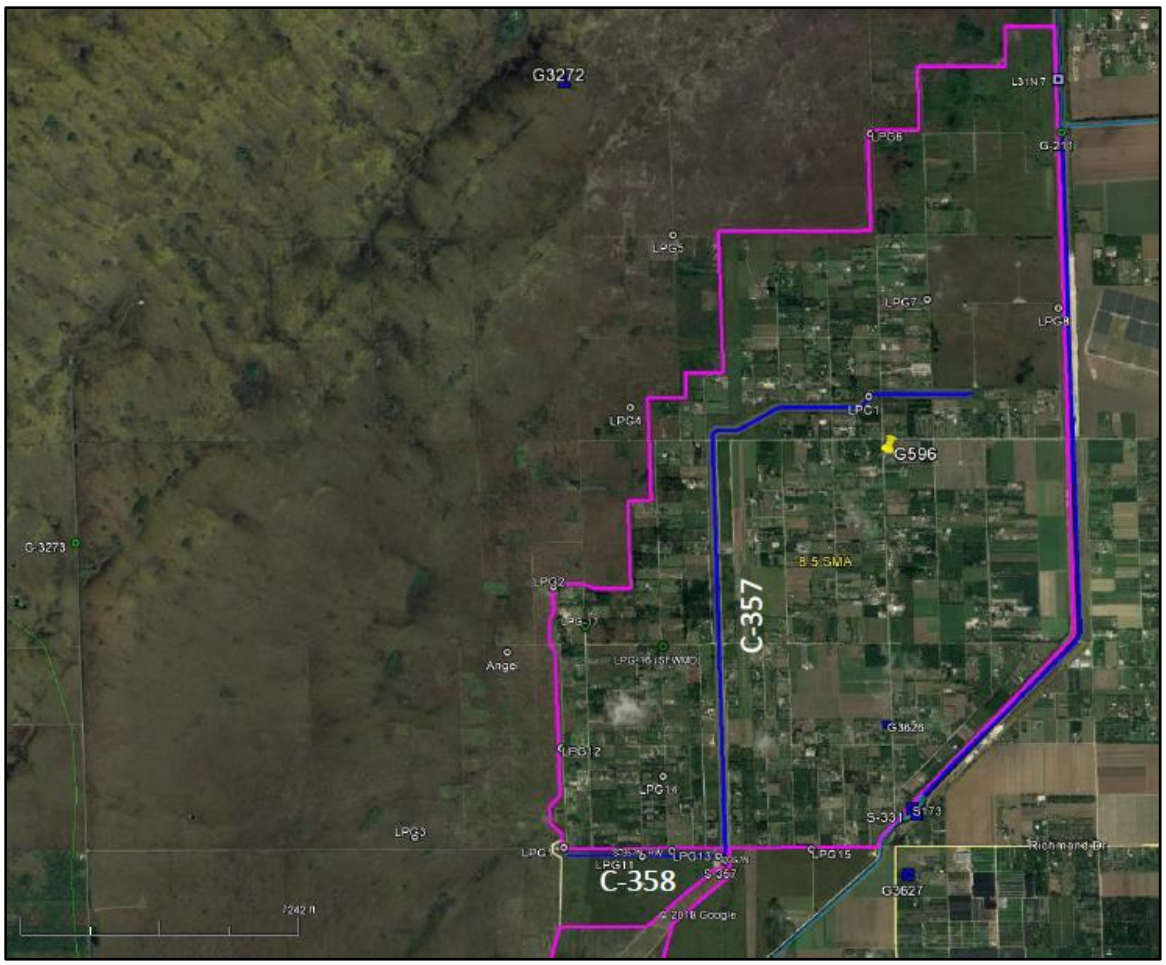

Figure 3-5. Major components of the MWD 8.5 SMA and proximal monitoring locations.

The 2008 8.5 SMA GRR/SEIS presented hydrologic modeling simulations, social impact assessments, policy analysis, real estate information, engineering design and cost analysis, environmental impact assessment, economics calculations and review of public concerns. The Record of Decision (ROD) for the 2000 8.5 SMA GRR/FSEIS stated that it would be implemented with added assurances and conditions described therein. The ROD contained the following assurances and conditions:

(1) "The periodic flooding of landowners east of the proposed levee, before and after project implementation, will remain unchanged from conditions in existence prior to implementation of the MWD project except where flowage easements are required. As with the 1992 General Design Memorandum plan, flood mitigation, not flood protection, should be provided by the design and operation of the Recommended Plan. No deviations are intended from the operations specified in the operations and maintenance manual (i.e. increased pumping in the seepage canal or the inclusion of additional pumps) due to anticipated public demand for increased flood relief inside the perimeter levee of the 8.5 SMA project."

(2) "Implementation of the Recommended Plan should not adversely impact the restoration levels of Everglade National Park's hydrology greater than that simulated through modeling of Alternative 6D."

A monitoring, evaluation, and reporting program shall be implemented to ensure operations are consistent with these levels. The ROD further prescribed that: the Hydraulic and Hydrogeologic Model Report (Appendix A) for the 2000 8.5 SMA GRR/FSEIS also recognized that the final operation of the C-111 South Dade pump stations and detention areas would require further study beyond the scope of the 2000 8.5 SMA GRR/FSEIS effort, while also including recognition that the C-111 South Dade components represented a large change in the local flow regime which could affect the study area.

The 8.5 SMA features must continue to provide mitigation for the increased water levels that will occur once the MWD project is fully implemented and the associated MWD additional water flows are delivered to ENP. The 8.5 SMA flood mitigation features do not work independently, as full mitigation is dependent on both the MWD 8.5 SMA features and the C-111 South Dade project features. The MWD project and the C-111 South Dade project work together, and the gradual introduction of more water deliveries (out of WCA 3A and into ENP) was phased throughout the MWD Incremental Field Tests in parallel with completion of S-357N and the C-111 South Dade North Detention Area (NDA) connection to the 8.5 SMA Detention Cell. The hydraulic connection between the 8.5 SMA and the NDA, which was envisioned by the 2000 8.5 SMA GRR/FSEIS for the 8.5 SMA, creates an interdependency between MWD and C-111 South Dade project operations which affects the flood mitigation performance for the MWD 8.5 SMA components, the flood protection performance of the C-111 South Dade project components, and the hydrologic/ecological benefits for both the MWD and C-111 South Dade projects. Completion of the C-111 NDA components and the levee components adjacent to the 8.5 SMA included in the C-111 South Dade construction contracts was integral to allow more water to flow south into ENP, and to ensure the 8.5 SMA features provide the flood mitigation required for the MWD project.

The full implementation of the MWD project requires that flood mitigation continue to be maintained for the 8.5 SMA. Throughout all phases of the MWD Incremental Field Tests, the USACE' operations within the L-29 canal and NESRS have been operated to not cause the 8.5 SMA to endure a greater duration of high water than they would have experienced prior to construction of the MWD project and prior to MWD implementation of increased flows to ENP. Development of the COP utilized regional hydrologic modeling in order to balance the ecological restoration objectives of the MWD and C-111 South Dade projects while demonstrating compliance with the project constraints, which l include requirements to maintain seepage mitigation for the project in the 8.5 SMA, and to maintain the level of flood damage reduction authorized in the 1994 C-111 GRR Recommended Plan. The results from the COP analyses will be used to update the flood mitigation analysis for the 2000 8.5 SMA GRR and to update the flood risk management analysis from the 1994 C-111 South Dade GRR, which did not originally identify inter-basin transfer of water from the MWD 8.5 SMA to the C-111 South Dade project lands. Development of the COP alternatives for 8.5 SMA operations, including S-357, S-357N, and S-331 were informed by the MWD Increment 1, Increment 1.1 and 1.2, and Increment 2 Field Tests.

Prior to completion of the regional hydrologic modeling under the COP, and prior to further raising the maximum operating stage limit for the L-29 canal, the hydrologic monitoring for the Increment 1.1 and 1.2 Field Test and the Increment 2 Field Test have conducted real-time monitoring of 8.5 SMA flood mitigation performance. Hydrologic response from increased stages in NESRS and the observed effects within the 8.5 SMA are continually analyzed across a wide range of temporal scales, including daily (early detection metrics), weekly, monthly, seasonal, and annual (water year) periods to inform real-time operations and identify potential performance limitations of the current 8.5 SMA and C-111 South Dade infrastructure configuration. Complete details regarding the ongoing flood mitigation assessment methodology for the 8.5 SMA, including updates from the MWD Incremental Field Tests' analyses and the

COP hydrologic modeling is included in the COP Adaptive Management and Monitoring Plan (COP AMMP) in **Appendix C**.

3.5.7 Biscayne Bay

Biscayne Bay is a shallow, tidal sound located near the extreme southeastern part of Florida. Biscayne Bay, its tributaries, and Card Sound are designated by the State of Florida as aquatic preserves, while Card and Barnes Sounds are part of the Florida Keys National Marine Sanctuary. A significant portion of the central and southern portions of Biscayne Bay comprise Biscayne National Park. Under the 2012 Water Control Plan (ERTP), specified canal water levels/ranges are meant to provide flood protection for the portions of the LEC and Miami-Dade County, which may result in discharges to Biscayne Bay.

3.5.8 Florida Bay

Florida Bay and the Ten Thousand Islands comprise approximately 1,500 square miles of ENP. The bay is shallow, with an average depth of less than three feet. To the north is the Florida mainland and to the south lie the Florida Keys. Sheet flow across the marl prairies of the southern Everglades and 20 creek systems fed by Taylor Slough and the C-111 canal provide direct inflow of freshwater to the bay. Surface water from SRS flows into Whitewater Bay and these flows may also provide essential recharge for central and western Florida Bay. Exchange with Florida Bay occurs when this lower salinity water mass flows around Cape Sable into the western sub-region of the bay.

3.6 Regional Water Management Operations

The C&SF project contains multiple water bodies created by the existing C&SF levee infrastructure and implementation of the water management operating criteria, including WCA 1, WCA 2, and WCA 3. Associated with the inflow to and discharge from the water bodies is an infrastructure of structures and canals that are managed by the implementation of water management operating criteria that can include specified water levels or ranges. The WCA 3A Interim Regulation Schedule, which was implemented with the 2012 Water Control Plan update for the Master Water Control Manual for the WCAs, ENP, and the SDCS (ERTP), is a compilation of water management operating criteria, guidelines, rule curves, and specifications that govern storage and release functions. The MWD Incremental Field Tests, including the current Increment 2 Field Test, have been implemented as temporary, planned deviations to the ERTP. Operational criteria which are not specifically changed by the operational strategy for the Increment 2 Field Test remain governed by the ERTP. Typically, a regulation schedule has water level thresholds which vary with the time of year and result in discharges. The threshold lines of regulation schedules define the discharge zones and are traditionally displayed graphically. Additionally, a corresponding table is typically used to identify the structure discharge rules for the zones. As with most regulation schedules, the WCA 1, WCA 2, and WCA 3A regulation schedules must take into account various, and often conflicting, project purposes. The WCAs are regulated for the Congressionally authorized C&SF project purposes to provide: flood control; water supply for agricultural irrigation, municipalities and industry, and ENP; regional groundwater control and prevention of saltwater intrusion; enhancement of fish and wildlife; and recreation. An important component of flood control is the maintenance of marsh vegetation in the WCAs, which provide a dampening effect on hurricane-induced wind tides that have the potential to affect residential areas to the east of the WCAs. The marsh vegetation, along with the east coast protection levee, also prevents floodwaters that historically flowed eastward from the Everglades from flowing into the developed areas along the southeast coast of Florida.

Besides releases from WCA 2A via the S-11 structures, WCA 3A receives inflow from pumping stations S-8, S-9, and S-140. The S-9 pump station removes runoff in the area west of Ft. Lauderdale known as Western C-11. The S-9A pump station, located adjacent to the S-9 pump station, returns seepage water from WCA 3A and WCA3B collected in the L-37, L-33, and the US 27 borrow canals. The S-140 pump station serves the 110 square mile area north and east of the interceptor canal and west of L-28. S-140 is used to maintain canal levels below 10.5 feet, NGVD unless gravity flow into WCA 3A is possible at an adequate rate. Water also enters northeastern WCA 3A by gravity through the S-150 gated culvert. Discharges at S-142 are made from WCA 3A into the North New River canal. The SFWMD can pump runoff from the North New River canal and the C-13 canal into WCA 3A through S-142 by operating their pump station, G-123.

Water levels in WCA 3A are managed primarily by five gated spillways: the S-12 structures (S-12A, S-12B, S-12C, and S-12D) and S-333. Additionally, the S-151, S-343A, S 343B and S-344 gated culvert structures can be utilized to discharge from WCA 3A. From July 2002 through October 2012, WCA 3A was regulated according to a seasonally varying 8.75 to 10.75 feet, NGVD regulation schedule and the Rainfall Plan (initiated in 1985), as per the Interim Operational Plan (IOP) (2002 IOP EIS and 2006 IOP FSEIS). In October 2012, the WCA 3A Regulation Schedule was revised with implementation of the ERTP recommended plan through the 2012 Water Control Plan. Revisions to the WCA 3A Regulation Schedule included incorporation of the WCA 3A 1960 9.5 to 10.5 feet, NGVD Zone A, along with expansion of Zone D forward to December 31 and expansion of Zone E1 backwards to January 1. The discharges made from WCA 3A through the S-12s and S-333 are target flows determined from the Rainfall Plan; when WCA 3A is in Zone A, these target flows are the maximum flow possible based on structure design capacities and consideration of downstream operational constraints. Under the Rainfall Plan, water deliveries are computed and operations adjusted weekly, if necessary based on the sum of two components: a rainfall response component and a WCA 3A supplemental regulatory component. The Rainfall Plan provides for the rainfall response component within all zones of the WCA 3A Regulation Schedule, with the additional regulatory release requirement added when the WCA 3A water levels fall within the higher regulation schedule zones above Zone E, including Zone E1. Under the 2012 Water Control Plan (ERTP), which were unchanged with the MWD Incremental Field Tests, discharge capacity from S-333 into the L-29 canal and NESRS is maximized prior to utilization of the S-12 structures, in order to limit potential effects from WCA 3A discharges on the CSSS western subpopulation (CSSS-A). When flows through the S-12 structures are determined necessary by the WCA 3A Regulation Schedule and the Rainfall Plan, water managers prioritize flow through the easternmost S-12 structures as capacity allows, in order to minimize flow through the S-12A and S-12B structures. The historical operational target flow distribution of 55% through S-333 into NESRS and 45% through the S-12 structures into ENP west of the L-67 extension levee is no longer used as a constraint governing water management operations of WCA 3A and northern ENP under the ERTP, including the MWD Incremental Field Tests. Weekly WCA 3A water management release decisions are coordinated with ENP. The 2012 Water Control Plan (ERTP) specified seasonal closure of the S-343A, S-343B, S-344, S-12A and S-12B structures, with the following rigid closure periods: November 1 through July 14 for S-343A, S-343B, S-344, and S-12A; and January 1 through July 14 for S-12B. There are no prescribed closure periods for S-12C or S-12D, although either or both of these structures may be closed when Rainfall Plan target releases are achieved through S-333.

Water deliveries to eastern ENP (NESRS) are controlled by the stage in L-29 canal, as pressure from the water within the canal (hydraulic head), is required to force water through the Tamiami Trail culverts and the bridge openings into ENP. As the L-29 canal stage increases, more water is forced beneath the road through 14 remaining sets of culverts (40 total culverts, three culverts per set in most locations), the one mile bridge, and the 2.3 mile bridge. The L-29 canal maximum operating stage was previously limited under the 2012 Water Control Plan (ERTP) and previous regional operating plans due to concerns

regarding: (1) potential flooding and seepage effects within residential or agricultural areas of Miami-Dade County; (2) potential damage to the Tamiami Trail roadway sub-base; and (3) potential flooding effects to privately-owned real estate adjacent to Tamiami Trail and within eastern ENP. The MWD Tamiami Trail Modifications (TTM) project, which was completed in December 2013, included construction of the one mile bridge and Tamiami Trail roadway reconstruction/resurfacing to allow for the maximum operating stage in the L-29 canal to be raised from 7.5 feet to a maximum of 8.5 feet, NGVD following the acquisition of the required real estate interests by the USACE and ENP. Following completion of the MWD TTM project, the 2012 Water Control Plan (ERTP) water management operating criteria for the L-29 canal between S-333 and S-334 limited the L-29 canal stage to no more than 7.5 feet, NGVD in response to potential flooding effects to privately-owned real estate adjacent to Tamiami Trail and within eastern ENP which may have resulted from extended durations with higher operating stages in the L-29 canal (above 7.5 feet, NGVD). The 2012 Water Control Plan (ERTP) also included an additional operational constraint for the L-29 canal water level related to potential flooding and seepage effects within residential and/or agricultural areas of Miami-Dade County; this constraint, which was removed during implementation of the MWD Incremental Field Tests' planned deviations, required S-333 discharges to NESRS to be discontinued when the G-3273 water level within NESRS reaches 6.8 feet, NGVD during the normal Column 1 mode of operations, or S-333 discharges into the L-29 canal to be matched with S-334 discharges out of the L-29 canal when operating under the Column 2 mode of operations.

When WCA 3A water levels are in Zone A of the WCA 3A Interim Regulation Schedule, S-343A, S-343B, and S-344 can be utilized to discharge from WCA 3A into BCNP outside of the prescribed closure period for these gated culvert structures. Discharges can also be made through S-343A, S-343B, and S-344 when agreed to by the SFWMD, the USACE, and National Park Service (NPS) to extend hydroperiods within BCNP. The S-151 gated culvert structure is located along the Miami canal and operated according to the WCA 3A Interim Regulation Schedule (USACE 2012c). S-151 discharges into the Miami canal (C-304) in WCA 3B for flood diversion and for the purpose of providing water supply to LEC canals and the SDCS. Under existing conditions, water does not flow directly from WCA 3B into the L-29 canal. There are two discharge structures, gated spillways S-355A and S-355B, along L-29 south of WCA 3B that are designed to move water from WCA 3B into the L-29 canal. The S-355 structures are completed components of the MWD project.

There were three distinct modes of water management operations for the 2012 Water Control Plan (ERTP), which were consistent with the previous IOP (2002 EIS; 2006 Supplemental EIS): Column 1, Column 2, and water supply. Column 1 refers to the condition when regulatory releases from WCA 3A were met by normal operation of the WCA 3A regulatory outlets (the S-12 structures, S-333, S-151, S-343A, S-343B, and/or S-344). Column 2 refers to the condition when regulatory releases from WCA 3A were made via S-333 to the L-29 canal and via S-334 to the L-31N canal and the SDCS; Column 2 operations generally required the use of pump stations S-331, S-332B, S-332C, and S 332D. During Column 2 operations, the control stages along the L-31N canal were also lowered to minimize potential flood impacts to the SDCS and also to provide the necessary downstream gradient for the S-334 releases to reach S-332B, S-332C, and S-332D pump stations. Column 2 operations were used to offset or mitigate for potential adverse effects on WCA 3A related to actions taken to protect CSSS sub-population A within western ENP, including seasonal closure of the S-12A and S-12B regulatory outlets under the 2012 Water Control Plan (ERTP) (S-12C seasonal closure criteria were additionally included with IOP). The IOP/ERTP generally prescribed that the Column 2 mode of operation would be used when any S-12 structure is closed in order to protect the CSSS (November 1 through July 14, under ERTP), although Column 1 operations would continue until the capacity of the S-12 structures that remain open is insufficient to handle the discharge from WCA 3A. Similarly, the IOP/ERTP generally prescribed that Column 2 operations may continue past

re-opening of the S-12 structures (July 15) to mitigate for adverse effects on WCA 3A stage levels resulting from the 2012 Water Control Plan (ERTP) closures of S-12A, S-12B, S-343A, S-343B, and S-344, based on comparison to WCA stage levels that would have been expected under the WCA 3A Regulation Schedule in place prior to the 2000 Interim Structural and Operational Plan (ISOP; the predecessor of IOP 2002); the cited 1985 WCA 3A Regulation Schedule first incorporated the Rainfall Plan and included no seasonal closures for the S-12s. Under historical IOP and 2012 Water Control Plan (ERTP) operations, the Column 2 mode of operations was also been used as an additional water management tool for WCA 3A high water conditions. Beginning in 2014, the USACE and the SFWMD began applying a WCA 3A water budget accounting tool to track the expected effect on WCA 3A stage levels resulting from the 2012 Water Control Plan (ERTP) closures of S 12A, S-12B, S 343A, S-343B, and S-344.

The MWD Incremental Field Tests were implemented as temporary planned deviations to the 2012 Water Control Plan (i.e. ERTP), starting in October 2015. Separate EAs were prepared, reviewed, and approved for each including supporting operational strategy documentation and monitoring plans. During implementation of the MWD Increment 1, Increment 1.1 and 1.2, and Increment 2 Field Tests, the 2012 Water Control Plan, including the WCA 3A Regulation Schedule and Rainfall Plan, continued to govern water management operations with the exception of operating criteria for S-12A, S-12B, S-328, S-151, S-331, S-333, S-334, S-335, S-337, S-338, S-343A, S-343B, S-344, S-355A, S-355B, S-356, S-357, S-357N, S-332B, S-332C, S-332D, S-194, S-196, S-176, S-177 and S-197. The water level constraint at G-3273 in NESRS was not a pre-determined constraint under the MWD Incremental Field Tests conducted from October 2015 to August 2020 and as a result, more water was delivered to NESRS from WCA 3A , relative to the 2012 Water Control Plan (ERTP). In addition, seepage from NESRS into the northern reach of the L-31N canal was returned to NESRS via the discharges from the S-356 pump station to the L-29 canal. Under Increment 1.1 and 1.2 the L-29 canal maximum operating limit was increased from 7.5 to 7.8 feet NGVD because of consideration of the downstream constraints including:

(1) Acquisition of required real estate interest and any associated improvements for the private ownership along Tamiami Trail including receipt of Tamiami Trail Bridge and roadway channel and flowage easements from the Florida Department of Transportation (FDOT);

(2) Completion of the C-358 canal (Richmond Drive Seepage Collection canal) and installation of S-357N (C-358 control structure);

(3) Completion of sufficient portions of Contract 8 (construction of the C-111 South Dade NDA L-315 western levee and the L-357W extension levee between Richmond Drive and the 8.5 SMA Detention Cell) and completion of the Contract 8A berms inside the 8.5 SMA Detention Cell.

With the completion of the C-111 South Dade Construction Contract 8 and 8A in September 2018, the L-29 canal maximum operating limit was raised to 8.5 feet, NGVD while maintaining required water levels in the residential and agricultural areas in southeastern Miami-Dade County. Operating the L-29 canal up to 8.5 feet, NGVD allowed more water to be delivered to NESRS, which is one of the main objectives of the MWD Increment 2 Field Test to be replaced by the COP in August 2020 subject to completion of this Draft EIS. Many of the operational criteria from Increment 2 were carried forward into the initial alternative formulation for development of the COP, as these criteria were informed by the previous MWD Incremental Field Tests and other condition-driven Emergency and Planned Deviations during 2016 and 2017. The Increment 1.1, 1.2, and 2 Field Test included expanded closure periods for S-12A, S-12B, S-343A, S-343B, and S-344 structures to address the mandated Reasonable and Prudent Alternative (RPA) of the July 2016 Biological Opinion (BO) for the ERTP. The WCA 3A water level (as measured using the average

of monitoring gauges/sites 63, 64, and 65) is utilized to define the priority of releases from S-333 and S-356 to the L-29 canal and NESRS. The L-29 canal inflow structures (S-333, S-355A/B, and S-356) are operated with the intention of limiting event durations with L-29 canal stages above 8.5 feet, NGVD to a target maximum duration of 72 hours. Once the stage in the L-29 canal reaches a stage of 8.5 feet, NGVD, input from all structures that discharge into the canal (S-333, S-355A/B, and S-356) shall be stopped until the level in the L-29 canal recedes below 8.5 feet, NGVD. For each water year (May through April), the L-29 canal inflow structures is currently managed to limit the duration of L-29 canal stages near 8.5 feet (as measured at the S-333 TW), NGVD to 90 cumulative days or to a maximum of 90 consecutive days. The number of either cumulative or consecutive days in each period (only one period per water year) is measured when L-29 stages exceed 8.3 feet, NGVD. Continued L-29 structure inflows which result in consecutive durations with L-29 canal stages at 8.5 feet, NGVD for longer than 90 days require written approval from the FDOT. The L-29 stage is maintained at or below 8.5 feet, NGVD by ceasing inflow into L-29 when the L-29 stage rises above 8.5 feet, NGVD. Event driven criteria is followed in accordance with Table 1 of the Increment 2 operational strategy, based on consideration of the Quantitative Precipitation Forecast (QPF). Continued L-29 structure inflows which result in consecutive durations with L-29 canal stages above 8.3 feet for longer than 90 days requires written approval from the FDOT, given evaluation of the monitoring data by FDOT in coordination with the USACE.

Additional operational flexibility was included within Increment 2 to allow for a rapid response to extreme high water levels in WCA 3A. Extreme high water levels in WCAs is defined as when any of these two conditions are met: (1) WCA 3A is above the Extreme High Water Action Line; and (2) the SFWMD monthly position analysis (monthly, semimonthly) shows at least a 10 percent probability of WCA 3A, 3-station average exceeding 12.7 feet, NGVD along with other forecast information prior to September 15.

The MWD 8.5 SMA features and the C-111 South Dade project NDA components are operated to accommodate increased flow to NESRS while evaluating whether the operational criteria meet the MWD Incremental Field Test objectives and constraints, most notably no reduction in current flood mitigation for the 8.5 SMA. With Increment 2, 8.5 SMA flood mitigation requirements are shifted to an increased reliance on S-357 given full operability of the NDA and a reduced dependency of 8.5 SMA on S-331. Column 2 operations are also generally reduced. Based on review and consideration of the 2016 and 2017 operations for the 8.5 SMA, as detailed in the February 2018 EA for the Increment 2 Field Test, the Increment 2 operational strategy included a tiered set of criteria for operating S-357 based on the stage at Angel's Well (0.25 miles west of LPG-2), the stage at LPG-2, and the duration of stages above the local ground elevation at LPG-2. Generally, as the stage at Angel's Well continues to rise and increase the stage gradient towards the 8.5 SMA, or as LPG-2 hydroperiod durations continue to increase, the tiered operations allow continued, gradual lowering of the C-357 operational level in order to ensure flood mitigation is maintained for the 8.5 SMA. As detailed in the Increment 2 operational strategy, the C-357 canal is generally maintained between 4.0-6.0 feet, NGVD. Currently, under the following two conditions, C-357 may be temporarily maintained within a range of 3.5-4.5 feet, NGVD: (1) If Angel's > 7.19 feet and LPG-2 > 6.59 feet, NGVD for 7 days or longer; or (2) If LPG-2 > 6.99 feet, NGVD for longer than 24 hours. The stage and recession rate of 8.5 SMA gages are reviewed based on conditions and if necessary the range may be lowered by 0.5 feet increments to meet flood mitigation requirements.

3.7 Flood Control

Water management and flood control is achieved in south Florida through a variety of canals, levees, pumping stations, and control structures within the WCAs, ENP, and SDCS. The WCAs provide a detention reservoir for rainfall over the WCAs, excess water from the EAA and parts of the east coast region, and for

flood discharge from Lake Okeechobee to tide. The WCAs provide levees to prevent the Everglades floodwaters from inundating the east coast urban areas; provide a water supply for the east coast areas and ENP; improve water supply for east coast communities by recharging underground freshwater aquifers reduce seepage; ameliorate salt-water intrusion in coastal well fields; and provide mixed quality habitat for fish and wildlife in the Everglades.

The East Coast canals are flood control and outlet works that extend from St. Lucie County southward through Martin, Palm Beach, and Broward Counties to Miami-Dade County. The East Coast canal watersheds encompass the primary canals and water control structures located along the LEC and their hydrologic basins. The main design functions of the project canals and structures in the East Coast canal area are to protect the adjacent coastal areas against flooding; store water in conservation areas west of the levees; control water elevations in adjacent areas; prevent salt-water intrusion and over-drainage; provide freshwater to Biscayne Bay; and provide for water conservation and public consumption. The East Coast canals consist of 40 independently operated canals, one levee, and 50 operating structures, consisting of 35 spillways, 14 culverts, and one pump station. The project operates to prevent major flood damage; however, due to urbanization, the existing surface water management system now has to handle greater peak flows than in the past. The SDCS provides a way to deliver water to areas of south Miami-Dade County. This canal system was overlaid on the existing flood control system. Many of these canals are used to remove water from interior areas to tide in times of excess water.

The C-111 South Dade project was authorized to remove 40 percent of the Standard Project Flood (SPF) flows. This purpose remains an important objective because of the remaining agriculture within the basin. The South-Dade County Basin (south of the S-331 pump station) provides flood protection by operation of the S-332B/S-332C/S-332D pump stations completed under the C-111 South Dade project and through operation of the L-31N and C-111 canal control structures (S-176, S-177, S-18C, and S-197). The South-Dade County basin may also receive inflows from upstream basin drainage through the S-331 pump station and the adjacent S-173 gated culvert structure. Under the current 2012 Water Control Plan (ERTP) and the MWD Incremental Field Tests, S-331/S-173 releases are the result of water management operations to: (1) maintain target L-31N canal stages; (2) provide flood mitigation to the 8.5 SMA eastern areas when sufficient capacity is available at S-357 and maintain flood mitigation for the 8.5 SMA when S-357 operational capacity is limited; and (3) maintain WCA 3A regulatory releases to the SDCS from S-334 during Column 2 operations. With each successive increment of the MWD Field Tests, the frequency and duration of the S-331 operations for 8.5 SMA flood mitigation operations and WCA 3A regulatory releases to the SDCS have been reduced in accordance with the prescribed operations, as documented in the respective EAs. The COP regional hydrologic modeling was scoped in accordance with the USACE' plan formulation process in order to balance the ecological restoration objectives of the MWD and C-111 South Dade projects while demonstrating compliance with the project constraints. The COP constraints include flood mitigation requirements to prevent potential MWD project-induced flood damages in the 8.5 SMA and to maintain the level of flood damage reduction associated with the 1994 C-111 GRR/EIS Recommended Plan. The performance of the C-111 South Dade project features, with respect to both project objectives and constraints, is dependent on the outcome of the COP, including details of the operational plans and operational constraints within WCA 3A, ENP (including the L-29 canal), and the 8.5 SMA.

3.8 Vegetative Communities

The Everglades landscape is dominated by a complex of freshwater wetland communities that includes open water sloughs and marshes, dense grass- and sedge-dominated marshes, forested islands, and wet

marl prairies. The primary factors influencing the distribution of dominant freshwater wetland plant species of the Everglades are soil type, soil depth, and hydrological regime (USFWS 1999). These communities generally occur along a hydrological gradient with the slough/open water marsh communities occupying the wettest areas (flooded more than nine months per year), followed by sawgrass marshes (flooded six to nine months per year), and wet marl prairie communities (flooded less than six months per year) (USFWS 1999). The Everglades freshwater wetlands eventually grade into intertidal mangrove wetlands and sub-tidal seagrass beds in the estuarine waters of Florida Bay. Development and drainage over the last century have dramatically reduced the overall spatial extent of freshwater wetlands within the Everglades, with approximately half of the pre-drainage 2.96 million acres of wetlands being converted for development and agriculture (Davis and Ogden 1997). Alteration of the normal flow of freshwater through the Everglades has also contributed to conversions between community types, invasion by exotic species, and a general loss of community diversity and heterogeneity.

Vegetative communities of the WCAs have suffered from both over-drainage and prolonged periods of inundation associated with the stabilization of water levels (USACE 1999). Many areas of WCA 3A still contain relatively good wetland habitat consisting of a complex of tree islands, sawgrass marshes, wet prairies, and aquatic sloughs. However, the northern portion of WCA 3A has been over-drained, resulting in increased fire frequency and the associated loss of tree islands, wet prairie, and aquatic slough habitat. Northern WCA 3A is currently dominated largely by mono-specific sawgrass stands and lacks the diversity of communities that exists in southern WCA 3A. In southern WCA 3A, Wood and Tanner (1990) first documented the trend toward deep water lily dominated sloughs due to impoundment. In approximately 1991, the hydrology of southern WCA 3A shifted to deeper water and extended hydroperiods resulting in corresponding shifts in vegetation communities (Zweig and Kitchens 2008). Typical Everglades vegetation, including tree islands, wet prairies, sawgrass marshes, and aquatic sloughs is contained in WCA 3B. However, within WCA 3B, the ridge and slough landscape has been severely degraded by the virtual elimination of overland sheetflow due to the L-67 canal and Levee system. WCA 3B experiences very little overland flow and has become primarily a rain-fed system pre-dominated by shorter hydroperiod sawgrass marshes with relatively few sloughs or tree islands remaining. Water levels in WCA 3B are also too low and do not vary seasonally, contributing to poor ridge and slough patterning. Loss of sheetflow to WCA 3B has also accelerated soil loss, reducing elevations of the remaining tree islands in WCA 3B and making them vulnerable to high water stages.

Vegetative trends in ENP have included a substantial shift from the longer hydroperiod slough/open water marsh communities to shorter hydroperiod sawgrass marshes (Davis and Ogden 1997; Armentano et al. 2006). In addition, invasion of sawgrass marshes and wet prairies by exotic woody species has led to the conversion of some marsh communities to forested wetlands (Gunderson et al. 1997).

The estuarine communities of Florida Bay have also been affected by upstream changes in freshwater flows through the Everglades. A reduction in freshwater inflows into Florida Bay and alterations of the normal salinity balance have affected mangrove community composition and may have contributed to a large-scale die-off of seagrass beds (USFWS 1999). Mangrove communities along Biscayne Bay have also seen a reduction in freshwater inflows and a reduction in historic habitat range by urban and agricultural development leaving only a remnant ribbon of suitable habitat immediately adjacent to the bay. Both bays experience salinities in excess of 40 practical salinity units (psu) on a seasonal basis. Manatee Bay and Barnes Sound are presently characterized by extended periods with little or no freshwater input, interspersed with erratic large volume discharges from the C-111 canal, which is presently the major source of freshwater flows.

In contrast to the vast extent of wetland communities, upland communities comprise a relatively small component of the Everglades landscape and are largely restricted to Long Pine Key, the northern shores of Florida Bay, and the many tree islands scattered throughout the region. Vegetative communities of Long Pine Key include rockland pine forest and tropical hardwood forest. In addition, substantial areas of tropical hardwood hammock occur along the northern shores of Florida Bay and on elevated portions of some forested islands.

3.9 Fish and Wildlife Resources

Aquatic macro invertebrates form a vital link between the algal and detrital food web base of freshwater wetlands and the fishes, amphibians, reptiles, and wading birds that feed upon them. Important macro invertebrates of the freshwater aquatic community include crayfish (*Procambarus alleni*), riverine grass shrimp (*Palaemonetes paludosus*), freshwater amphipods (*Hyalella azteca*), Florida apple snail (*Pomacea paludosa*), Seminole ramshorn (*Planorbella duryi*), and numerous species of aquatic insects (USACE 1999).

Small freshwater marsh fishes are also important processors of algae, plankton, macrophytes, and macro invertebrates. Marsh fishes provide an important food source for wading birds, amphibians, and reptiles. Common small freshwater marsh species include the native golden topminnow (*Fundulus chrysotus*), least killifish (*Heterandria formosa*), Florida flagfish (*Jordenella floridae*), golden shiner (*Notemigonus crysoleucas*), sailfin molly (*Poecilia latipinna*), bluefin killifish (*Lucania goodei*), eastern mosquitofish (*Gambusia holbrooki*), and small sunfishes (*Lepomis spp.*) (USACE 1999).

Within the Greater Everglades, numerous sport and larger predatory fishes occur in sloughs and in deeper canals. Common species include largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), black crappie (*Pomoxis nigromaculatus*), Florida gar (*Lepisosteus platyrhincus*), yellow bullhead (*Ameiurus natilis*), and bowfin (*Amia calva*) (USACE 1999). Larger fishes are an important food source for wading birds, alligators, otters, raccoons, and mink.

The freshwater wetland complex supports a diverse assemblage of reptiles and amphibians. Common amphibians include the greater siren (*Siren lacertina*), Everglades dwarf siren (*Pseudobranchus striatus*), two-toed amphiuma (*Amphiuma means*), pig frog (*Lithobates grylio*), southern leopard frog (*Rana sphenocephala*), Florida cricket frog (*Acris gryllus*), southern chorus frog (*Pseudacris nigrita*), squirrel tree frog (*Hyla squirella*), and green tree frog (*Hyla cinerea*) (USACE 1999). Amphibians also represent an important forage base for wading birds, alligators, and larger predatory fishes (USACE 1999).

Common reptiles of freshwater wetlands include the American alligator (*Alligator mississippiensis*), snapping turtle (*Chelydra serpentina*), striped mud turtle (*Kinosternon bauri*), mud turtle (*Kinosternon subrubrum*), cooter (*Chrysemys floridana*), Florida chicken turtle (*Deirochelys reticularia*), Florida softshell turtle (*Trionys ferox*), water snake (*Natrix sipidon*), green water snake (*Natrix cyclopion*), mud snake (*Francia abacura*), and Florida cottonmouth (*Agkistrodon piscivorus*) (USACE 1999).

The freshwater wetlands of the Everglades are noted for their abundance and diversity of colonial wading birds. Common wading birds include the white ibis (*Eudocimus albus*), glossy ibis (*Plegadus falcenellus*), great egret (*Casmerodius albus*), great blue heron (*Ardea herodius*), little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), snowy egret (*Egretta thula*), green heron (*Butorides virescens*), cattle egret (*Bubulcus ibis*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nycticorax violacea*), roseate spoonbill (*Platalea ajaja*), wood stork (*Mycteria americana*), snowy plover (*Charadrius nivosus*), and black skimmer (*Rynchops niger*) (USACE 1999).

Mammals that are well adapted to the aquatic and wetland conditions of the freshwater marsh *complex* include the marsh rice rat (*Oryzomys palustris*), round-tailed muskrat (*Neofiber alleni*), and river otter (*Lutra canadensis*). Additional mammals that may utilize freshwater wetlands on a temporary basis include the white-tailed deer (*Odocoileus virginianus*), Florida panther (*Puma concolor coryi*), bobcat (*Lynx rufus*), and raccoon (*Procyon lotor*).

3.10 Threatened and Endangered Species

Federally listed and state listed threatened and endangered species are known to occur within the study area.

3.10.1 Federally Listed Species

The USACE has coordinated with the United States fish and Wildlife Service (USFWS) in accordance with Section 7 of the Endangered Species Act (ESA), to determine federally listed threatened and endangered species that are either known to occur or are likely to occur within the project area (**Table 3-1**). The USACE requested written confirmation of federally listed threatened and endangered species that are either known to occur or are likely to occur within the project area from the USFWS by correspondence dated September 26, 2017. In correspondence dated October 31, 2017, the USFWS provided a revised list for the COP. The USACE provided subsequent email correspondence seeking clarification on the revised list due to the recent listing of several species. The USFWS provided concurrence on the revised list on November 27, 2017 via e-mail. Further details on the life history of each species can be found in **Section 4** (**Environmental Effects**) and in the Biological Assessment (BA) in **Appendix D.2** (**Endangered Species Act Compliance**).

Table 3-1. Federally threatened and endangered species within the study area (E: Endangered; T: Threatened; C: Candidate; CH: Critical Habitat; SA: Similarity of Appearance)

Common Name	Scientific Name	Federal Status
Mammals	-	-
Florida panther	*Puma concolor coryi*	E
Florida manatee	*Trichechus manatus latirostris*	E, CH
Florida bonneted bat	*Eumops floridanus*	E
Birds	-	-
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	E, CH
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	E, CH
Piping plover	*Charadrius melodus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Roseate tern	*Sterna dougallii*	T
Wood stork	*Mycteria americana*	T

Common Name	Scientific Name	Federal Status
Reptiles	-	-
American Alligator	*Alligator mississippiensis*	T, SA
American crocodile	*Crocodylus acutus*	T, CH
Eastern indigo snake	*Drymarchon couperi*	T
Gopher tortoise	*Gopherus polyphemus*	C
Green sea turtle*	*Chelonia mydas*	E
Hawksbill sea turtle*	*Eretmochelys imbricata*	E; CH
Kemp's ridley sea turtle*	*Lipodochelys kempii*	E
Leatherback sea turtle*	*Dermochelys coriacea*	E:CH
Loggerhead sea turtle*	*Caretta*	E
Fish	-	-
Smalltooth sawfish*	*Pristis pectinata*	E
Invertebrates	-	-
Elkhorn coral*	*Acropora palmata*	T, CH
Staghorn coral*	*Acropora cervicornis*	T, CH
Bartram's hairstreak butterfly	*Strymon acis bartrami*	E, CH
Florida leafwing butterfly	*Anaea troglodyta floridalis*	E, CH
Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	E
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	E
Stock Island tree snail	*Orthalicus reses(not incl. nesodryas)*	T
Plants	-	-
Crenulate lead plant	*Amorpha crenulata*	E
Deltoid spurge	*Chamaesyce deltoidea spp. deltoidea*	E
Garber's spurge	*Chamaesyce garberi*	T
Johnson's seagrass*	*Halophila johnsonii*	E, CH
Okeechobee gourd	*Cucurbita okeechobeensis ssp. okeechobeenis*	E
Small's milkpea	*Galactia smallii*	E

Common Name	Scientific Name	Federal Status
Tiny polygala	*Polygala smallii*	E
Big pine partridge pea	*Chamaecrista lineata var. keyensis*	E
Blodgett's silverbush	*Argythamnia blodgettii*	T
Cape Sable thoroughwort	*Chromolaena frustrata*	E, CH
Carter's small-flowered flax	*Linum carteri var. carteri*	E, CH
Everglades bully	*Sideroxylon reclinatum spp. austrofloridense*	T
Florida brickell-bush	*Brickellia mosieri*	E, CH
Florida bristle fern	*Trichomanes punctatum spp. floridanum*	E
Florida pineland crabgrass	*Digitaria pauciflora*	T
Florida prairie-clover	*Dalea carthagenesis floridana*	E
Florida semaphore cactus	*Consolea corallicola*	E, CH
Pineland sandmat	*Chaemaesyce deltoidea pinetorium*	T
Sand flax	*Linum arenicola*	E

*Species under the purview of the National Marine Fisheries Service (NMFS)

3.10.2 State Listed Species

The study area provides habitat for several state listed species (**Table 3-2**). Further details on the life history of each species can be found in **Section 4** (**Environmental Effects**).

Table 3-2. State listed species within the study area (T: Threatened)

Common Name	Scientific Name	Status
Mammals	-	-
Everglades mink	*Mustela vison evergladensis*	T
Birds	-	-
Black skimmer	*Rynchops niger*	T
Least tern	*Sterna antillarium*	T
White-crowned pigeon	*Patagioenas leucocephalus*	T
Little blue heron	*Egretta caerulea*	T
Tricolored heron	*Egretta tricolor*	T
Reddish egret	*Egretta rufescens*	T
Roseate spoonbill	*Platalea ajaja*	T

Common Name	Scientific Name	Status
Florida sandhill crane	*Antigone canadensis pratensis*	T
Southeastern American kestrel	*Falco sparverius paulus*	T

3.11 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act, 16USC 1801 et seq. reflects the Secretary of Commerce and Fishery Management Council authority and responsibilities for the protection of essential fish habitat (EFH). The southern estuaries comprise Biscayne National Park and a large portion of ENP and are a shallow estuarine system (average depth less than 3 feet). Florida Bay is the main receiving water of the greater Everglades. The southern estuaries contain essential fish habitat for corals; coral reef and live bottom habitat; red drum (*Sciaenops ocellatus*); penaeid shrimps; spiny lobster (*Panulirus argus*); other coastal migratory pelagic species and the snapper-grouper complex. Essential fish habitat in the southern estuaries is comprised of seagrasses, estuarine mangroves, intertidal flats, the estuarine water column, live/hard bottoms, and coral reefs.

3.12 Water Quality

Water quality in the study area is significantly influenced by development. The C&SF project led to significant changes in the landscape by opening large land tracts for urban development and agricultural uses, and by the construction of extensive drainage networks. Natural drainage patterns in the region have been disrupted by the extensive array of levees and canals which has resulted in further water quality degradation. Since the bypass of the stormwater treatment areas (STA's) has been essentially eliminated (except under extreme environmental conditions), the water quality of the project area is primarily influenced by legacy loading (previous nutrient loading delivered to the project area which remains in the project soils and can leach out for many years), untreated discharges from the S-9 and weather conditions/rainfall patterns. Dry out conditions in marsh/urban areas served by the S-9 and within the WCA's followed by high rainfall events are very likely associated with release of nutrients into the water column from sediments/vegetation. The northern WCAs are fed from Lake Okeechobee as well as runoff from the EAA. Typically under normal conditions all water from Lake Okeechobee and the EAA is routed through the STAs. The STAs were constructed to reduce total phosphorus from surface water runoff releases from Lake Okeechobee. Water quality delivered to the WCA's from Lake Okeechobee/EAA source water treated by the STAs has significantly improved (lower nutrient loading/concentrations). Water quality impairment within the study area can generally be attributed to nutrients and bioavailable forms of mercury.

The USACE does not control the quality of the water which enters or exits the system. Instead, the primary authority for managing the nutrient levels and overall quality of the water entering the study area and surrounding watersheds is the State of Florida. As such, the USACE relies upon the appropriate state agencies to determine the quality of the water and to ensure the water meets acceptable state water quality standards. In managing its projects, the USACE routinely coordinates with the State of Florida Department of Environmental Protection (FDEP), the State of Florida Department of Health (FDOH), the U.S. Department of Health & Human Services (HHS) (e.g., Agency for Toxic Substances and Disease Registry), U.S. Geological Survey (USGS), and the U.S. Environmental Protection Agency (USEPA).

A short discussion of water pollutants is provided below followed by a review of water quality within the study area.

3.12.1 Nutrients

Nutrients such as phosphorus and nitrogen compounds are a concern in the WCAs and ENP since they result in an imbalance of flora and fauna. To address nutrient discharges the FDEP has recently established surface water quality numeric nutrient criteria for all Florida water bodies and developed National Pollution Discharge Elimination (NPDES) Total Maximum Daily Loads (TMDLs) for many watersheds with excessive nutrient pollution. Additional information on the status and implementation of TMDLs within the study area can be found at http://www.dep.state.fl.us/water/tmdl/) Within the Everglades Protection Area (EPA), phosphorus concentrations are regulated by Florida Administrative Code Rule 62-302.540, "Water Quality Standards for Phosphorous Within the Everglades Protection Area" and additionally WCA 1 and the ENP (Outstanding Florida Waters within the Everglades Protection Area) are subject to the terms of the 1992 Consent Decree entered in United States v. South Florida Water Management. District (S.D. Fla No. 88-1886-CIV-MORENO). WCA 2 and WCA 3 are Class III waters with additional phosphorus constraints not applicable to other Class III waters. According to 62-302.540, "the numeric phosphorus criterion for Class III waters in the EPA shall be a long-term geometric mean of 10 ppb, but shall not be lower than the natural conditions of the EPA, and shall take into account spatial and temporal variability. Achievement of the criterion shall be determined by the methods in this subsection. Exceedances of the provisions of this subsection shall not be considered deviations from the criterion if they are attributable to the full range of natural spatial and temporal variability, statistical variability inherent in sampling and testing procedures or higher natural background conditions."

Total phosphorus (TP) is the primary nutrient of concern within WCA 3 and NESRS. SRS compliance for Water Year (WY) 2018 (October 1, 2017-September 30, 2018) was calculated using two methods. One method included S-356 flows and the other did not. SRS was in compliance using both methods with annual Flow Weighted Mean (FWM) of 7.3 parts per billion (ppb) as the result for both methods. The WY 2018 long-term limit for SRS using both methods was 7.6 ppb.

3.13 Hazardous, Toxic or Radioactive Wastes

Along the southern boundary of WCA 3A and WCA 3B there are levees and canals constructed in the 1950s and 1960s that limit vehicle access to the interior. Activity within the WCA is generally limited to fishing, hunting, and birding though there may be some illegal dumping of solid wastes along the perimeter. No soil testing for residual contaminants has been conducted within the WCA 3A and WCA 3B as part of this project since the lands have no history of prior agricultural or industrial use that would cause such contamination.

A search of the FDEP petroleum spill and storage sites database done in October of 2014 identified six petroleum storage sites and one spill site along Tamiami Trail between S-333 and S-356. Petroleum storage at Everglades Safari site was closed in 2005; however, a petroleum spill at this site is listed as ongoing as of October 2014. Petroleum storage facilities operated by the SFWMD are located at the S-333 and S-356 structures.

A search of the FDEP's databases of contamination sites and petroleum storage facilities identified five spill sites and 15 petroleum storage facilities located along the canal or within the 8.5 SMA. The SFWMD is listed as the permit holder for storage facilities at the S-357 and S-331 pump stations. The spill at the SFWMD's S-331 pump station has been completed. A spill at the General Portland, Inc. facility west of the canal is listed as ongoing. Three non-petroleum cleanup sites are located along the L-31N canal. Two of the sites are located along the L-31N canal buffer trail and one is located within the 8.5 SMA.

3.14 Air Quality

Air monitoring reports are prepared annually by the FDEP to inform the public of the air pollutant levels throughout the State of Florida. All areas within the state are designated with respect to each of the six pollutants (carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particle pollution (10 microns or less in diameter (PM_{10}), and 2.5 microns or less in diameter ($PM_{2.5}$), and sulfur dioxide (SO_2)) as attainment (i.e., in compliance with the standards); non-attainment (i.e., not in compliance with the standards); or unclassifiable (i.e., insufficient data to classify). Attainment areas can be further classified as maintenance areas. Maintenance areas are areas previously classified as non-attainment which have successfully reduced air pollutant concentrations to below the standard. Southeast Florida including Miami-Dade County continues to be classified by the USEPA as an attainment/maintenance area for ozone. Data collected by the state of Florida for the USEPA particle pollution standards for PM_{10}, and 2 ($PM_{2.5}$) has never had a monitor with a design value exceeding either standard. (Florida's Ozone and Particulate Matter Air Quality Trends (FDEP Website "Florida Ozone PM Trends" last modified August 22, 2019)).

3.15 Noise

Noise levels are associated with surrounding land use. Within the major natural areas of south Florida, external sources of noise are limited and of low occurrence. Existing sources of noise are limited to vehicular traffic travelling on roads adjacent to and cutting through the project area. Other sources of noise which may occur within these natural areas include airboats, off-road vehicles, swamp buggies, motor boats, and occasional air traffic. Sources of noise in rural areas include noise associated with agricultural production such as the processing and transportation of agricultural produce. Within the rural municipalities and urban areas, sound levels would be expected to be of greater intensity, frequency, and duration. Noise associated with transportation arteries, such as highways, railroads, primary and secondary roads, airports, operations at commercial and industrial facilities etc., inherent in areas of higher population would be significant and probably override those sounds associated with natural emissions.

3.16 Aesthetics

The visual characteristics of south Florida can be described according to the three dominant land use categories: natural areas, agricultural lands, and urban areas. The natural areas consist of a variety of upland and wetland ecosystems, including lakes, ponds, vast expanses of marsh and wet prairie, with varying vegetative components. Uplands are often dominated by pine, although other sub-tropical and tropical hardwoods do occur. Overall, the land is extremely flat, with few natural topographic features such as hills or other undulations. Much of the visible topographic features within the natural areas are man-made. Generally, urban development is concentrated along the LEC. Development is typically immediately adjacent to or nearby protected natural areas.

3.17 Socioeconomics

Florida's economy is characterized by strong wholesale and retail trade, government, and service sectors. The economy of south Florida is based on services, agriculture, and tourism. The three counties that comprise the LEC are heavily populated. Much of the land within the area potentially impacted is within ENP and is publicly owned. The areas with the most potential impacts which are not publically owned are the agricultural and residential/commercial parcels along the East Coast Protective Levee in Miami-Dade

County[2]. Within Miami-Dade county the market value of all agricultural products sold are $837.7 million, about 95% of which are from crops.

Miami-Dade County has a population of 2.7 million with a median age of 39.5. The majority of the population are Hispanic or Latino, making up over two-thirds of the total population followed by the second largest group, African American, which is approximately 16% (**Table 3-3**). The median household income is $46,338 with the largest percent of households (16.4%) earning between $50,000 and $74,999 (**Table 3-4**). The dominant employment sector of the county with one in every five worker employed is educational, healthcare, and social assistance services followed closely by professional services (**Table 3-5**). At the county level agriculture only makes up 0.7% of total employment but plays a larger role in the COP analysis due to the proximity of agriculture parcels to water management features controlled by the COP.

Table 3-3: Demographic Summary of Miami-Dade County

Demographics*	Number	Percent
Total population size	2,702,602	-
Hispanic or Latino (of any race)	1,823,038	67.5%
Mexican	61,903	2.3%
Puerto Rican	101,449	3.8%
Cuban	976,332	36.1%
Other Hispanic or Latino	683,354	25.3%
Not Hispanic or Latino	879,564	32.5%
White alone	371,233	13.7%
Black or African American alone	441,604	16.3%
American Indian and Alaska Native alone	2,344	0.1%
Asian alone	40,868	1.5%
Native Hawaiian and Other Pacific Islander alone	541	0.0%
Some other race alone	6,840	0.3%
Two or more races	16,134	0.6%

*American Community Survey 2017

Table 3-4: Income Summary of Miami-Dade County

Income and Benefits (In 2017 Inflation Adjusted Dollars)*	Number	Percent
Total households	858,289	100%
Less than $10,000	85,270	9.9%
$10,000 to $14,999	54,740	6.4%
$15,000 to $24,999	105,104	12.2%
$25,000 to $34,999	91,222	10.6%

[2] It is this county, Miami-Dade that the socioeconomic impact analysis focuses on solely as described in the Socio-economic Appendix.

Income and Benefits (In 2017 Inflation Adjusted Dollars)*	Number	Percent
$35,000 to $49,999	118,778	13.8%
$50,000 to $74,999	140,674	16.4%
$75,000 to $99,999	87,953	10.2%
$100,000 to $149,999	92,102	10.7%
$150,000 to $199,999	36,256	4.2%
$200,000 or more	46,190	5.4%
Median household income (dollars)	46,338	(X)
Mean household income (dollars)	72,162	(X)

*American Community Survey 2017

Table 3-5: Employment Summary of Miami-Dade County

Employment Summary*	Number	Percent
Civilian employed population 16 years and over	1,272,735	-
Agriculture, forestry, fishing and hunting, and mining	8,760	0.7%
Construction	95,264	7.5%
Manufacturing	57,907	4.5%
Wholesale trade	49,068	3.9%
Retail trade	156,449	12.3%
Transportation and warehousing, and utilities	96,852	7.6%
Information	26,374	2.1%
Finance and insurance, and real estate and rental and leasing	97,119	7.6%
Professional, scientific, and management, and administrative and waste management services	164,530	12.9%
Educational services, and health care and social assistance	252,739	19.9%
Arts, entertainment, and recreation, and accommodation and food services	145,040	11.4%
Other services, except public administration	79,606	6.3%
Public administration	43,027	3.4%

*American Community Survey 2017

3.18 Native Americans

There are two federally recognized tribes (Miccosukee Tribe of Indians of Florida (Miccosukee Tribe) and the Seminole Tribe of Florida (STOF)) that are located within and adjacent to the project area (**Figure 3-6**). Both tribes maintain a strong connection to the project area through continued use and regard the indigenous populations of Florida as their ancestors. The project area includes a large segment of the Miccosukee Tribe's Alligator Alley Reservation which spans portions of WCA 3A, the Tamiami Trail Reservation Area which consists of three parcels of land used for commercial services, and the Miccosukee Reserved Area which is the center of the Miccosukee Indian population. In addition, both tribes have leases and easements within WCA 3A and have historically recognized rights within ENP that stems from the Native Americans who lived within the ENP boundary prior to the Park's creation.

The Miccosukee Tribe and the STOF have a long history of living within the project area. Both tribes moved into the region during the eighteenth and nineteenth centuries from Georgia and Alabama. Fleeing the U.S. Army and the forced relocation policies of the Indian Removal Act (1830), the Miccosukee and Seminoles were part of Native American groups commonly referred to as Seminoles; however, there are references to some of the groups involved in the conflict as Mikasuki, which supports the subsequent separation of the two groups (Weisman 1999). Many of these groups fled into the swamp areas of south Florida and made their homes within the Everglades and other remote areas of region. The coming of the Civil War led to the abandonment of the removal efforts and the various Native American groups were largely left alone until the late nineteenth century. In 1928 the Tamiami Trail opened, cutting through the Everglades and bringing along with it tourists and explorers into the region, and, for the first time, bringing complete access for the various tribes to participate in the larger economy that was growing in south Florida.

As early as 1894, the Federal governmental and later the State of Florida started to acquire lands within the Big Cypress area. However, initial attempts to relocate tribal members to these areas failed as there were simply no incentives to abandon traditionally occupied areas in favor of the new lands (Weisman 1999). "The Indian New Deal changed that, and for the first time, services, programs, and land were brought together…at Big Cypress" (Weisman 1999:125). In the 1930s, the Federal Government started to bring services to the various Seminole groups. Some of the groups relocated and started to receive Federal aid, while some groups resisted government intrusion into their lives and remained in various traditional areas that now included sites along Tamiami Trail (Weisman 1999). Throughout the next two decades the Federal Government instituted various aid programs to assist the Native American groups living within the reservations until the early 1950s. In the early 1950s, the Federal Government's policies radically changed, as it was felt that native groups should now join "mainstream society" and that Federal aid should come to an end (Weisman 1999:131). Being faced with a reduction in support and possible termination of recognition as a group by the government, various Native American groups on these reservations began to organize and form their own tribal governments to assist in the protection of their interests. In 1957, the STOF received Federal recognition. However, wishing to remain separate and to maintain their own identity, many of the groups along the Tamiami Trail refused to join and instead held out to form their own government that would be federally recognized in 1962 as the Miccosukee Tribe of Indians of Florida.

Today most of the Miccosukee Tribe lives within the confines of the reservation located along the forty mile bend of Tamiami Trail, while many of the STOF live on various reservations properties with the largest being those of Big Cypress, Hollywood, and Brighton Reservations. In addition to the Federal reservation, the Miccosukee Tribe has also established a perpetual lease to large portions of the WCA 3A area while the STOF has a lease within the northwestern portion of WCA 3A.

Members of both groups maintain a traditional life style that is intricately connected to the Everglades. Traditional practices of hunting, fishing, and general living are still maintained, along with modern entrepreneurship through various enterprises such as cattle ranching and with tourism related businesses along Tamiami Trail. Today, both tribes have vibrant, thriving cultures based within the Everglades region. These practices continue to tie the Tribes to the Everglades in such a way that careful consideration of effects is warranted.

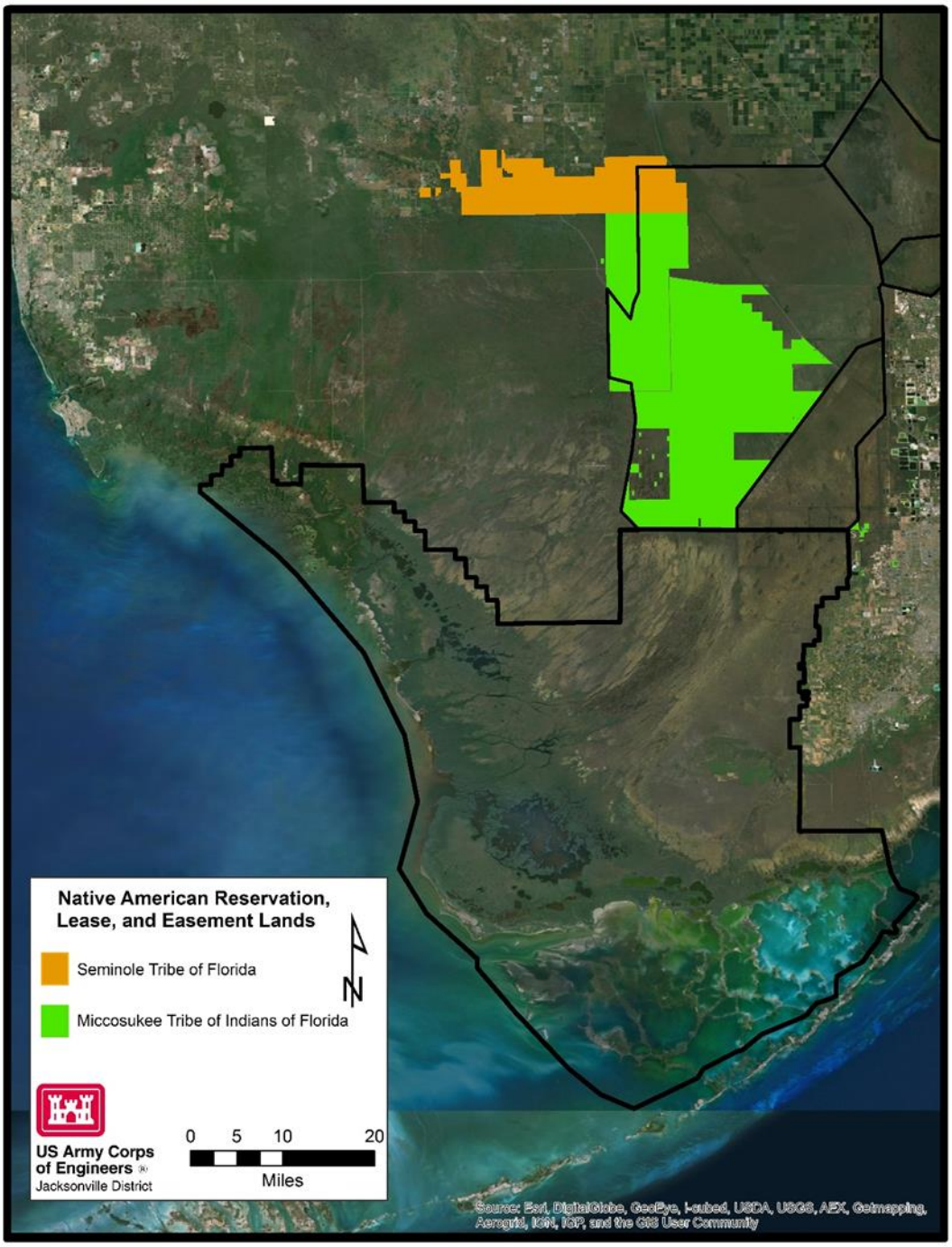

Figure 3-6. Map outlining the location of Tribal Reservation, Leased and Easement Lands

3.19 Cultural Resources

Within the larger region that includes ENP and WCA 3, there are numerous recorded archeological sites indicative of Native American habitation. Prior to European contact, the Everglades were a heavily populated area. Native Americans traveled via canoe and on foot through the sawgrass and inhabited many of the tree islands that dot the landscape. The earliest known habitation sites date to the Early

Archaic period (7500 BC) when the Everglades were much drier. However, within the larger area of south Florida, evidence of Paleo-Indian (12,000 to 7500 BC) habitation has also been recorded (i.e. Warm Mineral Springs (8SO18) and Little Salt Spring (8SO79) (Griffin 1988). Some of the Early Archaic habitation sites have only recently been rediscovered as the result of managed drainage programs in south Florida. As the climate warmed and sea level rose, many Native Americans abandoned the lowest of the tree islands as they became submerged. This process continued through what is known as the Middle Archaic, until climate conditions stabilized around 300 BC at the start of the Late Archaic. Today, many sites from both the Early and Middle Archaic periods are no longer submerged and may have more modern Native American use.

After the Archaic period, the region became incorporated into what is known as the Glades region and remained inhabited until European contact, when Old World diseases and slave raiding heavily reduced the Native populations during the late 1500s-1700s. Many of the tree islands through this portion of the Everglades have sites associated to the Glades period. This period has been broken down into successive stages starting with Glades I, which dates from 500 BC to AD 750, Glades Period II dating from AD 750 to 1200, and Glades Period III dating from AD 1200 to European contact in the 1500s. Typical habitation sites through this region are commonly referred to as middens, which are the accumulation of daily life activities on these tree islands. Material remains can stretch from the surface to well over one meter below the surface on certain islands. Native American burials can also be found among these habitation sites.

After European contact, Native American populations in the region continuously declined and remained at low levels until Miccosukee and Seminole tribal groups moved into the area while fleeing the U.S. Army and U.S. Governments' forced relocation program. Many sites associated with both the Miccosukee and Seminole tribes are known to exist throughout the region (see Native American section for more background).

The broad region of ENP and WCA 3 has been subject to numerous cultural resource investigations and has been found to contain a wide variety of cultural resources that vary within their significance. There are archaeological resources associated with some of the earliest habitation sequences within south Florida and relatively recent sites directly associated with modern Native American tribes who were removed from ENP shortly after its creation.

Approximately 283 cultural resources, as identified in the Florida Master Site File, are located within the project area. Of these resources, 124 sites are located within WCA 3 north of the L-29 canal. The majority of these sites were identified based on a 1987 aerial analysis of the WCA and the presence of archaeological materials was not ground-truthed (Taylor 1987). Only approximately 33 sites within WCA 3 have been identified based on a physical archaeological investigation. A total of 9 cultural resources within WCA3 have been listed or determined eligible for listing in the National Register of Historic Places (NRHP), including Mack's Fish Camp Historical District.

The southern portion of the project area, south of the L-29 canal, is located entirely within ENP. ENP has been subject to many archaeological investigations that have identified approximately 159 cultural resources within the project area. Of these resources, 43 have been listed or determined eligible for listing in the NRHP, including two archaeological districts. A small portion of Ten Thousand Islands Archaeological District is located on the western edge of the project area and the SRS Archaeological District in contained entirely within the project area. The SRS Archaeological District contains no less than 63 archaeological resources, 39 of which are contributing resources to the district (Schwandron 1996). Sites typically found

within the SRS are described as earth middens; however, multi-occupation sites such as Tiger Hammock (8DA11), which is associated with Glades II and III and Seminole occupations, have also been identified.

3.20 Environmental Justice

Environmental justice (EJ) is addressing, as appropriate, disproportionately high and adverse human health or environmental effects of Federal programs, policies, and activities on minority and/or low-income populations. The Executive Order 12898 on EJ requires an analysis of environmental effects, including human health, economic and social effects, of Federal actions, including effects on minority and/or low-income communities, when such analysis is required by NEPA. The intent of EJ is that no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental, and commercial operations or policies. This section identifies minority, low income, and Native American Tribal populations that exist within the COP study area. Reference **Section 3.18** (**Native Americans**) for a detailed description of tribal history, and **Section 3.19** (**Cultural Resources**) for additional discussion of other cultural, tribal, and religious freedom issues. **Section 4.17** (**Environmental Justice**) evaluates if any community would bear a disproportionate share of potentially adverse environmental consequences resulting from the proposed action.

3.20.1 Area of Analysis – Environmental Justice Community Determination

For the environmental justice analysis, Geographic Information System (GIS) files were extracted from the Miami-Dade County database. Minority populations and low- or moderate-income communities were used to define the potential for disproportionate adverse impacts. To determine low-moderate income communities the county had existing shapefiles which compiled all census block groups where 51% or more of the population is categorized as low-moderate income. These same census block groups were used in the COP analysis to determine if there were disproportionately high and adverse human health or environmental effects. The income-based block groups within the area specific to the impact analysis[3], 12 in total, are shown below in **Figure 3-7** with the census tract and block group identified by the seven digit number labeled in white. A second shapefile with demographic data was analyzed and any block group with a minority population that was 20% or greater than the county average (see **Table 3-3** for county averages) was determined to be an environmental justice community and is shown in **Figure 3-8** with 598 blocks in total.

A particular uncertainty related to the impact analysis with specific respect to the environmental justice portion is that impacts to agricultural parcels were measured in addition to residential/commercial structure impacts. However, the ownership information of each individual agriculture parcel (nearly 6,000 in total) was not available and there is no clear relationship between low-moderate income or minority population census blocks and agriculture parcel ownership (i.e. it is not clear if the agricultural parcels are owned by members of the census block communities or are independent commercial operators).

An additional area of analysis for environmental justice was conducted along the Tamiami Trail corridor with specific respect to airboat concessionaire operations in WCA 3A (**Figure 3-9**). There are not specific census blocks to reference in this analysis but there is a distinction in concessionaire ownership between

[3] Reference **Appendix I (Socioeconomic**) for full details on how the area of analysis was selected for impacts from the COP.

airboat operations west of the L-67 extension (Miccosukee Tribe owned airboat concessions) and east of the L-67 extension canal (various private owners).

Figure 3-7: Environmental justice communities based on income.

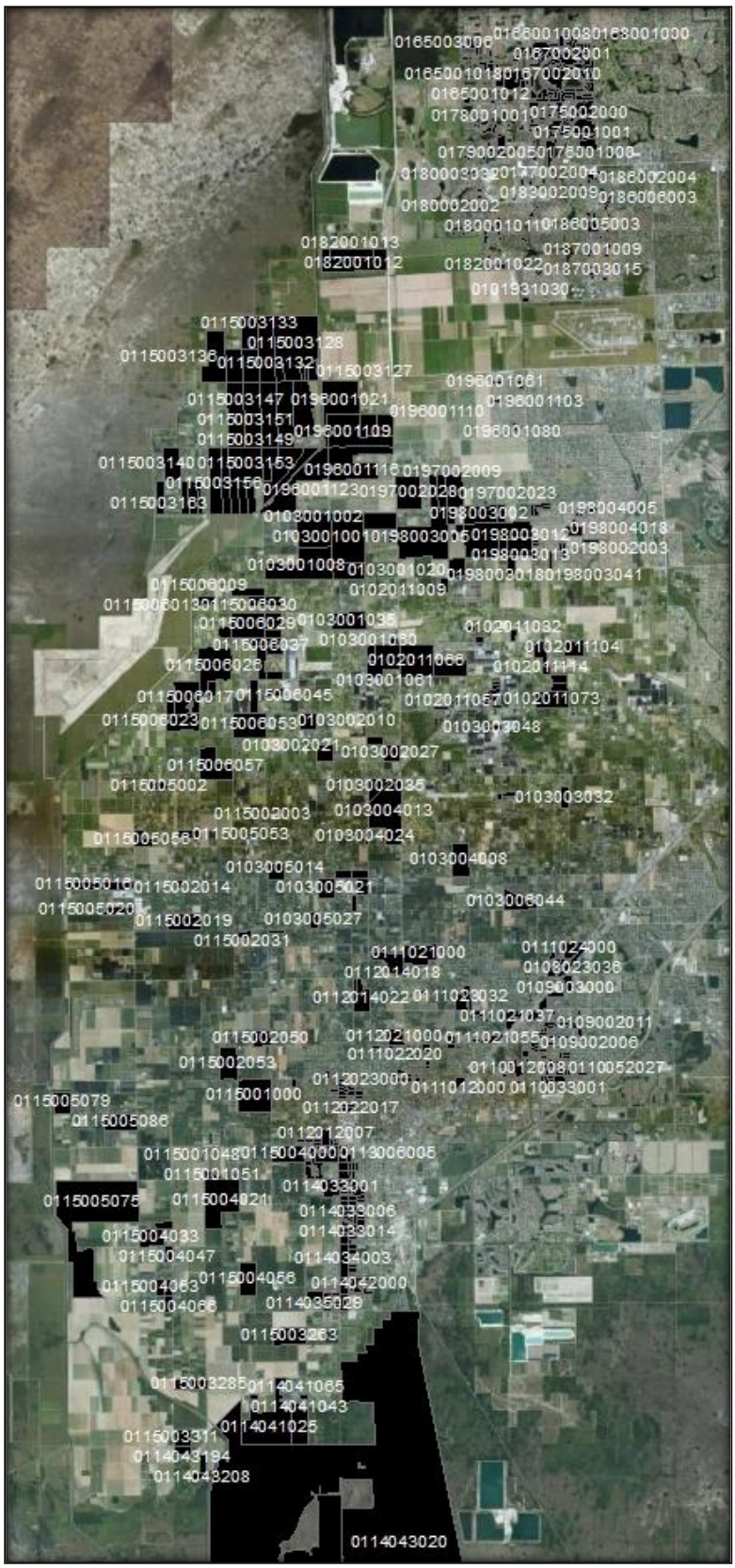

Figure 3-8: Environmental justice communities based on demographics.

Figure 3-9: Environmental Justice Analysis Area – Airboat Concessionaires

Numerous methods of engagement were employed as part of the COP study to engage minority, low-income, and Native American Tribes. **Table 3-6** summarizes overall engagement efforts with stakeholders on the project**. Table 6-1** in **Section 6** (**Public Involvement**) provides a list of Project Delivery Team (PDT) meetings conducted during plan formulation efforts for the COP. Designated public comment periods provided opportunities for public participation during PDT meetings. Additional briefings of the COP by the USACE and the SFWMD also occurred throughout the planning process including presentations to the SFWMD's Governing Board, the Water Resources Advisory Committee (WRAC) and the Everglades Technical Oversight Committee. **Table 6-2** in **Section 6** (**Public Involvement**) provides a list of government-to-government consultation meetings that were conducted with the Miccosukee Tribe, STOF, and Seminole Nation of Oklahoma.

Table 3-6. Summary of stakeholder engagement meetings.

Engagement Type	Date	Stakeholders
Notice of Intent (NOI) Mailing	A NOI to prepare an EIS for the COP was published in the Federal Register (FR Volume 82, Number 173) September 8, 2017. A NEPA	A NOI and NEPA scoping letter was used to invite comments from Federal, State, and local agencies, affected Indian Tribes, and other

Engagement Type	Date	Stakeholders
	scoping letter was prepared on September 22, 2017.	interested private organizations and individuals.
PDT Meetings	21 PDT Meetings (8 In Person Meetings and 13 Teleconference/Webinar Meetings)	PDT membership consisted of those individuals designated by the USACE, the implementing agency, and representatives designated by other governmental agencies or Tribes. Designated public comment periods provided opportunities for public participation during PDT meetings.
Government to Government with Tribes	14 Government to Government Consultation Meetings	Meetings held with Seminole Nation of Oklahoma, STOF, and the Miccosukee Tribe Florida to receive comments.

3.20.2 Existing Conditions/Affected Environment

This section provides a description of existing conditions within the study area as they relate to issues of environmental justice.

- **Unique characteristics of the geographic area**. According to the Council on Environmental Quality (CEQ's) regulation (40 CFR §1508.27), unique characteristics of the geographic area could include proximity to distinctive features such as historic or cultural resources, prime farmlands, wetlands, ecologically critical areas. There are two federally recognized tribes (Miccosukee Tribe and the STOF) that are located within and adjacent to the project area (**Figure 3-6**). The project area includes a large segment of the Miccosukee Tribe's Alligator Alley Reservation which spans portions of WCA 3A, the Tamiami Trail Reservation Area which consists of three parcels of land used for commercial services, and the Miccosukee Reserved Area which is the center of the Miccosukee Indian population. In addition, both tribes have leases and easements within WCA 3A and have historically recognized rights within ENP that stems from the Native Americans who lived within the ENP boundary prior to the parks creation. Both tribes maintain a strong connection to the project area through continued use and regard the indigenous populations of Florida as their ancestors; therefore lands used by both the Miccosukee Tribe and the STOF within the study area falls under this category and has been given special consideration when assessing the intensity of impacts listed below.

  Furthermore, the landscape of the study area is unique in that it contains the remaining portions of the Greater Everglades wetlands which includes a mosaic of interconnected freshwater wetlands and estuaries. A ridge and slough system of patterned, freshwater peat lands with higher elevation tree islands extends throughout the WCAs into NESRS in ENP. The ridge and slough wetlands drain into tidal rivers that flow through mangrove estuaries into the Gulf of Mexico. Higher elevation wetlands that flank either side of SRS are characterized by marl substrates and exposed limestone bedrock. Those wetland areas located to the east of NESRS include the drainage basin for Taylor Slough, which flows through an estuary of dwarf mangrove forests into northeast Florida Bay.

- **Aesthetics.** Current aesthetics reflect a natural landscape viewshed as most of the landscape in the study area consist of a wetland ecosystem. Several communities, roads, and canals bisect the

project area with the most populous urban areas being located east of ENP along the LEC. Reference **Section 3.16** (**Aesthetics**).

- **Noise**. Noise is relatively low in natural areas. Noise is loudest near roads and canals used for boat traffic. Agricultural activities also increase noise periodically to manage lands with heavy machinery. Reference **Section 3.15** (**Noise**).
- **Light pollution**. Light pollution is minimal from lights marking existing roads, existing water management infrastructure, rural houses, trailer parks, and other residential developments. Most light pollution would be located east of ENP along the LEC.
- **Air quality**. Minor, short-term air quality issues occur from burning of agricultural material or land management activities. Otherwise air quality is relatively good. Reference **Section 3.14** (**Air Quality**).
- **Native American and cultural resources**. Burial and cultural resources are found in tree islands within WCA 3 and ENP. Tree islands are used by the Miccosukee Tribe for traditional practices of hunting, fishing, frogging, trapping, and general living along with modern entrepreneurship with tourism related businesses (airboat concessionaires) along Tamiami Trail. Tree islands are also used by the Miccosukee Tribe for religious practices. Reference **Section 3.19** (**Cultural Resources**) and **Section 3.18** (**Native Americans**).
- **Economic impacts**. Socioeconomic statistics of the human population in this area are described in the next sections of the EJ analysis. The following are key issues that will need to be considered in the EJ analysis with respect to potential socio-economic impacts.
    - **Maintain water supply** for agricultural, Tribes, and utilities as it relates to surficial aquifer wells, and canals in the study area. Hydrologic modeling is used to explain comparison of water supply existing conditions with alternatives.
    - **Seepage and Restricted Drainage**. Ground water and surface water levels can be affected by water management operations. Excess seepage from project features and canals can affect agricultural land productivity by limiting drainage from farmlands and in extreme cases limit drainage from home and residential areas which could lead to risk of flooding. A consistently elevated water table may also impact agricultural land.
    - **Land acquisition**. Ground water and surface water levels can be affected by water management operations; however no land acquisition is being considered for the COP.
- **Human Health and Safety**
    - **Drinking water quality**. Drinking water for many residents in the project area is obtained from the surficial aquifer in the study area. Surface water quality is sufficient to meet drinking water standards with minimal treatment.
    - **Subsistence and recreational fishing and hunting**. Recreational fishing is plentiful in the study area. Operational changes that increase the frequency of high or low water depths can limit recreational access to WCA 3A due to mandated closures by the FWC.
    - **Life safety**. Operational changes that lead to the storage of large amounts of water with levees determined to be high hazard dams can pose a risk to immediate residential communities downstream of potential levee breaks.

3.20.3 Summary of Environmental Justice Communities

Low-income population concerns associated with the project relate to human health and safety, potential loss of affordable housing, loss of recreational fishing/hunting, and loss of job opportunities in the area where they live. The major minority population in the project area is Hispanic and African American.

In addition, there are two federally recognized tribes (Miccosukee Tribe and the STOF) that are located within and adjacent to the study area. The tribes' potential concerns are explained below. **Section 3.18** (**Native Americans**) contains additional information on each of these Tribes.

Numerous government-to-government consultations, along with other outreach efforts, were conducted with the Miccosukee Tribe and the STOF to solicit input from the tribal governments regarding their assessment of effects on Indian trust resources, tribal rights to use those resources, other resources traditionally used by tribes, and cultural values related to those resources and rights within the area resulting from the implementation of the COP. Members of both tribes continue to rely upon the Everglades and the study area to support their cultural, medicinal, subsistence, and commercial activities. The specific issues impacting each Tribe have been different over the last few decades, but they are all related to impacts from man-made changes to the Everglades ecosystem. (The reader should note that inclusion of any claims and assertions put forth by these tribes does not necessarily imply that the Federal Government endorses those views.)

The STOF's focus has been on the health and well-being of tree islands within the Everglades as well. Tree islands were and still are important places to the Native American populations of Florida. It is generally agreed that most of the tree islands of any reasonable size contain archaeological sites and many contain burial components. The Seminole tribe is concerned about protecting these cultural resources from inundation that is anthropogenic in origin beyond historic levels and not the result of naturally occurring weather events.

The Miccosukee Tribe's focus has been on the detrimental ponding of water on tribal leased lands in WCA 3A, which affects subsistence practices and increases inundation risks to tree islands that they use. They have also voiced concerns with regards to the impacts of nutrient pollution in the natural system both above and below ground. Concerns have also been expressed on the potential effects on tribal airboat concessionaries in southern WCA 3A due to implementation of the COP and the request for a socioeconomic analysis to be performed. The COP has the potential to decrease surface water stages in WCA 3 as water is moved into NESRS. While decreases in water levels in southern WCA 3A may provide a potential benefit to tree islands since this area is chronically ponded, decreases in water levels that potentially and temporarily prohibit access to tree islands may affect the ability of the Miccosukee Tribe to participate in cultural and religious practices that take place on these islands. Airboats are often used by the Miccosukee Tribe to gain access to tree islands in WCA 3A. Tree islands are often the location for "chickees" (which means "house" in the Miccosukee language) and are used to grow corn, both of which are an important part of ceremonial practices.

Members of both tribes maintain a traditional life style that is intricately connected to the Everglades. Traditional practices of hunting, fishing, frogging, trapping, and general living are still maintained, along with modern entrepreneurship through various enterprises such as cattle ranching and with tourism related businesses along Tamiami Trail. Today, both tribes have vibrant, thriving culture based within the Everglades region. These practices continue to tie the tribes to the Everglades in such a way that careful consideration of effects on Tribal cultural, well-being, and way of life is warranted.

Furthermore, during plan formulation efforts for the COP, the Miccosukee Tribe provided information on rights to access in the study area. The following summarizes the documents provided.

In 1982, the State of Florida (State) and the Miccosukee Tribe entered into a Lease Agreement to help clarify and more precisely define their respective rights with regard to lands within South Florida, including WCA 3A lying in Broward and Miami Dade Counties, Florida. The Lease Agreement largely covers hunting, fishing, and freshwater aquatic life and wildlife management practices. The Lease Agreement grants the Miccosukee Tribe the rights to reside in the Leased Area, use the Leased Area for tribal religious purposes, and to take and use native materials from the Leased Area for tribal purposes. The Lease Agreement also provides the Miccosukee Tribe with the exclusive right to offer airboat rides, guide services, or other tourist services in the Leased Area. All of the rights set forth in the Lease Agreement are subject to and shall not interfere with the rights, duties and obligations of the SFWMD or the USACE, pursuant to "any other present or future lawful authority to manage, regulate, raise, or lower the water levels within the Leased Area or WCA 3. Lease Agreement, paragraph 6 (1982).

The Lease Agreement was incorporated into a Settlement Agreement that was executed on April 16, 1982, and resolved litigation between the State of Florida and the Miccosukee Tribe. The Settlement Agreement contained certain commitments by both the State and the Miccosukee Tribe to resolve the Tribe's claims to land in South Florida, including the land in the Lease Agreement. The Settlement Agreement was effective upon the court's approval as well as the United States Congress and Florida Legislature enacting specific legislation memorializing the Settlement Agreement and recognizing certain terms, whichever occurred last.

Accordingly, the Florida Indian Land Claims Settlement Act (the Act) of 1982, 25 USC §§ 1741-1750e; Public Law 97-399, approves, ratifies, and confirms the Settlement Agreement between the State and the Miccosukee Tribe. In accordance with the Settlement Agreement, the Act extinguishes "[a]ll claims to lands within the State of Florida based upon aboriginal title by the Miccosukee Tribe, or any predecessor or successor in interest." 25 USC § 1744(b)(1). The Act holds that lands leased to the Miccosukee Tribe pursuant to the Lease Agreement "shall be treated as if such lands constituted a federally recognized Indian reservation" solely for the purpose of determining eligibility for Federal benefits and programs for which "Indians are eligible because of their status as Indians and of their residence on an Indian reservation." 25 USC § 1745(b). The Act authorizes and directs the Secretary of the Interior "to accept the transfer to the United States, to be held in trust for the use and benefit of the Miccosukee Tribe of Indians of Florida, of the lands authorized to be conveyed to the Miccosukee Tribe by section 285.061, Florida Statutes, and the lands described in Dedication Deed No. 23228 from the Trustees of the Internal Improvement Trust Fund subject to the provisions of section 285.061, Florida Statutes, and of this section."[4] 25 USC § 1747(a). The Act clarifies that any transfer of lands under the act is subject to all existing leases, easements, and rights-of-way; additionally, any transfer under the Act shall not confer upon the Miccosukee Tribe, or upon the lands within the reservation, any additional water rights. 25 USC § 1747(c).

[4] Florida Statute 285.061: "said board is further authorized to transfer to the United States to be held in trust for the use and benefit of the Miccosukee Tribe of Indians of Florida the following described lands: Sections 5, 6, 7, 8, 17, 18, 19, 20, 29, 30, 31, 32, Township 49 South, Range 36 East, and Township 49 South, Range 35 East, Township 50 South, Range 35 East, and Township 51 South, Range 35 East, said lands situate, lying and being in Broward County, Florida."

The Tribe also requested that the USACE provide an analysis of its trust responsibilities to the Miccosukee Tribe. The federal Indian trust responsibilities to the American Indian tribes requires the United States to support tribal sovereignty and economic prosperity, duties that stem from treaties between the United States and tribes to protect the tribes and respect their sovereignty. However, unless a statute, regulation, treaty, or agreement places a specific duty on the Government, the trust responsibility is satisfied by the agency's compliance with general regulations and statutes not specifically aimed at protecting Indian Tribes.

The Federal Statute establishing certain lands in trust for the Miccosukee Tribe of Indians of Florida is the Florida Indian Land Claims Settlement Act of 1982 (Act). Because the Act approves the Settlement Agreement which incorporates the Lease Agreement, the Corps can operate water levels in WCA 3 within its lawful authority, as laid out in paragraph 6 of the Lease Agreement.

3.21 Recreation

There are many recreational opportunities throughout south Florida. WCA 3 has been used for recreational activities including hunting, fishing, frogging, boating, camping, and off-road vehicle use. Private camps are located throughout WCA 3. A variety of other nature-based recreational opportunities are also provided to the public within WCA 3. These activities include wildlife viewing and nature photography. Hiking and bicycling are also permitted on existing levees within the project area where appropriate. There are also several recreation areas at locations along the boundary of WCA 3. Similar recreational opportunities are provided in ENP.

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4 ENVIRONMENTAL EFFECTS

Section 4 describes anticipated changes to the existing environment including direct, indirect, and cumulative effects. This assessment of environmental effects evaluates the anticipated environmental effects of the alternatives described in **Section 2** (**Alternatives**) (Alternative N (ALTN), Alternative O (ALTO), Alternative Q (ALTQ), and Alternative Q+ (ALTQ+), relative to the No Action Alternative (ECB19RR). Potential environmental effects are described within this section for each resource and are broadly summarized in **Table 4-1**. Reference **Section 4.1** (**Climate**) through **Section 4.19** (**Native Americans**) for further detailed information on the findings presented in **Table 4-1**. **Section 2** (**Alternatives**) further provides a description of each alternative and the justification for selection of ALTQ+ as the Preferred Plan.

For this analysis, intensity was rated as follows:

- Negligible effect to the resource or discipline is barely perceptible and not measurable and confined to a small area.
- Minor effect to the resource or discipline is perceptible and measurable and is localized.
- Moderate effect is clearly detectable and could have appreciable effect on the resource or discipline; or the effect is perceptible and measurable throughout the study area.
- Major effect would have a substantial, highly noticeable influence on the resource or discipline on a regional scale.

The duration of the effects in this analysis is defined as follows:

- Short term — effects last less than one year
- Long-term — effects that last longer than one year
- No duration — no effect

Table 4-1. Summary of potential environmental effects.

Alternatives					
Climate	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.
Geology and Soils	No significant effect. Geology and soils would not be expected to significantly change from existing conditions.	**WCA 3:** Negligible to Minor. Increased risk to soils in portions of WCA 3A and WCA 3B due to increased duration of dry downs; majority of area demonstrated a marsh that is consistent with peat accumulation marsh. **ENP:** Minor to Moderate. Beneficial reduction in cumulative drought intensity in NESRS and Taylor Slough. Increased inundation duration in existing wetlands in ENP is expected to promote peat accretion by reducing soil oxidation.	**WCA 3:** Negligible to Minor. Magnitude of increased risk relative to ECB19RR less than ALTN2. **ENP**: Minor to Moderate. Magnitude of decreased risk relative to ECB19RR less than ALTN2 in NESRS, greater than ALTN2 in Taylor Slough.	**WCA 3:** Negligible to Minor. Magnitude of increased risk relative to ECB19RR less than ALTN2. **ENP**: Minor to Moderate. Magnitude of decreased risk relative to ECB19RR less than ALTN2 and ALTO in central SRS; greater than ALTN2 in Taylor Slough.	**WCA 3 and ENP:** Similar to ALTQ.
Study Area Land Use	No significant effect. Land use within the study area would not be expected to change. Land use will continue to be used primarily as residential/commercial and agricultural. The primary use of land in the study area will	No significant effect. Negligible to minor increase in risk to agricultural production when compared to ECB19RR; risk is not anticipated to result in change to agricultural production.	No significant effect. Negligible to minor increase in risk to agricultural production, but performs better than ALTN2. The risk is not anticipated to result in change to agricultural production.	No significant effect. Risk is largely reduced compared to ECB19RR and therefore no change to agricultural production.	No significant effect. Same as ALTQ.

Alternatives	No Action Alternative (ECB19RR)*	Alternative N2 (ALTN2)	Alternative O (ALTO)	Alternative Q (ALTQ)	Alternative Q+ (ALTQ+)
	continue to be agriculture and residential/commercial. ALTN2, ALTO, ALTQ, and ALTQ+ are not anticipated to change the way in which the land is used in the future.				
Hydrology	**East-Central WCA 3A (3A-3):** Inundated 70% of the time. Median depth at 0.52 feet **Central WCA 3A (3A-4):** Inundated 91% of the time. Median depth at 1.11 feet **Southern WCA 3A (3A-28):** Inundated 98% of the time. Median depth at 1.97 feet **WCA 3B (3B-71):** Inundated 88% of the time. Median depth at 0.63 feet **Western SRS:** NP34 inundated 70% of the time with 0.31 feet median depth. NP201 inundated 58% of the time with 0.09 feet median depth. NP205 inundated 76% of the	**East-Central WCA 3A:** Minor adverse effects. **Central WCA 3A**: Minor to moderate adverse effects. **Southern WCA 3A**: Moderate adverse effects. **WCA 3B**: Minor adverse effects in the southern and central WCA 3B. Moderate adverse effects in northern WCA 3B. **Western SRS:** Minor improvement for dry conditions, moderate adverse effect for average to wet conditions. **NESRS:** Moderate to major improvement for all stages.	**East-Central WCA 3A:** Minor adverse effects under dry conditions. **Central WCA 3A:** Minor adverse effects under dry conditions. **Southern WCA 3A:** Similar to ECB19RR for wet conditions. Minor to moderate adverse effects for drier conditions. **WCA 3B:** Similar to ECB19RR with minor adverse effects for dry conditions. **Western SRS:** Moderate improvement for dry conditions, moderate adverse effect for wet conditions. Slight overall improvement.	**East-Central WCA 3A:** Minor adverse effects under dry conditions. **Central WCA 3A:** Minor to moderate adverse effects. **Southern WCA 3A:** Minor to moderate adverse effects. **WCA 3B:** Minor to moderate adverse effects in the southern and central WCA 3B. Moderate adverse effects in northern WCA 3B. **Western SRS:** Minor improvement for dry conditions, moderate adverse effect for wet conditions. Slight overall adverse effect.	**East-Central WCA 3A:** Similar to ALTQ. **Central WCA 3A:** Similar to ALTQ. **Southern WCA 3A:** No significant change from ALTQ. **WCA 3B:** Similar to ALTQ. **Western SRS:** Similar to ALTQ. **NESRS:** Similar to ALTQ. **Taylor Slough:** Similar to ALTQ with minor improvement. **Florida Bay:** Similar to ALTQ with no significant change.

Alternatives	No Action Alternative (ECB19RR)*	Alternative N2 (ALTN2)	Alternative O (ALTO)	Alternative Q (ALTQ)	Alternative Q+ (ALTQ+)
	time with 0.39 feet median depth. **NESRS:** NESRS1 inundated 93% of the time with 1.48 feet median depth. G3273 inundated 60% of the time with 0.30 feet median depth. **Taylor Slough (NP-TSB):** Inundated 44% of the time. Median depth at -0.2 feet. **Florida Bay:** 199,000 acre-feet of overland flow across Transects 23B and 23C.	**Taylor Slough:** No significant difference. **Florida Bay:** No significant difference.	**NESRS:** Moderate to major improvement for all stages. **Taylor Slough:** Slight improvement. **Florida Bay:** Minor improvement.	**NESRS:** Moderate to major improvement for all stages. **Taylor Slough:** Slight improvement. **Florida Bay:** Slight improvement.	
Water Supply: C-111 and L-31N Canals	No significant effect.	**C-111 and L-31N Canals**: Water supply availability is reduced in the dry season compared to ECB19RR.	**C-111 and L-31N Canals**: Same as ALTN2.	**C-111 and L-31N Canals**: Water supply availability is unchanged compared to ECB19RR.	**C-111 and L-31N Canals**: Same as ALTQ.
Water Supply: L-33 and L-37 Canals	No significant effect.	**L-33 and L-37 Canals**: Water supply availability is reduced in the dry season compared to ECB19RR.	**L-33 and L-37 Canals**: Same as ALTN2.	**L-33 and L-37 Canals**: Same as ALTN2.	**L-33 and L-37 Canals**: Same as ALTN2.

Alternatives	No Action Alternative (ECB19RR)*	Alternative N2 (ALTN2)	Alternative O (ALTO)	Alternative Q (ALTQ)	Alternative Q+ (ALTQ+)
Water Supply: L-40 N, L-40S, L-36, L-35A, and L-30 Canals	No significant effect.	**L-40 N, L-40S, L-36, L-35A, and L-30 Canals**: Water supply availability is unchanged compared to ECB19RR for all canals except L-30, which indicated water supply availability is reduced for Alternative N2.	**L-40 N, L-40S, L-36, L-35A, and L-30 Canals**: Water supply availability is unchanged compared to ECB19RR.	**L-40 N, L-40S, L-36, L-35A, and L-30 Canals**: Same as ALTO.	**L-40 N, L-40S, L-36, L-35A, and L-30 Canals**: Same as ALTO.
Vegetative Communities	No significant effect. Vegetative communities would not be expected to significantly change from existing conditions.	**WCA 3:** Negligible to Minor. During dry years, lowering of water levels in WCA 3 may decrease the spatial extent of deep-water sloughs and/or floating emergent marsh. Beneficial effect on chronically ponded areas of southern WCA 3A. **ENP:** Minor to Moderate. Increased inundation duration in ENP is expected to promote expansion of wetland vegetation and potential reduction of woody species. Increased flow to saltwater wetlands and nearshore bay areas is expected to result in	**WCA 3:** Negligible to Minor. Magnitude of potential adverse effect in WCA 3 relative to ECB19RR less than ALTN2. **ENP:** Minor to Moderate: Magnitude of potential beneficial effect less than ALTN2 in NESRS, greater than ALTN2 in Taylor Slough.	**WCA 3:** Negligible to Minor. Magnitude of potential adverse effect relative to ECB19RR less than ALTN2. **ENP**: Minor to Moderate. Magnitude of potential beneficial effect less than ALTN2 and ALTO in central SRS, greater than ALTN2 in Taylor Slough.	**WCA 3 and ENP:** Similar to ALTQ.

Alternatives	No Action Alternative (ECB19RR)*	Alternative N2 (ALTN2)	Alternative O (ALTO)	Alternative Q (ALTQ)	Alternative Q+ (ALTQ+)
		favorable changes to salinity that may positively affect seagrasses and mangroves.			
Fish and Wildlife Resources	No significant effect. Fish and wildlife resources would not be expected to significantly change from existing conditions.	**WCA 3:** Negligible to Minor. During dry years, lowering of water levels in WCA 3 may act to reduce the number or spatial extent of deeper water for large predatory fishes, although canals will continue to provide refugia. Potential for extended dry events in northern WCA 3A may affect nesting colonies. Mammals may benefit from lowering of water levels in WCA 3 during high water events when sources of upland refugia become limited. **ENP:** Minor to Moderate. Depending on location and species increased inundation duration in NESRS and Taylor Slough is expected to improve forage prey availability (i.e. crayfish and other	**WCA 3:** Negligible to Minor. Magnitude of potential adverse effect relative to ECB19RR less than ALTN2. **ENP:** Minor to Moderate. Magnitude of potential beneficial effect less than ALTN2 in NESRS, greater than ALTN2 in Taylor Slough.	**WCA 3:** Negligible to Minor. Magnitude of potential adverse effect relative to ECB19RR less than ALTN2. **ENP**: Minor to Moderate. Magnitude of potential beneficial effect less than ALTN2 and ALTO in central SRS, greater than ALTN2 in Taylor Slough.	**WCA 3 and ENP:** Similar to ALTQ.

Alternatives	No Action Alternative (ECB19RR)*	Alternative N2 (ALTN2)	Alternative O (ALTO)	Alternative Q (ALTQ)	Alternative Q+ (ALTQ+)
		invertebrates, fish), in turn providing beneficial effects for amphibian, reptile, small mammals, and wading bird species in ENP.			
Essential Fish Habitat (EFH)	No significant effect. EFH would not be expected to change significantly from existing conditions.	Minor to Moderate: Beneficial increase in average annual flow of 25,000 acre-feet to southern Taylor Slough and northern ENP Panhandle. Increased flow to saltwater wetlands and nearshore bay areas is expected to result in favorable changes to salinity. ALTN2 would not result in potential adverse effects to estuarine and marine resources including EFH.	Minor to Moderate: Beneficial increase in average annual flow of 46,000 acre-feet per year to southern Taylor Slough and northern ENP Panhandle. Magnitude of increased flow and potential change in favorable salinities greater than ALTN2.	Minor to Moderate: Beneficial increase in average annual flow of 36,000 acre-feet per year to southern Taylor Slough and northern ENP Panhandle. Magnitude of increased flow and potential change in favorable salinities greater than ALTN2.	Minor to Moderate: Similar to ALTQ.
Water Quality	No significant effect. There is a slight improvement trend in water quality delivered to ENP that is expected to continue without considering Restoration Strategies or CEPP project features yet to be built. ECB19RR modeling was	Minor effect lasting more than one year. Approximate increase of 0.8 ppb annual FWM into NESRS as compared to ECB19RR. Slight improvement trend in water quality delivered to ENP is expected to slowly reduce the difference from the	Minor effect lasting more than one year. Approximate increase of 0.9 ppb annual FWM into NESRS as compared to ECB19RR. Slight improvement trend in water quality delivered to ENP is expected to slowly reduce the difference from the	Minor effect lasting longer than 1 year. ALTQ 2018 conditions, relative to ECB19RR, indicated a 0.8 ppb increase in long-term flow weight mean for phosphorus inflows into ENP. This delta is expected to diminish to 0.2 ppb above baseline	Minor effect lasting longer than 1 year. By 2023 the NESRS LTFWM is expected to improve beyond baseline by 0.2 ppb for SRQ2_2023 and by 0.1 ppb for SRQ_2023. ALTQ+ has the option through adaptive management (AM) to improve water

Alternatives	No Action Alternative (ECB19RR)*	Alternative N2 (ALTN2)	Alternative O (ALTO)	Alternative Q (ALTQ)	Alternative Q+ (ALTQ+)
	determined to be 8.2 parts per billion (ppb) flow weighted mean (FWM) under 2018 conditions for total phosphorous. This baseline was used to evaluate the relative changes to water quality for each alternative.	baseline condition. This alternative is not expected to change the water quality delivered to the Taylor Slough/Coastal Basins.	baseline conditions. This delta is expected to reduce as compared to baseline by 2023. This alternative is not expected to change the water quality delivered to the Taylor Slough/Coastal Basins.	by 2023. This is due to the slight improvement trend in upstream water quality. This alternative is not expected to change the water quality delivered to the Taylor Slough/Coastal Basins.	quality delivered to NESRS as compared to ALTQ. ALTQ + has the potential to improve NESRS FWM by 0.4 ppb versus ALTQ under 2018 for SRQ2 and improve FWM conditions with SRQ3 by 0.3ppb as compared to ALTQ (2018). AM measures also allow for slight improvements in NESRS depths as compared to baseline. This alternative is not expected to change the water quality delivered to the Taylor Slough/Coastal Basins.
Hazardous, Toxic or Radioactive Waste	Negligible effect. HTRW within the study area would not be expected to change from existing conditions.	Negligible effect. ALTN2 consists of an operational change to the 2012 Water Control Plan and would not result in the discovery of HTRW. No construction is proposed. The risk for increased mobilization of existing HTRW where it might exist within the study area is low.	Negligible effect. Same as ALTN2.	Negligible effect. Same as ALTN2.	Negligible effect. Same as ALTN2.
Air Quality	Negligible effect. Air quality emissions would	Negligible effect. ALTN2 consists of an	Negligible effect. Same as ALTN2.	Negligible effect. Same as ALTN2.	Negligible effect. Same as ALTN2.

Alternatives	No Action Alternative (ECB19RR)*	Alternative N2 (ALTN2)	Alternative O (ALTO)	Alternative Q (ALTQ)	Alternative Q+ (ALTQ+)
	not be expected to change from existing conditions. Emissions would occur during operation of pump stations and would be limited to the immediate vicinity of the structures. Emissions would not be expected to cause negative effects to human health.	operational change to the 2012 Water Control Plan. Negligible increases in fuel consumption expected. No construction is proposed. ALTN2, would be similar to ECB19RR.			
Noise	Negligible effect. Noise levels would not be expected to change from existing conditions. Noise would occur during operation of pump stations and would be limited to the immediate vicinity of the structures. Noise levels would not be expected to cause negative effects to human health.	Negligible effect. ALTN2 consists of an operational change to the 2012 Water Control Plan. No construction is proposed. ALTN2, would be similar to ECB19RR.	Negligible effect. Same as ALTN2.	Negligible effect. Same as ALTN2.	Negligible effect. Same as ALTN2.
Aesthetics	No significant effect. Aesthetics would not be expected to change significantly from existing conditions.	No significant effect. ALTN2 consists of an operational change to the 2012 Water Control Plan. No construction is proposed. The existing landscape profile would	No significant effect. Same as ALTN2.	No significant effect. Same as ALTN2.	No significant effect. Same as ALTN2.

Alternatives	No Action Alternative (ECB19RR)*	Alternative N2 (ALTN2)	Alternative O (ALTO)	Alternative Q (ALTQ)	Alternative Q+ (ALTQ+)
		not be altered. ALTN2, would be similar to ECB19RR.			
Flood Risk Management (FRM)	No significant effect to FRM for LECSA 1, LECSA 2, and LECSA 3 within the C-111 Basin. L-31N and C-111 canals operating ranges are maintained consistent with long-term operating ranges maintained under the 2002 IOP and the 2012 ERTP Water Control Plans, following completion of the C-111 NDA/SDA construction. Reference **Figure 4-57** for a depiction of the LECSAs. Increased flood control releases from S-197 were included for Increment 1.1/1.2 to mitigate for potential risks to flood protection for areas within South Miami-Dade County, which may be affected by increased seepage to the L-31N canal south of the S-331 pump station.	No significant effect to FRM for LECSA 1, LECSA 2, and LECSA 3 within the C-111 canal Basin. Moderate FRM reduction for portions of LECSA 3 located north and east of S-331. Minor to moderate FRM reduction for portions of LECSA 3 located east of the C-111 NDA/SDA. Incomplete information available to comparably evaluate 8.5 SMA flood mitigation performance, due to a modeling error with the MD-RSM.	No significant effect to FRM for LECSA 1, LECSA 2, and LECSA 3 within the C-111 canal Basin. Minor FRM improvement for LECSA 3 located north and east of S-331. No significant effect to FRM for LECSA 3 located east of the C-111 NDA/SDA. Incomplete information available to comparably evaluate 8.5 SMA flood mitigation performance, due to a modeling error with the MD-RSM.	No significant effect to minor improvement with reduced flood risk. Same as ALTO for LECSA 1, LECSA 2, and LECSA 3. Moderate adverse effect for 1-3% of the 8.5 SMA flood mitigation area; moderate improved performance for all other portions of the 8.5 SMA flood mitigation area.	No significant effect to minor improvement with reduced flood risk Same as ALTO for LECSA 1, LECSA 2, and LECSA 3. Moderate adverse effect for 1-3% of the 8.5 SMA flood mitigation area; moderate improved performance for all other portions of the 8.5 SMA flood mitigation area.

Alternatives	No Action Alternative (ECB19RR)*	Alternative N2 (ALTN2)	Alternative O (ALTO)	Alternative Q (ALTQ)	Alternative Q+ (ALTQ+)
Socioeconomics	No significant effect. Flood risk to agriculture exists in many low-laying areas.	Flood risks to agriculture are slightly increased compared to ECB19RR but are decreased compared to the 1994 GRR condition and thus meets the constraint for flood risk management. Incomplete information available to comparably evaluate 8.5 SMA flood mitigation performance, due to a modeling error with the MD-RSM.	Flood risks to agriculture are slightly increased compared to ECB19RR but performs slightly better than ALTN2. Risks are decreased compared to the 1994 GRR condition and thus meets the constraint for flood risk management. Incomplete information available to comparably evaluate 8.5 SMA flood mitigation performance, due to a modeling error with the MD-RSM.	Flood risks to agriculture are largely improved compared to all base conditions. There is a significant improvement in flood mitigation as compared to the 1994 GRR condition. Some slight risk of nuisance flooding in the 8.5 SMA exists.	Same as ALTQ.
Recreation	No significant effect. Access to recreational resources would not be expected to significantly change from existing conditions.	**WCA 3:** Negligible to minor long-term adverse effects to recreational access in WCA 3 due to lowering of water levels. However, no significant effect on Everglades WMA FWC Closure Criteria: (1) 0.49% period of record decrease in number of days closed due to high water; and (2) 1.23% period of record increase in number of	**WCA 3:** Negligible to minor long-term adverse effects. Under ALTO: (1) 0.01% period of record increase in number of days closed due to high water; and (2) 0.89% period of record increase in number of days closed due to low water. **NP:** Minor to moderate long-term beneficial effect. Same as ALTN2.	**WCA 3:** Negligible to minor long-term adverse effects. Under ALTQ: (1) 0.17% period of record decrease in number of days closed due to high water; and (2) 0.82% period of record increase in number of days closed due to low water. **ENP:** Minor to moderate long-term beneficial effect. Some specific boat launching points along Tamiami Trail may experience	Same as ALTQ.

Alternatives	No Action Alternative (ECB19RR)*	Alternative N2 (ALTN2)	Alternative O (ALTO)	Alternative Q (ALTQ)	Alternative Q+ (ALTQ+)
		days closed due to low water. **ENP:** Minor to moderate long-term beneficial effects for nature based recreation in portions of ENP where hydrologic conditions would improve compared to ECB19RR, including Florida Bay.		increased risk of inaccessibility in years of below average rainfall.	
Cultural Resources	No adverse effect.	No adverse effect.	No adverse effect.	No adverse effect.	No adverse effect.
Native Americans	No significant effect. Access to Miccosukee lease areas in WCA 3 would not be expected to significantly change from existing conditions.	**WCA 3:** No effect to Tribal lands. Negligible to minor long-term adverse effects to airboat access of Miccosukee lease areas in WCA 3 during extremely dry periods due to lowering of water levels. However, no significant effect on Everglades WMA FWC Closure Criteria: (1) 0.49% period of record decrease in number of days closed due to high water; and (2) 1.23% period of record increase in number of days closed due to low water. Conditions are	**WCA 3:** No effect to Tribal lands. Negligible to minor long-term adverse effects to airboat access of Miccosukee lease areas in WCA 3 during extremely dry periods due to lowering of water levels. Under ALTO: (1) 0.01% period of record increase in number of days closed due to high water; and (2) 0.89% period of record increase in number of days closed due to low water. Conditions are highly dependent on	**WCA 3:** No effect to Tribal lands. Negligible to minor long-term adverse effects to airboat access of Miccosukee lease areas in WCA 3 during extremely dry periods due to lowering of water levels. Under ALTQ: (1) 0.17% period of record decrease in number of days closed due to high water; and (2) 0.82% period of record increase in number of days closed due to low water. Conditions are highly dependent on	Same as ALTQ.

Alternatives	No Action Alternative (ECB19RR)*	Alternative N2 (ALTN2)	Alternative O (ALTO)	Alternative Q (ALTQ)	Alternative Q+ (ALTQ+)
		highly dependent on weather and access to tree islands would be limited to other means during times of below average rainfall.	weather and access to tree islands would be limited to other means during times of below average rainfall.	weather and access to tree islands would be limited to other means during times of below average rainfall.	

4.1 Climate

The climate of south Florida is subtropical. Seasonal rainfall patterns in south Florida resemble the wet and dry season patterns of the humid tropics more than the winter and summer patterns of temperate latitudes. Of the 53 inches of rain that south Florida receives on average annually, 75% falls during the wet season months of May through October. Tropical storms and hurricanes also provide major contributions to wet season rainfall. During the dry season (November through April), rainfall is governed by large-scale winter weather fronts that pass through the region approximately weekly. However, due to the variability of climate patterns (La Niña and El Niño), dry periods may occur during the wet season and wet periods may occur during the dry season.

The impact of current or projected effects of climate change on Central and Southern Florida (C&SF) Project operations is difficult to estimate given the uncertainty in predictions of future weather patterns and water management strategies. Higher average ambient temperatures may result in increased evapotranspiration. Rainfall events may become less frequent and larger in magnitude. As a peat soil ecosystem, increasing drought would reduce available water to keep the soils wet, resulting in higher peat oxidation and loss of soil elevations in freshwater wetlands. Regional surface water storage systems (i.e. canals) will most likely experience more rapid water loss when compared to current water levels, ultimately impacting availability of water supplies. Sea level change is one of the more certain consequences of climate change, and because it affects the land/ocean interface, it has the potential for environmental impacts on coastal areas. Future rates of sea level change are expected to result in significant impacts on coastal canals and communities, with loss of flood protection and increased saltwater intrusion being the primary effects. Additionally, coastal ecosystems and estuaries are expected to be adversely affected and require additional deliveries of freshwater to maintain desirable salinity patterns and healthy ecosystems.

The influence of climate change is not anticipated to alter the severity or nature of impacts resulting from implementation of ALTN2, ALTO, ALTQ, or ALTQ+ as compared to ECB19RR. The overarching project need is to improve water deliveries (timing, location, volume) into ENP for the benefit of natural resources. Additional discussion of the potential effects on the COP performance and outcomes resultant from potential future climate change, including sea level change, is provided in **Section 4.20** (**Climate Change**).

4.2 Hydrology

The portion of the Greater Everglades within the COP study area includes Water Conservation Area (WCA) 3A, WCA 3B and Everglades National Park (ENP). This section presents a general overview of the effect of alternatives on regional hydrology in these areas compared to ECB19RR, including selected, representative performance measure graphics. For the evaluation of hydrological responses at various regions of the study area, RSM-GL model results for Round 2 and Round 3 simulations are used. RSM-GL software was used to simulate the hydrologic responses under a wide range of meteorological conditions encompassing a 41-year period from 1965 to 2005. RSM-GL simulates the region's complex hydrology using South Florida's climate records and technical details on regional canals, water control structures, local topography, and storage reservoirs. RSM-GL is better suited to evaluate the hydrological impacts in a regional scale than MDRSM, which is mainly used to evaluate flood risk management for C-111 South Dade Basin and the 8.5 SMA. For a more comprehensive suite of model outputs and performance measure graphics, the reader should refer to the complete suite of RSM-GL and MDRSM modeling results provided in **Appendix H – Annex 5**.

4.2.1 No Action Alternative

The No Action Alternative (ECB19RR) for COP is intended to represent the conditions assumed in place in 2020 without the implementation of the COP. ECB19RR includes improvements to the operations authorized by the Modified Water Deliveries (MWD) Increment 1.1 and 1.2 and providing more deliveries to the ENP by raising the L-29 canal maximum operating limit up to 7.8 feet National Geodetic Vertical Datum of 1929 (NGVD). A complete description of planning assumptions for ECB19RR is provided in **Section 2** (**Alternatives**) of this EIS, and a more detailed modeling assumptions table is provided in **Appendix H**, **Annex H-3** (**Modeling Assumptions**). Reference pages 6-15.

Simplifying assumptions are typically used during the scoping of hydrologic modeling efforts in order to effectively balance the overall schedule requirements of the project and the modeling needs of the project, including whether requisite operational specificity is able to be provided by the formulation team. Interpretation of the hydrologic modeling outputs requires consideration by the reviewer of such simplifying assumptions. For the COP No Action Alternative (MWD Field Test Increment 1.2), please note the following modeling assumptions were used: (1) explicit modeling the WCA 3A high water exit strategy operations for S-12A and S-12B; (2) the 90-day Florida Department of Transportation (FDOT) constraint for the Tamiami Trail roadway was not modeled since the maximum operating limit for the L-29 canal is 7.8 feet NGVD with the MWD Increment 1.2 Field Test; (3) explicit modeling of the Increment 1 WCA 3A high water action line (this was added during Round 2 modeling, since inclusion of the extreme high water line was identified as an important difference between alternatives during the Round 1 evaluations); (4) S-333N operations per the FDEP permit (July 2019), whereby S-333N is only operated under Emergency Limited Operations for WCA-3 High Water Relief in accordance with prescribed conditions (this was changed during Round 2 modeling, following issuance of the FDEP operational permit to the SFWMD); (5) the Decomp Physical Model (DPM, or S-152) water quality constraints per the Operational Strategy are represented in the model by limiting the operational window to September 1 through May 31, and limiting operations to when the L-67A canal stage at S-152 HW exceeds 9.6 feet, NGVD (Closed if WCA-3B Site 71 stage exceeds 8.5 feet, NGVD); and (6) Increment 1.1/1.2 operational flexibility to use one pump at S-332BW/S-332BN and S-332C and up to two pumps at S-332D at a range of 3.8-4.2 feet NGVD to assist with CSSS habitat and nesting targets is not modeled for the No Action Alternative, since the downstream stage targets will be condition dependent and are not explicitly identified in the Field Test Operational Strategy.

4.2.1.1 Water Conservation Area 3A

The stages in WCA 3A is represented as the average of three selected gauges: 3A-28, 3A-3, and 3A-4. A map showing the location of gauges can be found in **Figure H-5.70** of **Appendix H** – **Annex 5** (**Modeling Results Round 3**). To represent the hydrological conditions in WCA 3A for the existing condition baseline, a cyclic analysis of the 3-gauge average was conducted. Cyclic analyses are used to determine the stages corresponding to a given exceedance probability for each Julian Day. Exceedance probabilities are calculated as the percentage of a given stage to be equaled or exceeded for each day. The results of the analysis for the probability exceedance percentiles for 5%, 10%, 25%, 50% (median value), 75%, 90%, and 95% are provided in **Figure 4-1**. The maximum, minimum, and average stages for each Julian day along with Zone A and Extreme High Water Line (EHWL) are also shown in the figure (additional information on the EHWL can be found in **Appendix A** (**Water Control Plan**)). It should be noted that ECB19RR simulations did not include operational rules associated with the EHWL. The line is included in the graph for reference only.

To describe the hydrologic conditions and compare modeling scenarios stage-duration curves are commonly used. A stage-duration curves is a plot showing the percentage of time a particular stage value is equaled or exceeded. They are versatile tools in evaluation of hydrological conditions and comparison of modeling scenarios. Stage-duration curves for the simulated 3-gauge average for ECB19RR provided in **Figure 4-2** will be used in evaluation of effects of each of the COP planning alternative on the hydrology of WCA 3A in the following section.

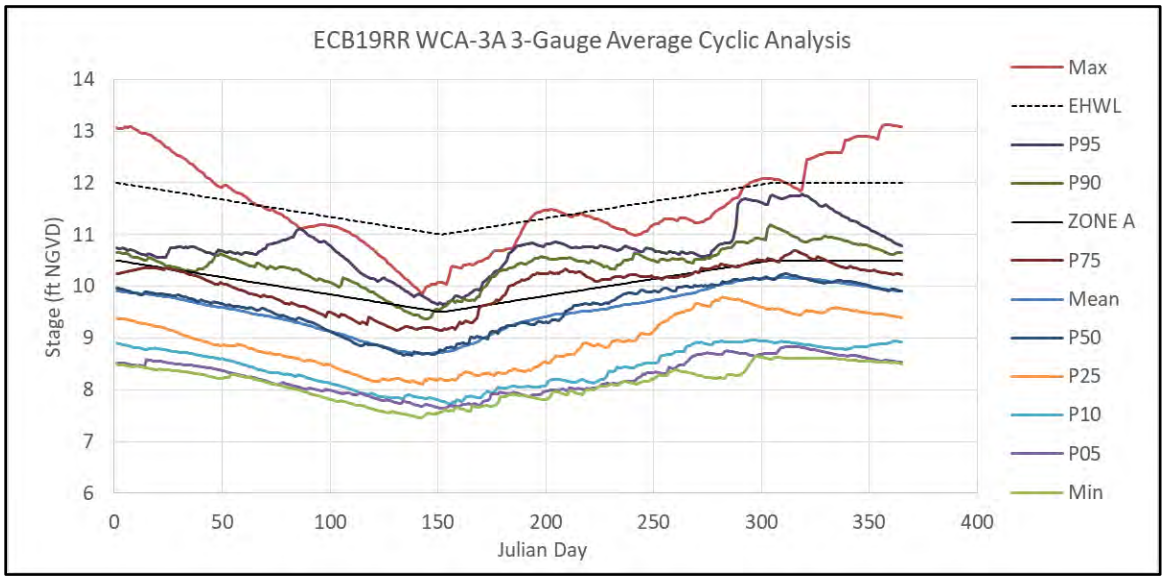

Figure 4-1. Cyclic Analysis of the WCA 3A 3-gauge average for ECB19RR.

Figure 4-2. Stage duration curves for WCA 3A 3-gauge average for ALTs N2, O, Q, and ECB19RR.

4.2.1.1.1 East-Central Water Conservation Area 3A (Gauge 3A-3)

Due to its large size, the hydrology of WCA 3A is monitored at multiple gauges. Stage gauge WCA_3A-3 (see **Figure H-5.70** for its location) is typically used to represent East-Central WCA 3A. The average of RSM-GL simulations was used to model hydrologic responses under a wide range of meteorological conditions encompassing the 41-year of period of record (1965 to 2005). The ponding depth duration curve provided in **Figure 4-3** compares the expected hydrologic effects at Gauge 3A-3 under different modeling scenarios. The results for ECB19RR indicate that the WCA_3A-3 gauge is expected to be inundated 70% of the time, with ground elevation marked as 0 feet ponding depth in the figure. 10%, 50%, and 90% exceedances correspond to 1.44 feet, 0.52 feet, and -0.58 feet ponding depths, respectively. Since the COP assumes no additional flows to WCA 3A and more deliveries from WCA 3A to NESRS are recommended to achieve COP objectives, long-term stages at this gauge are expected to experience a decrease under COP operations.

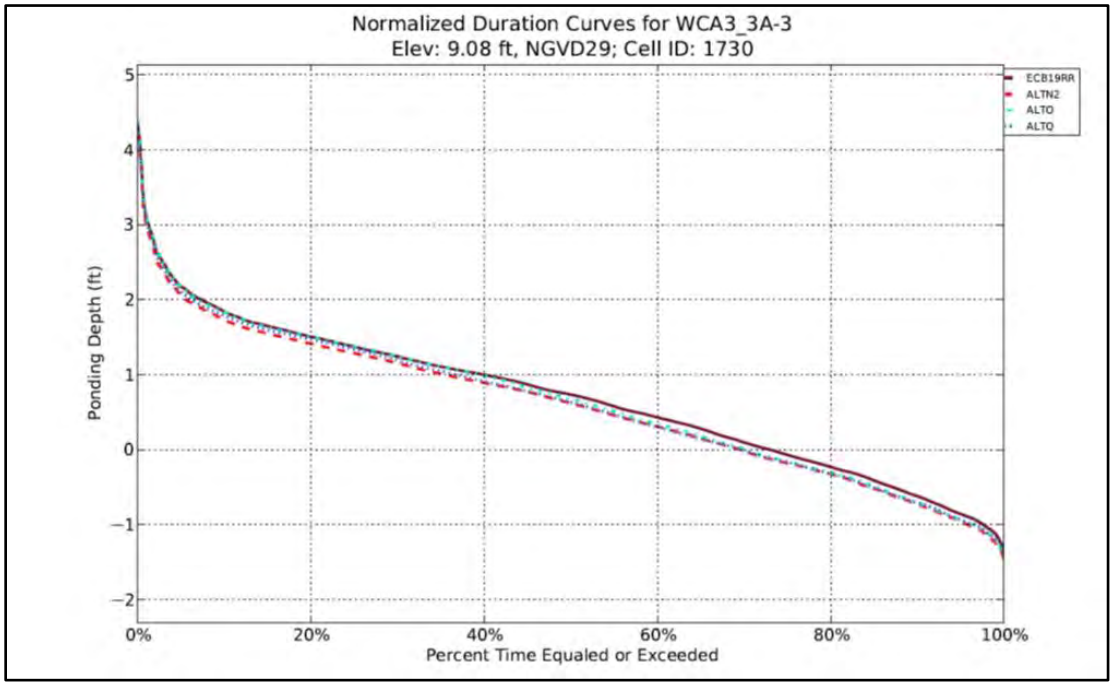

Figure 4-3. Depth duration curves for Gauge WCA_3A-3 for ALTs N2, O, Q, and ECB19RR.

4.2.1.1.2 Central Water Conservation Area 3A (Gauge 3A-4)

Gauge WCA_3A-4 can be used as the indicator of hydrologic conditions in Central WCA 3A. Results of the RSM-GL simulation for ECB19RR for the depth duration curves for this gauge are provided in **Figure 4-4**. The results indicate that Central WCA 3A will be inundated 91% of the time at the location of this gauge. 10%, 50%, and 90% exceedances correspond to 2.03 feet, 1.11 feet, and 0.01 feet ponding depths, respectively.

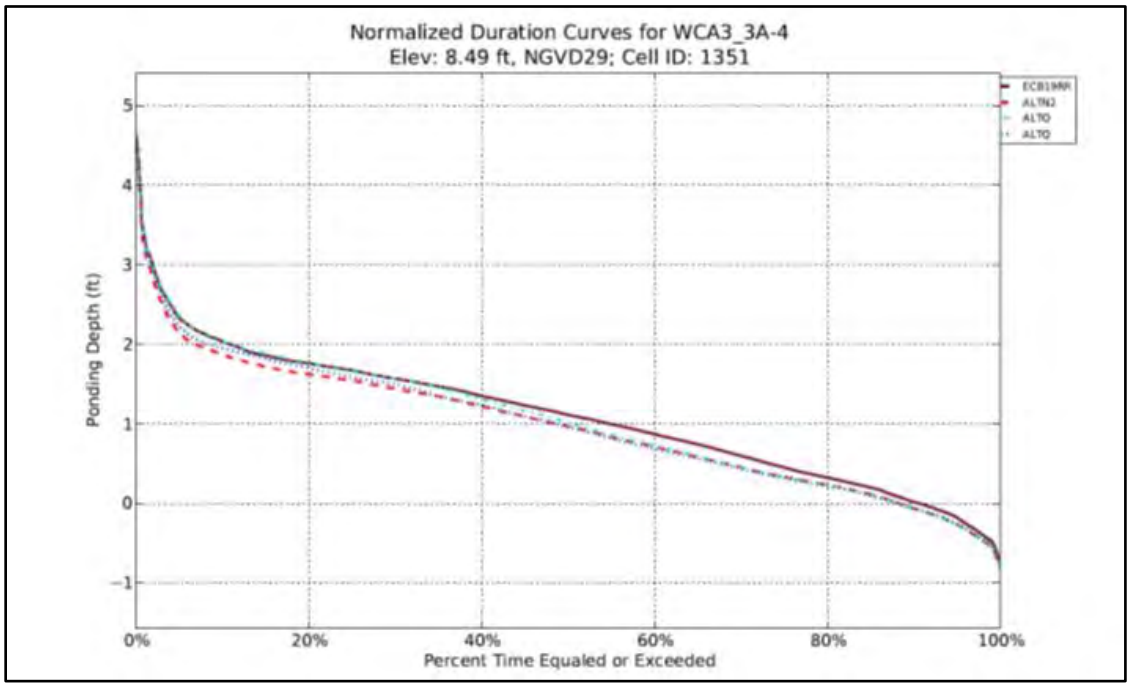

Figure 4-4. Depth duration curves for Gauge WCA_3A-4 for ALTs N2, O, Q, and ECB19RR.

4.2.1.1.3 Southern Water Conservation Area 3A (Gauge 3A-28):

Gauge WCA_3A-28 is commonly used as the indicator of hydrologic conditions in Southern WCA 3A. Results of the RSM-GL simulation for ECB19RR for the depth duration curves for this gauge are provided in **Figure 4-5**. The results indicate that Southern WCA 3A will be inundated 98% of the time at the location of this gauge. 10%, 50%, and 90% exceedances correspond to 2.84 feet, 1.97 feet, and 0.53 feet ponding depths, respectively.

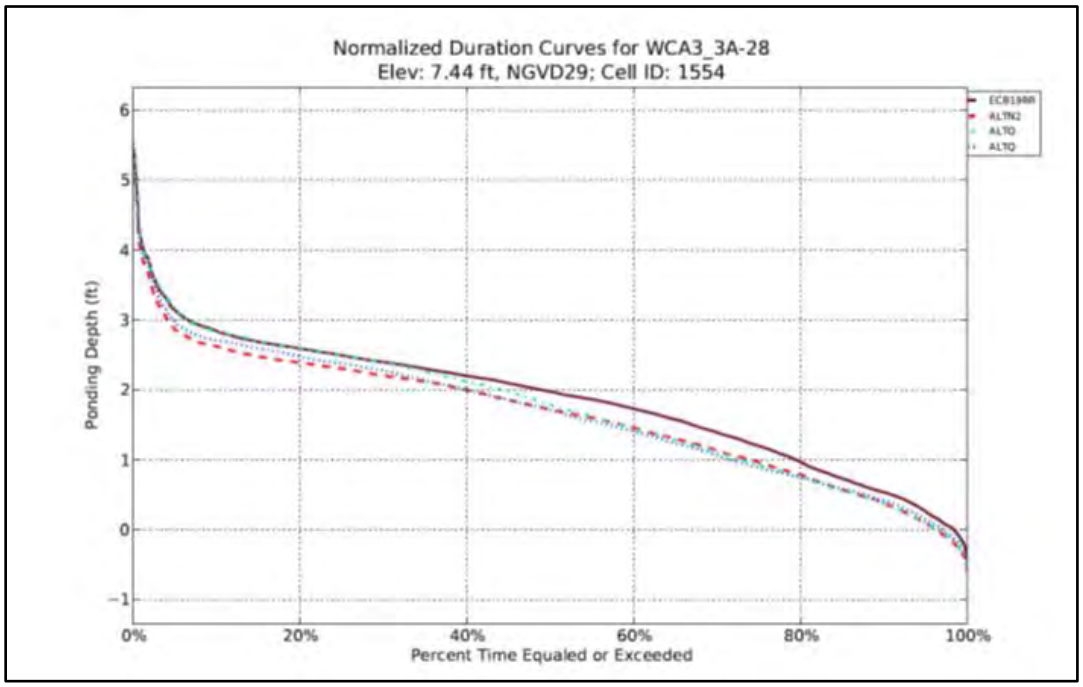

Figure 4-5. Depth duration curves for Gauge WCA_3A-28 for ALTs N2, O, Q, and ECB19RR.

4.2.1.2 Water Conservation Area 3B

Gauge WCA_3B-71 can be used as the indicator of the hydrologic conditions in WCA 3B. Results of the RSM-GL simulation for ECB19RR for the depth duration curves for this gauge are provided in **Figure 4-6**. The results indicate that WCA 3B at the location of this gauge will be inundated 88% of the time. 10%, 50%, and 90% exceedances correspond to 1.50 feet, 0.63 feet, and -0.08 feet ponding depths, respectively.

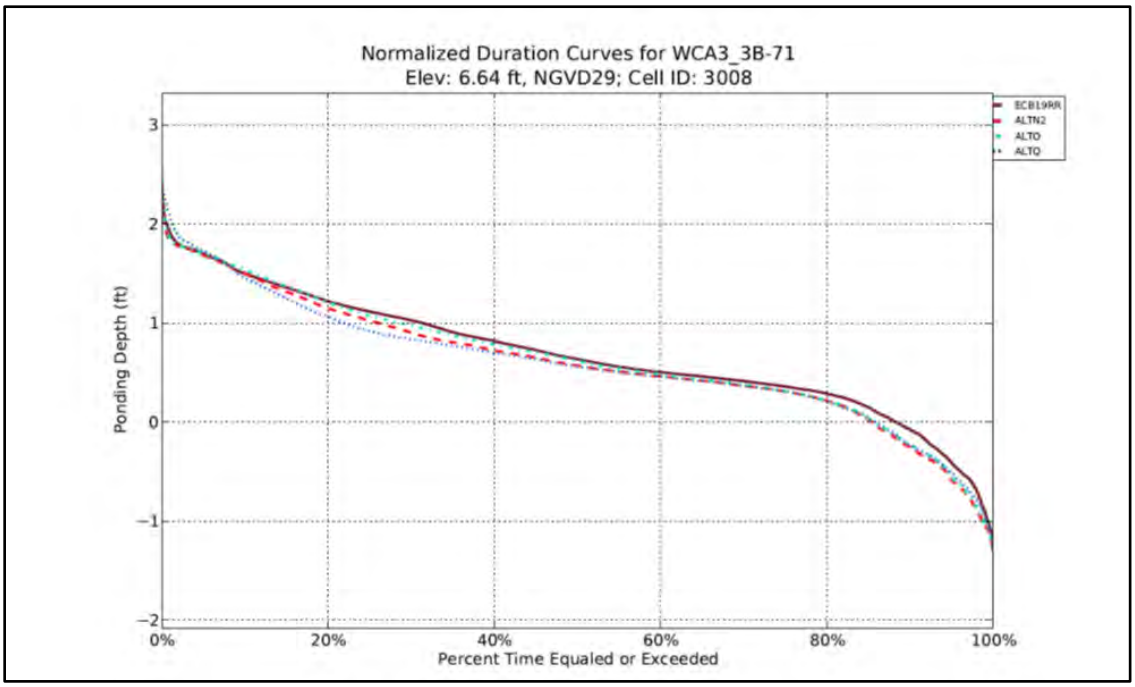

Figure 4-6. Depth duration curves for Gauge WCA_3B-71 for ALTs N2, O, Q, and ECB19RR.

4.2.1.3 Everglades National Park

4.2.1.3.1 Western Shark River Slough

Because of the variations in the observed ponding depths in Western Shark River Slough, three gauges were selected as indicators of the hydrologic conditions: NP34, NP201, and NP205 (Refer to **Figure H-5. 70** for gauge locations). Results of the RSM-GL simulation for ECB19RR for the depth duration curves for these gauges are provided in **Figure 4-7**, **Figure 4-8**, and **Figure 4-9**. The results for NP34 gauge indicate inundation at 70% of the time. 10%, 50%, and 90% exceedances correspond to 1.18 feet, 0.31 feet, and -1.40 feet ponding depths, respectively. The results for NP201 gauge indicate inundation at 58% of the time. 10%, 50%, and 90% exceedances correspond to 1.30 feet, 0.09 feet, and -0.72 feet ponding depths, respectively. The results for NP205 gauge indicate inundation at 76% of the time. 10%, 50%, and 90% exceedances correspond to 1.02 feet, 0.39 feet, and -1.16 feet ponding depths, respectively.

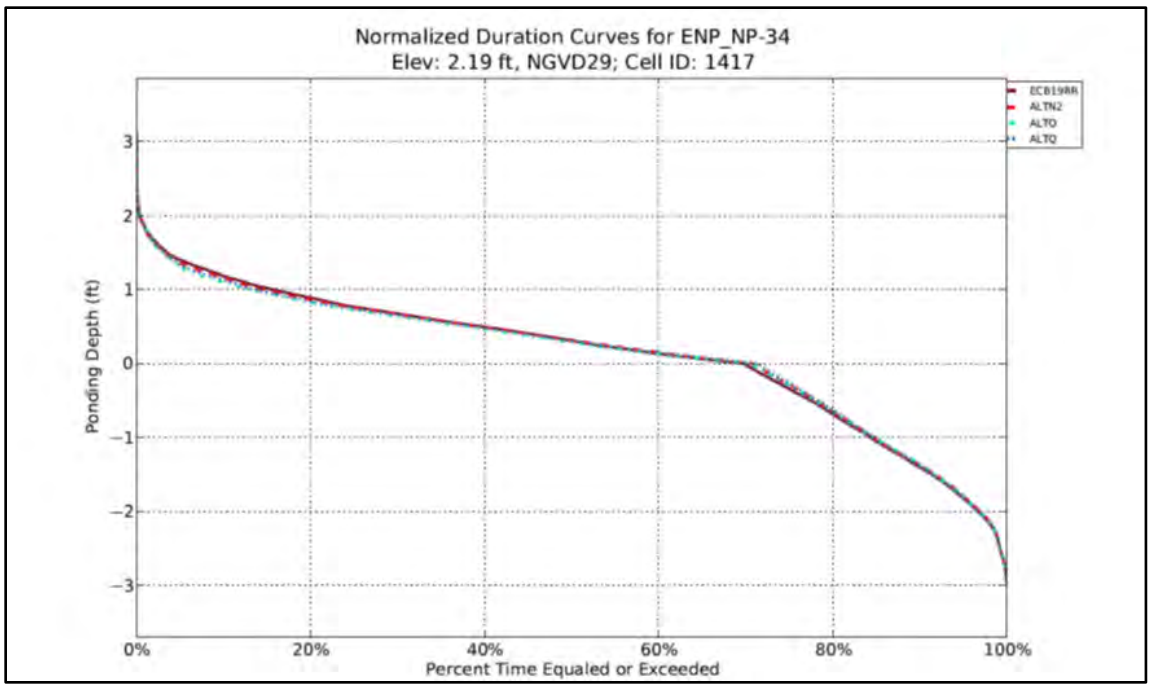

Figure 4-7. Depth duration curves for Gauge ENP_NP-34 for ALTs N2, O, Q, and ECB19RR.

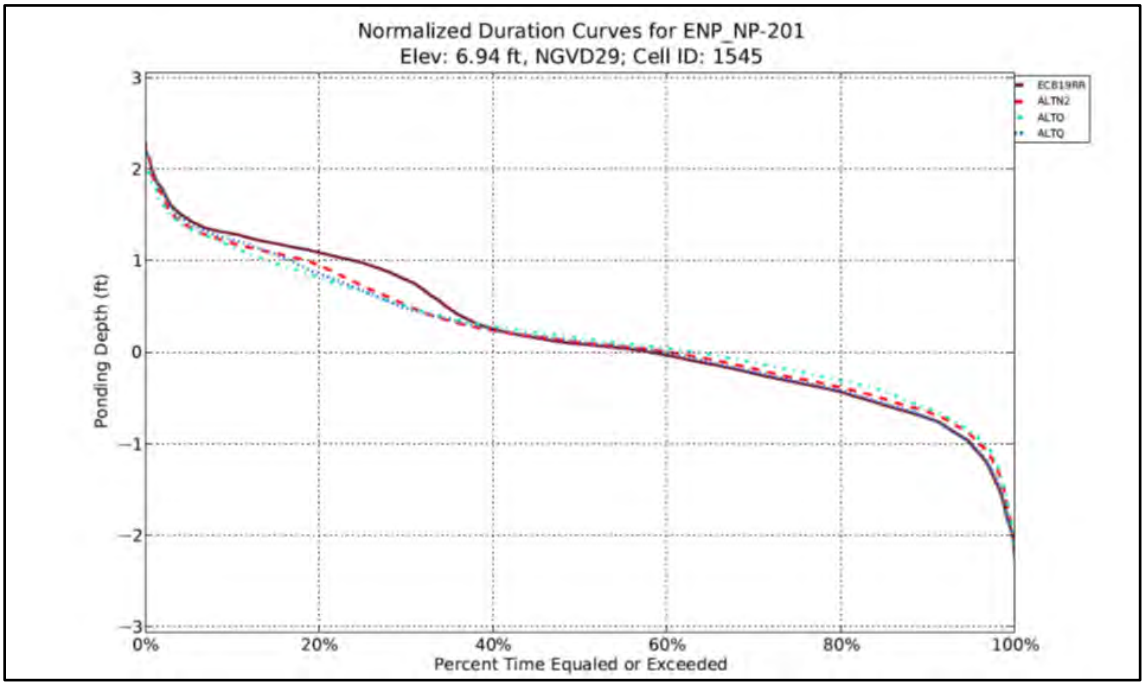

Figure 4-8. Depth duration curves for Gauge ENP_NP-201 for ALTs N2, O, Q, and ECB19RR.

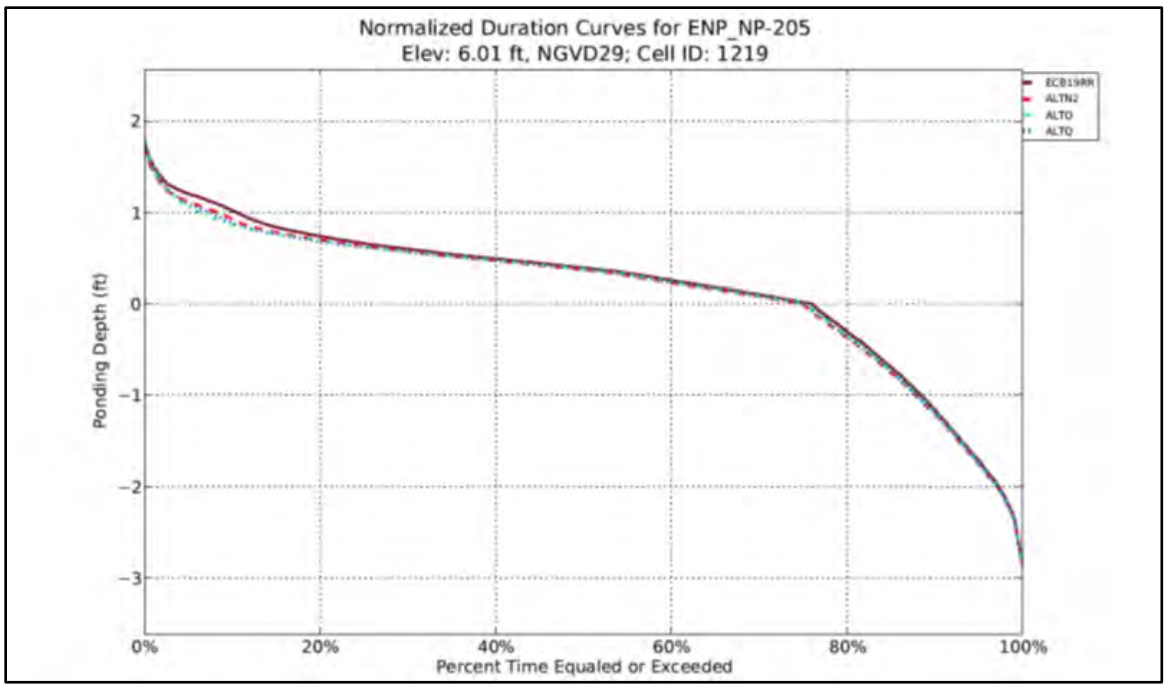

Figure 4-9. Depth duration curves for Gauge ENP_NP-205 for ALTs N2, O, Q, and ECB19RR.

4.2.1.3.2 Northeast Shark River Slough

Gauges NESRS1 and G3273 can be used as indicators of the hydrologic conditions in NESRS (Refer to **Figure H-5.70** for gauge locations). Results of the RSM-GL simulation for ECB19RR for the depth duration curves for these gauges are provided in **Figure 4-10** and **Figure 4-11**. The results indicate that NESRS at NESRS1 gauge is inundated 93% of the time. 10%, 50%, and 90% exceedances correspond to 1.80 feet, 1.48 feet, and 0.25 feet ponding depths, respectively. The results for G3273 gauge indicate inundation at 60% of the time. 10%, 50%, and 90% exceedances correspond to 0.83 feet, 0.30 feet, and -1.58 feet ponding depths, respectively.

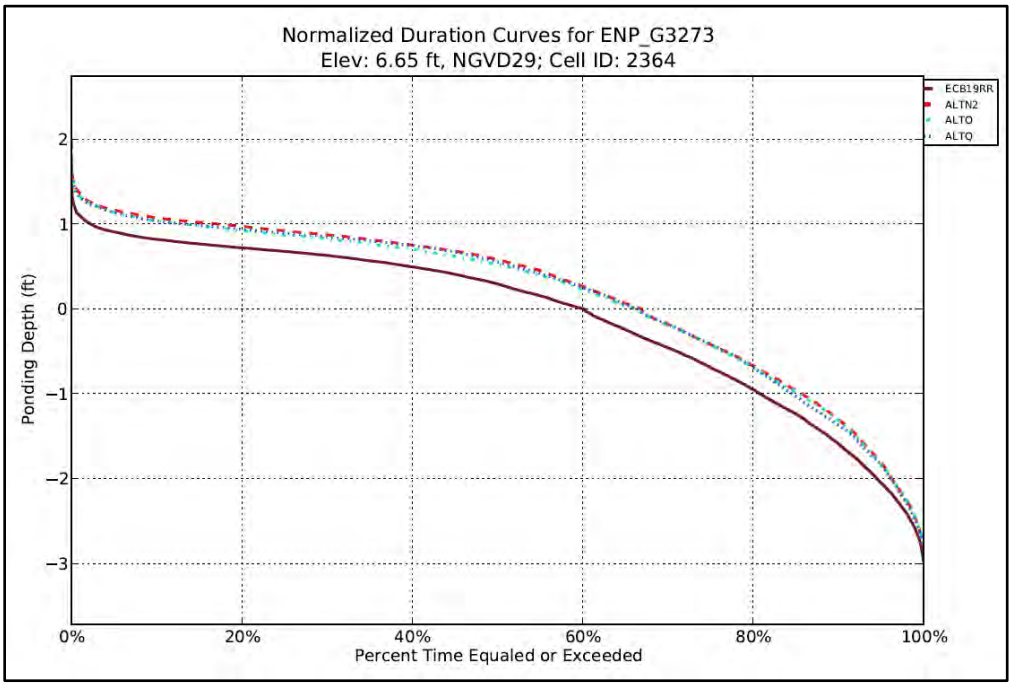

Figure 4-10. Depth duration curves for Gauge G-3273 for ALTs N2, O, Q, and ECB19RR.

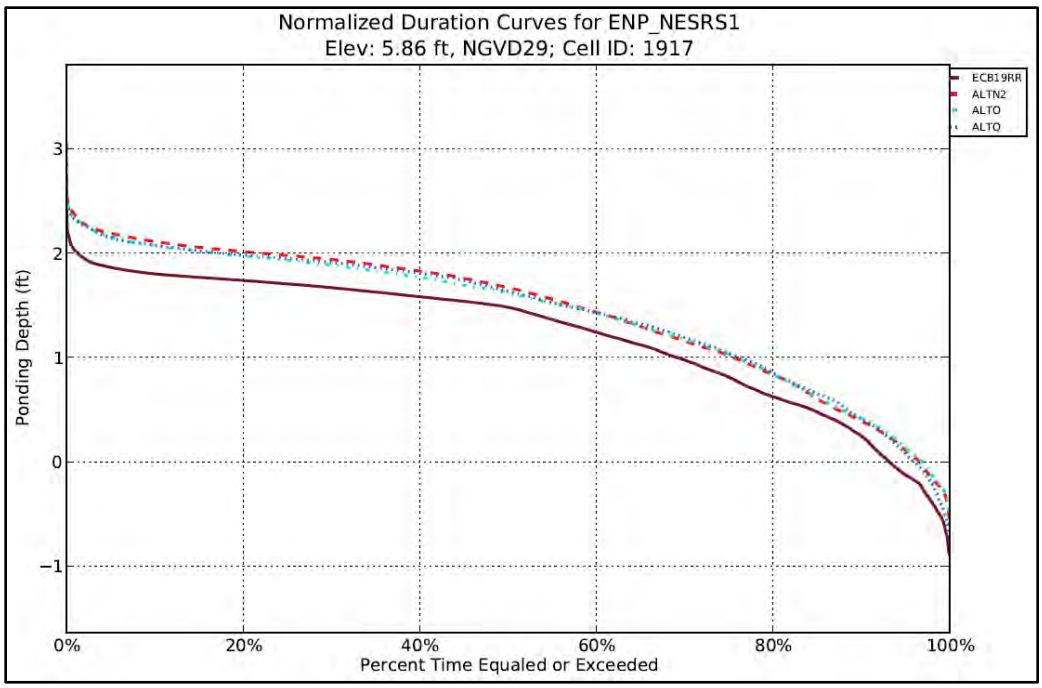

Figure 4-11. Depth duration curves for Gauge ENP_NESRS1 for ALTs N2, O, Q, and ECB19RR.

4.2.1.4 Taylor Slough

Gauge ENP_NP-TSB can be used as the indicator of the hydrologic conditions in Taylor Slough. Results of the RSM-GL simulation for ECB19RR for the depth duration curves for this gauge are provided in **Figure 4-12**. The results indicate that Taylor Slough at the location of this gauge will be inundated 44% of the time. 10%, 50%, and 90% exceedances correspond to 0.87 feet, -0.20 feet, and -1.58 feet ponding depths, respectively.

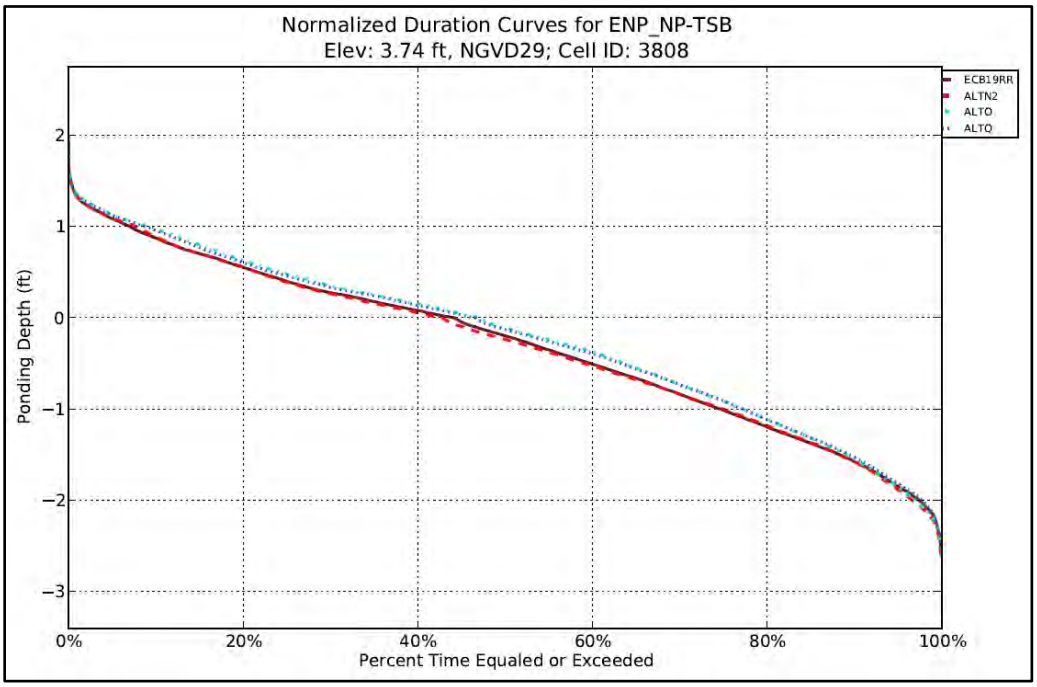

Figure 4-12. Depth duration curves for Gauge ENP_NP-TSB for ALTs N2, O, Q, and ECB19RR.

4.2.1.5 Florida Bay

Currently there is no available method directly estimating the deliveries to the Florida Bay. Two upstream transects, T23B and T23C, can be used for relative assessment of effects of alternatives on Florida Bay. A map showing the location of these transects can be found in Figure H-5.61. According to RSM-GL results average annual overland flow of 86,000 acre-feet and 113,000 acre-feet of flow volumes are estimated to pass through across Transects 23B and 23C, respectively (**Figure 4-13** and **Figure 4-14**).

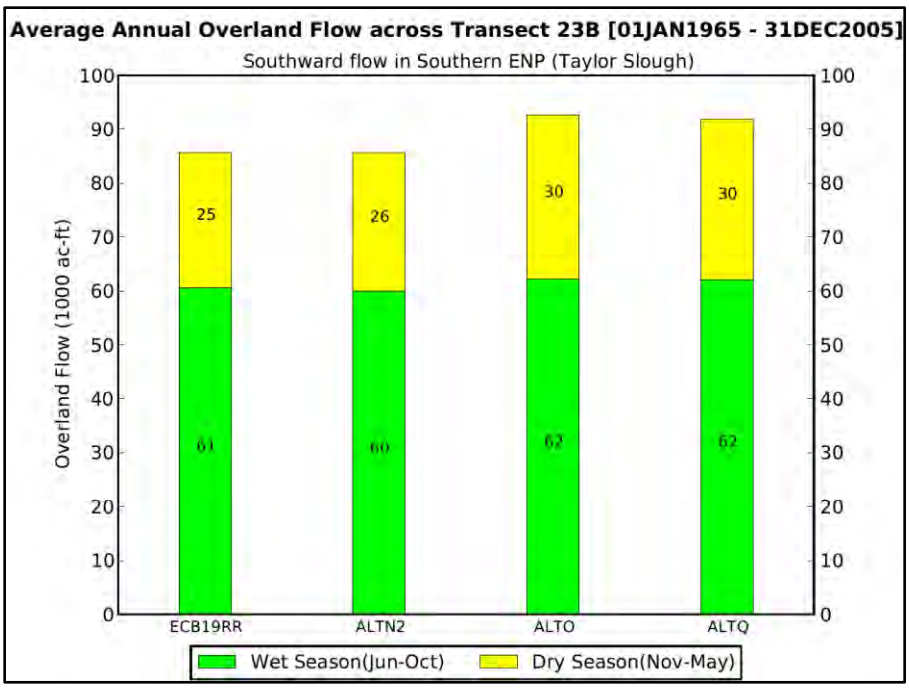

Figure 4-13. Comparison of overland flows across Transect 23B.

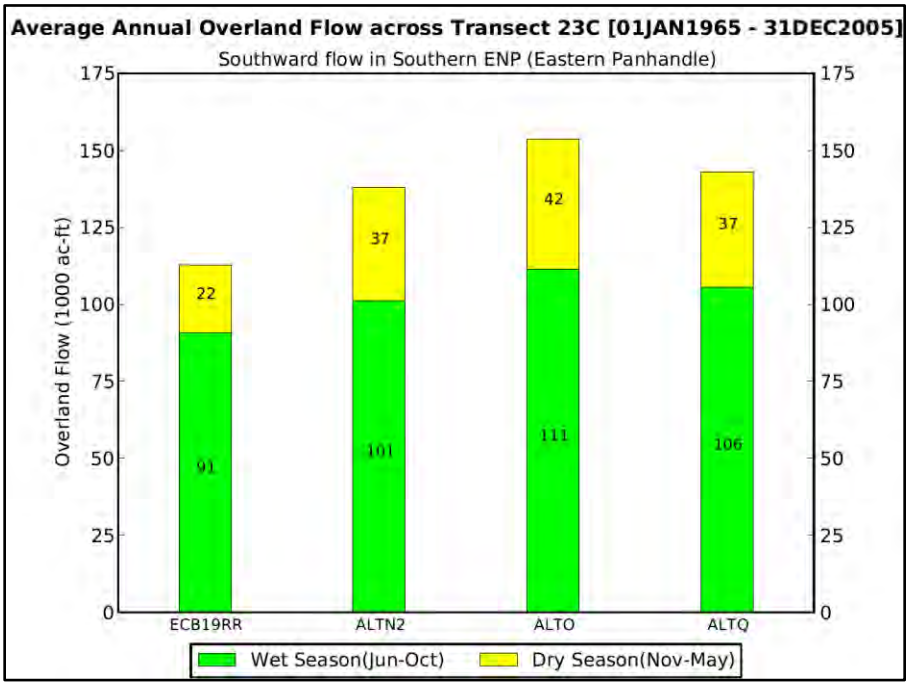

Figure 4-14. Comparison of overland flows across Transect 23C.

4.2.2 Alternative N2

Simplifying assumptions are typically used during the scoping of hydrologic modeling efforts in order to effectively balance the overall schedule requirements of the project and the modeling needs of the project, including whether requisite operational specificity is able to be provided by the formulation team. Interpretation of the hydrologic modeling outputs requires consideration by the reviewer of such simplifying assumptions. For ALTN2, please note the following modeling assumptions were used: (1) the 90-day FDOT constraint for the Tamiami Trail roadway was modeled by assuming an L-29 maximum operating limit of 8.5 feet NGVD during October through January (longer than 90 days was used in order to test the degree of restriction) and 8.25 feet NGVD for all other months; (2) explicit modeling of the WCA 3A EHWL (same as ECB19RRmodeling); (3) weekly flows from the iModel simulation of ALTN2 were used as RSM-GL internal boundary conditions to simulate flows to ENP from the WCA 3A release structures along Tamiami Trail (S-333, S-12A, S-12B, S-12C, and S-12D) and environmental deliveries to Taylor Slough and the SDCS canals (L-31N canal stages trigger operations at S-332B, S-332C, S-332D, S-194, and S-196) from L-30 via the S-335 gated spillway; (4) the WCA 3A Regulation Schedule includes expansion of Zone E1 (refer to Figure 2-1 in Section 2.1); (5) environmental deliveries to Taylor Slough and the SDCS canals from WCA 3A (up to 250 cfs was identified in the ALTN2 alternative formulation table) were not simulated, in absence of specific targets identified for Taylor Slough which would trigger the need for these deliveries; (6) S-333 has priority over S-356 when WCA 3A stages exceed the WCA 3A EHWL (Condition 3 and Condition 4, similar to the Increment 1.2 assumptions in the ECB19RR); if there is sufficient L-29 capacity for target S-333 flows (may be up to maximum capacity when WCA 3A is above Zone A) and operations at S-356, both structures would continue to operate until the EWHL is exceeded; when the EHWL is exceeded (anytime of the year), and if downstream capacity in the SDCS allows S-334 discharges, then S-334 would have priority over S-356 in order to expedite lowering of WCA 3A below the High Water line; and (7) S-357 pump station operations are triggered based on stage criteria at Angel's Well (as defined in the ALTN2 formulation table; this is a change from the ECB19RR that references LPG-2), consistent with the criteria used for the MWD Increment 2 Field Test following C-111 NDA completion (limited resolution is available with the RSM-GL, but the operations are included in the MD-RSM simulations used to assess 8.5 SMA flood mitigation performance). Assumptions previously detailed for the WCA 3A high water exit strategy, S-333N operations, and DPM operations in ECB19RRwere unchanged with ALTN2.

4.2.2.1 Water Conservation Area 3A

The cyclic analysis of the 3-gauge average of the stages at Gauges 3A-28, 3A-3, and 3A-4 for ALTN2 simulations is shown in **Figure 4-15**. The labels for the plotted traces indicate the probability exceedance percentiles for 5%, 10%, 25%, 50% (median value), 75%, 90%, and 95%. The maximum, minimum and average stages for each Julian day are also shown in the figure. It should be noted that ALTN2 simulations did not include operational rules associated with EHWL. The line is included in the graph for reference only.

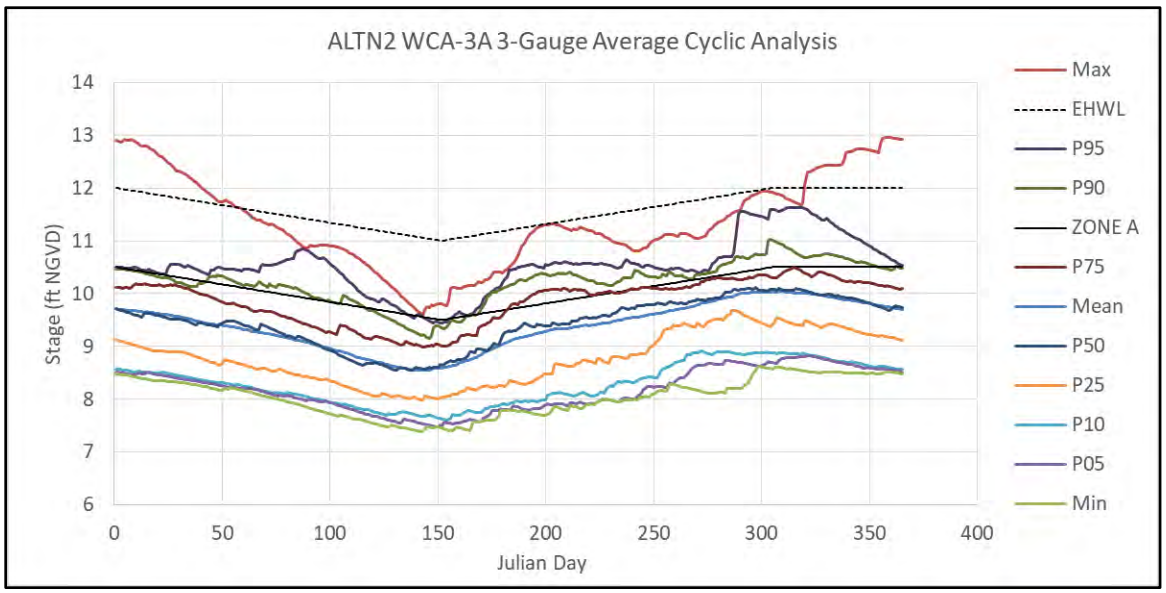

Figure 4-15. Cyclic Analysis of the WCA 3A 3-gauge average for ALTN2.

4.2.2.1.1 East-Central Water Conservation Area 3A (Gauge 3A-3)

As the ponding depth and average annual hydroperiod comparisons in **Figure 4-2** and **Figure 4-16** show, a minor decrease in depths is expected under ALTN2 in comparison to ECB19RR. As presented in **Figure 4-17** and **Figure 4-18**, shorter hydroperiods are expected during extreme dry years (1989), versus similar hydroperiods to ECB19RR during extreme wet years (1995). As the comparison of overland flow across Transect 12 shows (**Figure 4-19**) conditions very similar to (~3% difference) that of ECB19RR are expected for ALTN2 in East-Central WCA 3A.

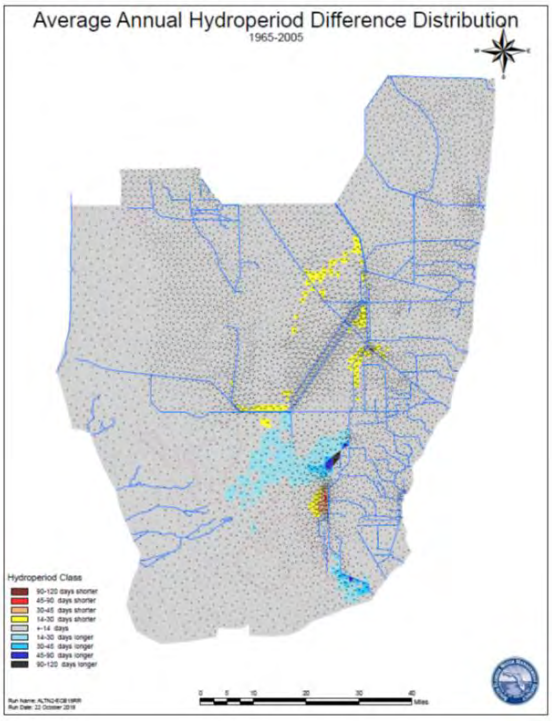

Figure 4-16. Differences in average annual hydroperiods for ALTN2 and ECB19RR.

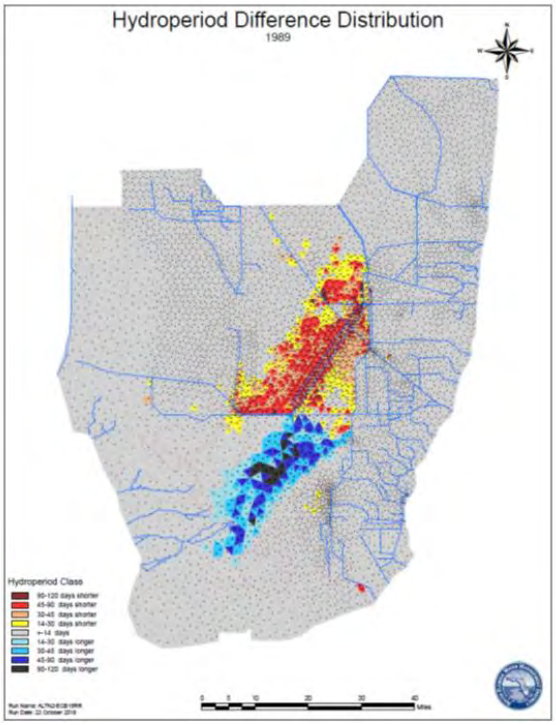

Figure 4-17. Differences in average annual hydroperiods for ALTN2 and ECB19RR for 1989.

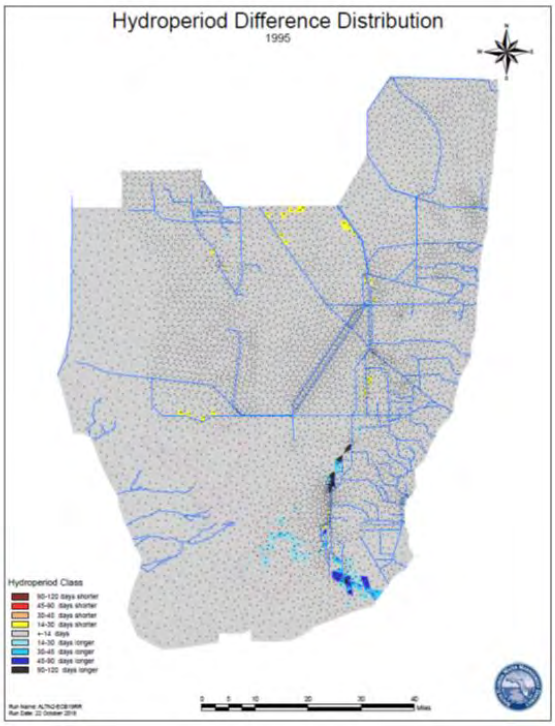

Figure 4-18. Differences in average annual hydroperiods for ALTN2 and ECB19RR for 1995.

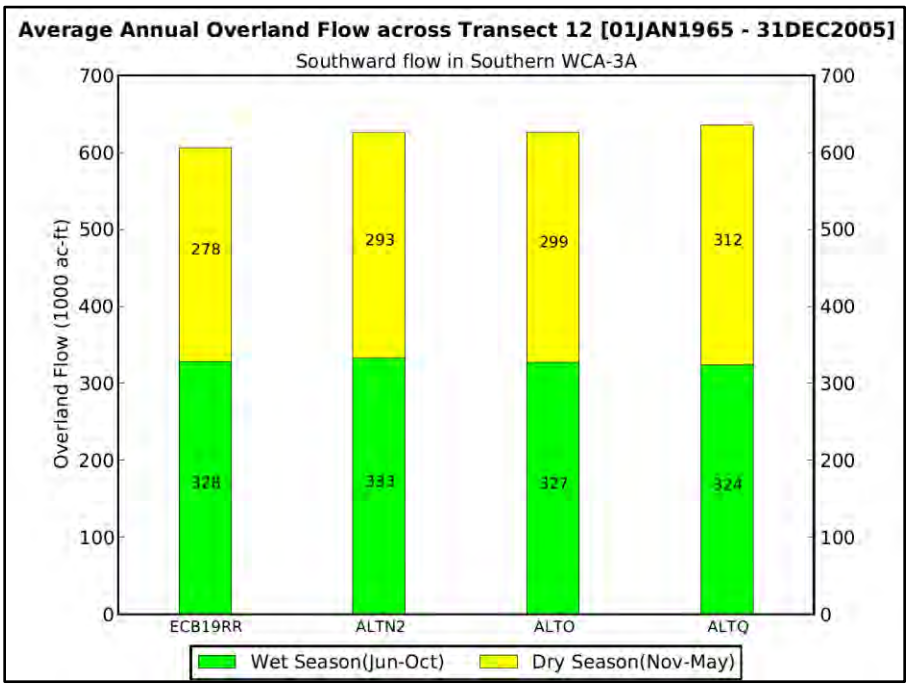

Figure 4-19 Comparision of overland flows across Transect 12.

4.2.2.1.2 Central Water Conservation Area 3A (Gauge 3A-4):

The average annual hydroperiods in Central WCA 3A are expected to experience a minor to moderate decrease under ALTN2 relative to ECB19RR (**Figure 4-16**). Hydroperiod differences for an extreme dry year and extreme wet year are also provided in **Figure 4-17** and **Figure 4-18**, respectively. The comparison of hydroperiods for Gauge 3A-4 as the representative of the hydrological conditions in Central WCA 3A is shown in **Figure 4-4**.

4.2.2.1.3 Southern Water Conservation Area 3A (Gauge 3A-28):

The stages in Southern WCA 3A are expected to be lower under ALTN2 than the ECB19RR conditions. The difference becomes more pronounced for dry conditions. The comparison of hydroperiods for the Gauge 3A-28 as the representative of the hydrological conditions in Central WCA 3A, is shown in **Figure 4-5**. Hydroperiod differences for an extreme dry year and extreme wet year are provided in **Figure 4-17** and **Figure 4-18**, respectively. The decrease in stages at the end of the dry season tends to be more pronounced in the southern part of WCA 3A (**Figures H-5.37** – **H-5.40**) than the differences in end of the wet season (**Figures H-5.41** – **H-5.44**).

4.2.2.2 Water Conservation Area 3B

The comparison of ponding depths for the Gauge WCA3_3B-71 as the representative of the hydrological conditions in WCA 3B is shown in **Figure 4-6**. A reduction in ponding depths is experienced for this gauge with more pronounced differences under dry conditions. While minor adverse effects are expected in southern and central WCA 3B, moderate adverse effects are expected in northern WCA 3B in the areas adjacent to Miami canal (**Figure 4-16**).

4.2.2.3 Everglades National Park

4.2.2.3.1 Western Shark River Slough

The average ponding depth differences for the 41-year simulation period indicated that the long-term stage averages for Western SRS under ALTN2 will mostly remain unchanged relative to ECB19RR conditions (**Figure 4-16**). The comparison of simulated ponding depths at ENP_NP-201 gauge indicated a slight increase for dry conditions, and a moderate decrease (smaller than 0.4 feet) for average to wet conditions (see **Figure 4-8**). As shown in **Figure 4-20**, the average annual overland flow across Transect 17 is reduced for ALTN2 relative to ECB19RR. Therefore, this slight overall increase can be attributed to the hydration of adjacent areas in NESRS.

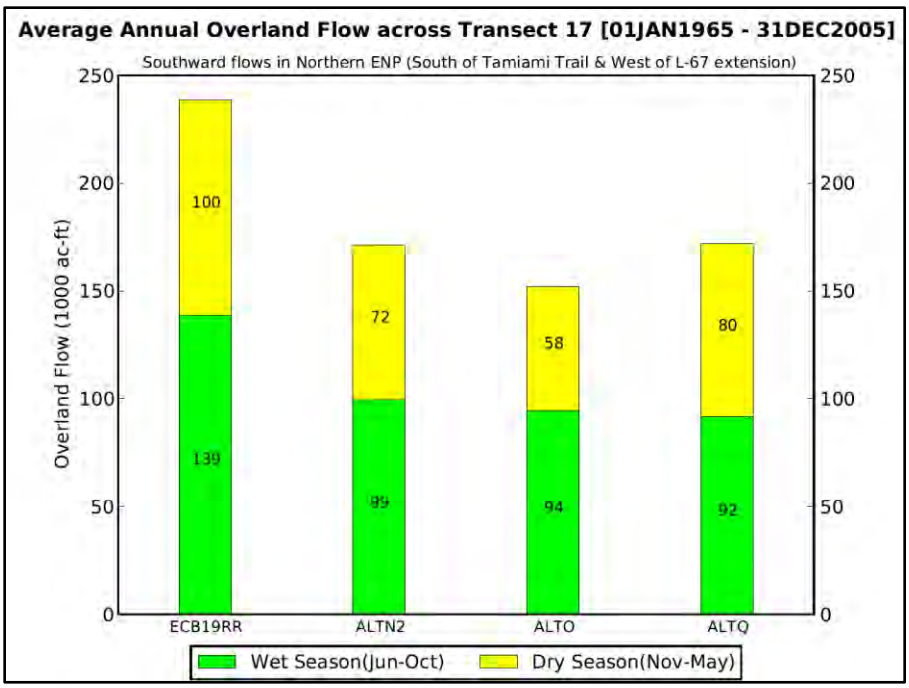

Figure 4-20 Comparision of overland flows across Transect 17.

4.2.2.3.2 Northeast Shark River Slough

The average ponding depth differences for the 41-year simulation period indicated an overall moderate to major increase in the NESRS under ALTN2 relative to ECB19RR conditions (**Figure 4-16**). The areas adjacent to L-29 canal and northern segments of L-31N canal experienced the highest increases. As shown in the duration curves for the Gauge ENP_G3273 (**Figure 4-10**), higher stages are expected for all stage levels.

4.2.2.4 Taylor Slough

The average ponding depth differences for the 41-year simulation period do not indicate a significant difference in the hydrologic conditions of the Taylor Slough under ALTN2 relative to ECB19RR conditions, as simulated at Gauge ENP_NP-TSB (**Figure 4-12**).

4.2.2.5 Florida Bay

The average hydroperiod differences for the 41-year simulation period indicated no significant change in the areas that may affect deliveries to the Florida Bay for ALTN2 relative to ECB19RR conditions (**Figure 4-16**). Comparison of average annual overland flows across Transects 23B and 23C also indicate that no significant difference in the hydrology of the Florida Bay is expected under ALTN2 (**Figure 4-13** and **Figure 4-14**). ALTN2 decreased structure flow through S-197 and improved overbank flow into ENP's Eastern Panhandle relative to ECB19RR. Annual flow through S-197 decreased to 20,200 acre-feet for ALTN2 from 60,400 acre-feet for ECB19RR. Additional discussion on S-197 discharges can be found in **Section 4.6.4** (**Mangrove Wetlands and Seagrass Beds**).

4.2.3 Alternative O

Following completion of the Round 2 modeling, during development of the operational refinements for the Round 3 modeling, the COP modeling team identified an error with the RSM-GL simulation of ALTO. Since the simulated performance of ALTO was identified by the COP project delivery team (PDT) as the preferred starting point for development of the optimized alternative in the subsequent Round 3 modeling, including the development of the new Tamiami Trail Flow Formula (TTFF) targets for water deliveries from WCA 3A to ENP, the USACE, the SFWMD, and ENP determined that this error correction would be appropriately addressed during the Round 3 modeling rather than through a schedule delay that would ultimately delay later implementation of the COP. Specifically, the RSM-GL simulation inadvertently included annual seasonal closure criteria for the S-12C gated spillway during the period from 01 February through 14 July; the formulation table for ALTO (as well as the 2019 ECB and all other of the COP alternatives) included no seasonal closure for S-12C, and this error was not included in any of the other modeling simulations. Although not quantifiable in the absence of comparative hydrologic modeling, the combined effect of the S-12C seasonal closure period with the use of the WCA 3A and ENP stage targets with the iModel resulted in reduced releases to Western Shark Slough during the annual closure period and higher stages in WCA 3A during the dry season months because the iModel targets (when WCA 3A stages were below Zone A) and "up to maximum" releases when WCA 3A stages were above Zone A would not be fully delivered with reliance on S-333 and S-12D only (S-12A and S-12B are also closed during the identified S-12C closure period). Compared to the expected performance with ALTO as formulated by the COP project team, the simulated additional WCA 3A storage through the dry season months resulted in higher WCA 3A deliveries to SRS and extended hydroperiods further south within Central SRS during some years with moderate to dry hydrologic conditions.

The hydrologic modeling results described within this section include the inadvertent seasonal closure period for S-12C. Since the development of the TTFF during the Round 3 modeling was unable to fully realize the extended hydroperiods within Central SRS during some years with moderate to dry hydrologic conditions, despite development of the TTFF based on using statistical methods to match the ALTO system-wide hydrologic performance, the COP Adaptive Management and Monitoring Plan (AMMP) includes a dry season Field Test to opportunistically provide these supplemental dry season flows when conditions warrant in SRS and when conditions allow within WCA 3A.

Simplifying assumptions are typically used during the scoping of hydrologic modeling efforts in order to effectively balance the overall schedule requirements of the project and the modeling needs of the project, including whether requisite operational specificity is able to be provided by the formulation team. Interpretation of the hydrologic modeling outputs requires consideration by the reviewer of such simplifying assumptions. For ALTO, please note the following modeling assumptions were used: (1) the 90-day FDOT constraint for the Tamiami Trail roadway was modeled by assuming an L-29 maximum operating limit of 8.5 feet NGVD during October through January (longer than 90 days was used in order to test the degree of restriction) and 8.25 feet NGVD for all other months (same assumption as ALTN2); (2) no explicit modeling of the WCA 3A high water action line, as this feature is not identified for ALTO; (3) weekly flows from the iModel simulation of ALTO were used as RSM-GL internal boundary conditions to simulate flows to ENP from the WCA 3A release structures along Tamiami Trail (S-333, S-12A, S-12B, S-12C, and S-12D) and environmental deliveries to Taylor Slough and the SDCS canals (L-31N canal stages trigger operations at S-332B, S-332C, S-332D, S-194, and S-196) from L-30 via the S-335 gated spillway; (4) the WCA 3A Regulation Schedule includes only Zone A; (5) environmental deliveries to Taylor Slough and the SDCS canals from WCA 3A (up to 250 cfs was identified in the ALTO alternative formulation table) were not simulated, in absence of specific targets identified for Taylor Slough which would trigger the

need for these deliveries; (6) S-356 has priority over S-333, consistent with the intent detailed in the ALTO formulation table, independent of WCA 3A stages; (7) S-357 pump station operations are triggered based on stage criteria at Angel's Well (same as ALTN2), consistent with the criteria used for the MWD Increment 2 Field Test following C-111 NDA completion (limited resolution is available with the RSM-GL, but the operations are included in the MD-RSM simulations used to assess 8.5 SMA flood mitigation performance). Assumptions previously detailed for the WCA 3A high water exit strategy, S-333N operations, and DPM operations in ECB19RR were unchanged with ALTO.

4.2.3.1 Water Conservation Area 3A

The cyclic analysis of the 3-gauge average of the stages at Gauges 3A-28, 3A-3, and 3A-4 for ALTO simulations is shown in **Figure 4-21**. The labels for the plotted traces indicate the probability exceedance percentiles for 5%, 10%, 25%, 50% (median value), 75%, 90%, and 95%. The maximum, minimum and average stages for each Julian day are also shown in the figure. It should be noted that ALTO simulations did not include operational rules associated with EHWL. The line is included in the graph for reference only.

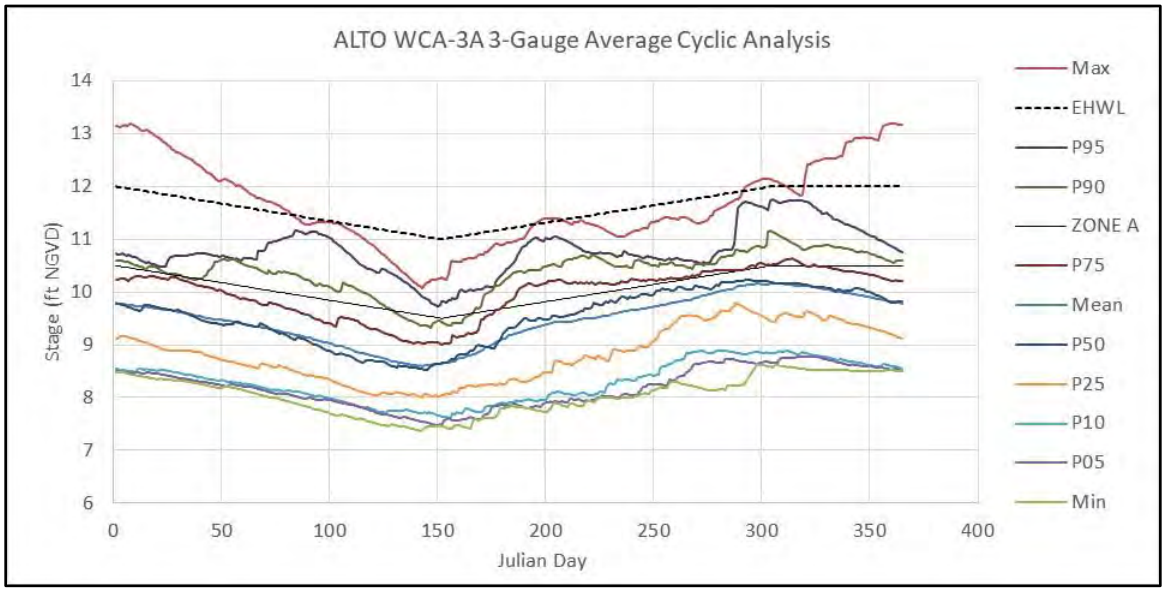

Figure 4-21. Cyclic Analysis of the WCA 3A 3-gauge average for ALTO.

4.2.3.1.1 East-Central Water Conservation Area 3A (Gauge 3A-3)

Under ALTO, East-Central WCA 3A is expected to experience slightly lower stages and shorter hydroperiods relative to the ECB19RR (**Figure 4-2** and **Figure 4-22**). As the hydroperiod duration comparison shows, a minor decrease in ponding depths is expected under ALTO in comparison to ECB19RR, with shorter hydroperiods in extreme dry years (**Figure 4-23**) and virtually unchanged ponding depths under wet conditions (**Figure 4-24**). As the comparison of overland flow across Transect 12 shows (**Figure 4-19**) conditions very similar to (approximately 3% difference) that of ECB19RR are expected for ALTO in East-Central WCA 3A.

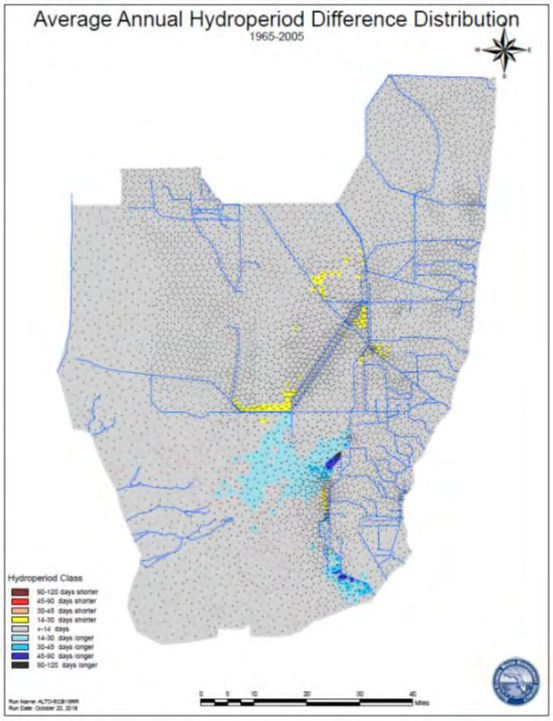

Figure 4-22. Differences in average annual hydroperiods for ALTO and ECB19RR.

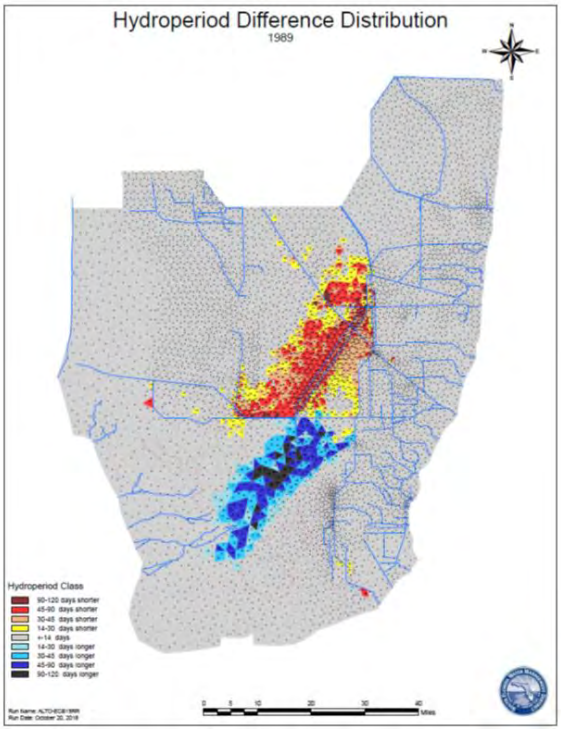

Figure 4-23. Differences in average annual hydroperiods for ALTO and ECB19RR for 1989.

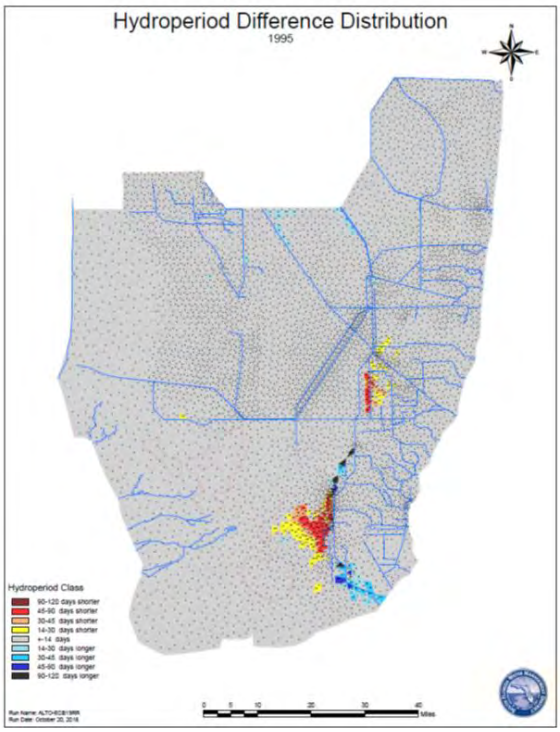

Figure 4-24. Differences in average annual hydroperiods for ALTO and ECB19RR for 1995.

4.2.3.1.2 Central Water Conservation Area 3A (Gauge 3A-4):

Similar to East-Central WCA 3A, the stages in Central WCA 3A under ALTO are expected to be very similar to ECB19RR conditions, with slight decrease in stages for dry conditions (**Figure 4-4**). As shown in **Figure 4-22**, the difference in the 41-year average of simulated hydroperiods does not indicate a noticeable change in long-term stage averages for Central WCA 3A, while moderate to major differences for extreme dry conditions (**Figure 4-23**) and no significant differences for extreme wet conditions (**Figure 4-24**) are expected.

4.2.3.1.3 Southern Water Conservation Area 3A (Gauge 3A-28):

The stages in the Southern WCA 3A for ALTO are expected to be similar to ECB19RR for wet conditions, with minor to moderate decreases in stage in drier conditions. As shown in **Figure 4-5**, for high stages with exceedances lower than 30%, the ALTO results are virtually the same as ECB19RR conditions, with minor to moderate decreases for drier conditions. The difference in the 41-year average of simulated stages indicate a minor decrease in long-term stage averages for Southern WCA 3A, while moderate to major differences for extreme dry conditions (**Figure 4-23**) and no significant differences for extreme wet conditions (**Figure 4-24**) are expected.

4.2.3.2 Water Conservation Area 3B

Similar hydrologic responses in WCA 3B are expected under ALTO relative to the ECB19RR conditions. The comparison of ponding depths presented in **Figure 4-6** indicates a minor decrease in ponding depths for dry conditions.

4.2.3.3 Everglades National Park

4.2.3.3.1 Western Shark River Slough

The average stage differences for the 41-year simulation period indicated that the long-term stage average for the Western SRS under ALTO will slightly increase relative to ECB19RR conditions (**Figure 4-22**). As shown in **Figure 4-20**, the average annual overland flow across Transect 17 is significantly (36%) reduced for ALTO relative to ECB19RR. Therefore, this slight overall increase can be attributed to the hydration of adjacent areas in NESRS. The comparison of simulated hydroperiods at ENP_NP-201 gauge indicated a moderate increase for dry conditions, and a moderate decrease (less than 0.4 feet) for moderately wet conditions (**Figure 4-8**).

4.2.3.3.2 Northeast Shark River Slough

The average ponding depth differences for the 41-year simulation period indicated an overall moderate to major increase in the NESRS under ALTO relative to ECB19RR conditions (**Figure 4-22**). As shown in the duration curves for the Gauge ENP_G3273 (**Figure 4-10**), higher stages are expected for all stage levels.

4.2.3.4 Taylor Slough

The average stage differences for the 41-year simulation period indicate a slight improvement in the hydrologic conditions of the Taylor Slough under ALTO relative to ECB19RR conditions, as simulated at Gauge ENP_NP-TSB (**Figure 4-12**).

4.2.3.5 Florida Bay

Comparison of average annual overland flows across Transects 23B and 23C (**Figure 4-13** and **Figure 4-14**) indicate that a minor (~7%) increase is expected for ALTO relative to ECB19RR conditions. With the minor increase in the hydration of areas upstream of the Florida Bay a slight improvement in deliveries to the Bay can be expected for ALTO. ALTO decreased structure flow through S-197 and improved overbank flow into ENP's Eastern Panhandle relative to ECB19RR. Annual flow through S-197 decreased to 13,400 acre-feet for ALTO from 60,400 acre-feet for ECB19RR. Additional discussion on S-197 discharges can be found in Section **4.6.4** (**Mangrove Wetlands and Seagrass Beds**).

4.2.4 Alternative Q

Simplifying assumptions are typically used during the scoping of hydrologic modeling efforts in order to effectively balance the overall schedule requirements of the project and the modeling needs of the project, including whether requisite operational specificity is able to be provided by the formulation team. Interpretation of the hydrologic modeling outputs requires consideration by the reviewer of such simplifying assumptions. For ALTQ, please note the following modeling assumptions were used: (1) the 90-day FDOT constraint for the Tamiami Trail roadway was modeled by assuming an L-29 maximum operating limit of 8.5 feet NGVD during October through January (longer than 90 days was used in order to test the degree of restriction) and 8.25 feet NGVD for all other months (same assumption as ALTN2); (2) no explicit modeling of the WCA 3A EHWL, as this feature is not identified for ALTQ (unchanged from ALTO); (3) weekly flow targets for WCA 3A release structures along Tamiami Trail (S-333, S-12A, S-12B, S-12C, and S-12D) are computed using the TTFF, as detailed in the COP Water Control Plan; (4) environmental deliveries to Taylor Slough and the SDCS canals (L-31N canal stages trigger operations at S-332B, S-332C, S-332D, S-194, and S-196) from L-30 via the S-335 gated spillway of up to 400 cfs are

triggered using L-30 stage criteria when canal stages are between 5.3 and 6.0 feet NGVD during the period from 01 August through 14 February (with triggers informed by iModel application using Taylor Slough stage targets from the COP Eco sub-team); (5) the WCA 3A Regulation Schedule includes only Zone A (same as ALTO); (6) environmental deliveries to Taylor Slough and the SDCS canals from WCA 3A (up to 300 cfs was identified in the ALTQ alternative formulation table) were not simulated, in absence of specific targets identified for Taylor Slough which would trigger the need for these deliveries (increased to 300 cfs, versus 250 cfs for ALTO); (7) S-356 has priority over S-333, consistent with the intent detailed in the ALTQ formulation table, independent of WCA 3A stages (same as ALTO); (8) S-357 pump station operations are triggered based on stage criteria at Angel's Well (same as ALTN2 and ALTO), consistent with the criteria used for the MWD Increment 2 Field Test following C-111 NDA completion (limited resolution is available with the RSM-GL, but the operations are included in the MD-RSM simulations used to assess 8.5 SMA flood mitigation performance); and (9) WCA 3A low water floor criteria, below which water supply deliveries to the SDCS requires in-kind inflows to WCA 3A, is shifted from referencing the S-333 headwater stage to referencing the 3-69W stage located approximately 12 miles north along the L-67A canal. Assumptions previously detailed for the WCA 3A high water exit strategy, S-333N operations, and DPM operations in ECB19RR were unchanged with ALTQ.

Increased use of S-333 can cause a local drawdown at the S-333 Headwater location creating a "false" need for upstream water. A similar trend was identified and addressed for the CERP Central Everglades Project. To address this "false" need, the alternative incorporates the CEPP operational change which relies on a more remote upstream gauge at 3-69W in WCA 3A (approximately 11.5 miles north of S-333, along the L-67A Canal) to help indicate the need for Lake Okeechobee in-kind releases (item 9 is the preceding list). CEPP identified the floor as falling below 7.5 feet NGVD at 3-69W, or falling below 7.0 feet NGVD at S-333 Headwater.

4.2.4.1 Water Conservation Area 3A

The cyclic analysis of the 3-gauge average of the stages at Gauges 3A-28, 3A-3, and 3A-4 for ALTQ simulations is shown in **Figure 4-25**. The labels for the plotted traces indicate the probability exceedance percentiles for 5%, 10%, 25%, 50% (median value), 75%, 90%, and 95%. The maximum, minimum and average stages for each Julian day are also shown in the figure. Comparison of stages corresponding to 10%, 50%, and 90% exceedance probability percentiles can be found in **Figure 4-27**, **Figure 4-28**, and **Figure 4-29,** respectively. It should be noted that ALTQ simulations did not include operational rules associated with EHWL. Simulated daily WCA 3A stages for the entire 41-year POR is shown in **Figure 4-26**. Numerical simulations performed for ALTQ and ECB19RR indicated that the EHWL was exceeded only three times during the 41 year of continuous simulations for both scenarios. Total durations for the exceedances in number of days was 15% less for ALTQ than ECB19RR. The period of exceedances are 7/16/1968 - 7/24/1968 (9 days), 11/16/1994 - 3/4/1995 (109 days), and 10/23/1995 - 10/31/1995 (9 days) for ALTQ; and 7/11/1968 – 7/28/1968 (18 days), 11/16/1994 - 3/9/1995 (114 days) , and 10/19/1995 - 11/7/1995 (20days) for ECB19RR.

As indicated in the figure, EHWL is expected to be exceeded infrequently and the modeling results would not be significantly altered by the decision to not explicitly model the EHWL operations. The simulated stages for ECB19RR are included in the graphs for comparison purposes. The existing operations for the study area didn't include the shown EHWL as a part of WCA 3A regulation schedule.

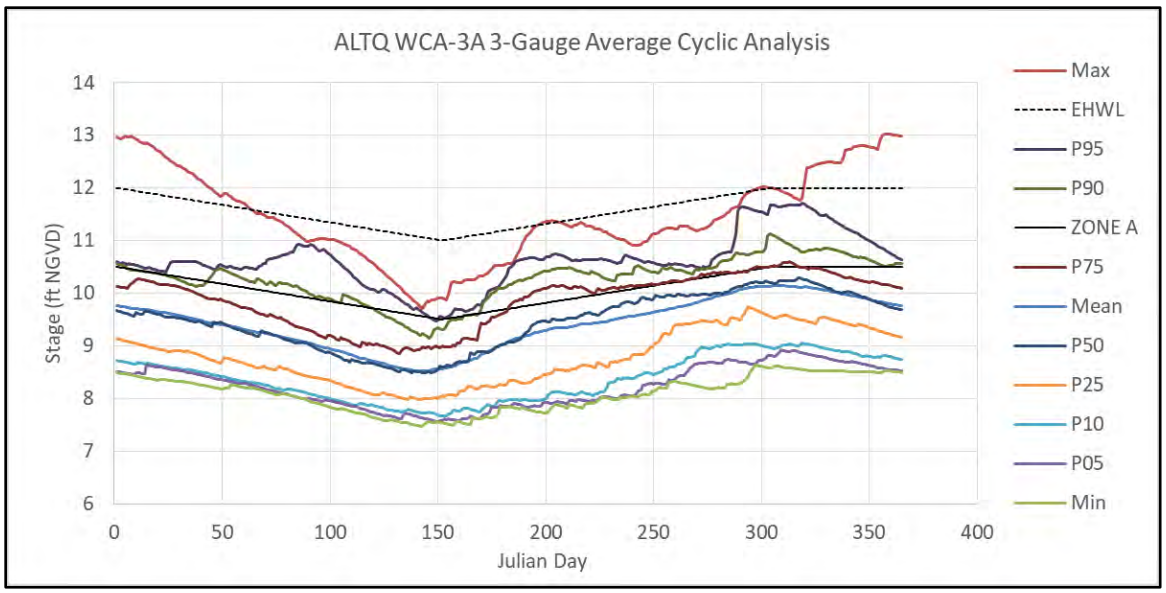

Figure 4-25. Cyclic Analysis of the WCA 3A 3-gauge average for ALTQ.

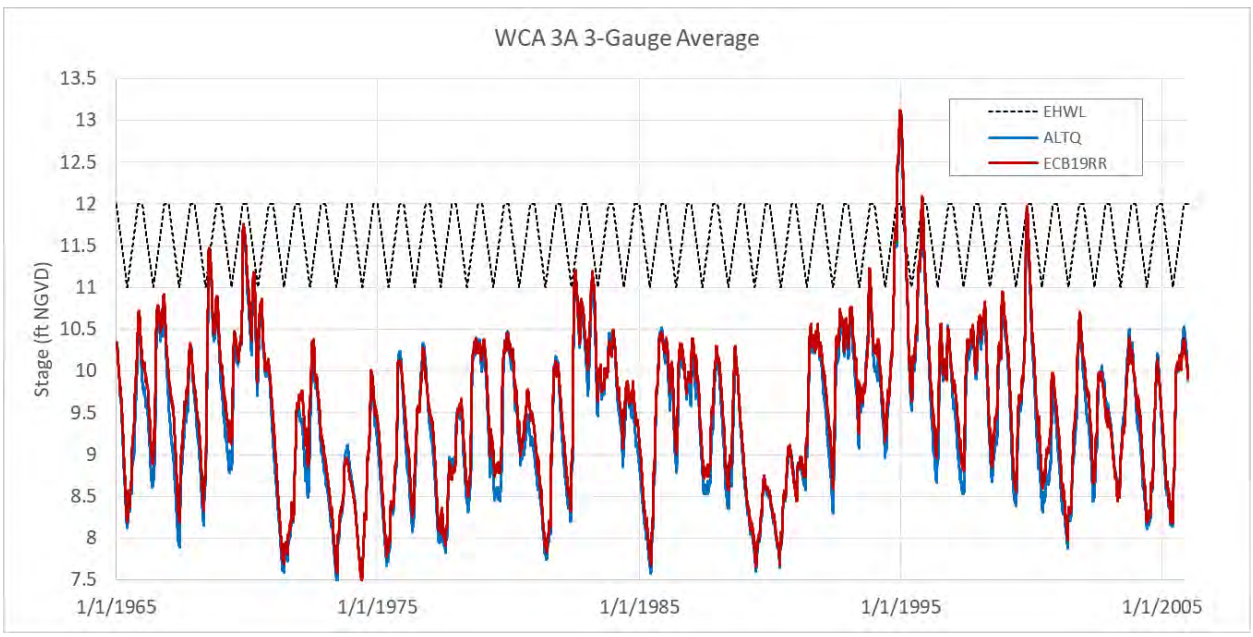

Figure 4-26. Extreme High Water Line and simulated WCA 3A stages.

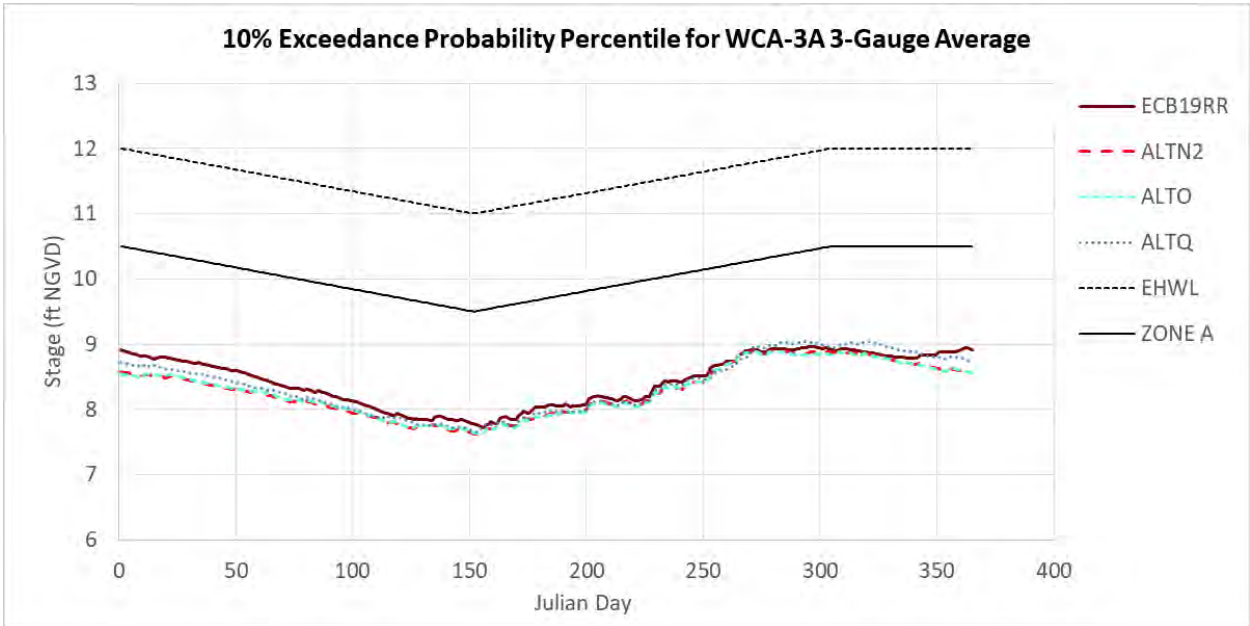

Figure 4-27. 10% Exceedance Probability Percentile for WCA 3A 3-Gauge Average.

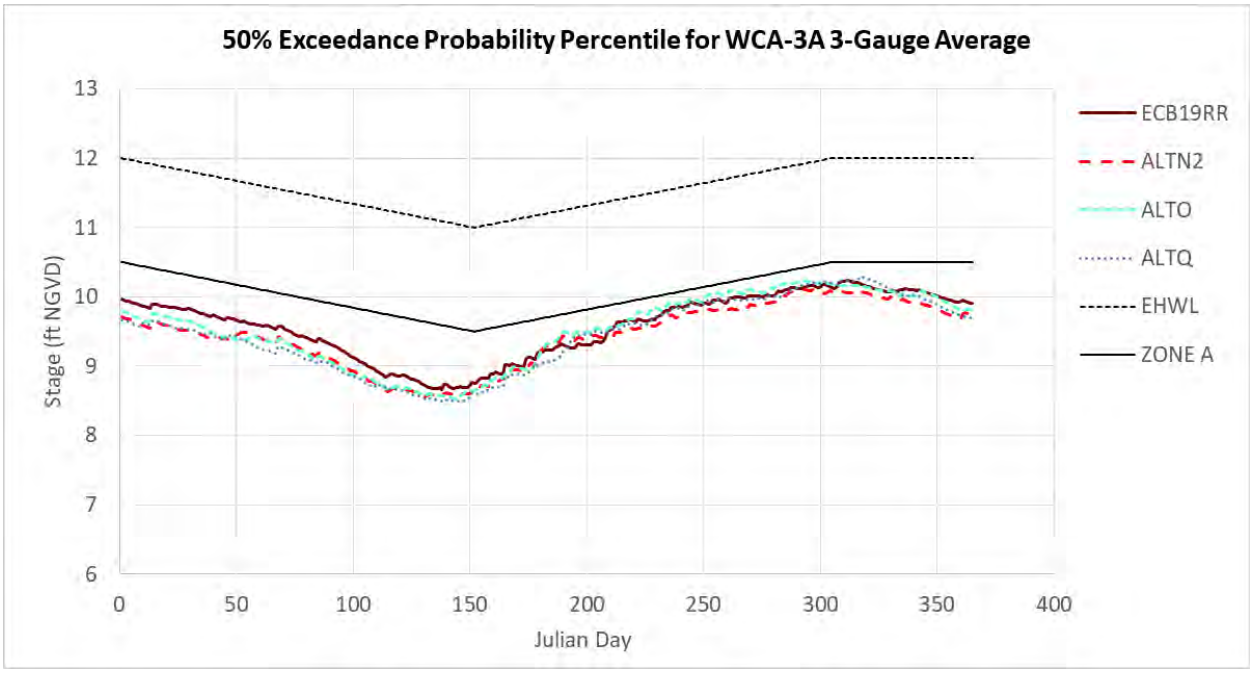

Figure 4-28. 50% Exceedance Probability Percentile for WCA 3A 3-Gauge Average.

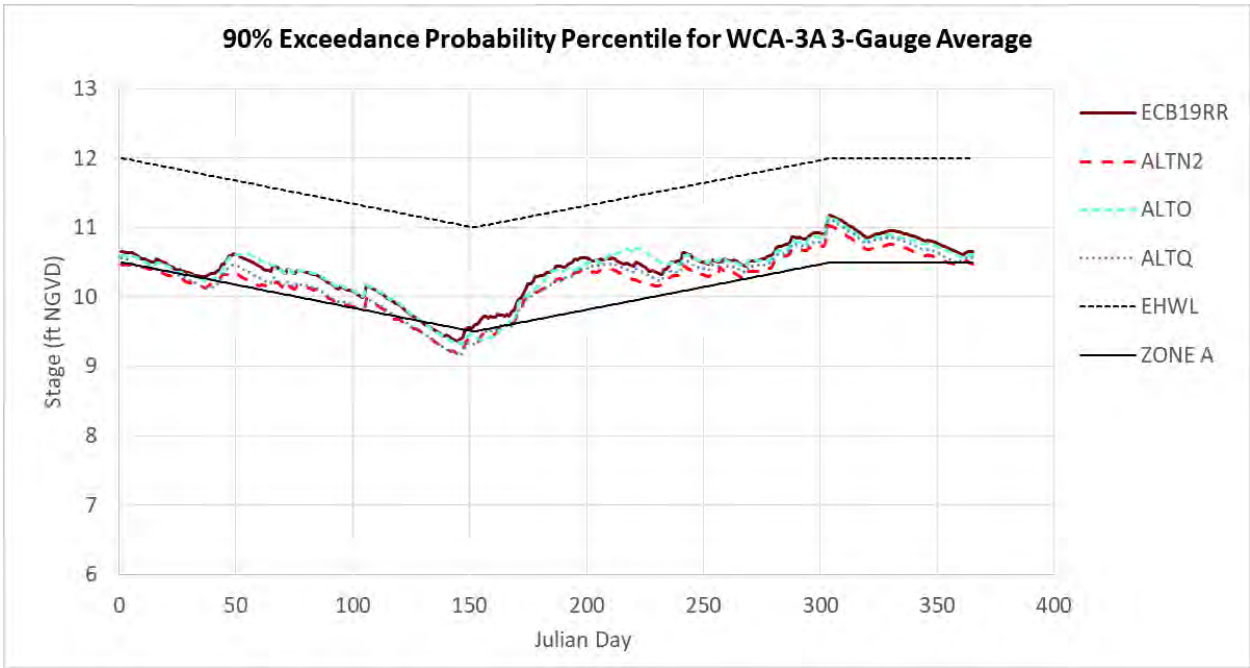

Figure 4-29. 90% Exceedance Probability Percentile for WCA 3A 3-Gauge Average.

4.2.4.1.1 East-Central Water Conservation Area 3A (Gauge 3A-3)

As the ponding depth and hydroperiod duration comparisons (**Figure 4-2** and **Figure 4-30**) indicates, a slight decrease in the stages is expected under ALTQ in comparison to ECB19RR conditions for East-Central WCA 3A. The extent of the reduced hydroperiods can be seen in the figure. The reduction in depths becomes more pronounced under drier conditions, with virtually unchanged stages under extremely wet conditions. As presented in **Figure 4-31** and **Figure 4-32**, considerably shorter hydroperiods in East-Central WCA 3A are expected during extreme dry years, versus the similar hydroperiods with ECB19RR during extreme wet years.

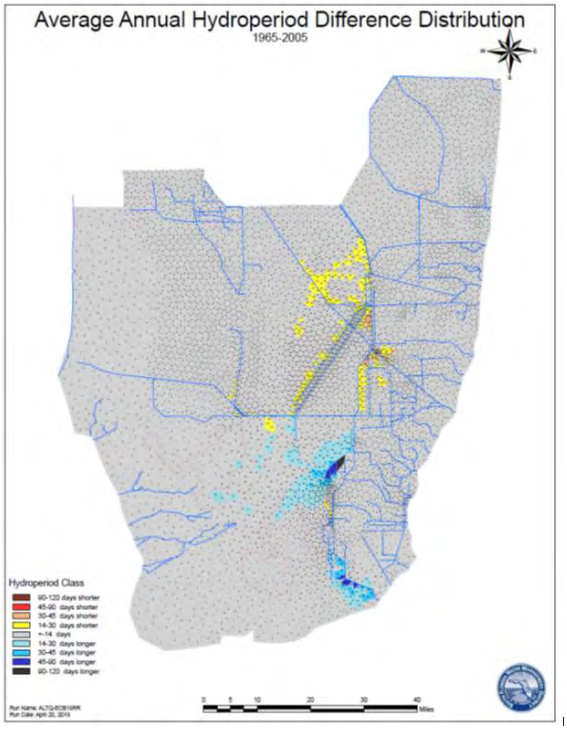

Figure 4-30. Differences in average annual hydroperiods for ALTQ and ECB19RR.

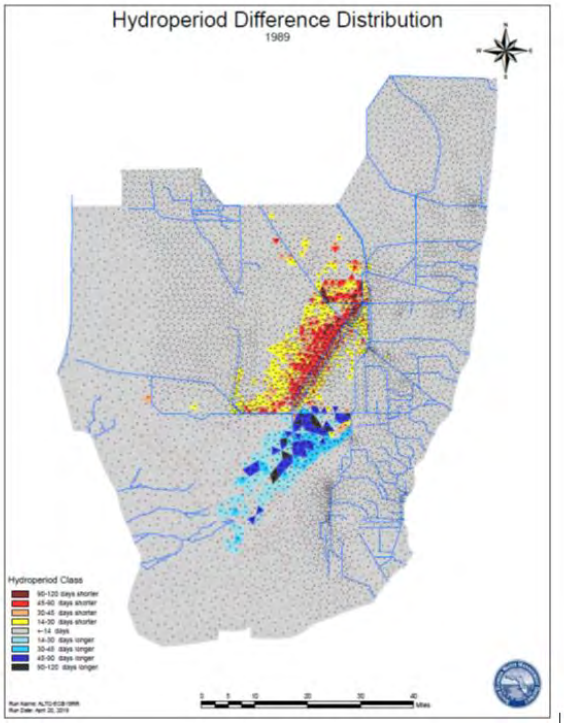

Figure 4-31. Differences in 1989 (dry year) hydroperiods for ALTQ and ECB19RR.

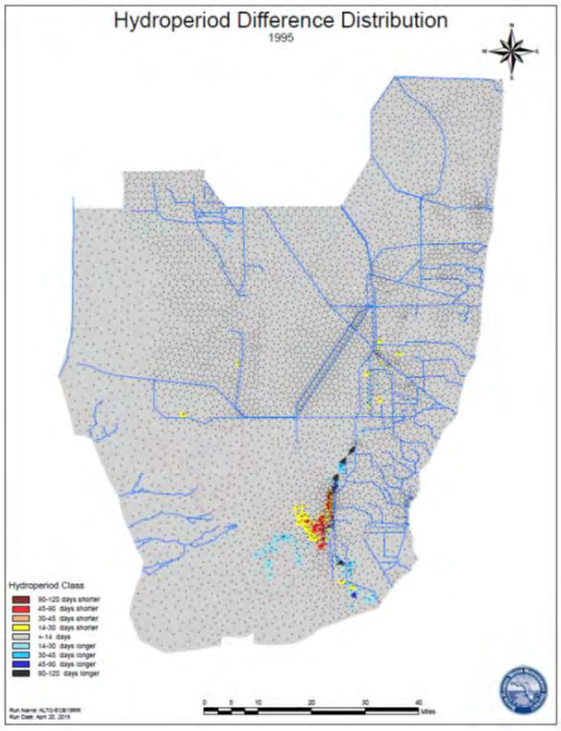

Figure 4-32. Differences in 1995 (wet year) hydroperiods for ALTQ and ECB19RR.

4.2.4.1.2 Central Water Conservation Area 3A (Gauge 3A-4)

As the ponding depth duration comparison shown in **Figure 4-4** indicates, a minor to moderate decrease in the stages is expected under ALTQ in comparison to ECB19RR conditions for Central WCA 3A. The difference in 41-year average of simulated depths indicates less than 0.25 feet of decrease in long-term averages for Central WCA 3A. The reduction in stages becomes more pronounced under drier conditions, with virtually unchanged stages under extremely wet conditions. As presented in **Figure 4-31** and **Figure 4-32**, considerably shorter hydroperiods in Central WCA 3A are expected during extreme dry years, versus the similar hydroperiods during extreme wet years.

4.2.4.1.3 Southern Water Conservation Area 3A (Gauge 3A-28)

The stages in Southern WCA 3A are expected to be slightly to moderately lower under ALTQ than the ECB19RR conditions (**Figure 4-5**).

4.2.4.2 Water Conservation Area 3B

Reduction in stages are expected for WCA 3B under ALTQ relative to ECB19RR conditions. The comparison of hydroperiods for the Gauge WCA3_3B-71 as the representative of the hydrological conditions in the WCA 3B (**Figure 4-6)** indicate minor to moderate reduction in ponding depths for this gauge. While minor to moderate adverse effect are expected in the southern and central WCA 3B, moderate adverse effects are expected in northern WCA 3B.

4.2.4.3 Everglades National Park

4.2.4.3.1 Western Shark River Slough

The average stage differences for the 41-year simulation period indicated that the long-term stage average for the Western SRS under ALTQ will slightly decrease relative to ECB19RR conditions **(Figure 4-30**).The comparison of simulated hydroperiods at ENP_NP-201 gauge indicated a moderate increase for dry conditions, and a moderate decrease in ponding depths for moderately wet conditions (**Figure 4-31** and **Figure 4-32**).

4.2.4.3.2 Northeast Shark River Slough

The average stage differences for the 41-year simulation period indicated moderate to major increases in the NESRS under ALTQ relative to ECB19RR conditions (**Figure 4-30**). As shown in the duration curves for the Gauge ENP_G3273 (**Figure 4-10**), higher stages are expected for all stage levels.

4.2.4.4 Taylor Slough

The average stage differences for the 41-year simulation period indicate a slight improvement in the hydrologic conditions of the Taylor Slough under ALTQ relative to ECB19RR conditions as simulated at Gauge ENP_NP-TSB (**Figure 4-12)**. The hydroperiods in Taylor Slough are influenced by upstream operational changes at S331, which may reduce the pumping duration at S332B, S332C, and S332D and slightly reduce hydroperiod durations. COP Water Control Plan has the ability to utilize WCA 3A as a separate source of water to maintain the hydraulic ridge along the C-111 detention areas and/or provide deliveries to Taylor Slough under limited circumstances.

4.2.4.5 Florida Bay

Comparison of average annual overland flows across Transects 23B and 23C indicate that a minor (~7%) increase is expected for ALTQ relative to ECB19RR conditions. With the minor increase in the hydration of areas upstream of the Florida Bay a slight improvement in deliveries to the Bay can be expected for ALTQ. ALTQ decreased structure flow through S-197 and improved overbank flow into ENP's Eastern Panhandle relative to ECB19RR. Discharges to Manatee Bay and Barnes Sound through S-197 are minimized through reduced use of the structure by 41,000 acre-feet per year on average (a decrease of 69% from 60,000 acre-feet to 19,000 acre-feet). The average number of days with non-zero deliveries through S-197 was also reduced 78% (from 223 to 48 days per year). ALTQ simulations show a decrease in the percent of days with average daily flows exceeding 0, 200, 400, and 800 cfs through S197 compared with ECB19RR **Figure 4-33** (14,975 days in the period of record). Increased freshwater flows to Florida Bay will improve salinities, resulting in better conditions for the diversity of sea grasses and other estuarine plant and animal species that inhabit the Bay. Additional discussion on S-197 discharges can be found in **Section 4.6.4** (**Mangrove Wetlands and Seagrass Beds**).

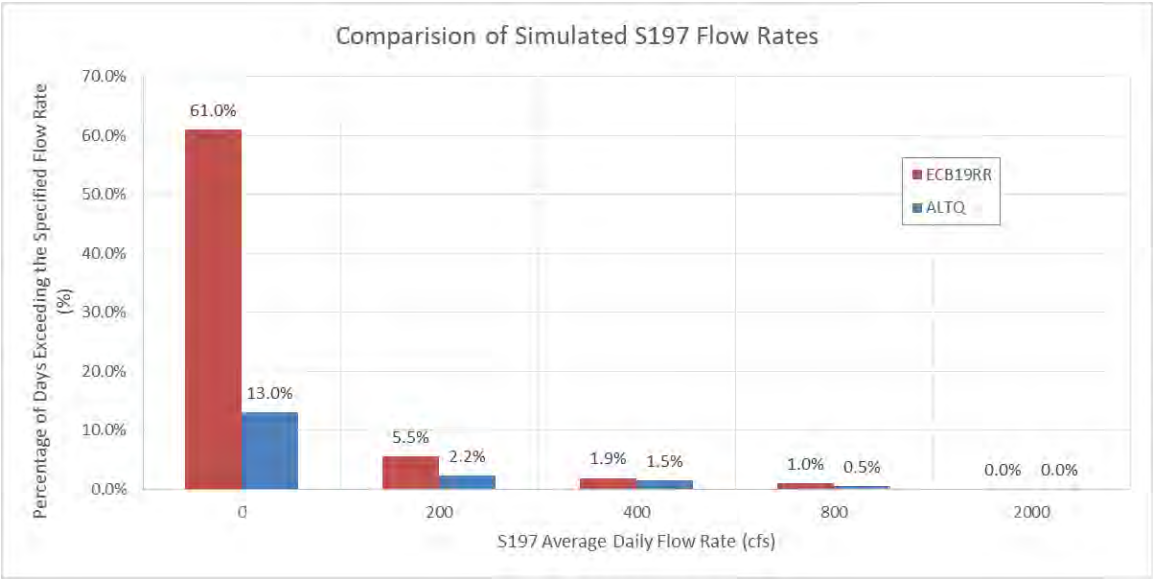

Figure 4-33. Comparison of S-197 Flow rates for ALTQ and ECB19RR.

4.2.5 Alternative Q+

Three rounds of hydrologic modeling were conducted during development of the COP, consistent with the COP hydrologic modeling strategy that was vetted through the COP interagency PDT. Given consideration of the purpose and limitations of the hydrologic modeling tools applied for the COP, it is not feasible nor practical to conduct hydrologic modeling of all variations and combinations of the COP operational criteria. Water managers additionally require some degree of latitude to evaluate real-time hydrologic conditions and forecast information to effectively operate the complex C&SF System, based on adherence to the established objectives and constraints which govern the COP implementation. The level of detail included in the operational criteria table for ALTQ was appropriate for distinguishing between alternatives evaluated during the hydrologic modeling phase of COP development. In addition to ALTQ, Round 3 sensitivity runs were conducted with both RSM-GL and MD-RSM to investigate other potential operational components for considerations within the Preferred Alternative; information gained from these sensitivity runs was leveraged to develop ALTQ+. After Round 3, no additional hydrologic modeling was conducted for the COP, aside from the MD-RSM design storm analysis (conducted starting from the MD-RSM representation of ALTQ, including high water operations using S-331 for 8.5 SMA flood mitigation – simulation ALTQm) to support the socio-economic evaluation of the South Dade Basin.

Throughout the interagency alternative formulation process and hydrologic modeling efforts, the USACE had recognized and communicated to the PDT the need to translate operational criteria appropriate for distinguishing between modeled alternatives into more refined operational criteria suitable for inclusion in the COP Water Control Plan. Due to the wide breadth of alternatives that were evaluated during the COP, the prerequisite for further development of the COP Water Control Plan was the formal identification of the Preferred Alternative based on consideration of evaluation results and interagency PDT review comments. Starting from the ALTQ+ Preferred Alternative (refer to **Appendix H**, **Annex H-3** (**Modeling Assumptions**) (reference pages 1-5), which was briefed to the PDT throughout May and June 2019, further development of the operational table and associated Water Control Plan was conducted with additional technical input from the COP Modeling sub-team and the COP Water Management sub-

team, while maintaining the operational intent and operational priorities established with ALTQ+, the Preferred Plan.

ALTQ+ includes the following additions, compared against the modeling simulations of ALTQ conducted during the Round 3 modeling:

1) Capability to further extend and/or remove the 90-day annual cumulative duration limitation for operating the L-29 canal above 8.3 feet NGVD (referenced as the FDOT roadway constraint), while continuing to adhere to the maximum operating stage limit of 8.5 feet NGVD (included in RSM-GL Round 3 sensitivity simulation SRQ1)
2) Removal of seasonal closures for S-344 (included in RSM-GL Round 3 sensitivity simulation SRQ4)
3) Removal of seasonal pumping capacity restriction for S-332D during the month of December (included in RSM-GL Round 3 sensitivity simulation SRQ4, which additionally removed S-332D seasonal pumping capacity restrictions during January through 14 July)
4) Additional operational flexibility within the COP Water Control Plan to address uncertainties identified in the COP Adaptive Management and Monitoring Plan regarding: (a) water quality inflows to SRS (included in RSM-GL Round 3 sensitivity simulations SRQ2 and SRQ3); and (b) TTFF dry season operations for SRS (Dry Season Field Test criteria developed based on technical evaluation of RSM-GL ALTO versus ALTQ hydrologic responses within WCA 3A and ENP)
5) Operational criteria and operational flexibility developed by the COP Water Management sub-team (and vetted through the COP PDT), as needed to effectively translate the operational intent and operational priorities established with the ALTQ+ Preferred Plan for inclusion in the COP Water Control Plan (the ALTQ+ table specifically identified which structures would require "further details to be developed thru the Operational Subteam").

Item 1 relates to the up-front decision by the COP formulation and modeling team that throughout the COP alternative modeling Rounds 1, 2, and 3 (ALTQ) in order to ensure the safety and stability of the Tamiami Trail (US-41) Highway under operations, the L-29 canal maximum operating stage limit was constrained to 8.5 feet NGVD, with a maximum cumulative duration of 90 days per water year (May through April) for stages above 8.3 feet NGVD. These operational restrictions are consistent with the coordination between the USACE and the FDOT regarding implementation of the "Contract between the United States of America and the FDOT for Relocation, Rearrangement, or Alteration of Facilities Modified Water Deliveries to Everglades National Park Project," which was prescribed in the Operational Strategy for the MWD Increment 2 Field Test. For the alternative modeling simulations, the representation of this constraint assumed an L-29 canal stage constraint of 8.5 feet at the end of the wet season, for a maximum duration of 123 days from 01 October through 31 January; for the remaining months of the year, the L-29 canal stage constraint was 8.25 feet NGVD. The four month duration (rather than 90 days) and late wet season timing was assumed for the hydrologic modeling since specific condition-based rules were not established by the COP formulation team and to ensure the ability to check whether the 90 day limit was restrictive during any specific simulated event in the modeling period-of-record.

ALTQ+ includes the capability to further extend and/or remove the cumulative duration criteria for operating the L-29 canal above 8.3 feet NGVD (referenced as the FDOT roadway constraint), while continuing to adhere to the maximum operating stage limit of 8.5 feet NGVD. Implementation of this change would not occur without: (1) written approval from FDOT to remove the L-29 canal constraint identified in **Appendix A** (**Water Control Plan**), based on a joint evaluation of monitoring data by the USACE and the FDOT (this data evaluation is ongoing with the MWD Increment 2 Field Test); (2)

demonstration of the capability of the completed MWD Project components to maintain flood mitigation requirements for the 8.5 SMA under the raised L-29 canal maximum operating limit of up to 8.5 feet, NGVD; and (3) consideration of increased low-water stages within WCA 3A, including along the western L-29 canal between S-12A and S-333. The requirement for all three pre-conditions to be met may preclude these operations during the initial implementation period of the COP, since additional inflows of treated water to WCA 3A from the upstream Lake Okeechobee and EAA basins and/or additional flood mitigation requirements may be necessary. Additional discussion of hydrologic effects is provided in **Section 4.5.1** (**Water Supply Analysis**).

Independent of the COP, as Phase 2 of the Tamiami Trail Next steps Project, the DOI is partnering with the State of Florida to re-construct the non-bridged roadway sections and to install additional bridges along the remaining portions of the Tamiami Trail roadway between S-333 and S-334 (L-29 canal reach) to accommodate the design high water stage of 9.7 feet NGVD that is planned for full implementation of the CERP. Design efforts are ongoing concurrent with the COP, and construction completion is currently anticipated by early 2023. Completion of the roadway modifications would allow for written approval from FDOT to remove the L-29 canal constraint identified in **Appendix A** (**Water Control Plan**), independent of the joint evaluation of monitoring data for the existing roadway by the USACE and the FDOT under the MWD Increment 2 Field Test. Since the potential raising of the L-29 canal maximum operating stage limit will not be completed prior to implementation of the COP Water Control Plan in 2020, consistent with the up-front plan formulation assumptions, the higher L-29 stage limit was not considered, modeled, or evaluated during the COP development; regional operational changes to utilize an L-29 canal maximum operating limit above 8.5 feet NGVD will be further evaluated during CERP implementation, given that CERP also provides additional inflows to the WCA 3A.

Additional discussion of hydrologic effects associated with the seasonal closures for S-344 and removal of seasonal pumping capacity restriction for S-332D (from evaluation of the SRQ4 sensitivity run) is provided in **Section 4.2.5.3.1** (**Western Shark River Slough**) and **Section 4.2.5.4** (**Taylor Slough**). Additional discussion of hydrologic changes and the resultant water quality effects associated with application of operational flexibility under the COP to address uncertainties identified in the COP Adaptive Management and Monitoring Plan regarding water quality inflows to SRS (from evaluation of sensitivity simulations SRQ2 and SRQ3 is provided in **Section 4.9** (**Water Quality**). The potential hydrologic effects associated with the TTFF dry season operations for SRS are not expected to significantly differ from the evaluation of Alternative Q and Alternative Q+ for WCA 3A, Taylor Slough, and within the SDCS due to the protective constraints identified in the AMMP; the short-term hydrologic benefits within Central SRS associated with the short-duration of elevated TTFF flow targets are expected to be consistent with the performance of Alternative O detailed in **Section 4.2.3.1** (**Everglades National Park**).

4.2.5.1 Water Conservation Area 3A

Differences in average annual hydroperiods for SRQ1 with respect to ECB19RR, and ALTQ are provided in **Figure 4-34**. As seen in the figure the hydrologic effect of ALTQ+ on WCA 3A is expected to be very similar to that of ALTQ. The comparison of the modeling results provided in **Figure 4-35** and **Figure 4-36** indicate that the similar responses are expected even during extreme dry (1989) and extreme wet years (1995).

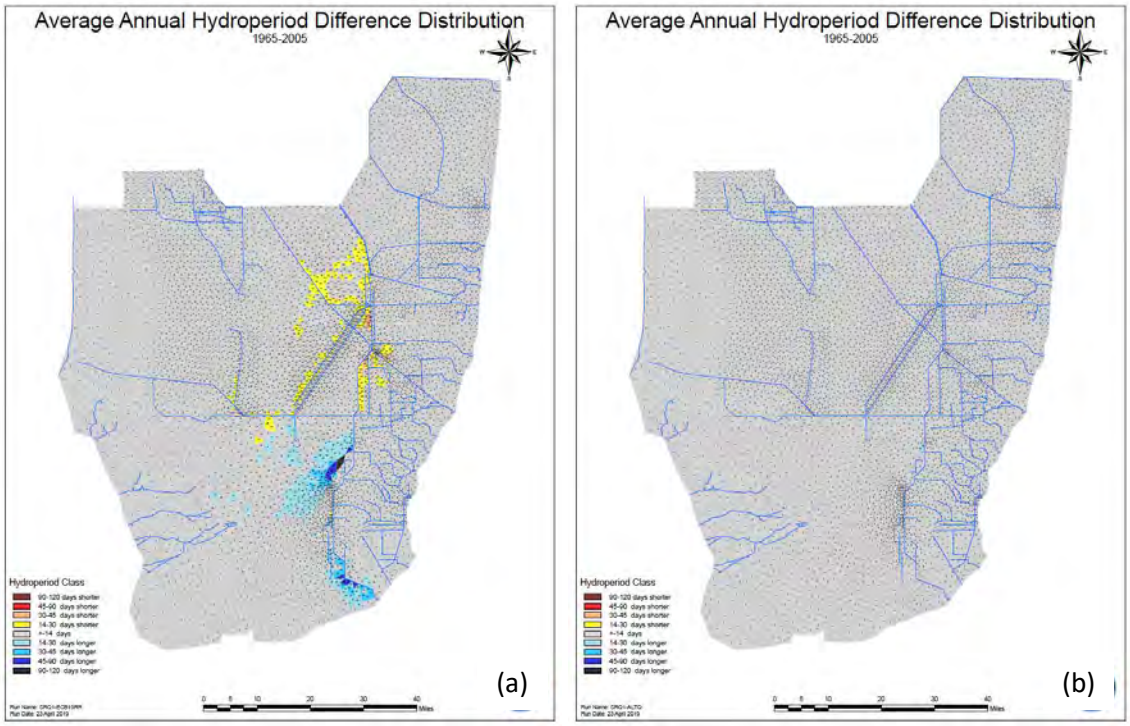

Figure 4-34. Differences in average annual hydroperiods for SRQ1 with respect to (a) ECB19RR, and (b) ALTQ.

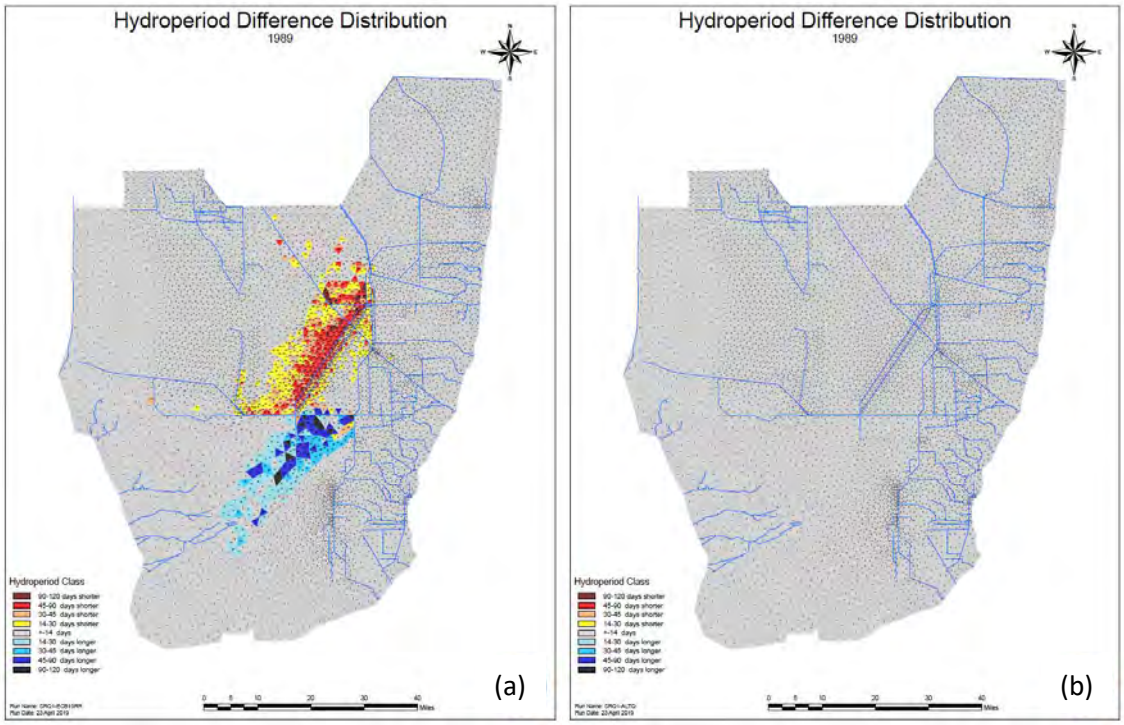

Figure 4-35. Differences in 1989 (dry year) hydroperiods for SRQ1 with respect to (a) ECB19RR, and (b) ALTQ.

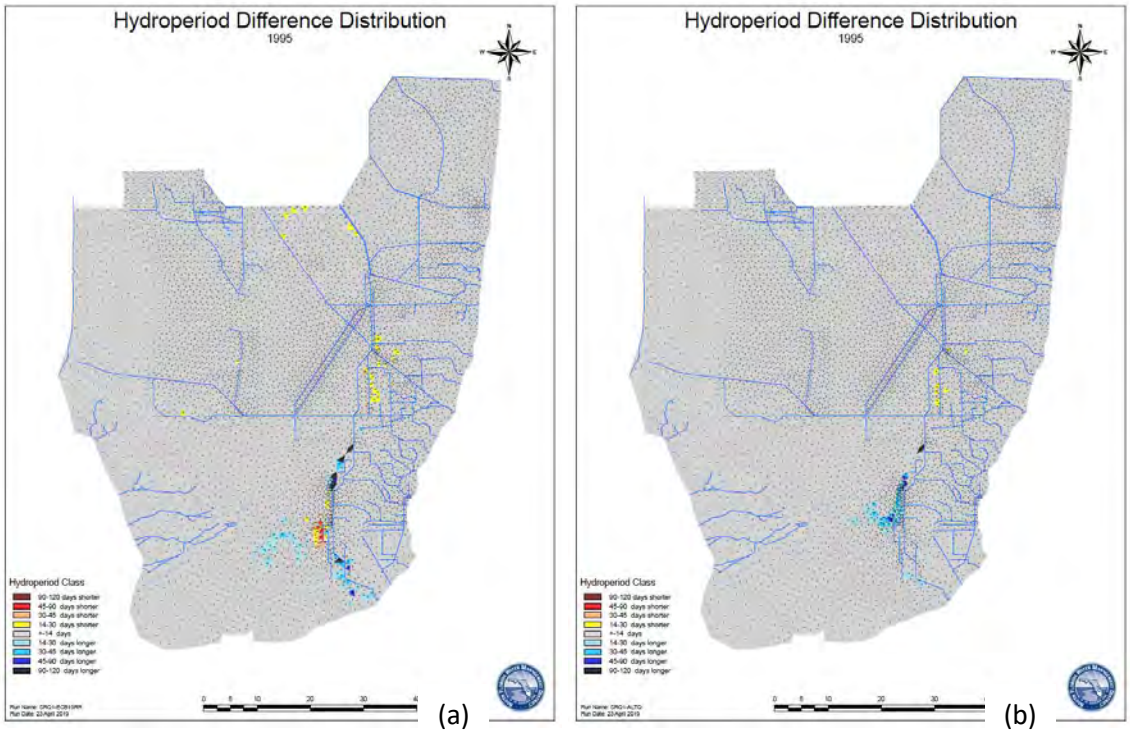

Figure 4-36. Differences in 1995 (wet year) hydroperiods for SRQ1 with respect to (a) ECB19RR, and (b) ALTQ.

4.2.5.1.1 East-Central Water Conservation Area 3A (Gauge 3A-3)

Hydrologic conditions very similar to ALTQ are expected under ALTQ+ for East-Central WCA 3A (**Figure 4-34**, **Figure 4-35**, and **Figure 4-36**). Depth duration curves shown in **Figure 4-37** indicate the similar depths are expected for the entire range of expected stages at Gauge WCA_3A-3.

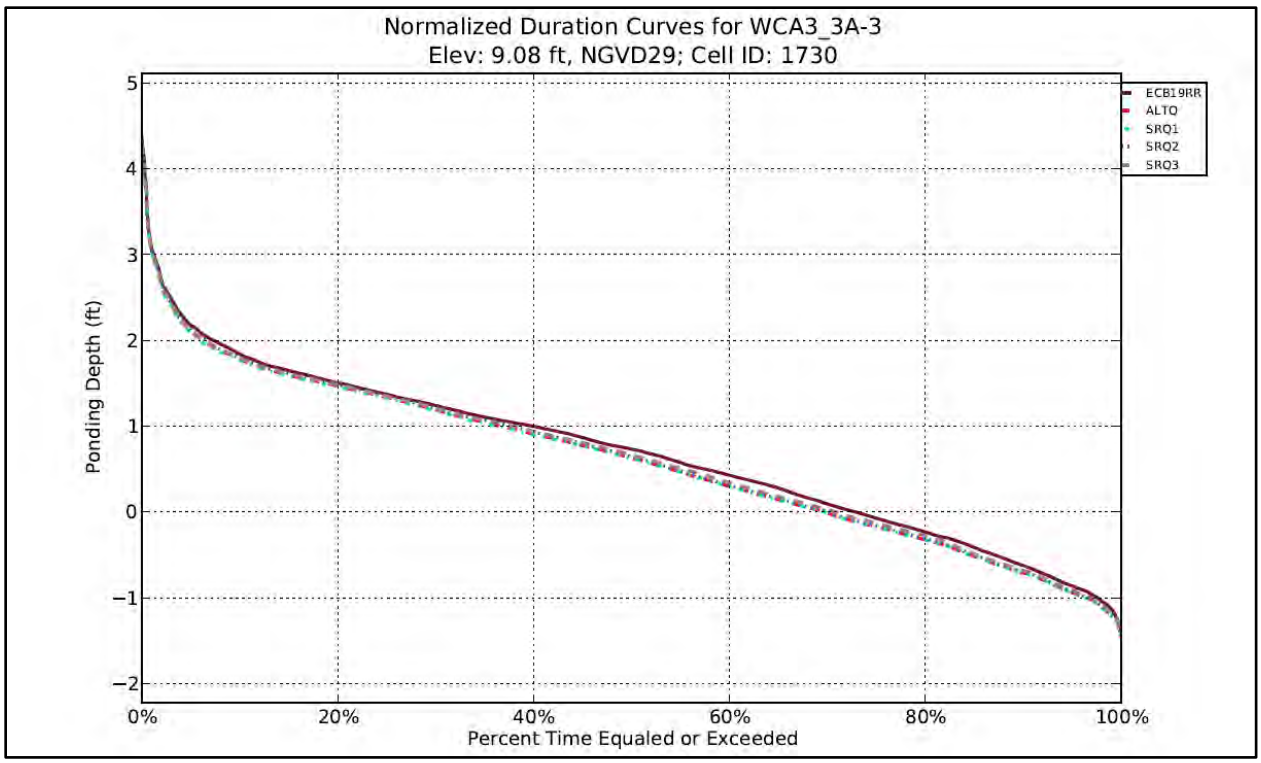

Figure 4-37. Depth duration curves for Gauge WCA_3A-3 for the sensitivity runs SRQ1, SRQ2, and SRQ3 against ALTQ, ECB19RR.

4.2.5.1.2 Central Water Conservation Area 3A (Gauge 3A-4)

Hydrologic conditions very similar to ALTQ are expected under ALTQ+ for East-Central WCA 3A (**Figure 4-34**, **Figure 4-35**, and **Figure 4-36**). Depth duration curves shown in **Figure 4-38** indicate the similar depths are expected for the entire range of expected stages at Gauge WCA_3A-4.

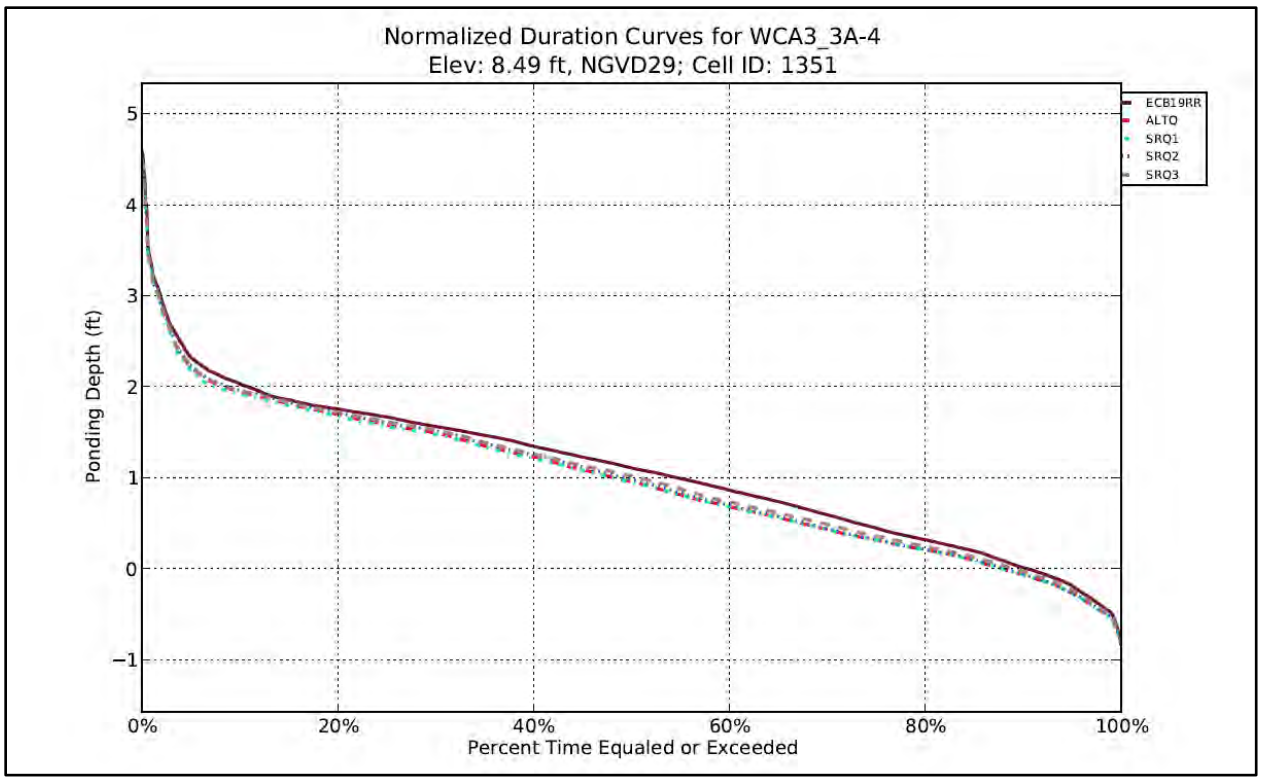

Figure 4-38. Depth duration curves for Gauge WCA_3A-4 for the sensitivity runs SRQ1, SRQ2, and SRQ3 against ALTQ, ECB19RR.

4.2.5.1.3 Southern Water Conservation Area 3A (Gauge 3A-28):

As the hydroperiod comparison maps provided in **Figure 4-34**, **Figure 4-35**, and **Figure 4-36** indicate, hydrologic conditions in Southern WCA 3A under ALTQ+ is expected to be very similar to ALTQ with no significant change. Depth duration curves shown in **Figure 4-39** indicate the similar depths are expected for the entire range of expected stages at Gauge WCA_3A-28.

The annual average volume through the S-344 structure is simulated to be 6,000 acre-feet for SRQ4 sensitivity run, versus 7,000 acre-feet for ECB19RR. The difference in the simulated S-344 volumes is less than 1% of the total deliveries form WCA 3A. Therefore, no significant differences in ALTQ+ over that of ALTQ is expected for WCA 3A.

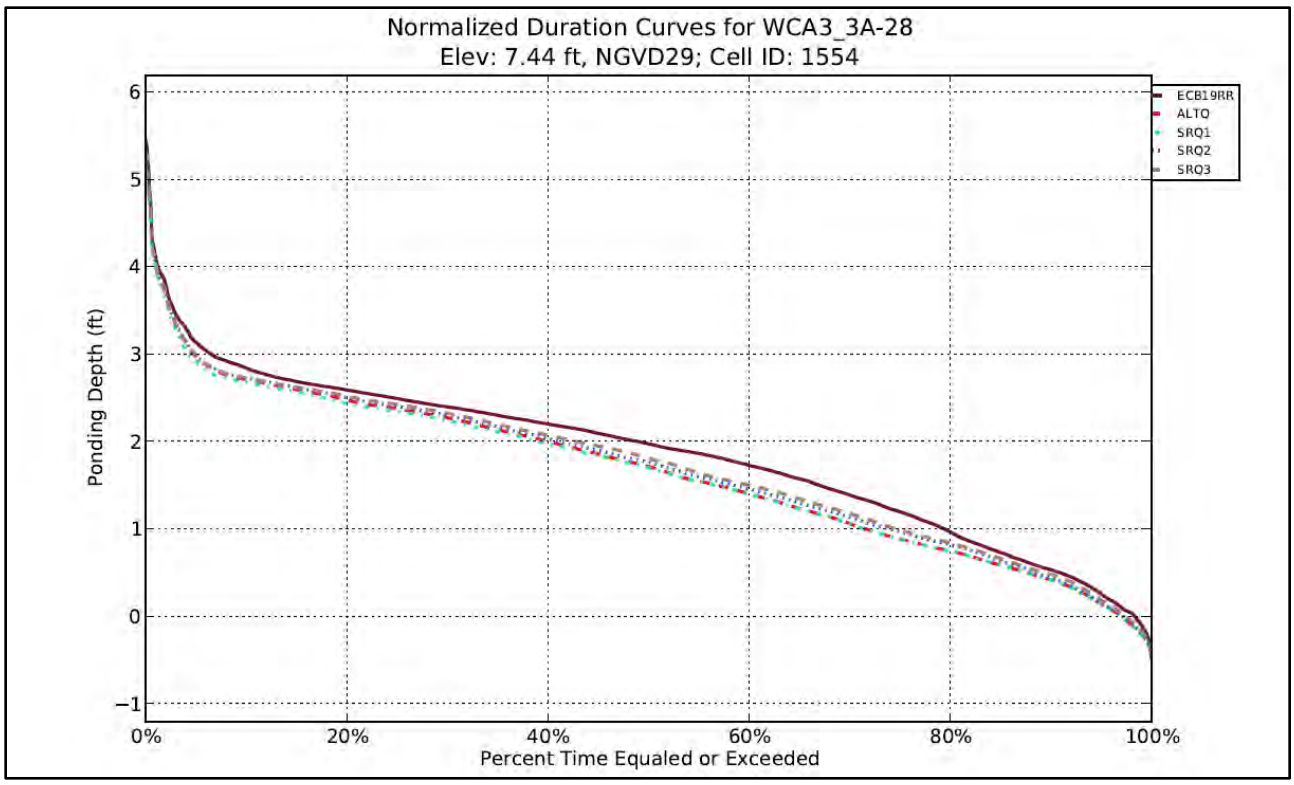

Figure 4-39. Depth duration curves for Gauge WCA_3A-28 for the sensitivity runs SRQ1, SRQ2, and SRQ3 against ALTQ, ECB19RR.

4.2.5.2 Water Conservation Area 3B

As the hydroperiod comparison maps provided in **Figure 4-34**, **Figure 4-35**, and **Figure 4-36** indicate, hydrologic conditions in WCA 3B under ALTQ+ is expected to be very similar to ALTQ with no significant change. Depth duration curves shown in **Figure 4-40** indicate the similar depths are expected for the entire range of expected stages at Gauge WCA_3B-71.

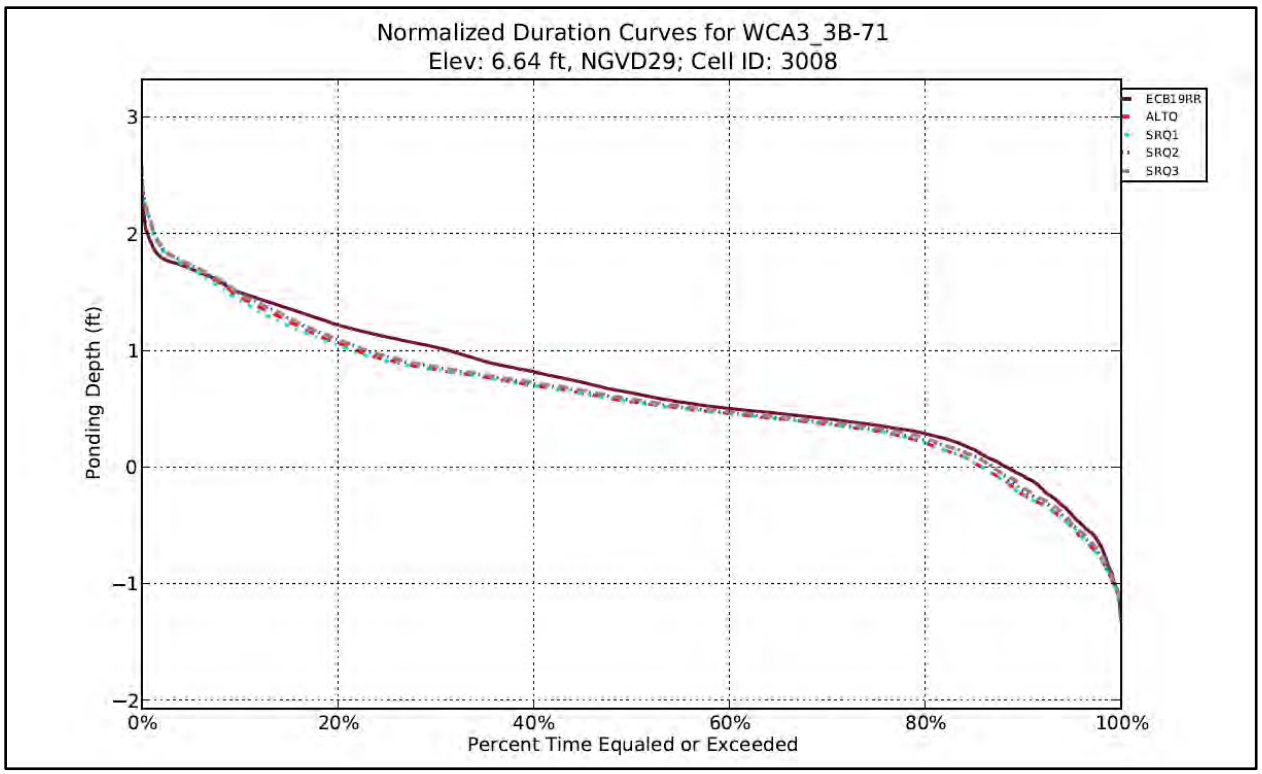

Figure 4-40. Depth duration curves for Gauge WCA_3B-71 for the sensitivity runs SRQ1, SRQ2, and SRQ3 against ALTQ, ECB19RR.

4.2.5.3 Everglades National Park

A table comparing the deliveries to the ENP under ALTQ and ECB19RR conditions is provided in **Table 4-2.** The summation of average monthly discharges for the S-12s, S-333, and S-333N was used to estimate the deliveries to the ENP from the WCA-3A. Total deliveries to the ENP additionally accounts for S356 flows and discounts S334 flows to estimate the total volumes delivered to the ENP. As seen in the table, a year-around improvement in deliveries to the ENP is expected for ALTQ over ECB19RR. The average annual total volume of water delivered to ENP (Northeast and Western SRS combined) is expected to increase by 25% (from 824,399 acre-feet to 1,030,876 acre-feet). The hydrologic conditions in the greater ENP under ALTQ+ are expected to be similar to what is simulated for ALTQ.

Table 4-2. Monthly deliveries to ENP for ALTQ/ALTQ+ and ECB19RR.

Month-	ALTQ Total acre-feet	ALTQ from WCA 3A acre-feet	ECB19RR Total acre-feet	ECB19RR from WCA 3A acre-feet
Jan	94,032	78,042	59,662	47,070
Feb	71,840	60,257	47,036	36,520
Mar	67,467	57,942	49,194	39,523
Apr	53,437	46,499	39,574	33,179
May	44,727	37,970	34,649	27,538
Jun	50,701	40,514	44,127	35,124

Month-	ALTQ Total acre-feet	ALTQ from WCA 3A acre-feet	ECB19RR Total acre-feet	ECB19RR from WCA 3A acre-feet
Jul	82,166	70,075	76,003	67,035
Aug	99,784	82,734	91,316	81,227
Sep	100,847	82,643	95,174	84,070
Oct	126,787	105,058	119,926	107,761
Nov	128,007	107,174	100,194	87,606
Dec	111,083	91,744	67,544	52,899
Total	1,030,876	860,650	824,399	699,551

The main reason for the observed differences in modeled ALTQ and ECB19RR deliveries to the ENP from WCA 3A is the implementation of Tamiami Trail Flow Formula (TTFF). More information on the development of TTFF can be found in Appendix H – Annex 8. To compare the effects of simulation scenarios on the monthly deliveries, a cyclic analysis of the total monthly deliveries for the 41-year simulation period was conducted. The results of the analysis corresponding to 10%, 50%, and 90% percentiles are provided in **Figure 4-41**, **Figure 4-42**, and **Figure 4-43**, respectively. The figures indicate that the more pronounced improvement in the deliveries to the ENP is expected under dry conditions. For all three presented exceedance percentiles, the dry season months experience higher increases in deliveries under ALTQ, with more drastic improvement for 10% percentile representing extreme dry conditions (**Figure 4-41**).

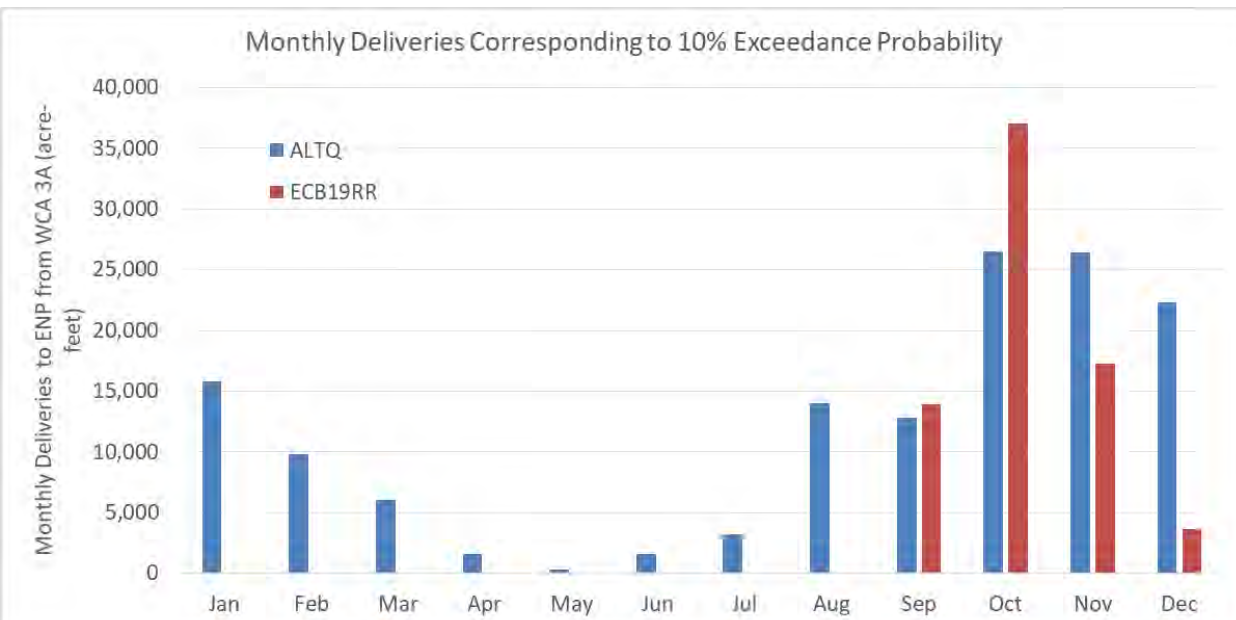

Figure 4-41. Monthly deliveries to the ENP from WCA 3A corresponding to 10% exceedance probability percentile.

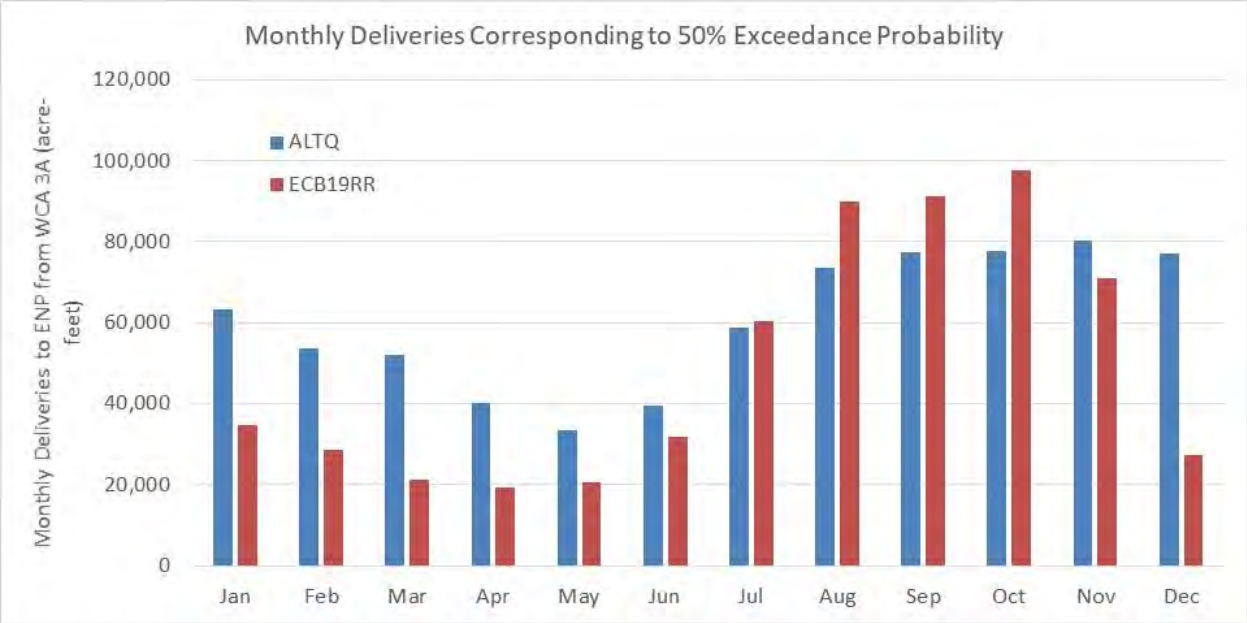

Figure 4-42. Monthly deliveries to the ENP from WCA 3A corresponding to 50% exceedance probability percentile.

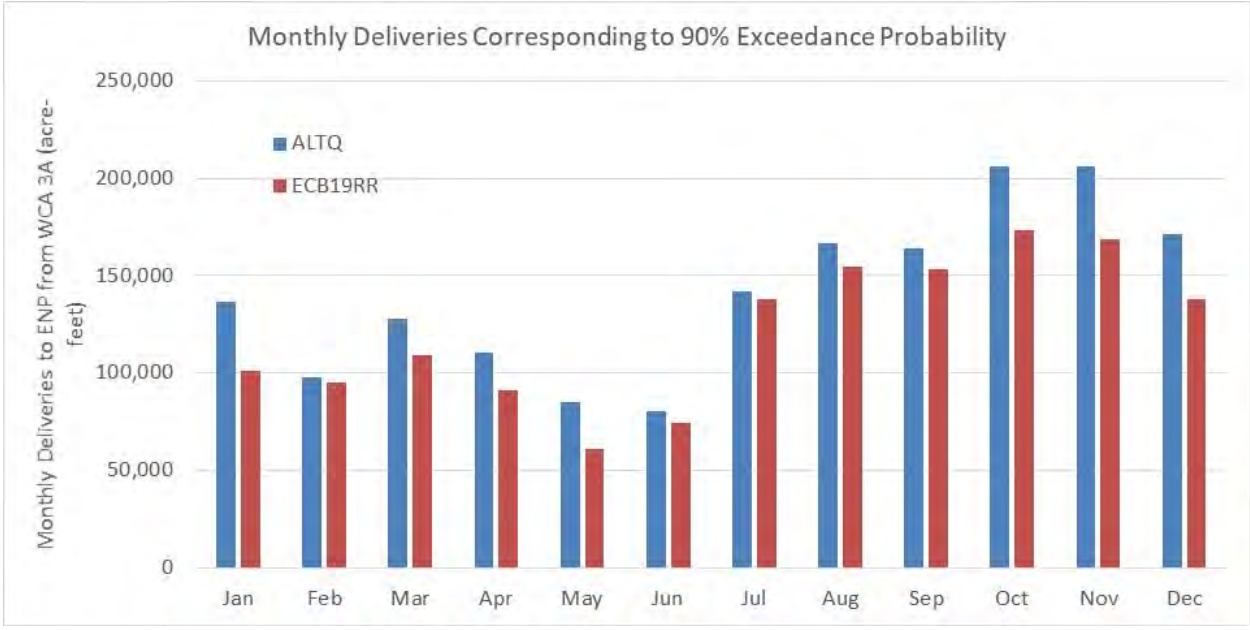

Figure 4-43. Monthly deliveries to the ENP from WCA 3A corresponding to 90% exceedance probability percentile.

The 1996 Master WCM will be replaced by COP System Operating Manual. The monthly distribution of deliveries to the ENP from the WCA 3A under ALTQ and ECB19RR scenarios are compared against the minimum monthly deliveries specified in 1996 Master WCM in **Table 4-3**. More information on the minimum deliveries is provided in Section 1.3.10.1. Despite the considerable increases in total deliveries under both ALTQ and ECB19RR, it is possible that, under very dry conditions, monthly deliveries will be lower than what is indicated in 1996 WCM. The monthly deliveries for 1989, the calendar year with the

lowest total deliveries to the ENP, are provided in **Table 4-3**. Five out of 41 years of simulated years are expected to deliver below 260,000 acre-feet total yearly volume for ALTQ, versus seven out of 41 years for ECB19RR.

Table 4-3. Monthly deliveries to Shark River Slough from WCA 3A.

Month	1996 Master WCM (Table 7-2) (acre-feet)	ALTQ Average of 41 years (acre-feet)	ECB19RR Average of 41 years (acre-feet)	ALTQ 1989 (Min Yearly Total) (acre-feet)	ECB19RR 1989 (Min Yearly Total) (acre-feet)
Jan	22,000	78,042	47,070	17,886	0
Feb	9,000	60,257	36,520	7,760	0
Mar	4,000	57,942	39,523	6,014	0
Apr	1,700	46,499	33,179	4,812	0
May	1,700	37,970	27,538	7,517	0
Jun	5,000	40,514	35,124	1,955	0
Jul	7,400	70,075	67,035	1,840	0
Aug	12,200	82,734	81,227	1,787	0
Sep	39,000	82,643	84,070	6,960	3,795
Oct	67,000	105,058	107,761	17,232	34,518
Nov	59,000	107,174	87,606	11,473	24,452
Dec	32,000	91,744	52,899	9,821	2,808
Total	260,000	860,650	699,551	95,056	65,574

4.2.5.3.1 Western Shark River Slough

As the hydroperiod comparison maps provided in **Figure 4-34**, **Figure 4-35**, and **Figure 4-36** indicate, hydrologic conditions in Western SRS under ALTQ+ is expected to be very similar to ALTQ with no significant change. Depth duration curves shown in **Figure 4-44**, **Figure 4-45**, and **Figure 4-46** indicate the similar depths are expected for the entire range of expected stages at Gauges ENP_NP-34, ENP_NP-201, and ENP_NP-205**.**

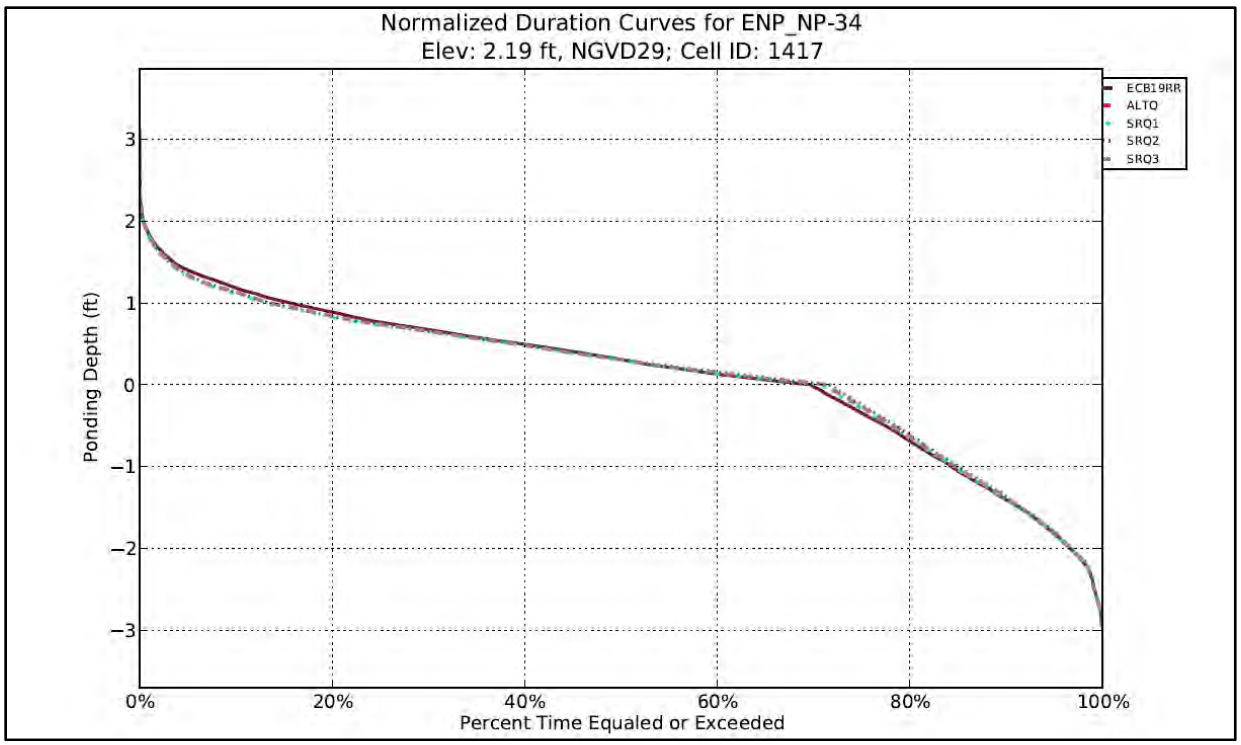

Figure 4-44. Depth duration curves for Gauge ENP_NP-34 for the sensitivity runs SRQ1, SRQ2, and SRQ3 against ALTQ, ECB19RR.

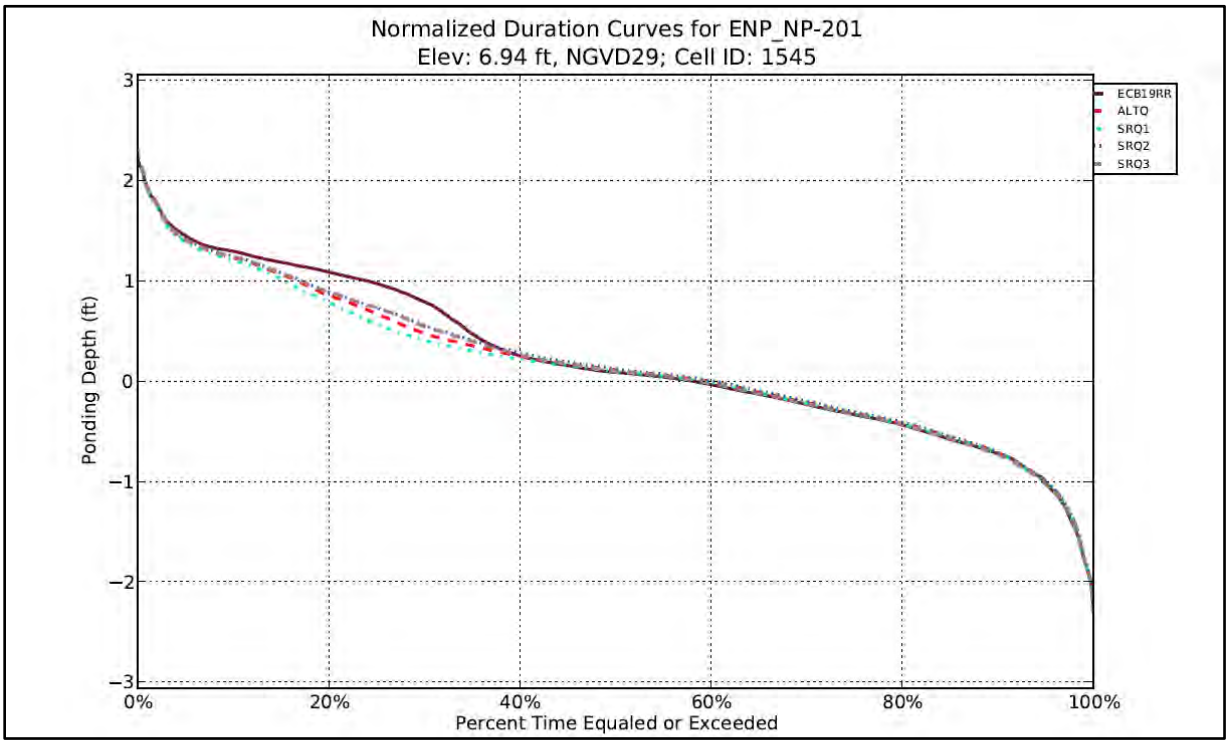

Figure 4-45. Depth duration curves for Gauge ENP_NP-201 for the sensitivity runs SRQ1, SRQ2, and SRQ3 against ALTQ, ECB19RR.

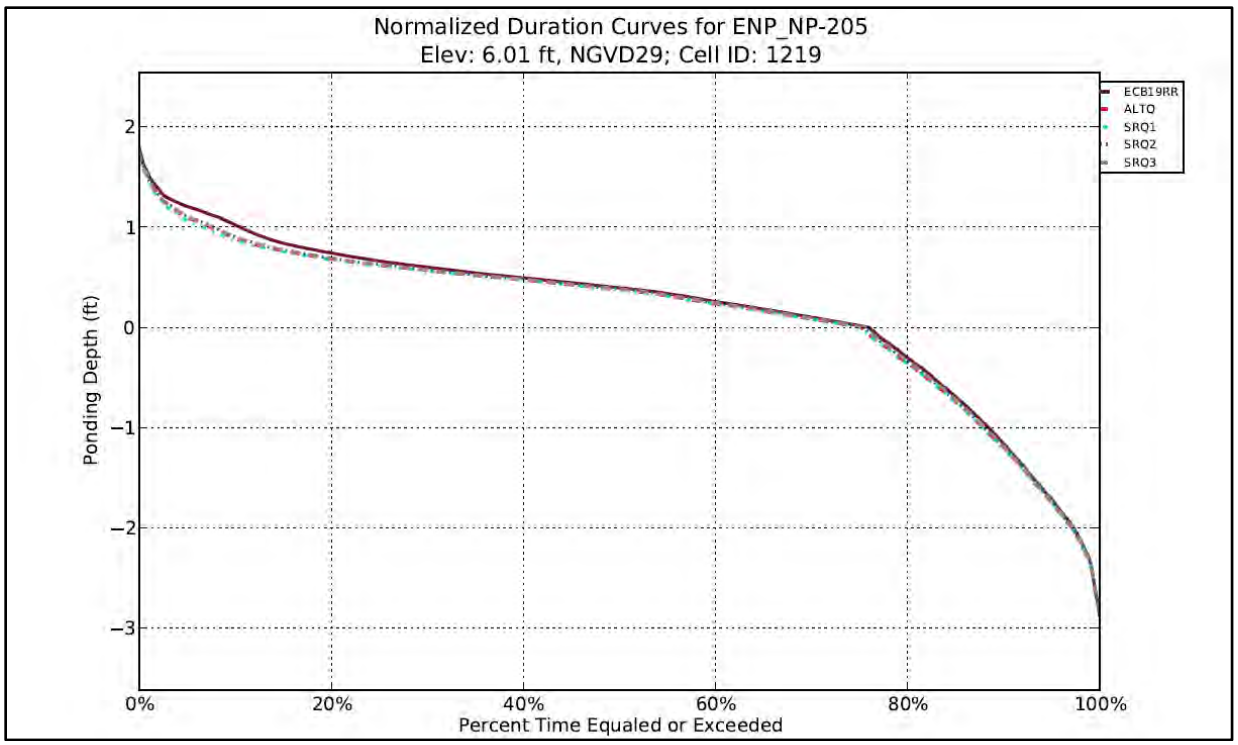

Figure 4-46. Depth duration curves for Gauge ENP_NP-205 for the sensitivity runs SRQ1, SRQ2, and SRQ3 against ALTQ, ECB19RR.

4.2.5.3.2 Northeast Shark River Slough

The potential hydrologic effects from complete removal of the L-29 canal FDOT roadway constraint was evaluated using a RSM-GL sensitivity simulation during the COP Round 3 modeling. The sensitivity simulation (SRQ1) was developed starting from the RSM-GL simulation of ALTQ, with incorporation of this single change. The removal of the constraint results in an average annual flow volume increase into the L-29 canal of approximately 50,000 acre-feet, approximately a 7 percent increase. Total inflows to NESRS (Transect 18) are increased by 43,000 acre-feet, with approximately two-thirds of this increase occurring during the wet season months of June to October. The TTFF limits the additional increased flows from WCA 3A to ENP based on a system-wide balance given consideration of hydrologic stage conditions in both areas, and no significant changes to hydroperiods or depths within ENP were observed with the SRQ1 simulation. As the hydroperiod comparison maps provided in **Figure 4-34**, **Figure 4-35**, and **Figure 4-36** indicate, hydrologic conditions in NESRS under ALTQ+ are expected to be very similar to ALTQ with no significant change.

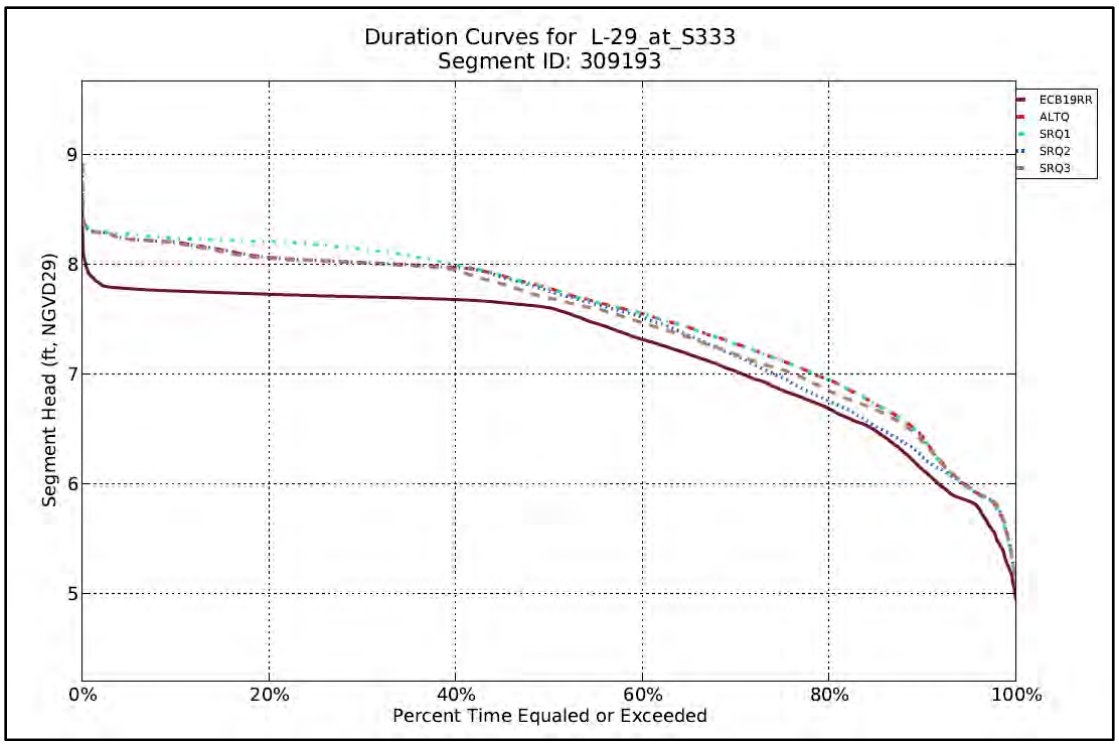

Figure 4-47. Canal stage duration curves for L-29 canal at S-333 for the sensitivity runs SRQ1, SRQ2, and SRQ3 against ALTQ, ECB19RR.

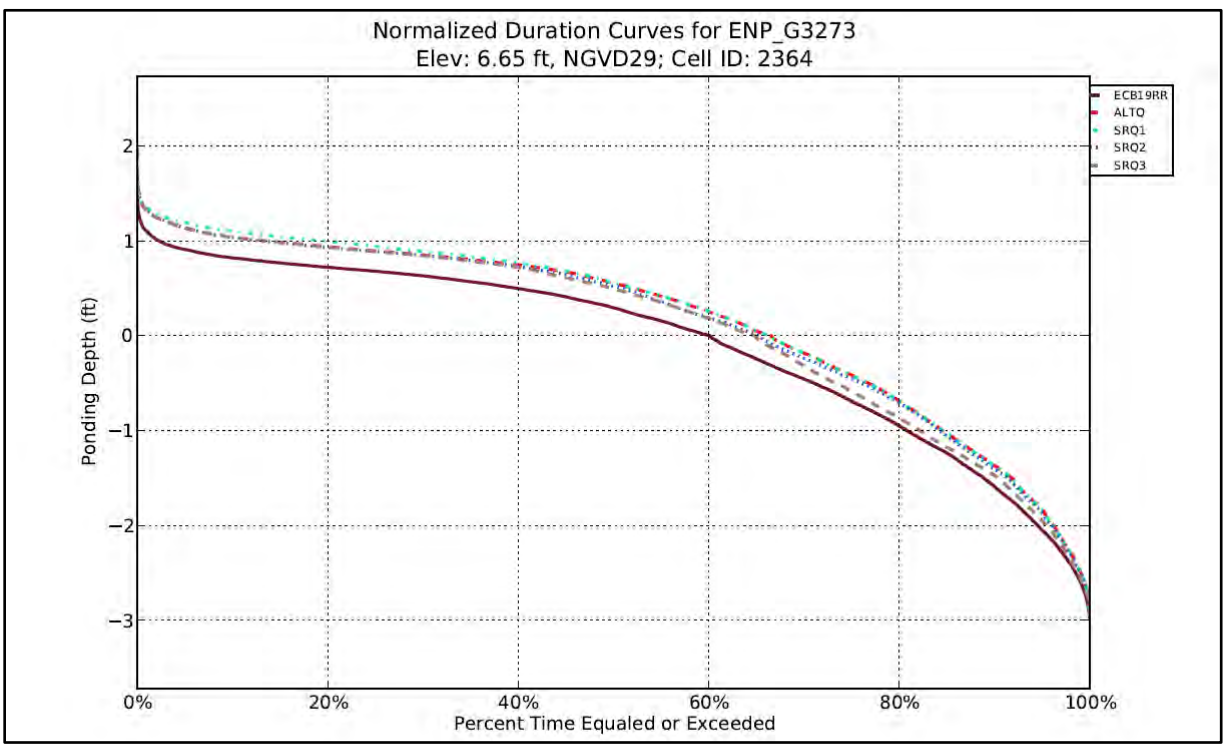

Figure 4-48. Depth duration curves for Gauge ENP_G3273 for the sensitivity runs SRQ1, SRQ2, and SRQ3 against ALTQ, ECB19RR.

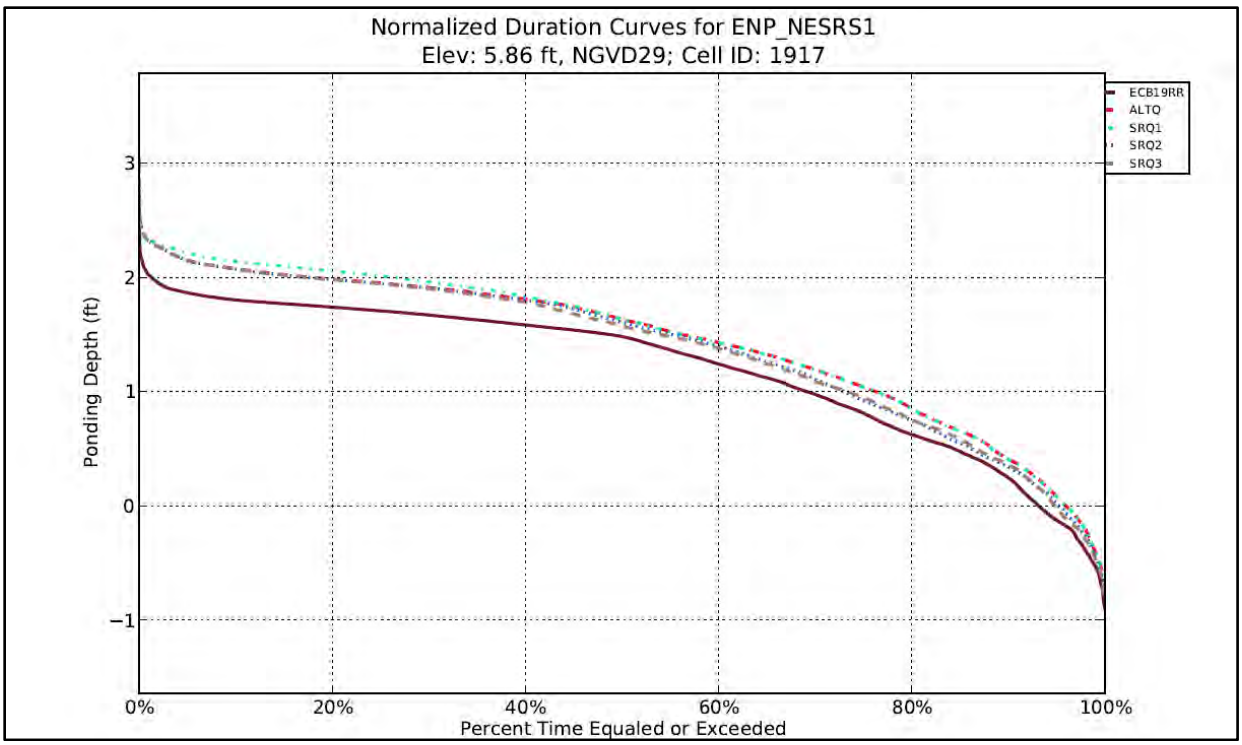

Figure 4-49. Depth duration curves for Gauge ENP_NESRS1 for the sensitivity runs SRQ1, SRQ2, and SRQ3 against ALTQ, ECB19RR.

4.2.5.4 Taylor Slough

Hydrologic conditions very similar to ALTQ with minor improvement are expected under ALTQ+. The main difference between ALTQ and ALTQ+, expected to effect the Taylor Slough is the removal of seasonal pumping capacity restriction for S-332D during the month of December. The removal of restrictions for month of December was not explicitly modeled. However, the results for SRQ4, which included removal of seasonal restrictions for S-332D, indicated average December flow rates of 217.7 cfs, which is approximately 10% higher than the simulated average December flow rates for ALTQ, 197.8 cfs. The average monthly flow rate through S-332D is 132.4 cfs for ECB19RR. Therefore, the hydrologic conditions in Taylor Slough under ALTQ+ are expected to experience a slight improvement relative to ECB19RR conditions.

The 1996 Master WCM will be replaced by the COP System Operating Manual. The monthly distribution of deliveries to Taylor Sough via S-332D (the SFWMD C-111 Spreader Canal Flows via G-737 is not included in the table) under ALTQ and ECB19RR scenarios are compared against the minimum monthly deliveries specified in 1996 Master WCM in **Table 4-4**. More information on the minimum deliveries is provided in Section 1.3.10.1. Despite the considerable increases in total deliveries under both ALTQ and ECB19RR, it is possible that, under very dry conditions, monthly deliveries will be lower than what is indicated in 1996 WCM. The monthly deliveries for 1971, the calendar year with the lowest total deliveries to Taylor Slough, are provided in **Table 4-4**. Two out of 41 years of simulated years are expected to deliver below 36,940 acre-feet total yearly volume for ALTQ, versus five out of 41 years for ECB19RR.

Table 4-4. Monthly deliveries to Taylor Slough.

Month	1996 Master WCM (Table 7-3) (acre-feet)	ALTQ Average of 41 years (acre-feet)	ECB19RR Average of 41 years (acre-feet)	ALTQ 1971 (Min Yearly Total) (acre-feet)	ECB19RR 1971 (Min Yearly Total) (acre-feet)
Jan	740	9,517	6,415	0	0
Feb	370	5,248	4,975	0	0
Mar	185	3,705	4,429	0	0
Apr	185	2,362	3,226	0	0
May	370	3,373	3,881	0	0
Jun	6,600	8,274	9,904	2,700	1,016
Jul	7,400	9,439	12,670	2,653	112
Aug	2,960	19,098	14,068	549	0
Sep	5,920	20,779	15,345	10,662	7,377
Oct	7,770	21,360	15,893	4,671	3,308
Nov	3,700	16,755	12,462	5,962	6,992
Dec	740	12,160	8,137	0	0
Total	36,940	132,070	111,406	27,196	18,805

4.2.5.5 Florida Bay

The 1996 Master WCM will be replaced by the COP System Operating Manual. More information on the minimum deliveries is provided in Section 1.3.10.1. The monthly distribution of deliveries to the Eastern Panhandle toward Florida Bay through S18C under ALTQ and ECB19RR scenarios are compared against the minimum monthly deliveries specified in 1996 Master WCM in **Table 4-5**. The monthly deliveries for 1971, the calendar year with the lowest total deliveries to Florida Bay is also provided in the table. Even for this driest year, the total annual deliveries to the Florida Bay far exceeds 18,000 acre-feet indicated in 1996 Master WCM. Despite the considerable increases in annual deliveries for both ALTQ and ECB19RR, monthly deliveries under very dry conditions may be lower than what is indicated in 1996 WCM. Deliveries through the S-197 structure is expected to be very similar to deliveries under ALTQ. Additional discussion on S-197 discharges can be found in **Section 4.6.4**.

Table 4-5. Minimum monthly deliveries to Eastern Panhandle toward Florida Bay at S-18C.

Month	1996 Master WCM (Table 7-4) (acre-feet)	ALTQ Average of 41 years (acre-feet)	ECB19RR Average of 41 years (acre-feet)	ALTQ 1971 (Min Yearly Total) (acre-feet)	ECB19RR 1971 (Min Yearly Total) (acre-feet)
Jan	1,540	5,427	4,888	1,553	1,980
Feb	630	3,669	4,807	2,100	2,268
Mar	290	2,883	5,404	4,057	4,228
Apr	110	2,763	5,474	908	1,188
May	110	5,352	6,872	3,469	3,451
Jun	340	22,714	23,662	3,298	2,846
Jul	510	16,866	19,401	2,953	2,566

Month	1996 Master WCM (Table 7-4) (acre-feet)	ALTQ Average of 41 years (acre-feet)	ECB19RR Average of 41 years (acre-feet)	ALTQ 1971 (Min Yearly Total) (acre-feet)	ECB19RR 1971 (Min Yearly Total) (acre-feet)
Aug	860	15,816	16,524	898	898
Sep	2,690	21,469	21,489	8,856	9,146
Oct	4,630	22,402	22,666	6,208	5,764
Nov	4,060	10,570	10,584	6,286	6,159
Dec	2,230	5,849	5,429	2,201	2,201
Total	18,000	135,781	147,199	42,788	42,694

4.3 Geology and Soils

The proposed action consists of an operational change to current water management operations and would not include construction of permanent structures or modifications to existing water management features. Geologic impacts resulting from removal of surface cover (vegetation and soil) or removal of cap rock from blasting due to construction would not occur under continued implementation of ECB19RR nor under implementation of ALTN2, ALTO, ALTQ, or ALTQ+.

ALTN2, ALTO, and ALTQ increased overland flow, water depths and resulting hydroperiods in portions of ENP, including NESRS and Taylor Slough, having the potential for minor to moderate long-term beneficial effects on soils. Reference **Section 4.2** (**Hydrology**). Existing canal and levee systems within the study area chronically affect current water patterns. If water levels decrease far enough below ground to dry out the surface of organic soils, peat or muck fires, can occur. Suppressing fires during extremely dry conditions is essential for protecting organic soils. Two performance measures (inundation duration and cumulative drought intensity (i.e. soil oxidation)) were used to evaluate the risk of soil oxidation across WCA 3 and ENP. Inundation duration is the percent period of time water levels are above ground surface over the modeled period of record (1965-2005). Cumulative drought intensity is the sum of the daily depth of stage below ground (negative ponded depth) across the modeled period of record (1965-2005).

Figure 4-50 depicts the difference in inundation duration over the period of record for each of the COP alternatives relative to ECB19RR. Values greater than zero on the horizontal axis indicate increased inundation duration relative to ECB19RR. Values less than zero indicate decreased inundation duration relative to ECB19RR. The percent period of record (PPOR) of inundation for ECB19RR, ALTN2, ALTO, and ALTQ for each indicator region (IR) are reported in **Appendix E.1** (**Ecological Evaluation of Round 1, Round 2, and Round 3 Alternatives**), **Table E.1-11**. Reference **Appendix E.1** (**Ecological Evaluation of Round 1, Round 2, and Round 3 Alternatives**), **Figure E.1-1** for the location of each IR. ALTN2, ALTO, and ALTQ increased inundation duration at all IRs south of Tamiami Trail (IRs in NESRS (IR129, IR130, IR131, and IR132) and in Taylor Slough (IR133N and IR133S)) relative to ECB19RR. ALTN2 and ALTO increased inundation duration to a greater extent than ALTQ at IR130, IR131, and IR132 except at IR129 where performance among the alternatives was similar. ALTO and ALTQ increased inundation duration to a greater extent than ALTN2 at IR133N and IR133S in Taylor Slough. The target (i.e. Natural Systems Model (NSM)) was not met under each of the COP alternatives in ENP; however significant improvement toward the target was observed (**Appendix E.1** (**Ecological Evaluation of Round 1, Round 2, and Round 3 Alternatives**), **Figure E.1-24**).

ALTN2, ALTO, and ALTQ decreased inundation duration at IRs in WCA 3A and WCA 3B relative to ECB19RR. The greatest magnitude of increase was observed in WCA 3A at IR118, IR119, and IR123. IR118 and IR119 are located east of the Miami canal and north of WCA 3B in WCA 3A. IR123 is located west of the Miami canal in central to southern WCA 3A. Decreases in inundation duration were also observed in WCA 3B at IR124, IR125, and IR126. Observed differences between each alternative at any given location ranged from +/- 5 PPOR of inundation (1% of the period of record equates to ~ 150 days). ALTN2 decreased inundation to the greatest extent relative to ALTO and ALTQ.

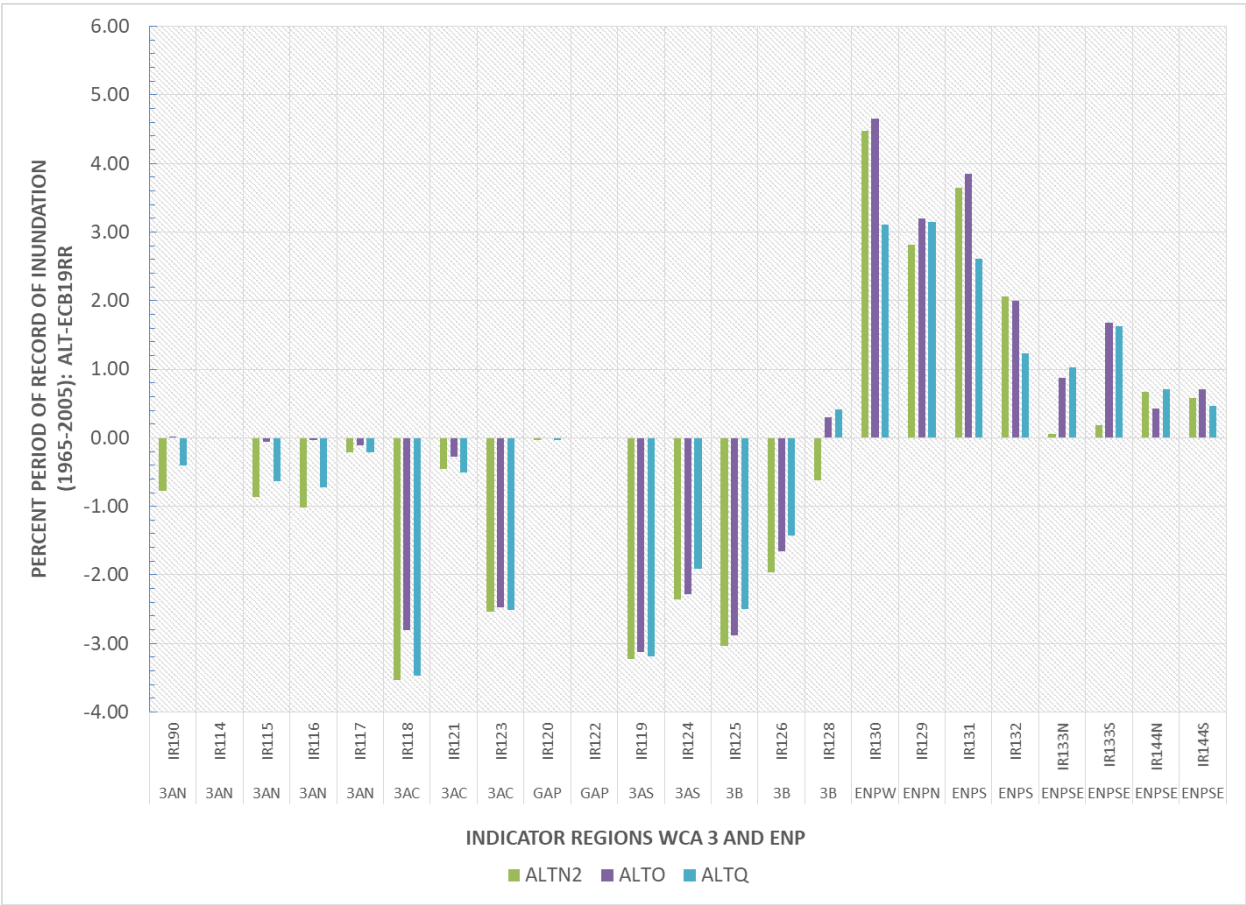

Figure 4-50.Difference in inundation duration (percent period of record in which water depth is above land surface elevation) for each of the COP alternatives relative to ECB19RR.

Figure 4-51 displays cumulative drought intensity over the period of record (1965-2005) for each alternative relative to ECB19RR. Values greater than zero on the horizontal axis indicate increased risk for soil oxidation relative to ECB19RR. Values less than zero indicate decreased risk. The number of foot-days below ground for ECB19RR, ALTN2, ALTO, and ALTQ for each IR are reported in **Appendix E.1** (**Ecological Evaluation of Round 1, Round 2, and Round 3 Alternatives**), **Table E.1-12**. Reference **Appendix E.1** (**Ecological Evaluation of Round 1, Round 2, and Round 3 Alternatives**), **Figure E.1-1** for the location of each IR.

ALTN2, ALTO, and ALTQ decreased drought intensity at IRs in NESRS (IR129, IR130, IR131, and IR132) and in Taylor Slough (IR133N and IR133S) relative to ECB19RR. ALTO and ALTQ decreased drought intensity to a greater extent than ALTN2 at IR129; however at IR131 and IR132 in central SRS, both ALTN2 and ALTO

decreased drought intensity to a slightly greater extent than ALTQ. In Taylor Slough, ALTO and ALTQ decreased drought intensity to a greater extent than ALTN2. The target (NSM) was not met under each of the COP alternatives in ENP; however significant improvement toward the target was observed (**Appendix E.1** (**Ecological Evaluation of Round 1, Round 2, and Round 3 Alternatives**)**, Figure E.1.-29**). ALTN2, ALTO, and ALTQ increased drought intensity at IRs in WCA 3A and WCA 3B relative to ECB19RR. The greatest magnitude of increase was observed in WCA 3A at IR118, IR119 and IR123. Increased drought intensity was also observed in WCA 3B at IR124, IR125, and IR126.

To evaluate the significance of observed changes in cumulative drought intensity, an approximate 1247 foot-days threshold can be used to discern whether an IR is likely to support a peat accumulation marsh. The 1247 foot-days threshold is indicative of a marsh that is hydrated 11 of 12 months on average over a 41-year period (which corresponds to 14,974 days; 1247 foot-days is 1/12 of 14,974). In ECB19RR, 15 of the 24 IRs demonstrated scores consistent with peat accumulation, and in ALTQ, 17 of the 24 IRs demonstrated scores consistent with peat accumulation. Additionally, 3 of the IRs under ALTQ that were not observed to demonstrate peat accumulation, were observed to show clear improvement in the direction of a peat accumulating condition. Two IRs under ALTQ showed negligible increased risk of not accumulating peat soils (less than 45 foot-days of change – IR115 and IR116), and 2 IRs showed notable deterioration in their capacity to accumulate peat soils (IR118 and IR140 show 210 – 328 foot-days of additional risk). ALTN2 and ALTO demonstrated consistent results as ALTQ. The relative differences in performance among the alternatives are depicted in **Figure 4-51**. Taken together, the simulated outcomes clearly indicate that ALTQ delivered an enhanced condition for soils across WCA 3 and ENP.

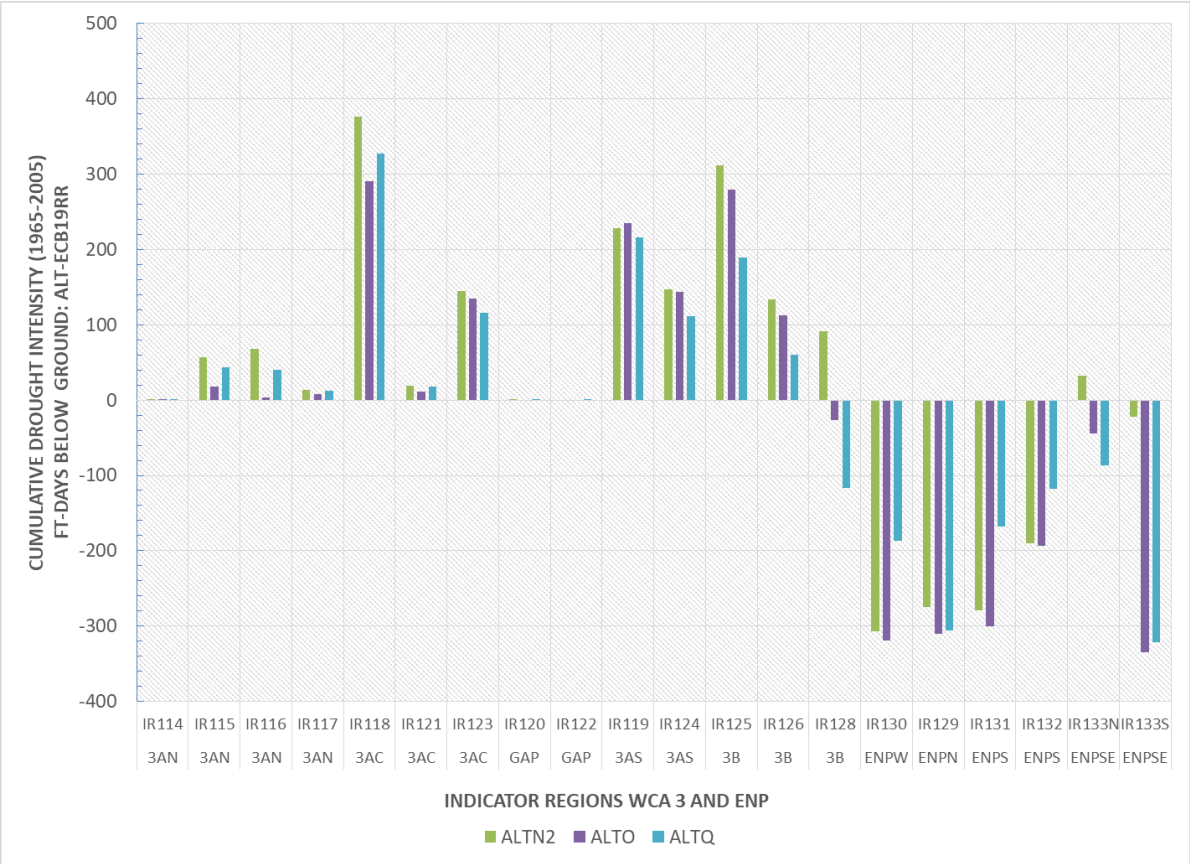

Figure 4-51. Difference in cumulative drought intensity (water depth relative to land surface elevation foot days below ground) for each of the COP alternatives relative to ECB19RR.

ALTQ+ would result in similar effects as discussed under ALTQ for each of the performance measures described above. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages. ALTQ+ includes potential implementation of the TTFF Field Test. The TTFF Field Test (referenced **Section 4** (**Environmental Effects**) is designed in such a manner that the test can be implemented without introducing additional risks to peat soils in WCA3 A (beyond conditions observed in ALTQ+) and is expected to deliver more water to ENP to support reduction of soil risks in ENP.

The TTFF Field Test is a short event based operation in which constraints were developed to ensure that potential environmental effects to WCA 3 and ENP did not exceed that which was simulated under ALTO and ALTQ. The TTFF Field Test was developed based on the differences in modeled performance for Central SRS between ALTO and ALTQ in response to stakeholder concerns regarding the timing of flow to NESRS during a transition from the wet season to the dry season. Reference **Section 4.2** (**Hydrology**) for further information on the TTFF.

When the criteria for the TTFF Field Test have been met, the TTFF Field Test would allow the general flexibility to increase the TTFF prescribed deliveries up to 400 cfs above the TTFF recommended flows for significant portions of the period, and also allow the introduction of nonlinearities in lowest flow conditions (sometimes lower flows than suggested by the TTFF – during the driest of conditions,

sometimes tripling-quadrupling very low - 25-100 cfs flows – perhaps during the early onset of the wet season). Review of representative years from the modeling indicates that the TTFF Field Test would increase expected deliveries to NESRS by 32,000 – 80,000 acre-feet over the entire November-May period above the level of delivery by the TTFF identified in ALTQ (which delivered 75,000 acre-feet in 1973-74, 50,000 acre-feet in 1989-90, and 180,000 acre-feet in 1990-91 respectively during the November 1 – May 30 period). These additional deliveries to ENP and Central SRS correspond to the differences in deliveries observed in ALTO and ALTQ during these three specific years. The anticipated effect of the TTFF Field Test may result in negligible to minor effects in WCA 3A, in addition to negligible to minor beneficial effects in the SRS portion of ENP. A comparison between ALTO and ALTQ indicates that the maximum stage differences were in WCA 3A by 0.1-0.5 feet over roughly 35% of WCA 3A. Stage level reductions of no more than 0.3-0.5 feet would potentially occur within the first 0.5 miles upstream of the L-29 canal, 2-4 miles upstream of the L-67 canal, while 0.1-0.3 foot stage reductions would potentially occur 0.5-3 miles upstream of the L-29 canal and 4-10 miles upstream of the L-67 canal respectively. Due to the protective limitations (test is halted based on WCA 3A low-water conditions as prescribed in the COP AMMP for Uncertainty #12b), low volume releases (limited to 400 cfs above the weekly TTFF target) and infrequent anticipated frequency of the onset triggers for the TTFF Field Test, minor to moderate stage effects to southern WCA 3A of 0.2-0.5 may be realized during the 6-8 week increments and subsequent dry season months after a Field Test event, with conditions expected to reset prior to the following dry season.

In summary, increases in inundation duration in NESRS and Taylor Slough, may enable the promotion of peat accretion by potentially reducing soil oxidation. ALTN2, ALTO, ALTQ, and ALTQ+ may have negligible to minor long-term beneficial effects on soils in ENP by decreasing cumulative drought intensity. A potential decrease in dry event severity relative to ECB19RR, is expected to result in reduced fire incidence; however it should be recognized, that the frequency of fires within the study area are primarily influenced by weather patterns combined with human-caused ignition sources during extreme dry conditions. Observed differences in inundation duration between each alternative at any given location ranged from +/- 5 PPOR of inundation. ALTN2, ALTO, ALTQ and ALTQ+ may have negligible to minor long-term adverse effects on soils in WCA 3A and WCA 3B due to the potential for increased drought intensity.

Reference **Appendix E.1**, **Figure E.1-25** and **Figure E.1-26** for additional information on another performance measure used to further evaluate the number and duration of dry events in NESRS. Each action alternative generally decreased the number and average duration of dry events in NESRS relative to ECB19RR.

4.4 Study Area Land Use

The primary use of land in the study area will continue to be agriculture and residential/commercial. ALTN2, ALTO, ALTQ, and ALTQ+ are not anticipated to change the way in which the land is used in the future.

4.5 Water Supply

The majority of water supply demands for existing legal users in the South Dade area is met with groundwater from the Biscayne aquifer. The top of the Biscayne aquifer in this area is at land surface and is directly recharged by rainfall and seepage from ENP to the west. The modeling tool used for this operational plan (RSM-GL) is primarily a surface water model and does not provide water levels (stages) below the shallow water table. Because recharge to the Biscayne aquifer is directly affected by canal stages during the dry season, changes in canal stages can be used to predict impacts to the underlying

Biscayne aquifer as a result of the modeled alternatives. A prolonged reduction in canal stages will affect groundwater levels, which could result in movement of saline water into the Biscayne aquifer, causing harmful impacts to water supply well fields during drought conditions. Maintaining canal stage elevations for water supply and prevention of saline water intrusion are essential purposes of the C&SF Project that the COP must meet. A water supply analysis of several simulated alternatives was performed, which identified the potential risk of impacts to water supply and increased saline water intrusion.

Water supply performance was quantified for ENP and the C-111 Canal South Dade Projects for ALTN2, ALTO, ALTQ, and ALTQ+ compared to ECB19RR based on RSM-GL modeling. The period of simulation (1965 to 2005) used for the hydrologic modeling encompassed a wide range of historical climatologic and meteorological conditions that are representative of South Florida hydrology. This 40-year analysis period includes several moderately wet and moderately dry periods as well as less frequent and potentially more impactful periods of extreme high rainfall and extreme drought conditions. Analysis of the model results indicated that only ALTQ and Q+ maintain the pre-project levels of service for water supply, consistent with the requirements of the WRDA 2000 and Section 373.1501, F.S. Pursuant to Subsection 373.1501(5)(d), F.S, the District is required to "…provide reasonable assurances that the quantity of water available to existing legal users shall not be diminished by implementation of project components so as to adversely impact existing legal users…".

4.5.1 Water Supply Analysis

Shallow water table stages predicted by the RSM-GL model were analyzed to determine if water supply would be affected by the alternatives. Canal stage duration curves derived from the modeled alternatives were examined to determine if prolonged reductions in canal stages would affect saline water intrusion or water supply.

Model results indicated that canal stage elevations would fall below the maintenance stage elevations sooner and for an increased duration (increase in number of days, not events) under ALTN2 and ALTO compared to ECB19RR. This occurred in the southern reaches of the study area, specifically the C-111 canal reaches between structures S-176 and S-177 and between structures S-177 and S-18C, as shown in the stage duration curves (**Figure 4-52** and **Figure 4-53**). Reference the area of concern as depicted by the circles in **Figure 4-52** and **Figure 4-53**. Prolonged reduction in canal stage elevations will affect groundwater levels, which could result in movement of saline water into the Biscayne aquifer, resulting in harmful impacts to water supply well fields (e.g., Florida Keys Aqueduct Authority) and other existing legal users during drier conditions. **Figure 4-54** compares water levels of the Florida Keys Aqueduct Authority's Biscayne aquifer groundwater monitor wells (G864 and FKS-9) to S-176 and S-177 canal stage elevations. As shown in **Figure 4-54**, groundwater levels correlate and respond quickly to canal stage elevation changes in this area. If saline water intrusion occurs in the Biscayne aquifer as a result of prolonged reductions in canal stage elevations below ECB19RR, many permitted users in the area and along the coastal margin would be adversely affected.

ALTQ used the modified WCA 3A floor reference location. Increased use of S-333 can cause a local drawdown at the S-333 Headwater location creating a "false" need for upstream water. A similar trend was identified and addressed for the CERP Central Everglades Project. To address this "false" need, the alternative incorporates the CEPP operational change which relies on a more remote upstream gauge at 3-69W in WCA 3A (approximately 11.5 miles north of S-333, along the L-67A Canal) to help indicate the need for Lake Okeechobee in-kind releases. CEPP identified the floor as falling below 7.5 feet NGVD at 3-69W, or falling below 7.0 feet NGVD at S-333 Headwater. ALTQ and ALTQ+ would have the same

frequency or ability to maintain stages as ECB19RR in the canals where saline water intrusion is a concern. Alternatives Q and Q+ include use of the C-111 and L-31N canals to convey water from WCA 3A to ENP. The C-111 and L-31N canals provide irrigation water supply to adjacent users in the South Dade area by recharging the aquifer. According to model results, ALTQ and ALTQ+ do not reduce water supply in these canals below ECB19RR (**Figure 4-52** and **Figure 4-53)**. Therefore, no impact to water supply is expected as a result of operations under these alternatives.

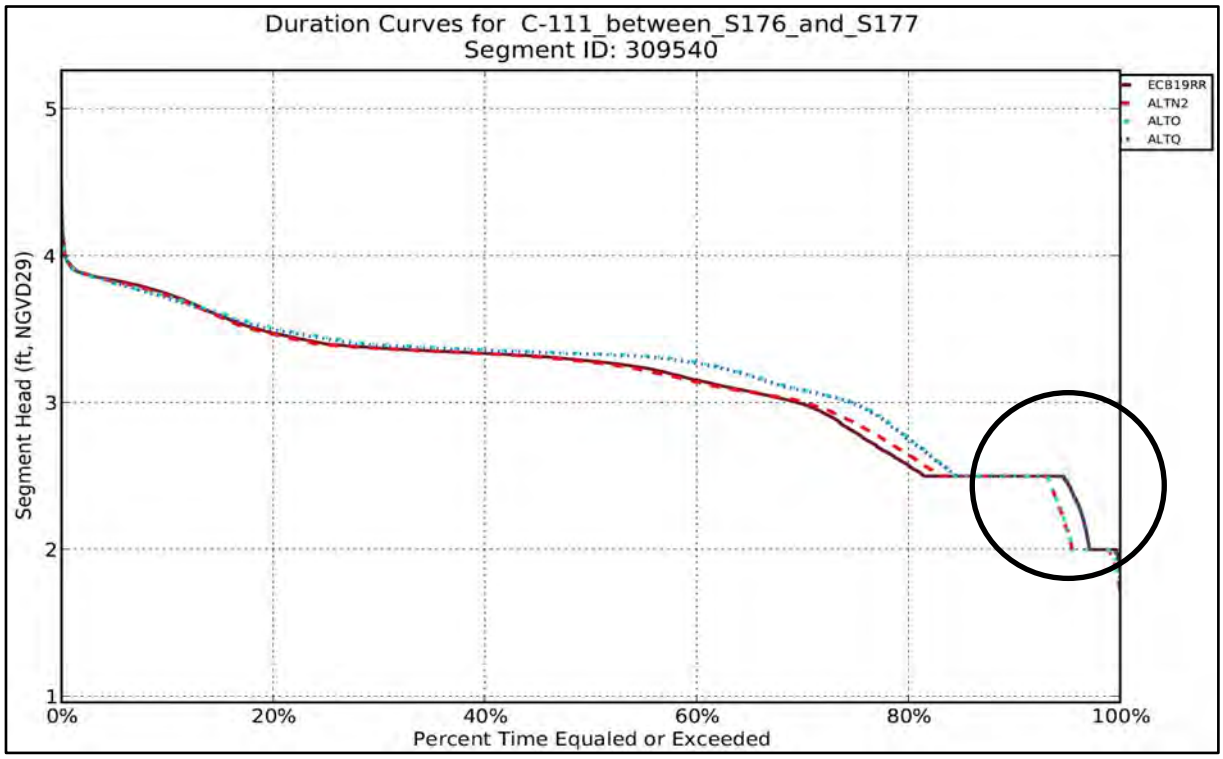

Figure 4-52. Stage duration curves between the S-176 and S-177 structures.

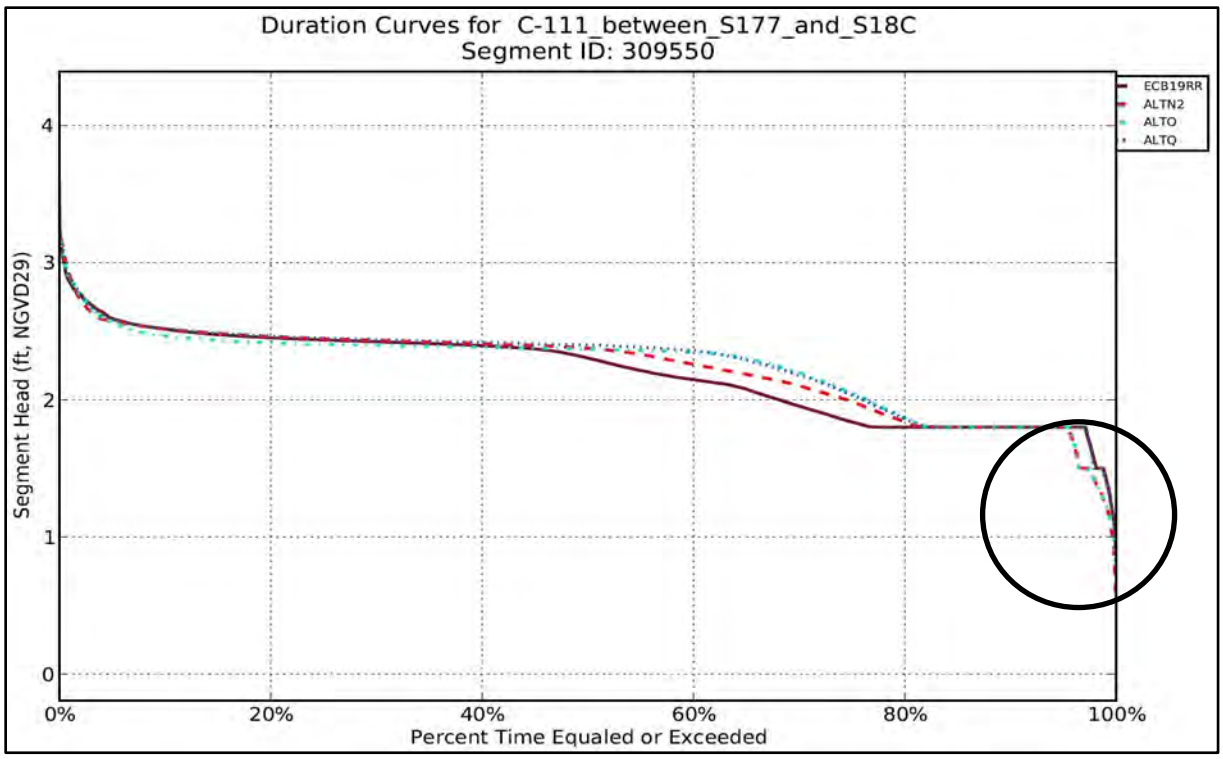

Figure 4-53. Stage duration curves between the S-177 and S-18C structures.

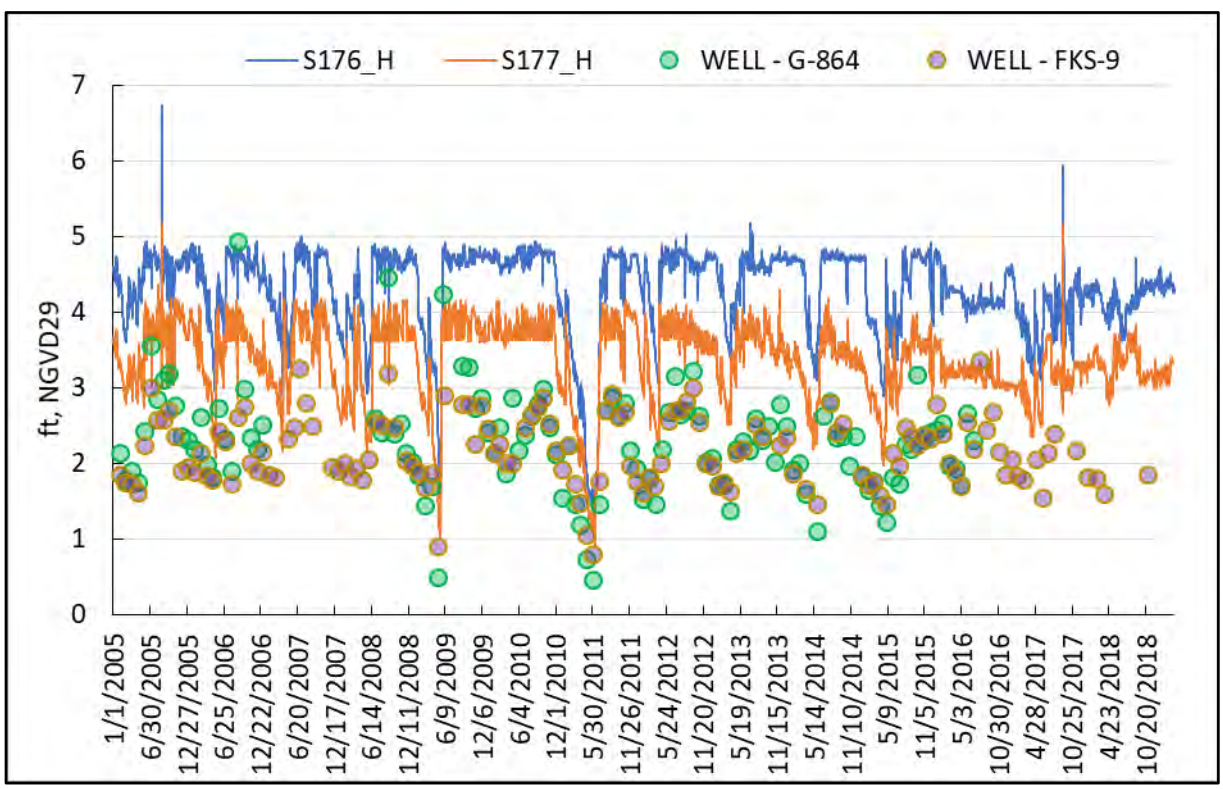

Figure 4-54. Biscayne aquifer levels versus canal levels.

Water supply for existing legal users in the vicinity of the L-33N and L-37 canals primarily is groundwater from the Biscayne aquifer. The Biscayne aquifer is hydraulically connected to the shallow water table and surface water; therefore, changes in canal stages have a direct effect on groundwater levels in the shallow portions of the Biscayne aquifer. Model results indicated water supply performance may be reduced in the L-33N and L-37 canals below ECB19RR (**Figure 4-55** and **Figure 4-56**). Stage duration curves indicate the degree the alternatives fall below ECB19RR was for a limited period of time and at a minimal difference (less than 0.5 feet NGVD); therefore, minimal impact to the nearest existing legal users is expected in this area. In addition, the saline water interface is more than 13 miles east of the canals. Based on analysis of the modeling results and this information, water supply availability and the saline water interface should not be adversely affected as a result of implementation of ALTN2, ALTO, ALTQ, and ALTQ+ in the L-33N and L-37 canals.

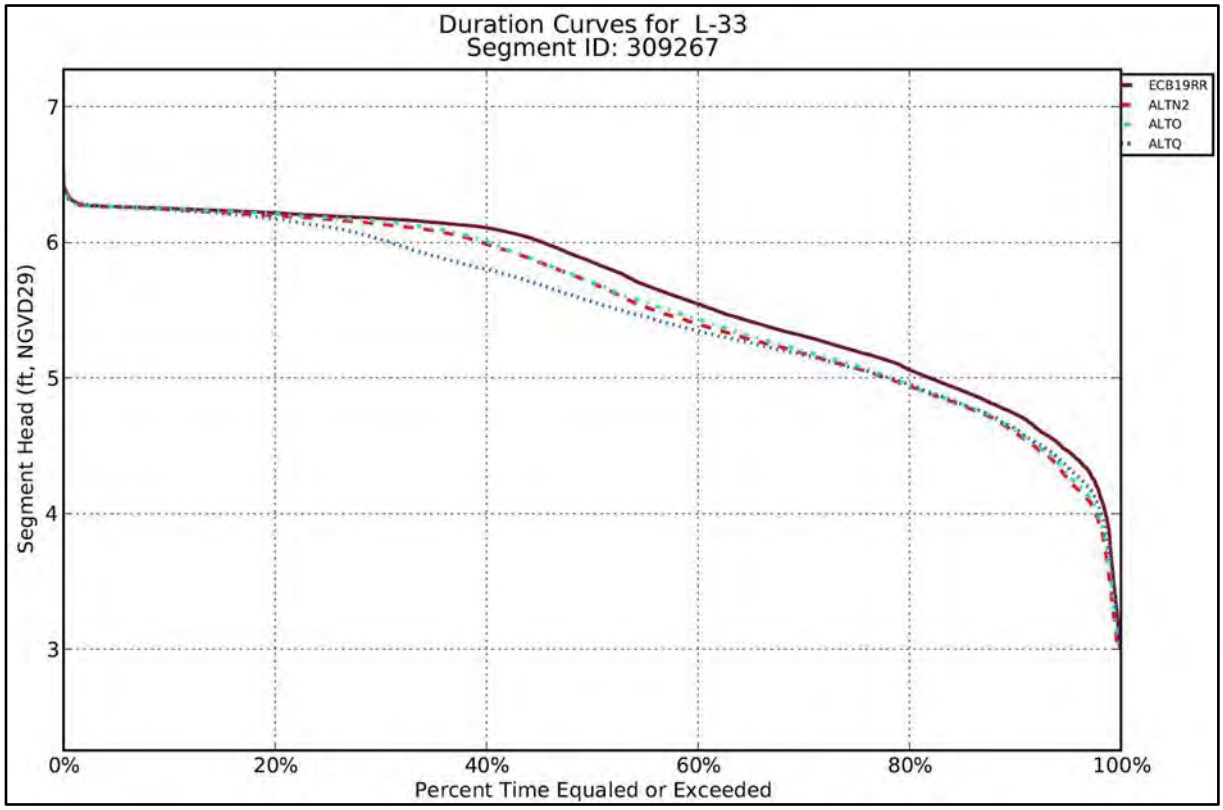

Figure 4-55. Stage duration curves for the L-33 canal.

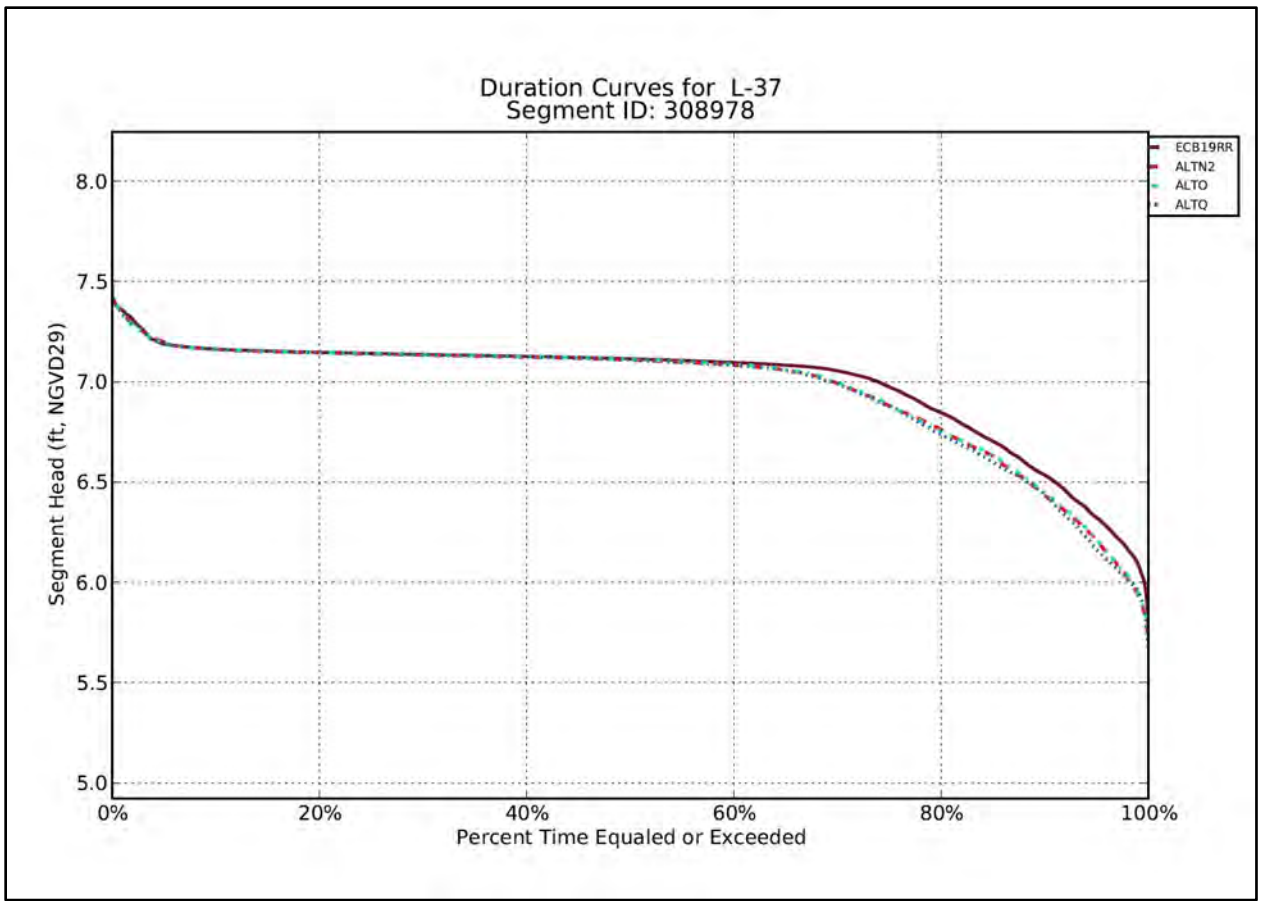

Figure 4-56. Stage duration curves for the L-37 canal.

4.5.1.1 Frequency of Water Supply Shortages

In the South Dade area, water supply demand primarily is met with groundwater from underlying aquifers. Aquifers are recharged and maintained by seepage from ENP and surface water deliveries from the C&SF regional system, including Lake Okeechobee and the WCAs. The ability to continue meeting urban and agricultural demands with the implementation of COP was evaluated by assessing relative changes in the frequency of water supply cutbacks in Lower East Coast Service Areas (LECSAs) 1, 2, and 3 (**Figure 4-61** through **Figure 4-60**. **Figure 4-57** depicts the location of LECSAs 1, 2, and 3 in the study area. Although the RSM-GL model predictions of the absolute number of water supply cutback events and the corresponding frequency of occurrence have a high degree of uncertainty, relative comparisons between ECB19RR and ALTN2, ALTO, ALTQ and ALTQ+, provide a meaningful comparison to quantify potential effects of project implementation as shown in **Figure 4-58** through **Figure 4-69** below. Water supply cutbacks to the LECSAs can be triggered by low stages in the regional system (e.g., Lake Okeechobee, WCAs) or local groundwater levels.

The total number of cutback events (water years with three or more consecutive months with restrictions) and the resulting frequency for LECSAs remains the same between ECB19RR and ALTN2, ALTO, ALTQ, and ALTQ+ at all events (18, 32, and 14 events at LECSAs 1, 2, and 3, respectively), indicating no change in water supply performance within the LECSAs and the relative insensitivity of this performance metric.

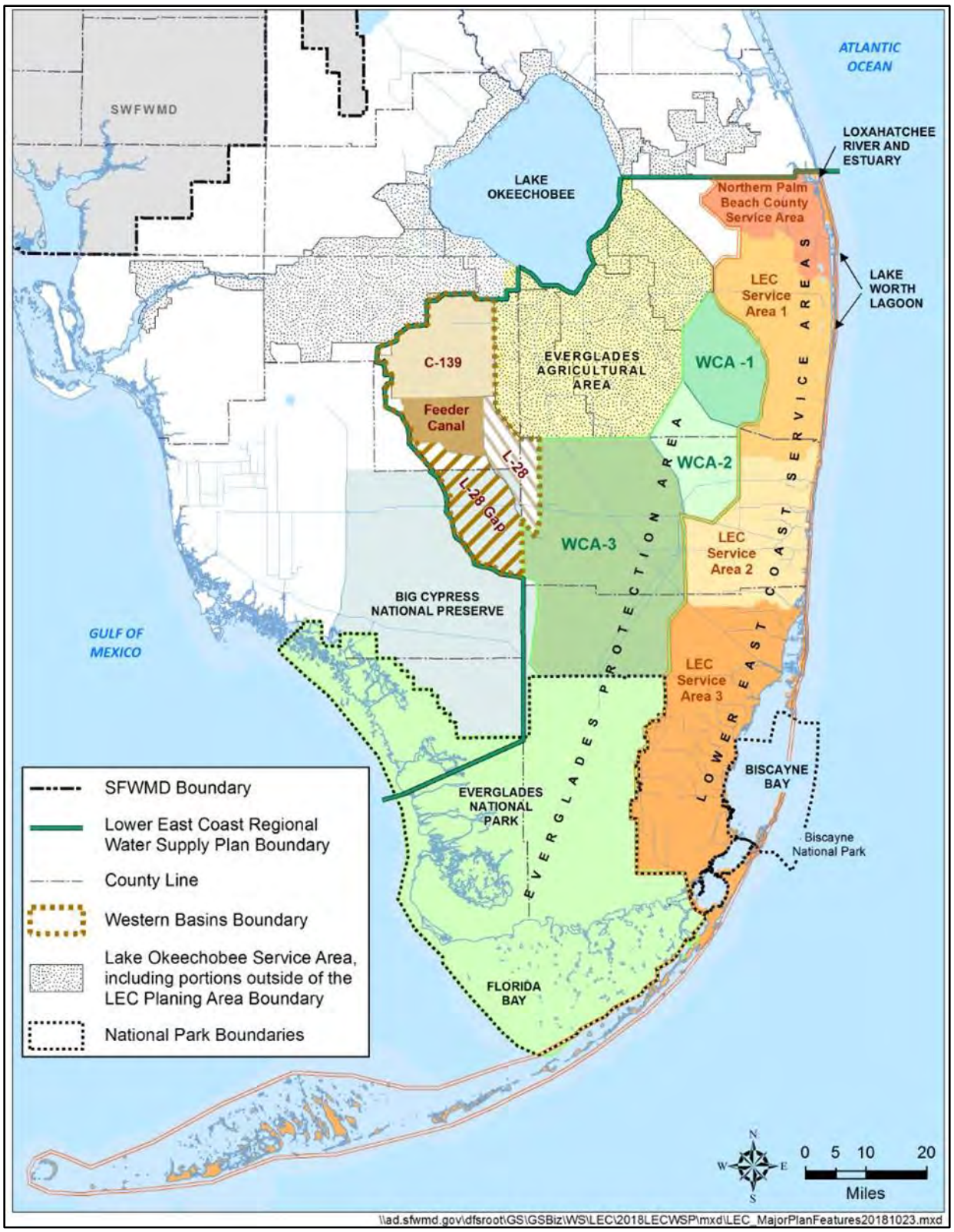

Figure 4-57. Location of LECSAs 1, 2, and 3.

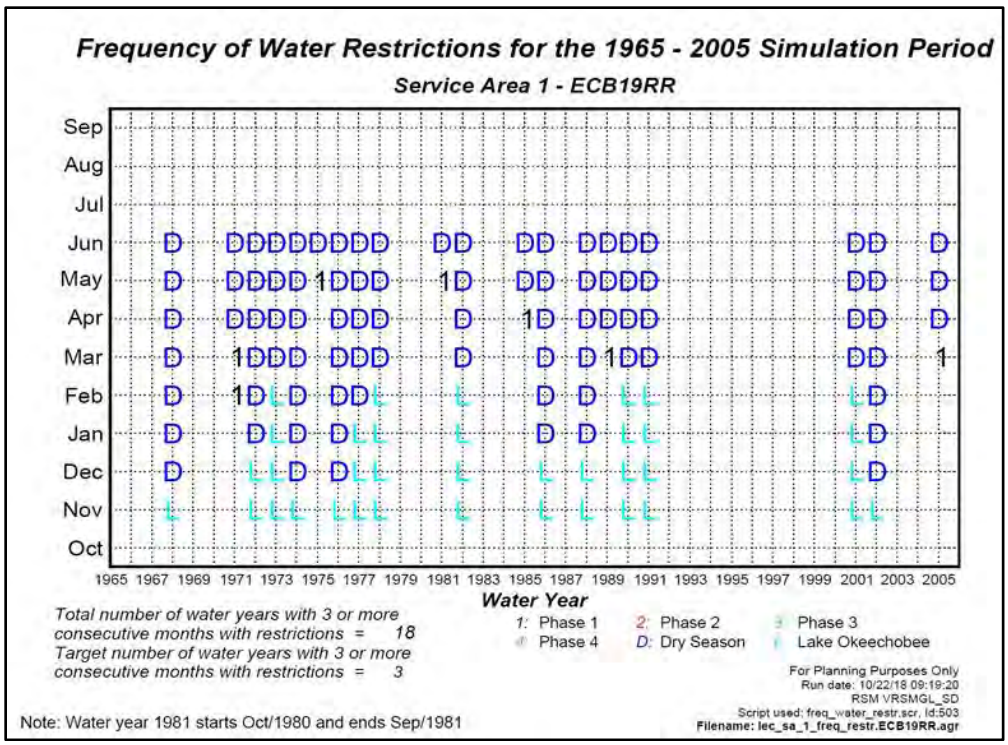

Figure 4-58. Frequency of water restrictions during the 1965-2005 simulation period for LECSA 1 under ECB19RR.

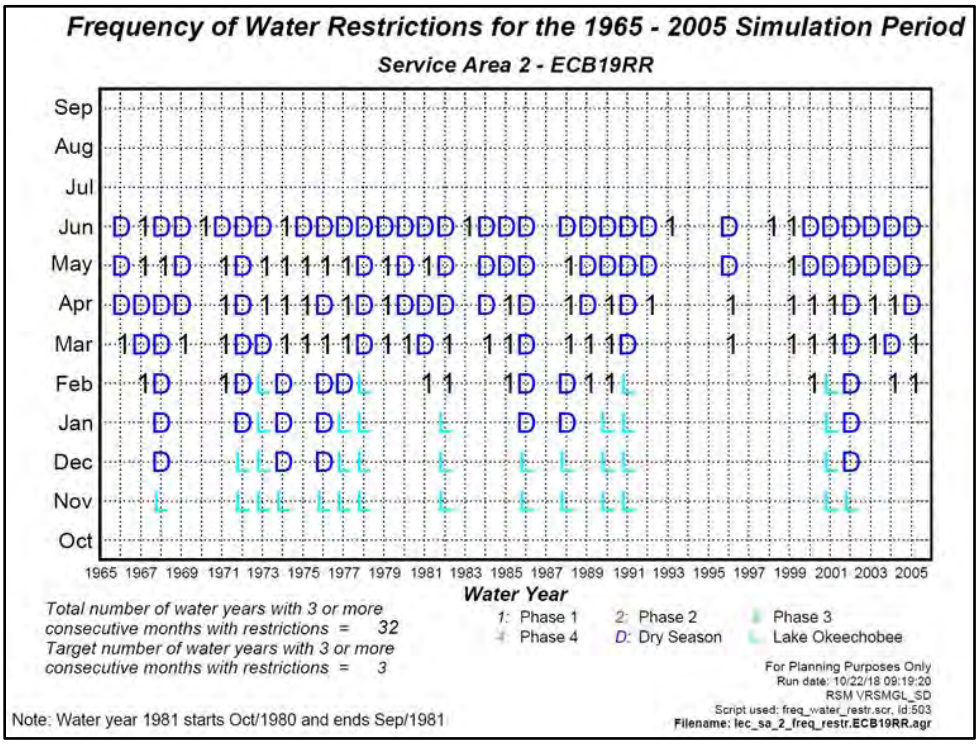

Figure 4-59. Frequency of water restrictions during the 1965-2005 simulation period for LECSA 2 under ECB19RR.

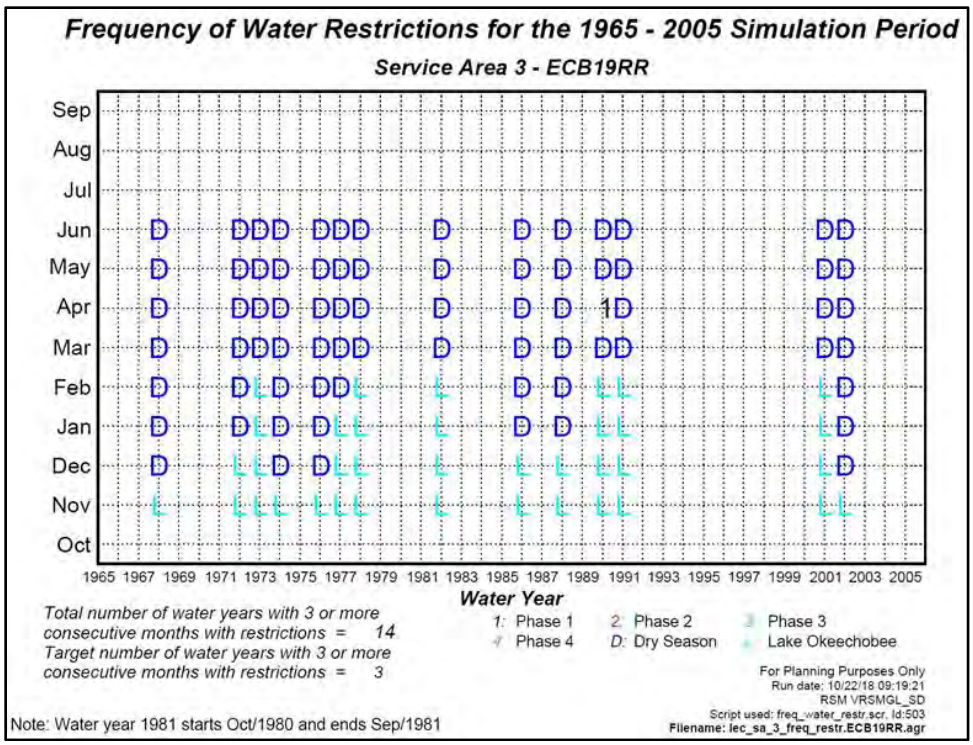

Figure 4-60. Frequency of water restrictions during the 1965-2005 simulation period for LECSA 3 under ECB19RR.

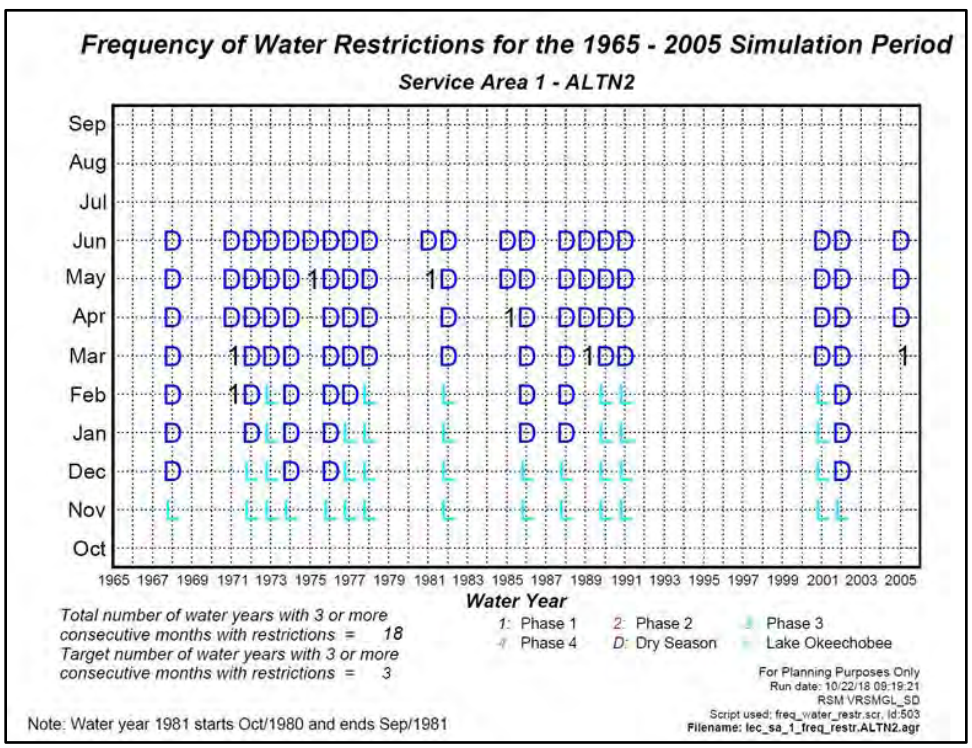

Figure 4-61. Frequency of water restrictions during the 1965-2005 simulation period for LECSA1 under ALTN2.

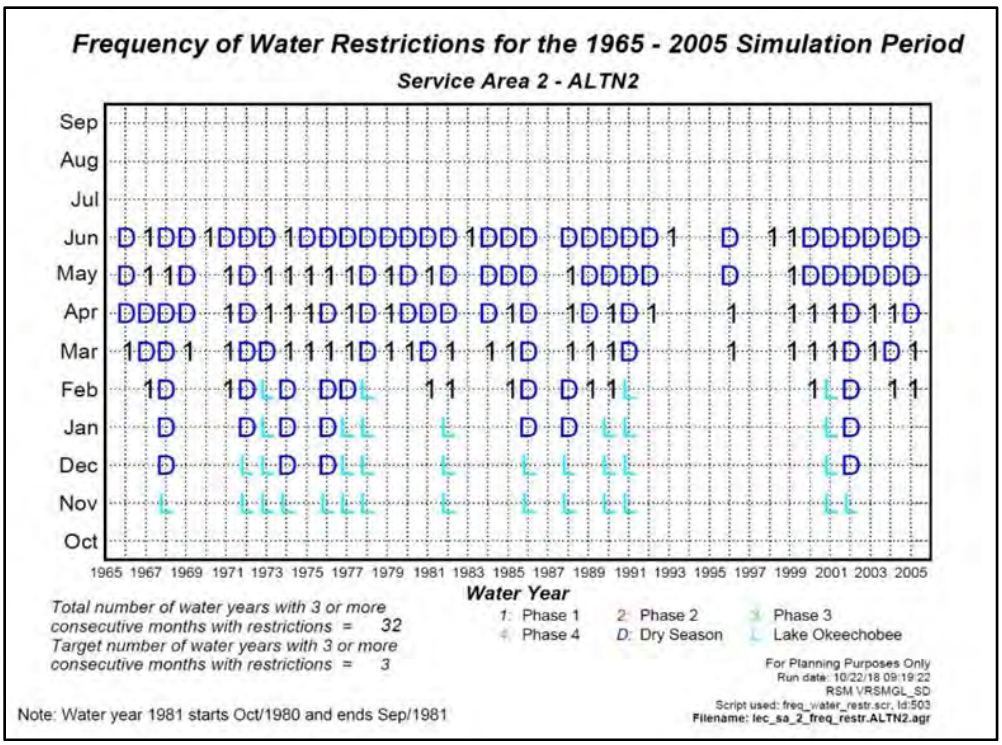

Figure 4-62. Frequency of water restrictions during the 1965-2005 simulation period for LECSA2 under ALTN2.

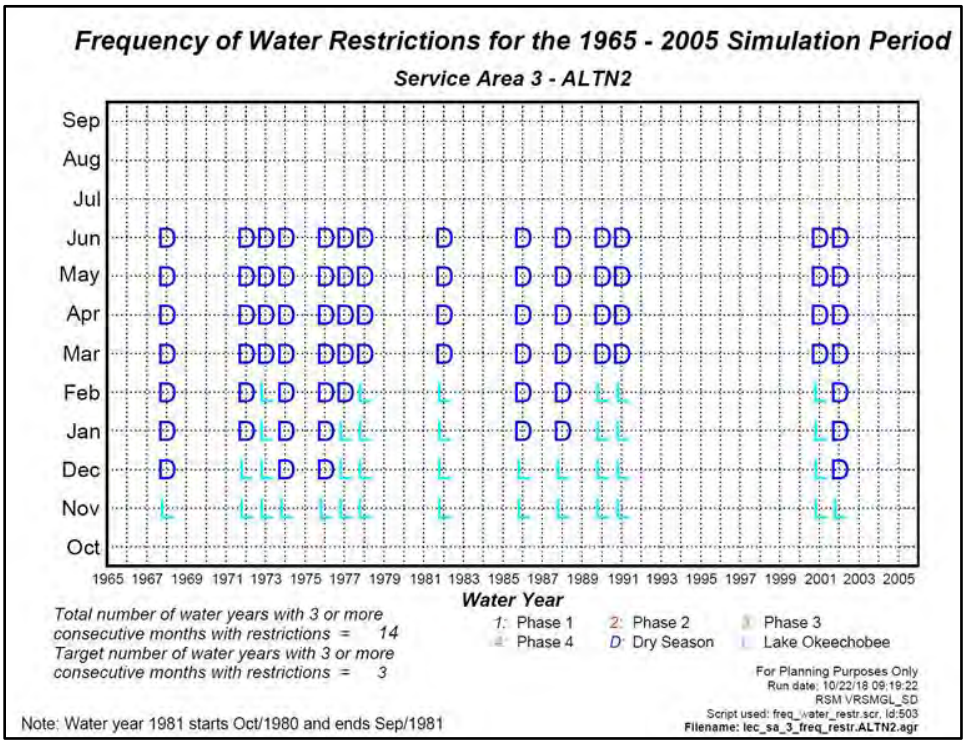

Figure 4-63. Frequency of water restrictions during the 1965-2005 simulation period for LECSA3 under ALTN2.

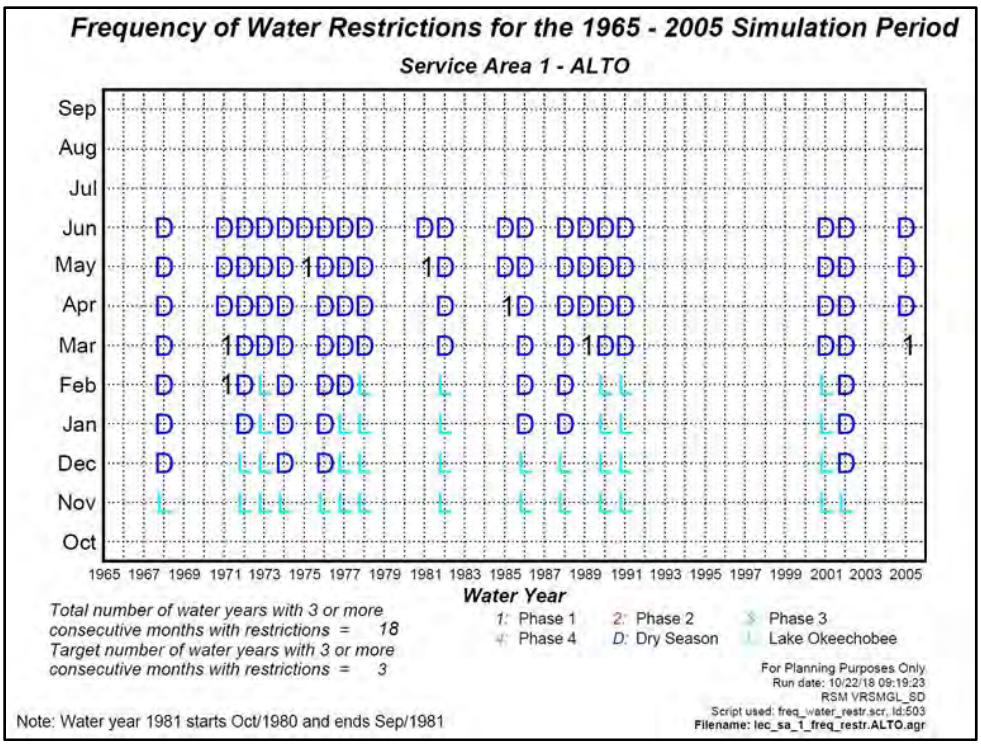

Figure 4-64. Frequency of water restrictions during the 1965-2005 simulation period for LECSA1 under ALTO.

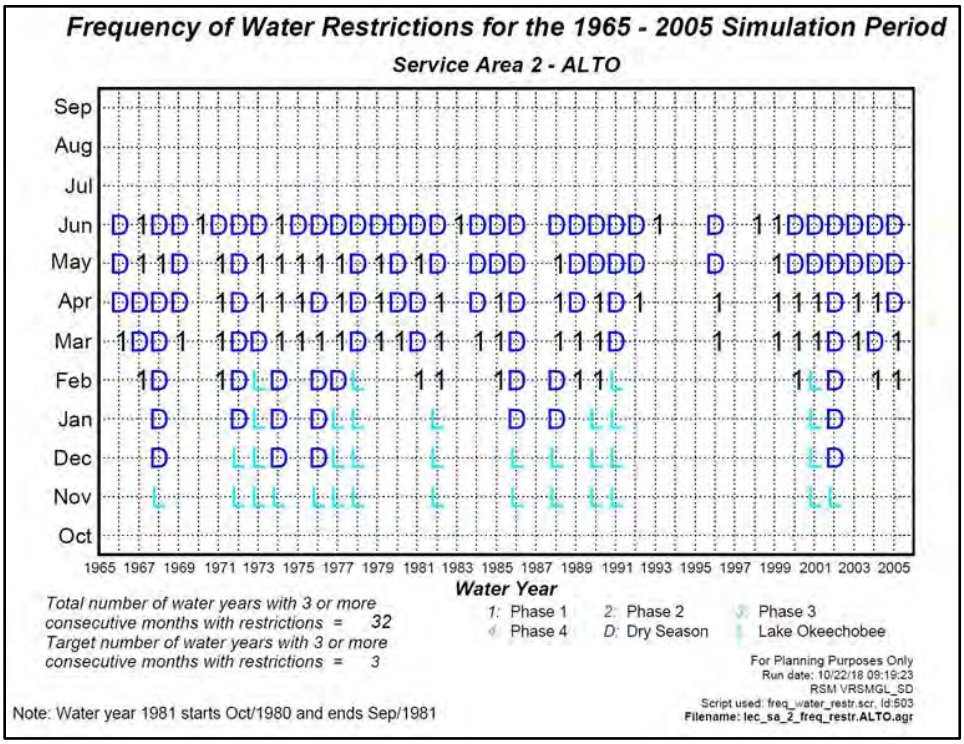

Figure 4-65. Frequency of water restrictions during the 1965-2005 simulation period for LECSA2 under ALTO.

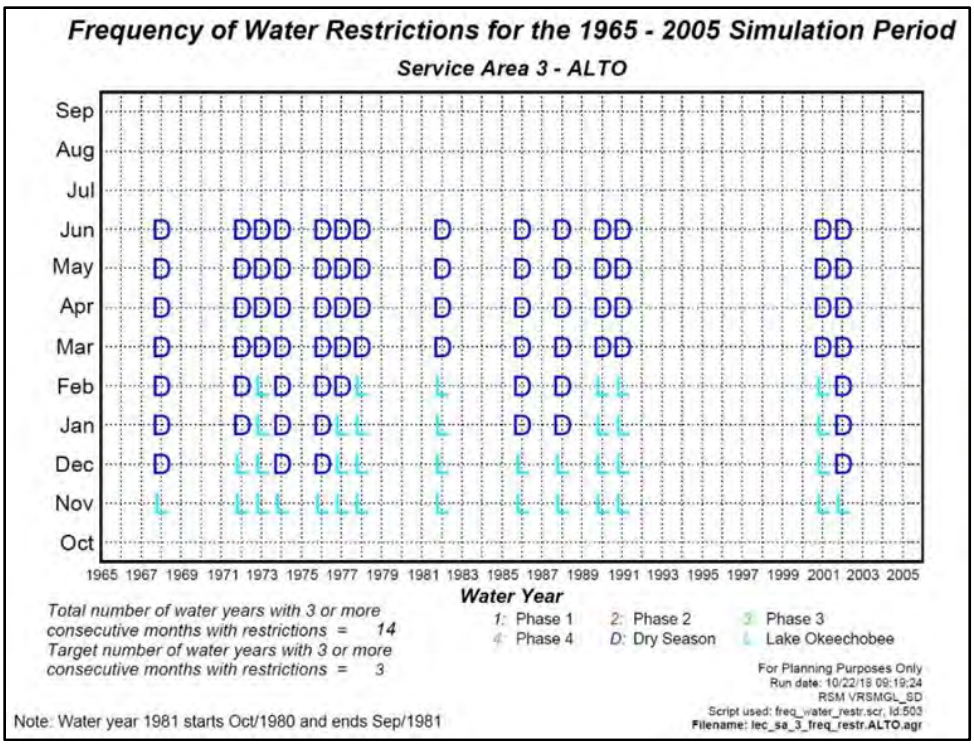

Figure 4-66. Frequency of water restrictions during the 1965-2005 simulation period for LECSA3 under ALTO.

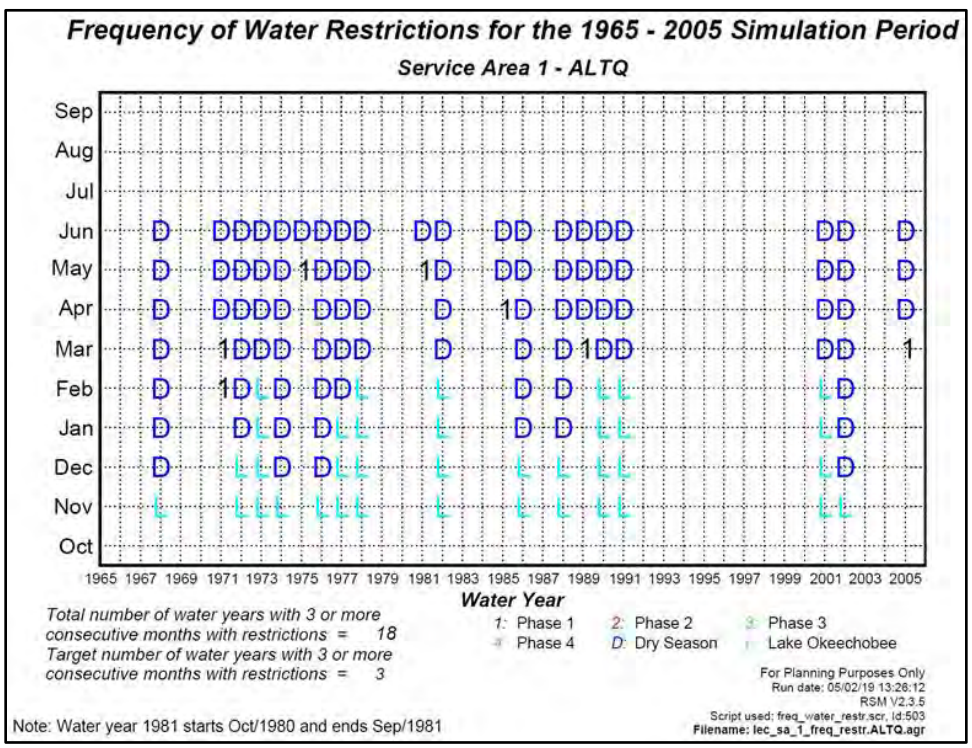

Figure 4-67. Frequency of water restrictions during the 1965-2005 simulation period for LECSA 1 under ALTQ and ALTQ+.

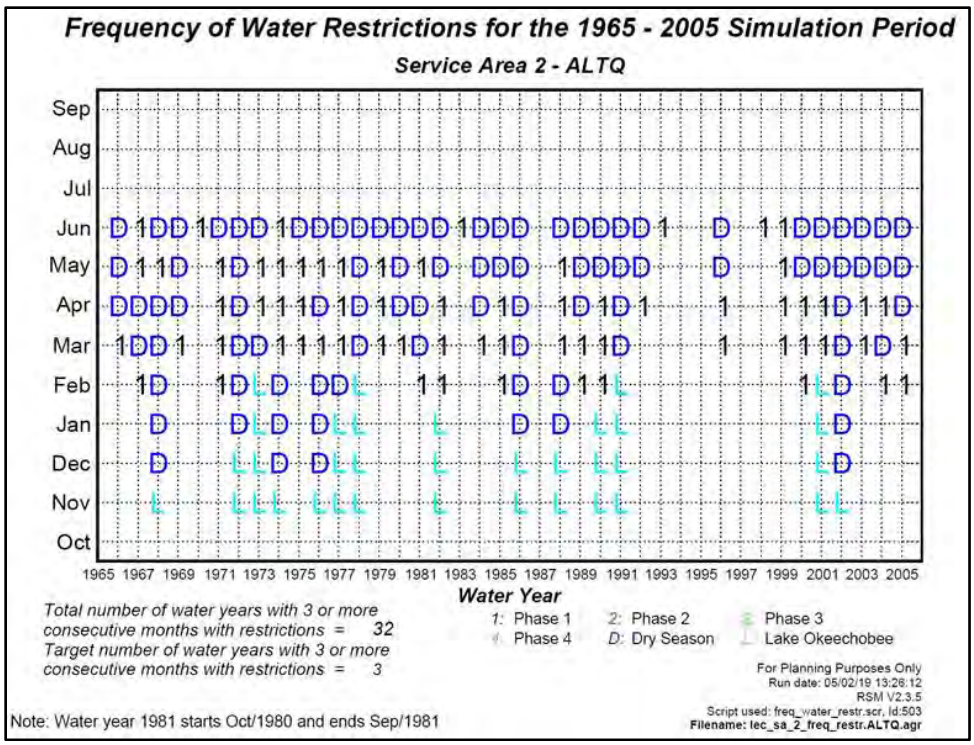

Figure 4-68. Frequency of water restrictions during the 1965-2005 simulation period for LECSA 2 under ALTQ and ALTQ+.

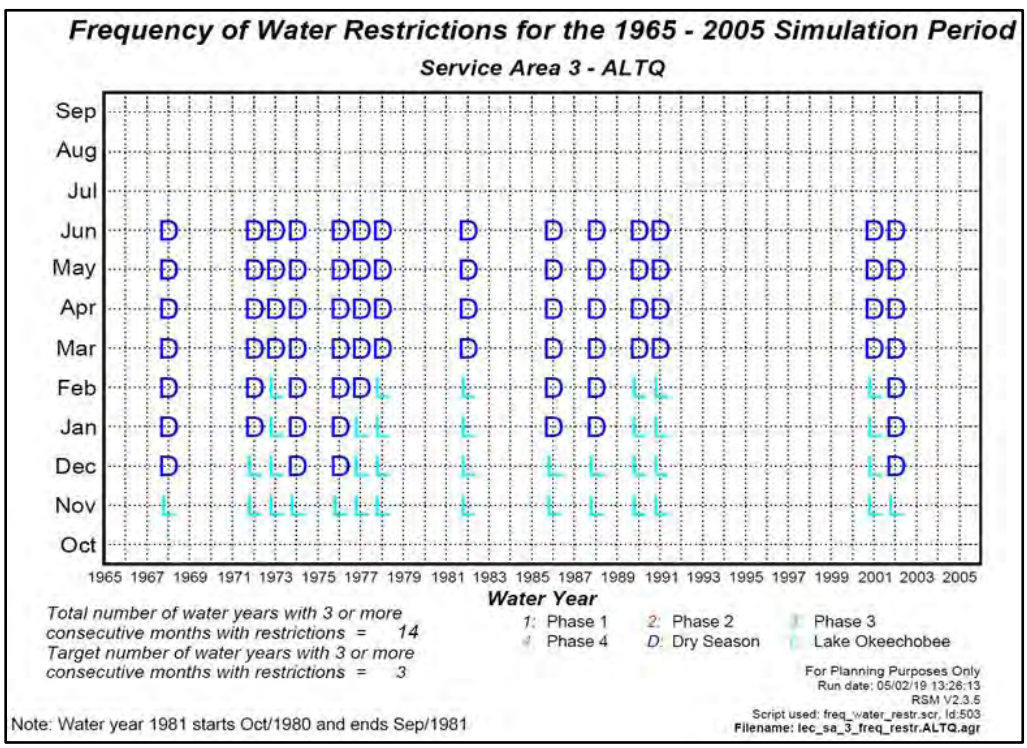

Figure 4-69. Frequency of water restrictions during the 1965-2005 simulation period for LECSA 3 under ALTQ and ALTQ+.

4.5.1.2 Stage Difference Comparison

The regional groundwater stage difference map comparing ALTQ/ALTQ+ and ECB19RR was used to identify where systemic groundwater reductions may occur. The April 1989 and April 2001 difference maps were selected to determine whether the project affects groundwater levels during specific dry-year conditions when regional water levels are most likely to be impacted. April typically is the driest month of the year and 1989 was one of severest droughts within the period of simulation. For comparison of ALTQ/ALTQ+ to the ECB19RR, the average April 1989 regional water levels were unchanged for LECSA 1; reduced in WCA 3 (0.1 to 0.5 feet); and improved (0.10 to 1.00 foot higher) in a small portion of LECSAs 2 and 3 and the southern part (ENP) of the study area (**Appendix H**, **Annex 5** (**Modeling Results Round 3**) **Figure H.5-46**). For the 2001 comparison, no change was evident in LECSA 1; a more significant reduction was evident in WCA 3 (0.10 to 1.00 foot lower); and an improvement was evident (0.01 to 1.00 foot higher) in a small portion of LECSAs 2 and 3 and the southern part of the study area (**Appendix H**, **Annex 5** (**Modeling Results Round 3**) **Figure H.5-48**). ALTN2 and ALTO in 1989 showed no change in water levels in LECSA 1 and a greater reduction in water levels in LECSAs 2, 3, WCA 3, and ENP south of the LECSA 3 southern boundary (**Appendix H**, **Annex 5** (**Modeling Results Round 3**) **Figure H.5-38** and **Figure H.5-42**) than in ALTQ/ALTQ+. For the 2001 comparison, ALTN2 and ALTO showed no change in water levels in LECSAs 1 and 2, a greater reduction in water levels in LECSA 3 and the area adjacent to the west of LECSA 3, and less of a reduction in water levels in WCA 3 than in ALTQ/ALTQ+ (**Appendix H**, **Annex 5** (**Modeling Results Round 3**) **Figure H.5-40** and **Figure H.5-44**). The saline water interface is more than 9 miles east of WCA 3A, and no change in groundwater availability east of LECSAs 1, 2, and 3 (East Coast Protective Levee Area) was evident based on the frequency of water shortage restrictions. Therefore, based on analysis of the modeling results and this information, water supply availability and the saline water interface should not be adversely affected by ALTQ and ALTQ+.

4.6 Vegetative Communities

Prior to construction of the C&SF Project, the inundation pattern of the pre-drainage system supported an expansive system of freshwater marshes including longer hydroperiod sawgrass “ridges” interspersed with open water “sloughs” in the WCAs, higher elevation marl prairies on either side of NESRS in ENP and forested wetlands in BCNP. Historically the ridge and slough was the predominant landscape type of the central Everglades (present day WCAs), including NESRS in ENP (NRC 2003). Rainfall and seasonal discharge from Lake Okeechobee into these spatially extensive, low topographic relief wetlands resulted in overland surface flows (sheetflow) in the pre-drainage system (RECOVER 2006). The landscape was a long-hydroperiod, hydrologically interconnected, freshwater marsh with long-term storage capacity and shallow to very deep organic peat soils. In this system, parallel sawgrass ridges and tree islands were separated by more open water slough communities aligned with historic flow directions (NRC 2003, SCT 2003). As a result, the vegetation patterns in this combined “wet prairie-sawgrass-slough-tree island mosaic” (Davis et al. 1994) largely reflected seasonal water depths, and the distribution and timing of surface water flows.

Construction of the C&SF Project including channelization and physical manipulation of how water flows into the study area has altered or eliminated sheetflow and related hydrologic characteristics throughout much of the central Everglades. Deep slough communities formerly occurred throughout the pre-drainage ridge and slough region of the central Everglades (McVoy et al. 2011). Sloughs within the central Everglades have been degraded by compartmentalization resulting in reduced sheetflow, water depths and inundation durations, altering vegetation community structure and resulting in expansion of wet

prairie and sawgrass marsh communities (Davis et al. 1994, Davis and Ogden 1997; Armentano et al. 2006; McVoy et al. 2011).

The Everglades Landscape Vegetation Succession Model (ELVes) was used to predict vegetation community change over time in response to environmental conditions. The model uses empirically based probabilistic functions of vegetation community niche space and temporal lags to evaluate expected community response within the model's domain. For the evaluation, ELVes was run with ten vegetation communities (1) sawgrass; (2) sawgrass short; (3) open marsh; (4) cattail; (5) floating emergent marsh; (6) marl prairie (drier); (7) marl prairie (wetter); (8) swamp shrubland; (9) willow shrub cattail; (10) cypress shrub sawgrass; (11) bay head shrub; and (12) rockland pine. **Table 4-6** provides a description of the vegetation classes used in ELVes as shown in **Figure 4-70** through **Figure 4-81.** For more details reference Pearlstine et al 2011.

Table 4-6. Description of vegetation classes utilized in ELVes.

Vegetation Class	Description
Sawgrass	Sawgrass (*Cladium jamaicense*) dominated marsh
Sawgrass-Short	Sawgrass dominated marsh with average height less than 2.5 meters.
Open Marsh	Open water dominated freshwater marsh often with a mix of sparse graminoids, herbaceous, and/or emergent freshwater vegetation, such as Spikerush (*Eleocharis spp.*), Panicgrass (*Panicum spp.),* low stature sawgrass, Cattail (*Typha spp*.), Arrowhead (*Sagittaria spp*.), Pickerelweed (*Pontederia cordata*), Waterlily (*Nymphaea spp*.), Green Arum (*Peltandra virginica*), Swamp-Lily (*Crinum americanum*), Spiderlilies (*Hymenocallis spp*.), among others.
Cattail	Greater than or equal to 50% areal coverage of Cattail.
Floating Emergent Marsh	Typically Nuphar or Nymphaea. Also Lemna, Salvinia
Drier Marl Prairie	Short hydroperiod marsh characterized primarily by graminoids that includes low-stature sawgrass, Muhly Grass (*Muhlenbergia capillaris var. filipes*),
Wetter Marl Prairie	Short hydroperiod marsh characterized by a mix of graminoids that includes low-stature sawgrass, Little Bluestem (*Schizachyrium scoparium*), Gulfdune Paspalum (*Paspalum monostachyum*), Beakrush (*Rhynchospora spp*.), Black Sedge (*Schoenus nigricans*), among others.
Swamp Shrubland	Primrose willow and wax myrtle
Willow Shrub Cattail	Willow (*Salix caroliniana*) dominant shrubland with freshwater marsh species. Cattail may be prominent.
Cypress Shrub Sawgrass	Dwarf Cypress (*Taxodium spp*.) with freshwater marsh species. Dwarf cypress may be in a sawgrass matrix.
Bayhead Shrubland	Mix of Cocoplum (*Chrysobalanus icaco*), Swamp Bay (*Persea palustris*), Red Bay (*Persea borbonia*), Dahoon Holly (*Ilex cassine*), Willow (*Salix caroliniana*), Wax Myrtle (*Myrica cerifera*), Sweetbay (*Magnolia virginiana*), Cypress (*Taxodium spp*.), Pond Apple (*Annona glabra*), among others.
Pine Rockland	Pine upland found on low ridges of oolitic limestone. Found on the Miami rock ridge, in the Florida Keys, ENP, and in BCNP.

Figure 4-70 through **Figure 4-72** illustrate the percent acreage change in vegetation communities relative to ECB19RR for a representative wet year (1995), dry year (1989) and average year (1978). The lower right

quadrant in these figures shows areas that were changed in each alternative (green = change). The light brown line noted as the COP area of interest in **Figure 4-73** through **Figure 4-81** was identified at the start of the planning efforts for the COP and was used to define the maximum acreage that could be potentially affected by the COP and was utilized in the calculations in **Figure 4-70** through **Figure 4-72**. The greatest percent acreage change was observed during a representative wet year (1995) and dry year (1989), in which a significant decrease (> 60%) in floating emergent marsh was observed under ALTN2, ALTO, and ALTQ. This was coupled with a minor to moderate increase (>10%) in swamp shrub land and sawgrass. During an average year (1978), minor to moderate increases (>10%) were observed for each alternative for floating emergent mash and moderate to significant increases in (> 40%) cypress shrub sawgrass. In the bottom right corner of **Figure 4-73** through **Figure 4-81** the location (depicted in green coloration) in WCA 3 and ENP where a change in vegetation community was observed to occur as a result of ALTN2, ALTO, and ALTQ is shown. Changes in vegetation primarily were observed to occur under each alternative in northern WCA 3A east of the Miami canal, in portions of WCA 3B, in southern WCA 3A and in portions of ENP including NESRS and Taylor Slough. Performance between ALTN2, ALTO, and ALTQ was variable. Generally speaking, the difference between any given alternative fell within a range of +/- 10%. ELVes was not utilized for ALTQ+, since a separate RSM-GL model simulation was not conducted for the ALTQ+. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ. Hydroperiods and similar depths are expected for the entire range of expected stages.

A comparison of potential effects on vegetation in the COP study area is further summarized below in **Section 4.6.1** (**Slough/Open Water Marsh**) through **4.6.4 (Mangrove Wetlands and Seagrass Beds**). These sub-sections contain information on additional performance measures and performance indicators used to evaluate potential effects on vegetation communities.

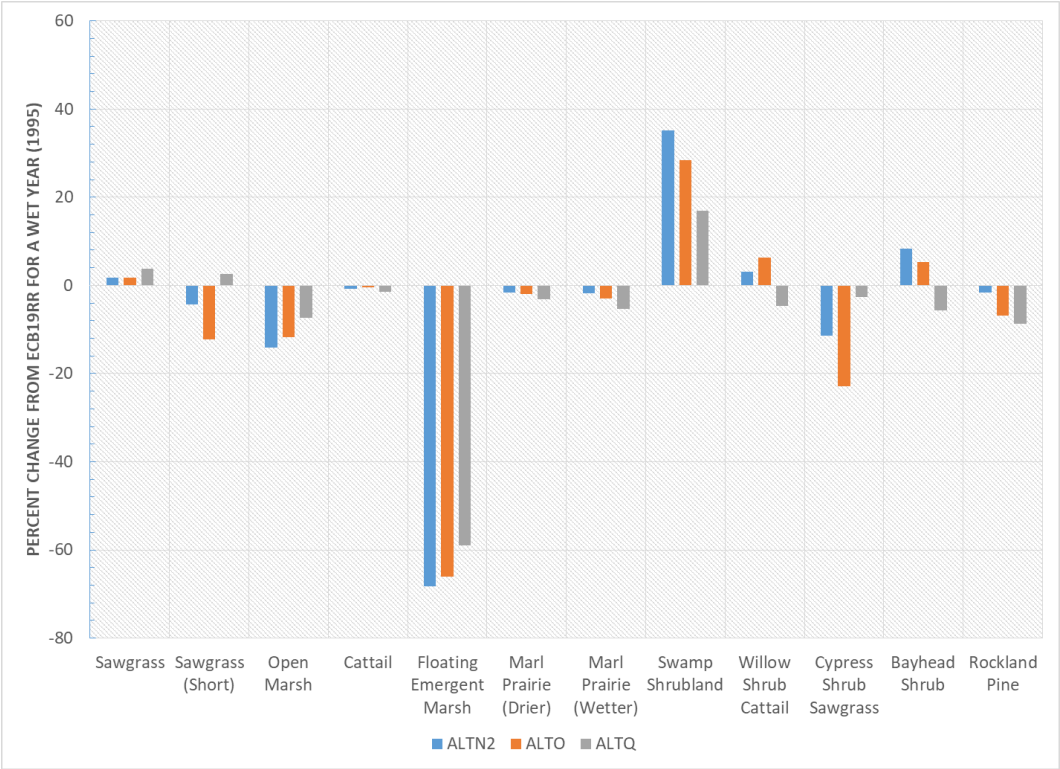

Figure 4-70. Percent change in acreage of vegetation relative to ECB19RR for a wet year (1995).

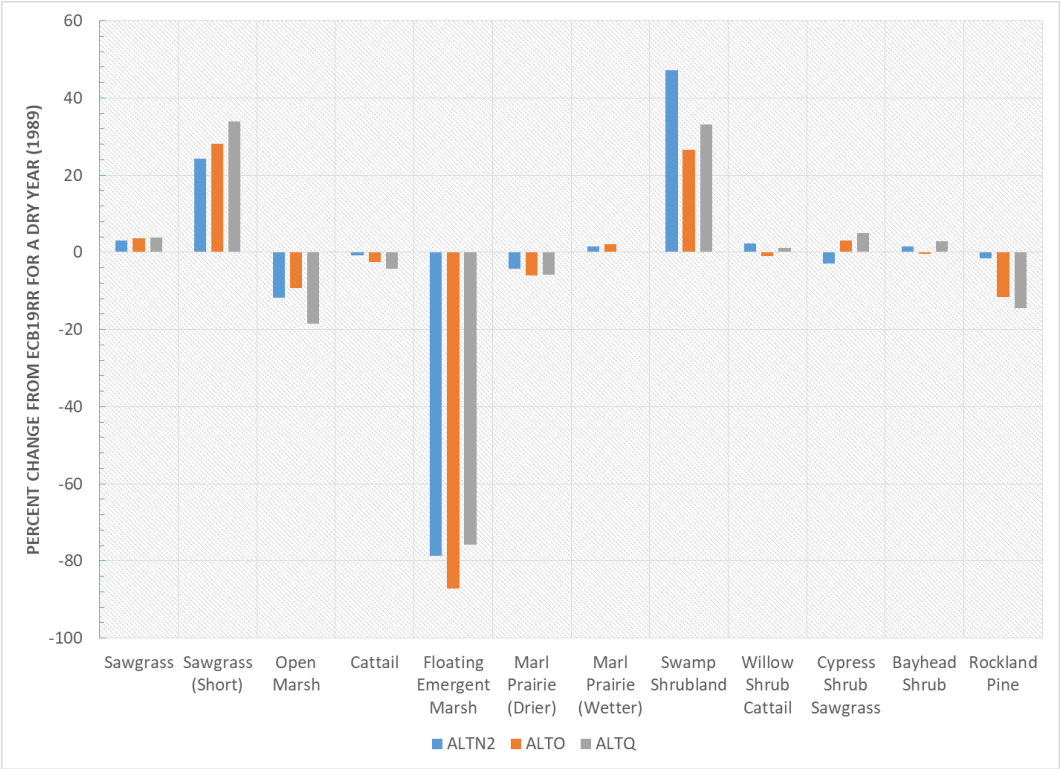

Figure 4-71. Percent change in acreage of vegetation relative to ECB19RR for a dry year (1989).

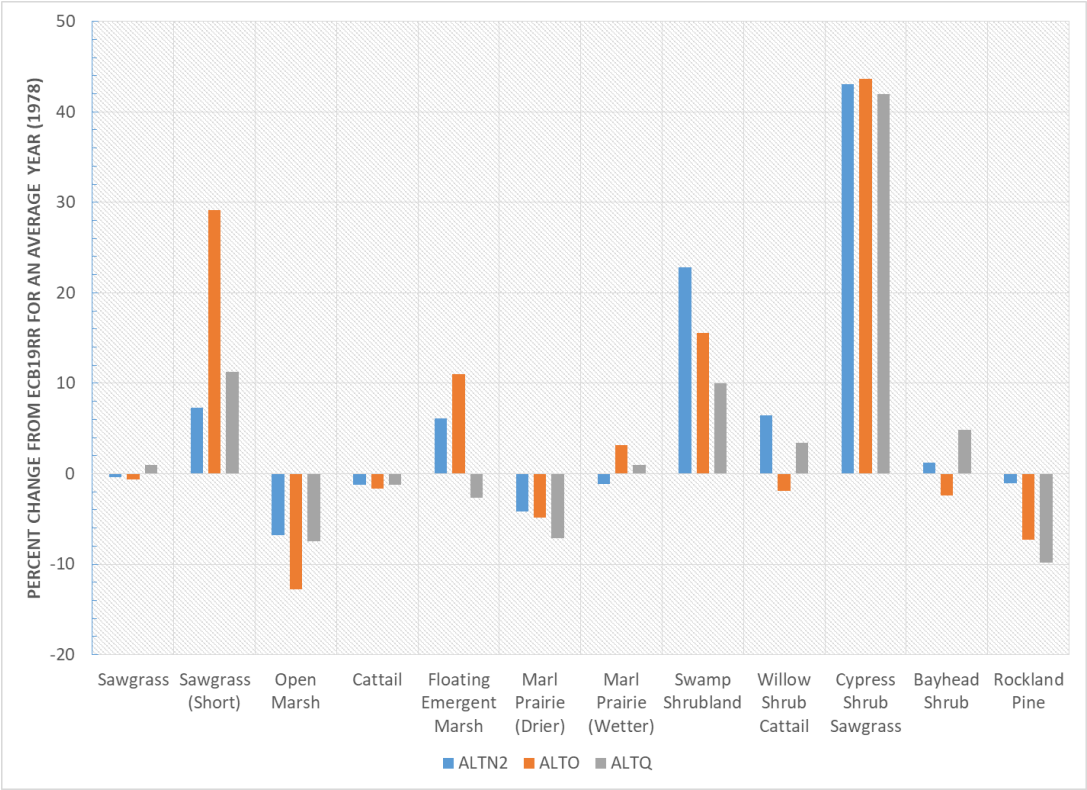

Figure 4-72. Percent change in acreage of vegetation relative to ECB19RR for an average year (1978).

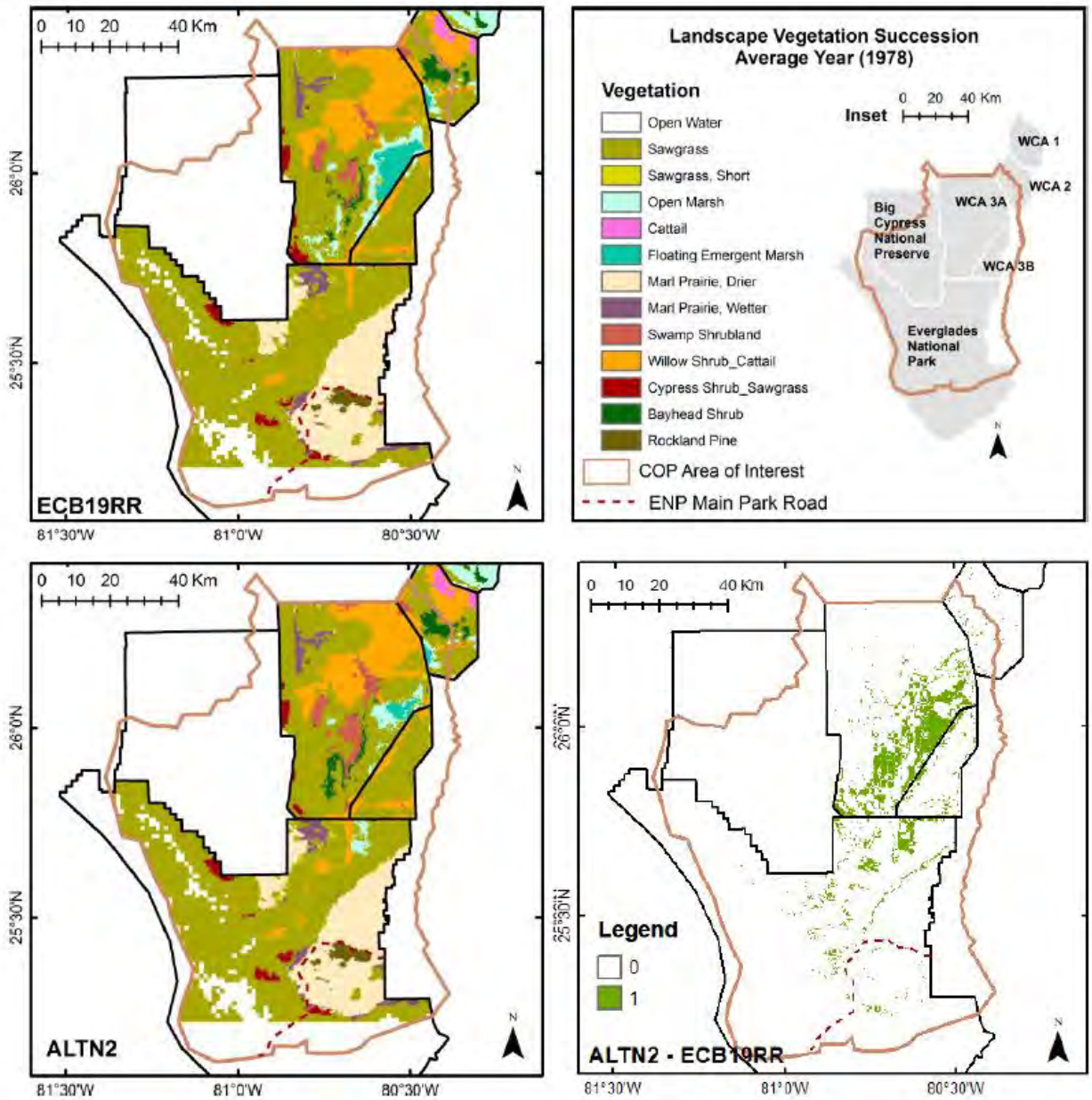

Figure 4-73. Landscape vegetation succession for an average year (1978) for ALTN2.

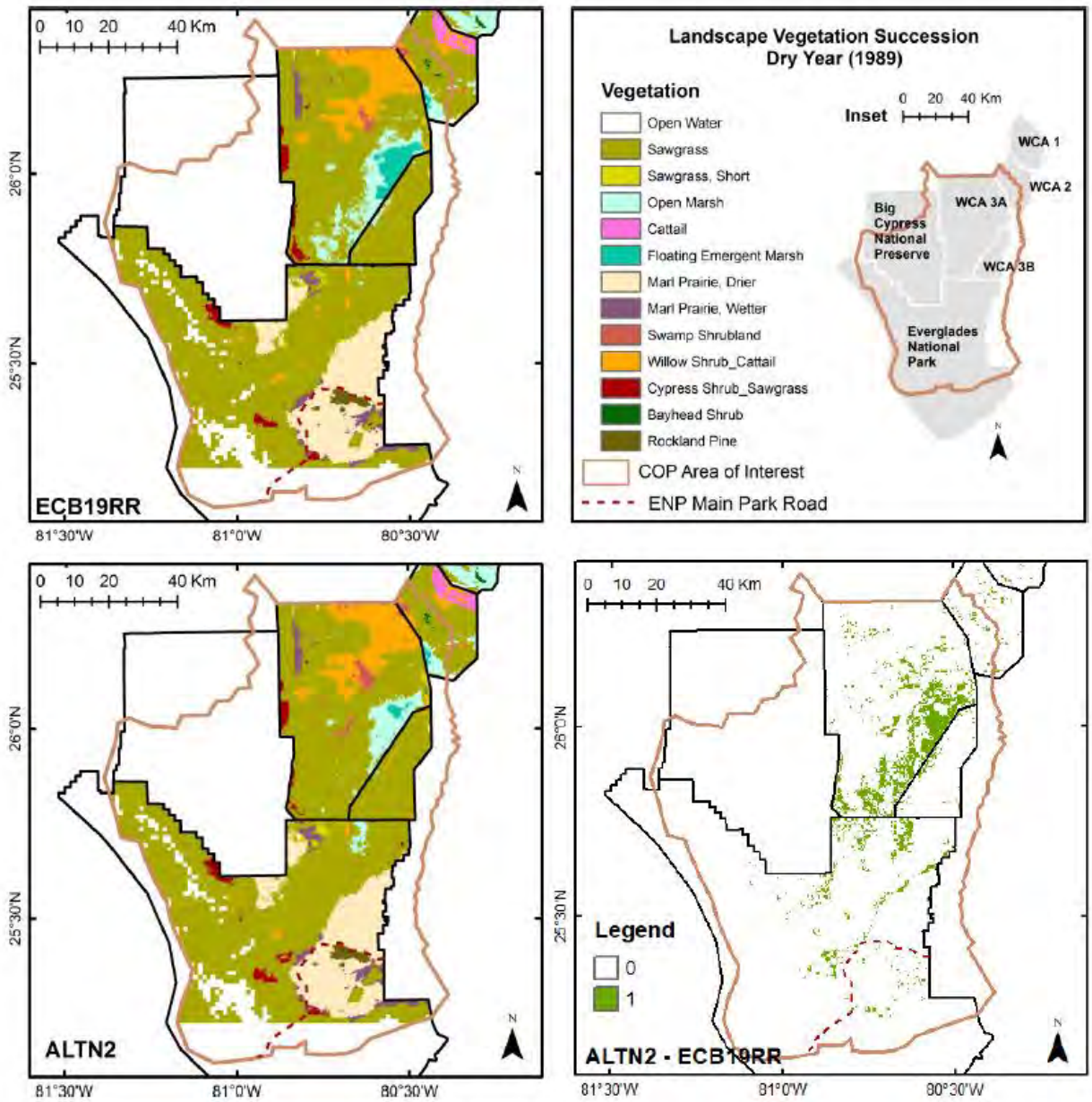

Figure 4-74. Landscape vegetation succession for a dry year (1989) for ALTN2.

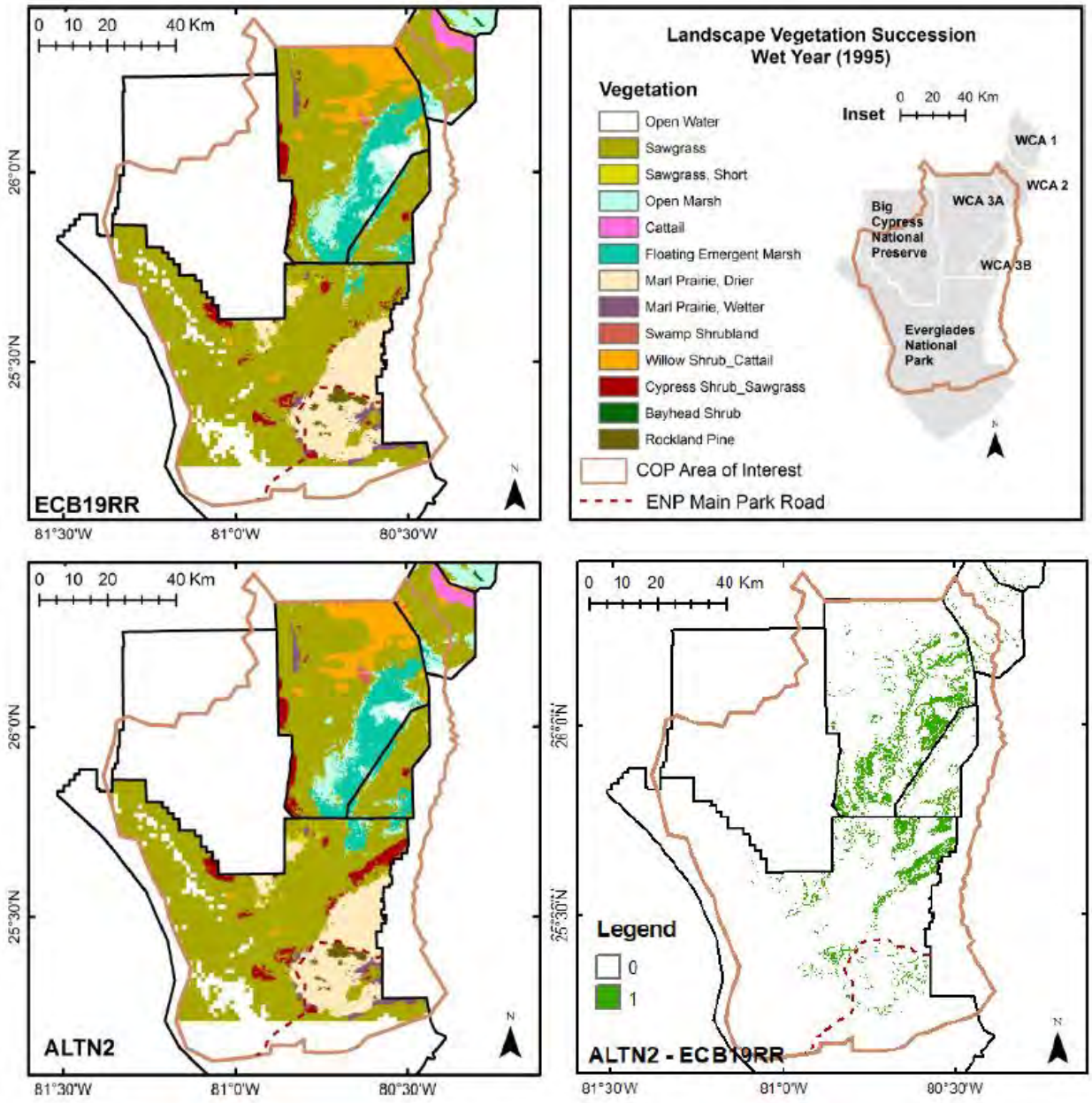

Figure 4-75. Landscape vegetation succession for a wet year (1989) for ALTN2.

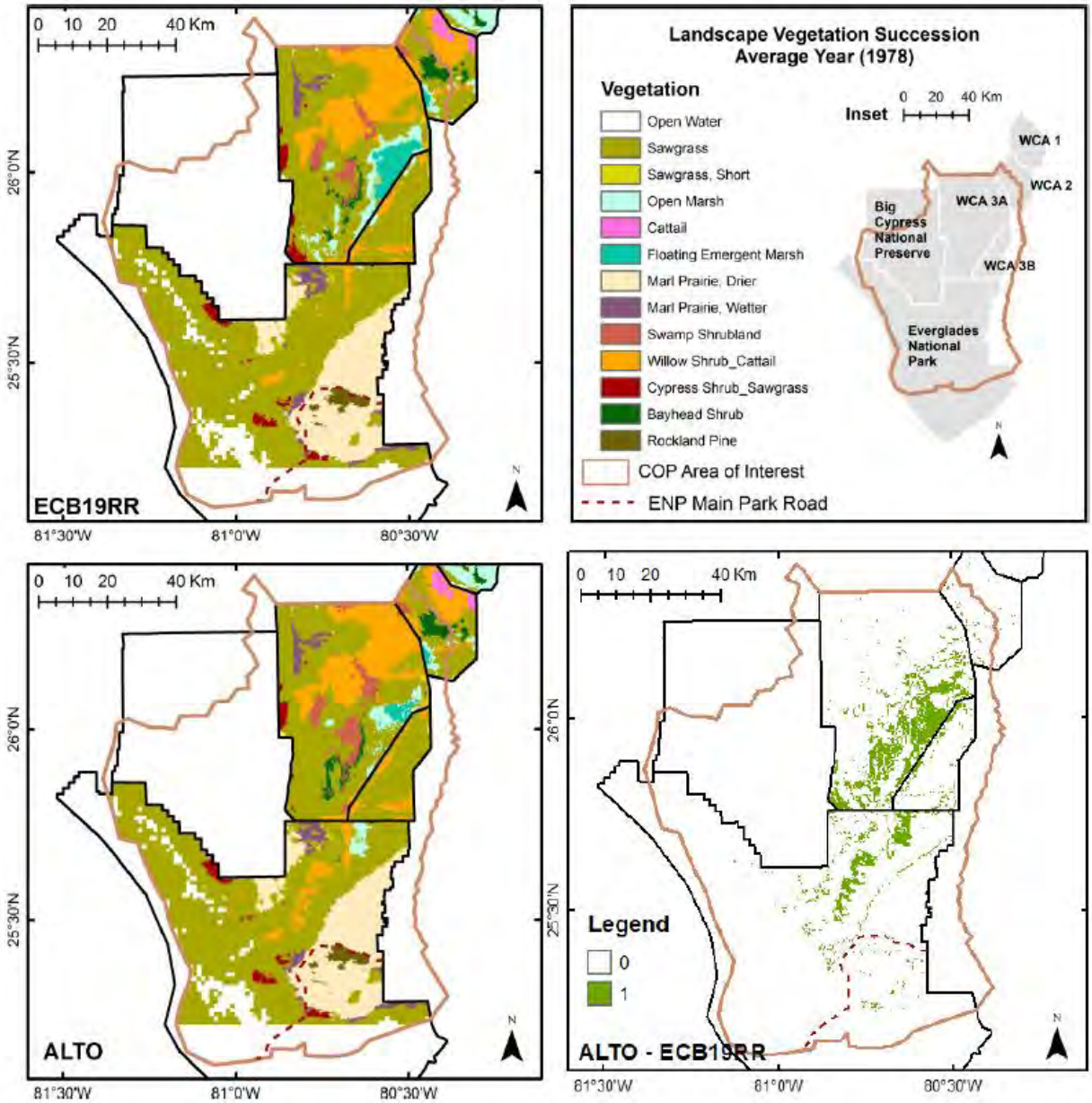

Figure 4-76. Landscape vegetation succession for an average year (1978) for ALTO.

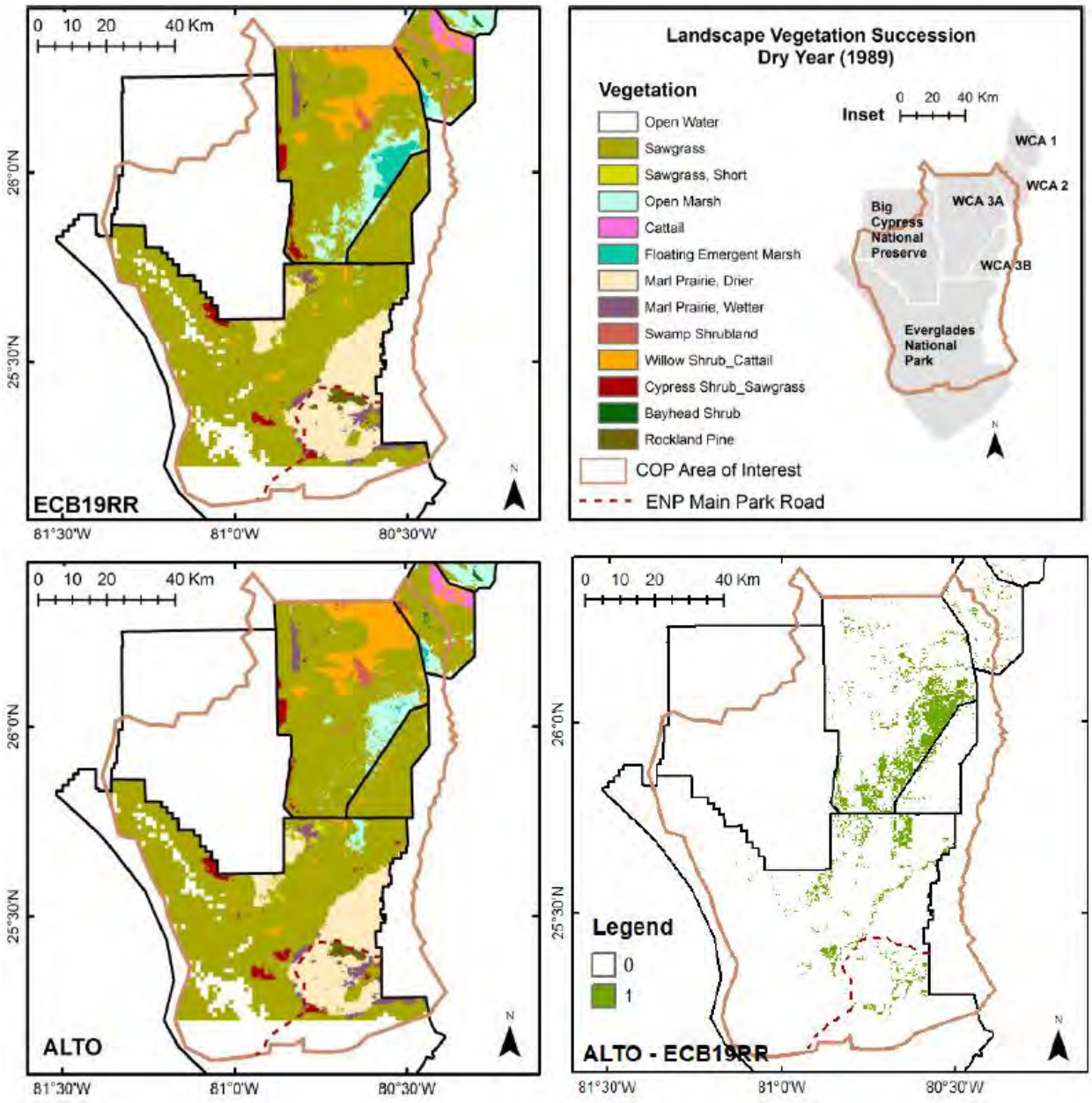

Figure 4-77. Landscape vegetation succession for a dry year (1989) for ALTO.

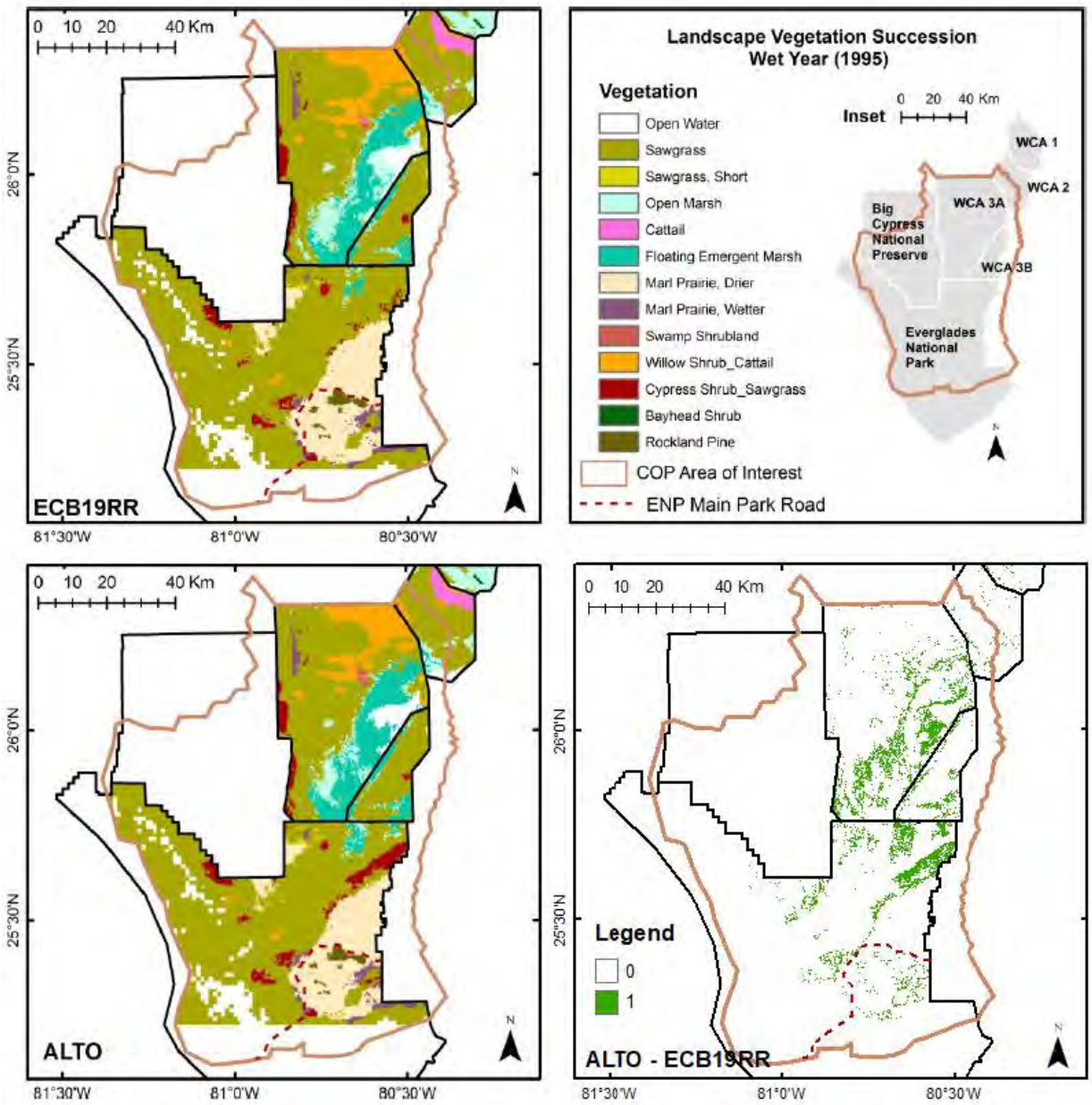

Figure 4-78. Landscape vegetation succession for a wet year (1995) for ALTO.

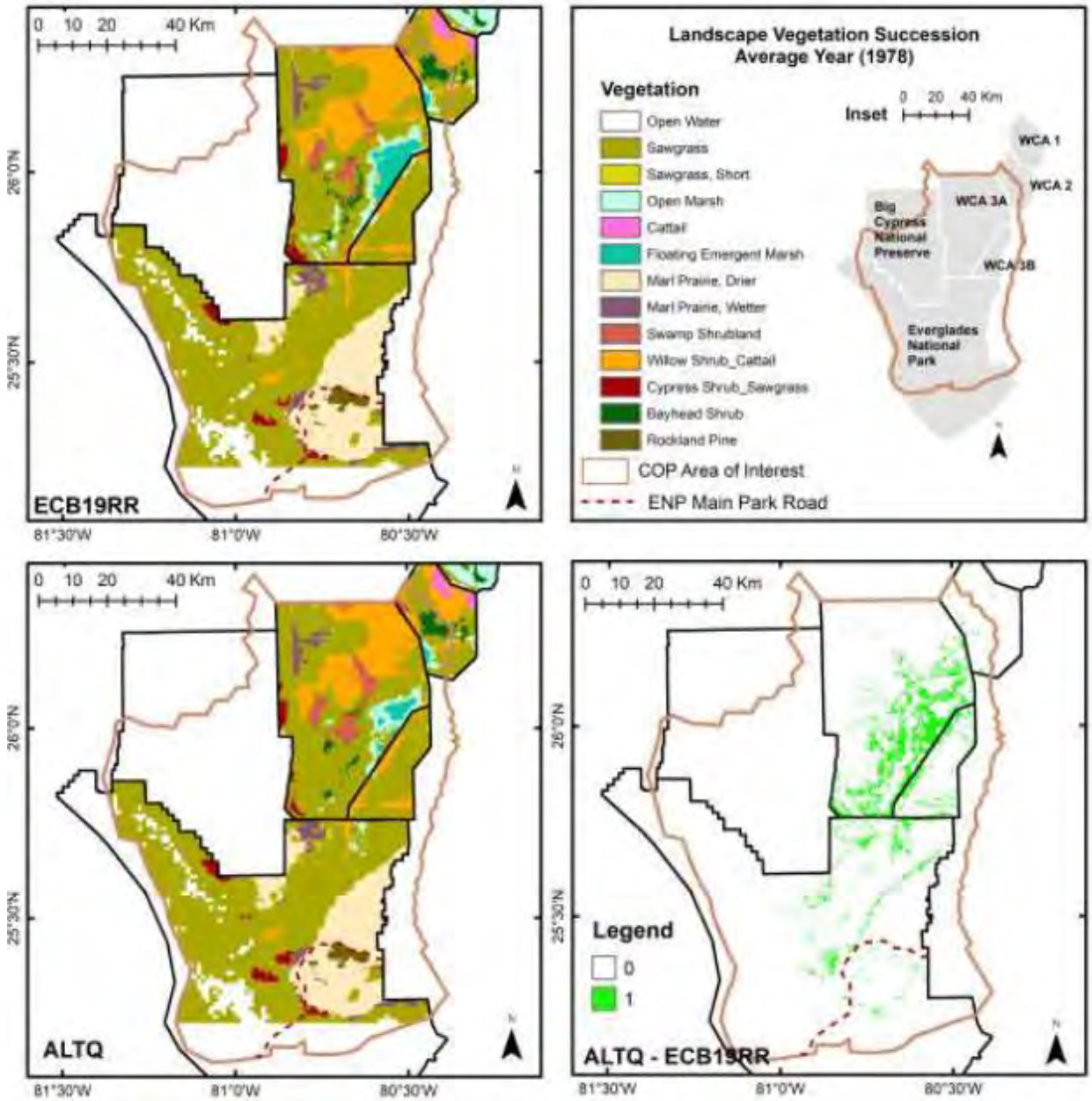

Figure 4-79. Landscape vegetation succession for an average year (1978) for ALTQ.

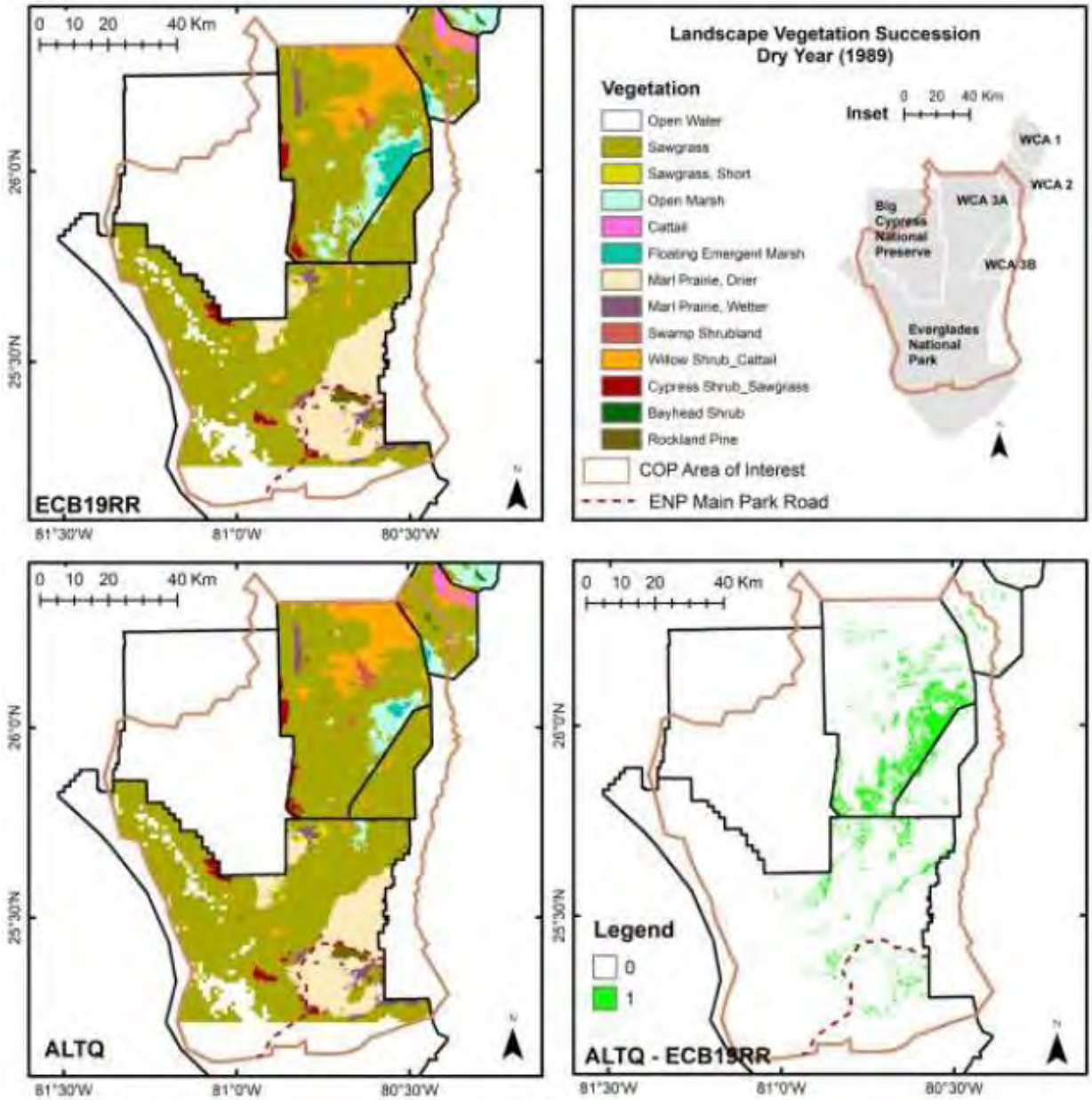

Figure 4-80. Landscape vegetation succession for a dry year (1989) for ALTQ.

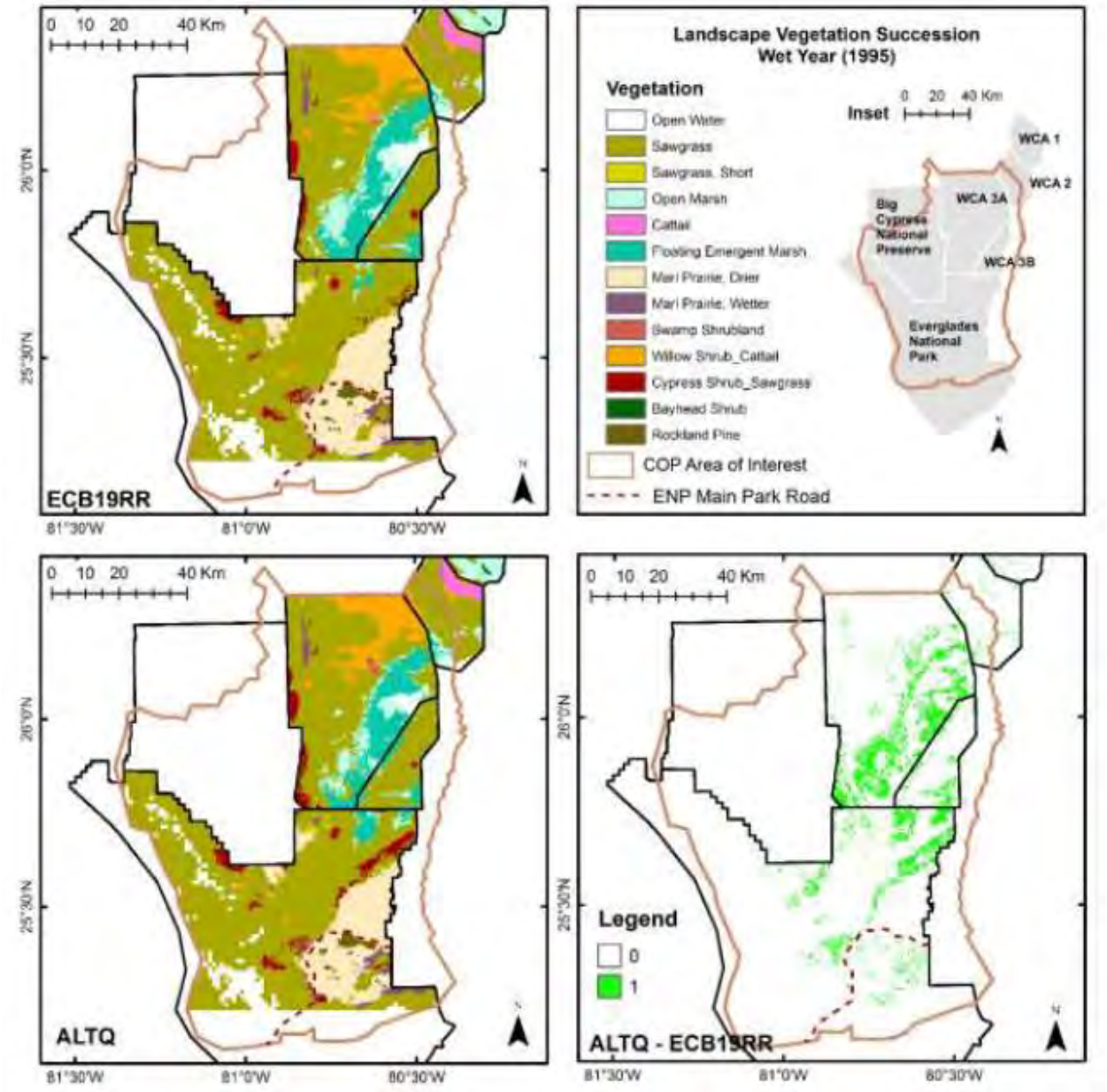

Figure 4-81. Landscape vegetation succession for a wet year (1995) for ALTQ.

4.6.1 Slough/Open Water Marsh

A slough vegetation performance measure was used to evaluate potential effects to the ridge and slough vegetation within the central Everglades. An analysis of plant associations across the Everglades has identified that slough communities were historically dominated by white water lily as well as species of bladderwort prior to the construction of the C&SF Project. Based on scientific literature, the optimal hydrologic conditions for these two indicator species are: (1) to maximize continuous hydroperiods (days with depth ≥ 0.0 feet) (Hydroperiod); (2) to minimize dry down events below 0.7 feet (20 cm) (Drydown); (3) to maintain dry season average depths of 1.5 to 2 feet (~46 to 60 cm) (Dry Season Depth); and to (4) maintain wet season average depths of 2 to 3 feet (~60 to 90 cm) (Wet Season Depth). For this performance measure IR scores were based solely on suitability for these desired vegetation types.

The Miami canal functions as a major, unnatural drainage for WCA 3A. In combination with the northern levees of WCA 3A (L-4 and L-5), the Miami canal has substantially impacted historical sheetflow and natural wetland hydroperiods. As a result the natural capability of northern WCA 3A to store water is lost and the Miami canal effectively over-drains the area. These hydrologic changes have increased the frequency of severe peat fires and have also resulted in the loss of ridge and slough topography along with nearly all tree islands that were once characteristic of the area. Most of WCA 3A north of Interstate 75 has experienced some form of fire and in more recent years those fires have moved farther south into the western portion of WCA 3A. Today, northern WCA 3A is largely dominated by sawgrass, cattail and scattered shrubs and lacks the structural diversity of plant communities seen in central and western WCA 3A. This area is approximately 250 square miles in area (or nearly 30% of the 850 square miles total area of WCA 3A). Northern WCA 3A is furthest from historical hydrologic conditions in WCA 3A (as represented by the Natural Systems Regional Simulation Model – NSRSM).

Central WCA 3A covers 230 square miles of what is considered to be fairly well conserved ridge and slough habitat. Vegetation and patterning in the central portion of WCA 3A resembles the pre-drainage conditions most closely and represents some of the best examples of Everglades habitat left in south Florida. This region of the Everglades appears to have changed little since the 1950s (which was already post-drainage) and contains a mosaic of tree islands, wet prairies, sawgrass stands, sawgrass ridges, and aquatic sloughs. Hydropatterns in central WCA 3A are the closest match to pre-drainage hydropatterns of any portion of the existing system, and this region covers approximately 27% of WCA 3A.

The southern portion of WCA 3A covers approximately 230 square miles of WCA 3A, and is primarily affected by long durations of high water and a lack of seasonal variability in water depths created by impoundment structures (L-29 levee) under existing conditions. This area covers approximately 27% of WCA 3A. The increased duration of high water events in southern WCA 3A has negatively impacted tree islands and caused fragmentation of the sawgrass ridges, again resulting in the loss of historic landscape patterning. Implementation of any of the COP alternatives would provide beneficial effects to southern WCA 3A through reduction in high water levels or duration.

The L-28 Gap area covers approximately 74 square miles of marshes in WCA 3A (approximately 9% of WCA 3A). This portion of WCA 3A is well hydrated, but also suffers from challenges with water quality, and is supported hydrologically by the S-140 structure to the north of the area as well as from deliveries via a spreader canal to the west-central portion of this region.

WCA 3B is approximately 150 square miles of wetlands that are predominately sawgrass marsh with few remaining tree islands. WCA 3B functions as part of a seepage protection system for Miami-Dade county, and water levels in WCA 3B tend to be shallow, with little variability, and long hydroperiods. The lack of flow and variability in water levels in WCA 3B have resulted in a flattened landscape dominated by sawgrass marsh and long hydroperiods marl prairies.

Typical Everglades vegetation, including tree islands, wet prairies, sawgrass marshes, and aquatic sloughs also occur throughout WCA 3B. However, within WCA 3B, the ridge-and-slough landscape has been severely degraded by the virtual elimination of overland sheetflow due to the L-67 canal and Levee system. WCA 3B experiences very little overland flow and has become primarily a rain and seepage fed system predominated by shorter hydroperiod sawgrass marshes with relatively few sloughs or tree islands remaining. Water levels in WCA 3B are also too low and do not vary seasonally, contributing to poor ridge and slough patterning. Loss of sheetflow to WCA 3B has also accelerated soil loss reducing elevations of the remaining tree islands in WCA 3B and making them vulnerable to high water stages. The northern

portion of WCA 3B has experienced soil consuming peat soil fires and is now lower in elevation than the central/southern regions. The northern region has no remaining tree islands. Stabilizing the northern portion of WCA 3B requires protecting it from additional fires and managing inflows to ensure that they don't flow northward and produce chronic deep-water conditions.

ENP is located south of Tamiami Trail and is supported hydrologically by deliveries through the S-333 and S-12 structures. The area of ENP totals approximately 1.5 million acres (or 2400 square miles) of marshes, coastal mangrove forests, and the estuarine areas of Florida Bay and the Florida Gulf coast. The current park area includes a 168.9 square mile area added to ENP in 1989. The addition of these lands to ENP in Public Law 101-229 was coupled with instructions by Congress for the National Park Service to work with the USACE to restore hydrologic conditions in ENP, with particular emphasis on the newly added lands positioned southeast of the S-333 structure. The COP creates the operational rules that will be used to move restoration flows into NESRS – the dominant natural drainage of ENP.

Inflows to SRS under the current configuration of compartmentalized WCAs and water management practices are greatly reduced when compared with pre-drainage conditions. The result has been lower wet season depths and more frequent and severe dry downs in sloughs and reduction in extent of shallow water edges. Vegetative trends within ENP have also included the conversion of slough/open-water marsh communities to shorter hydroperiod sawgrass marshes and wet prairies (Davis et al. 1994, Davis and Ogden 1997; Armentano et al. 2006; McVoy et al. 2011). Over-drainage in the peripheral wetlands along the eastern flank of NESRS (an area often referred to as the Rocky Glades) has resulted in shifts in community composition, invasion by exotic woody species and increased susceptibility to fire.

Taylor Slough is the major drainage feature on the eastern side of ENP. A small area of remnant slough-ridge-tree island patterned landscape persists in Taylor Slough. This pattern is diminished and narrow at the upstream end, but then broadens south of Anhinga Trail, toward the coast. The Taylor Slough ecological area covers almost 2% of ENP (30,100 acres or 48 square miles). Marl and peat soils occur over Miami limestone in this region and primary agents of change (or stressors) in this unit include: regional water management infrastructure along the eastern boundary of ENP (specifically canals, seepage structures, and water detention areas); altered fire regime; historical land uses; climate change (particularly sea-level rise); exotic plants and animals.

With respect to the slough vegetation performance measure, ALTN2, ALTO, and ALTQ performed similarly to ECB19RR in northern WCA 3A at IR114 and IR117 (areas located west of the Miami canal). At IR119 (located east of the Miami canal and just north of WCA3B), modest differences in continuous hydroperiod were observed relative to ECB19RR. ALTO and ALTQ were predicted to be the wettest alternatives, however within all of these areas, no meaningful ecological difference is expected to occur with respect to slough vegetation suitability under COP.

Slight differences in slough vegetation suitability were observed among ALTN2, ALTO, and ALTQ in IR locations in the remainder of the study area. At IR115, IR116, and IR118 (areas located in northern WCA 3A east of the Miami canal), and at IR120 and IR122 (areas located in the L-28 Gap), ALTO performed slightly better for each of the slough vegetation performance measure metrics. In central and southern WCA 3A at IR121, IR123, and IR124, ALTO performed slightly better when the dry season average depth metric was evaluated. In WCA 3B, ALTO also performed slightly better than ALTN2 and ALTQ, as this alternative was slightly less dry; however ECB19RR was often observed to perform the best for slough vegetation in this portion of the study area. Within ENP, ALTQ performed slightly better in NESRS (IR129) than ALTN2 and ALTO, as this alternative was slightly wetter; however ALTN2 performed slightly better

than ALTO and ALTQ in central SRS (IR130, IR131, and IR132). In southern Taylor Slough (IR133N and IR133S) ALTO and ALTQ were observed to perform slightly better as these alternatives were slightly wetter than ALTN2. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages.

4.6.2 Tree Islands

The COP project delivery team developed a performance indicator for tree islands in order to determine how the simulated alternatives compare to one another as well as how they compare to the observed performance of tree islands in the real system starting in 1991 and extending through 2017. The tree island performance indicator uses mapped elevations of 387 of the largest tree islands in WCA 3 and ENP. These tree islands were surveyed and mapped by principle investigators through specific RECOVER monitoring efforts. The latitude, longitude, and elevation of each island larger than 1 acre was obtained. Mapped islands are not a statistically random sample of a set of known islands, instead the 387 mapped islands (identified in **Figure 4-82**) are a large proportion of all available tree islands that meet the prescribed size/location criteria. The 387 tree islands used for the performance indicator are thought to be reasonably representative of the general condition of tree islands in each of the target hydrologic zones.

ALTN2, ALTO, and ALTQ, as well as ECB19RR were summarized by comparing a daily water surface covering the entirety of WCA 3 and most of the terrestrial area of ENP with the tree island elevations. If the water surface was above the tree island elevation, then that tree island was scored as inundated. The total number of days inundated was summarized for each tree island. The alternatives compare elevations with a 41 year sequence of days consistent with the RSM-GL simulation period (January 1, 1965 through December 31, 2005), while the observed conditions compare elevations to a 26 year sequence of observed daily water levels (using data extracted from the Everglades Depth Estimation Network: EDEN, found online at sofia.usgs.org/eden). The results of these comparisons are compiled in **Table 4-7** and **Table 4-8**, and histogram summaries of ALTN2, ALTO, and ALTQ can be found in **Appendix E.1**, **Figure E.1-42** through **Figure E.1-46**. ECB19RR, ALTN2, ALTO, and ALTQ increased the proportion of tree islands that were inundated less than 10% of the period of record when compared to the observed conditions since 1991. The most significant changes were observed to occur in the central portion of WCA 3A, the southern portion of WCA 3A, WCA 3B, and the L29 Gap area in WCA 3A. ENP is virtually unchanged in any of the alternatives, and northern WCA 3A contains so few remaining tree islands (6 total) that only small differences in tree island inundation are possible.

Tree island decline across WCA 3A, WCA 3B, and ENP has been extensively documented (Sklar et al. unpublished). There has been a ~10% reduction in the number of tree islands larger than 1 acre each decade beginning 1952-2004. The rate of tree island loss is different in different portions of the landscape. The central portion of WCA 3A has the largest number of tree islands per square mile. This portion of the landscape also exhibits tree islands occurring adjacent to each other which have very different tendencies to be inundated. Between May 1, 2016 and April 30, 2017 there were many examples of adjacent tree islands where the highest elevation portion of one tree island was never below the water surface while a tree island next to it had over 300 days of inundation. Because of the high density of tree islands and the condition of the central WCA 3A landscape, this area is thought to be most representative of the target condition for the ridge, slough, and tree island landscape. Central WCA 3A demonstrates a characteristic distribution of tree island inundation – a core of islands that are inundated less than 10% of the period of

record, with an even distribution of islands inundated more frequently, up to nearly continuous inundation. Improvements to the tree island performance indicator are perceived based on the degree to which the population of tree islands in a geographic region tends to match the distribution of inundation found in central WCA 3A. The simplest summary metric is a count of the number of tree island inundated less than 10% of the period of record. This summary information is provided for each alternative in **Table 4-7** and **Table 4-8**.

ECB19RR, ALTN2, ALTO, and ALTQ increased the proportion of tree islands that were inundated less than 10% of the period of record when compared to the observed conditions since 1991, having the potential for negligible to minor long-term beneficial effects in portions of WCA 3. All of the differences in performance of the tree island indicator were explained by different degrees of inundation in WCA 3. Tree island inundation in ENP was not affected by any alternative. ALTQ performed better in the chronically inundated area of southern WCA 3A. The tree island performance indicator was not utilized for ALTQ+ since a separate RSM-GL model simulation was not conducted for the alternative. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages.

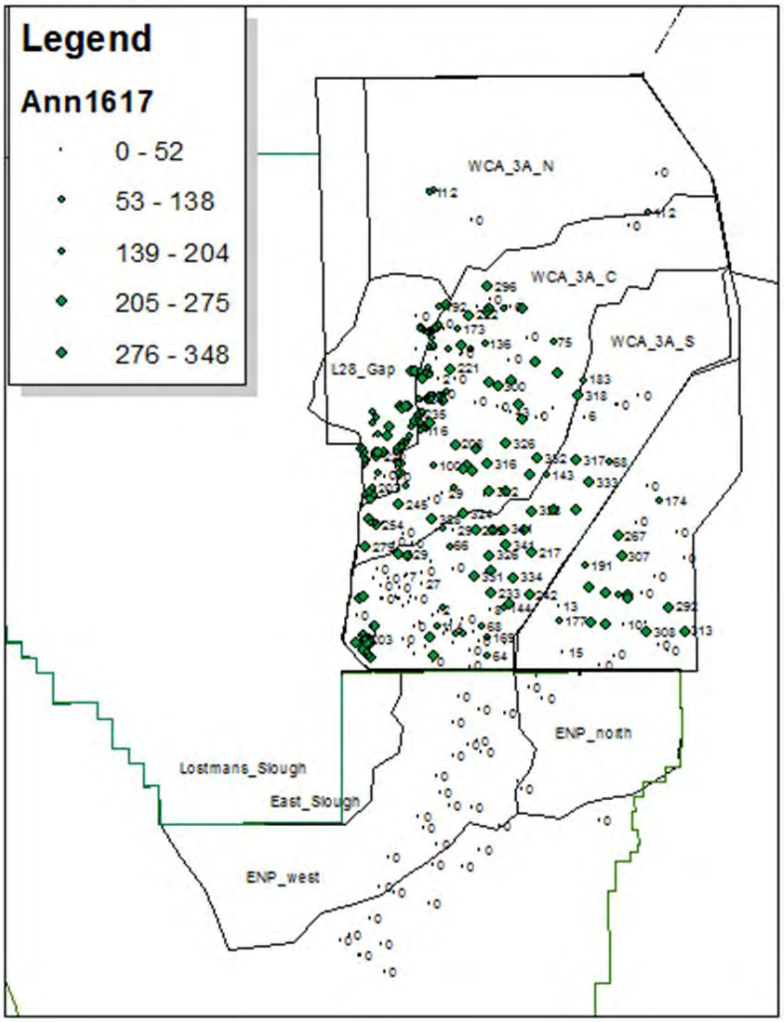

Figure 4-82. Location of mapped tree islands with estimate of number of days inundated during May 1 2016 and April 30, 2017. This period was a wet year with emergency operations that moved significant amounts of water south.

Table 4-7. Total number of tree islands inundated less than 10% of time period. For observed this is equal to 950 days over 26 years. For ALTs this is equal to 1461 days over 41 years.

Alternative	WCA 3AC	WCA 3AN	WCA 3AS	WCA 3B	ENPN	ENPS	ENPW	Gap	Sum
Observed	16	3	19	11	4	14	18	6	91
ECB19RR	45	1	24	9	4	14	18	23	138
ALTN2	61	1	34	15	4	14	18	27	174
ALTO	52	4	30	12	4	14	18	19	153
ALTQ	56	4	41	13	4	14	18	21	171

Table 4-8. Percent of mapped tree islands inundated less than 10% of the time period. For observed this is equal to 950 days over 26 years. For ALTS this is equal to 1461 days over 41 years.

Alternative	WCA 3AC	WCA 3AN	WCA 3AS	WCA 3B	ENPN	ENPS	ENPW	Gap	Total
Observed	12%	50%	17%	38%	100%	100%	100%	9%	24%
ECB19RR	35%	17%	22%	31%	100%	100%	100%	34%	37%
ALTN2	47%	17%	31%	52%	100%	100%	100%	40%	46%
ALTO	40%	67%	27%	41%	100%	100%	100%	28%	40%
ALTQ	43%	67%	37%	45%	100%	100%	100%	31%	45%

4.6.3 Wet Marl Prairies

Marl prairie communities have short-hydroperiods (the period of time during which a wetland is covered by water) and contain a mosaic of moderately dense, clumped grasses. Areas within the western marl prairies between the boundary of BCNP and ENP are currently considered to be too wet. Areas within the eastern marl prairies along the boundary of ENP suffer from over-drainage, reduced water flow, exotic tree invasion, and frequent human-induced fires (Lockwood et al. 2003; Ross et al. 2006). To alleviate the perpetually drier conditions and associated problems, increased water flows focused on the eastern marl prairies are required.

In addition to ELVes, the CSSS Marl Prairie ecological planning tool was utilized to evaluate the potential effects of ALTN2, ALTO, ALTQ, and ALTQ+ on marl prairie habitat in relation to the CSSS. The CSSS Marl Prairie ecological planning tool was developed to simulate hydrologic suitability of marl prairie habitat based on hydrologic thresholds derived from CSSS survey presence/absence data collected over several decades. The CSSS Marl Prairie ecological planning tool scores specifically target hydrologic indicators of suitable marl prairies inhabited by the CSSS. Output is provided as a percent to target met by the hydrologic scenario (Pearlstein et. al. 2016). **Figure 4-83** through **Figure 4-85** shows the results of the ecological planning tool overlaid with CSSS critical habitat for ALTN2, ALTO, and ALTQ relative to ECB19RR over the period of record (1965-2005). ALTN2, ALTO, and ALTQ were observed to increase flow to NESRS and the eastern marl prairies relative to ECB19RR; however changes to the eastern marl prairies generally fell within a range of +/- 10% in those subpopulations currently inhabited by CSSS-B through CSSS-F. Marl prairie habitat suitability increased in the northern portion of CSSS-Ax under each alternative. ALTN2, ALTO, and ALTQ performed similarly. Areas of decreased suitability were observed in portions of CSSS-E and CSSS-D; however these observed decreases were coupled with observed increases in suitability in areas directly east of CSSS-E and north and south of CSSS-F and CSSS-C. Minor to moderate, long-term beneficial effects may potentially occur in portions of the western and eastern marl prairies as a result of the COP. The CSSS Marl Prairie ecological planning tool was not utilized for ALTQ+ since a separate RSM-GL model simulation was not conducted for the alternative. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages.

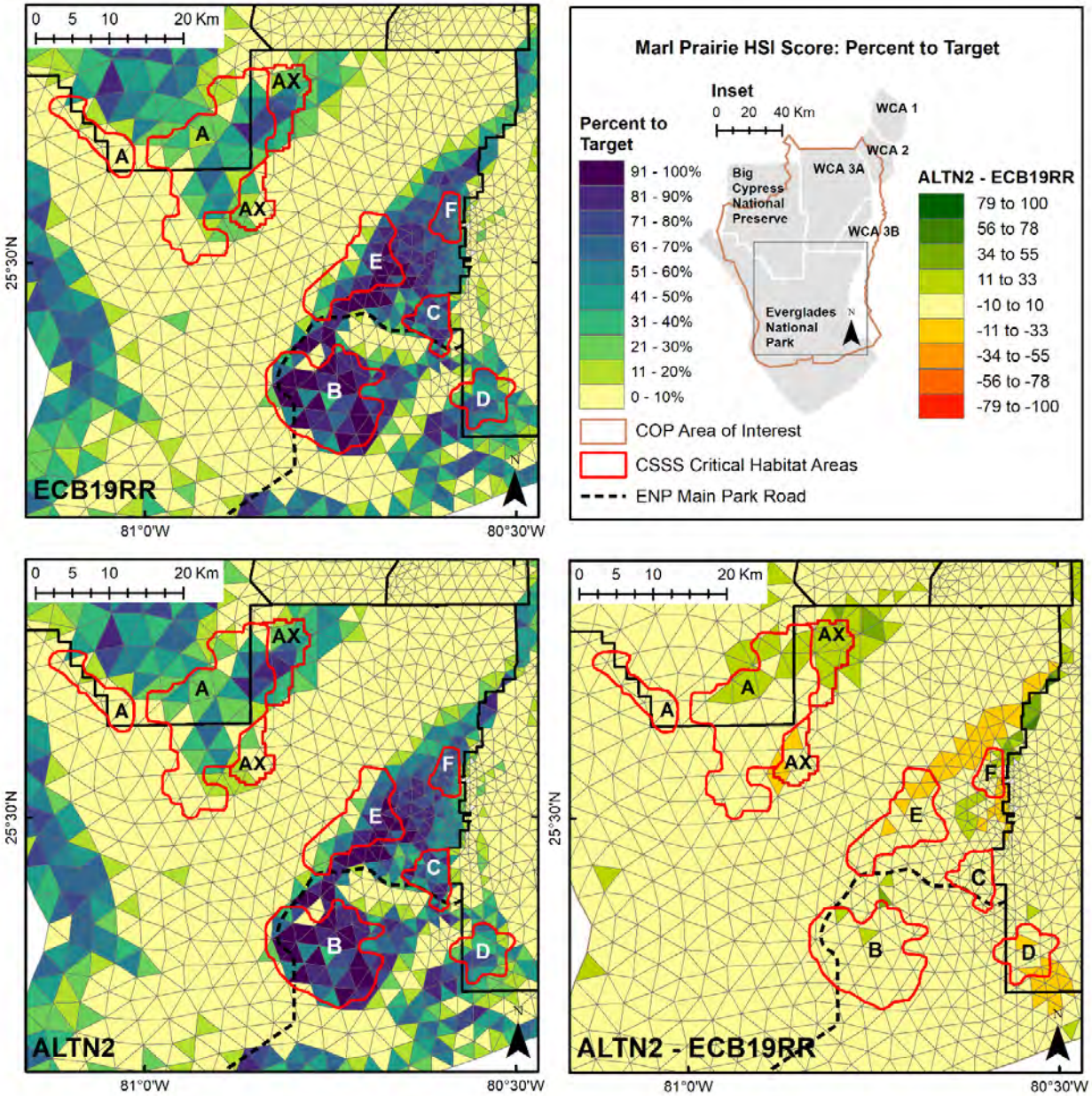

Figure 4-83. Marl prairie habitat suitability in ENP for ALTN2.

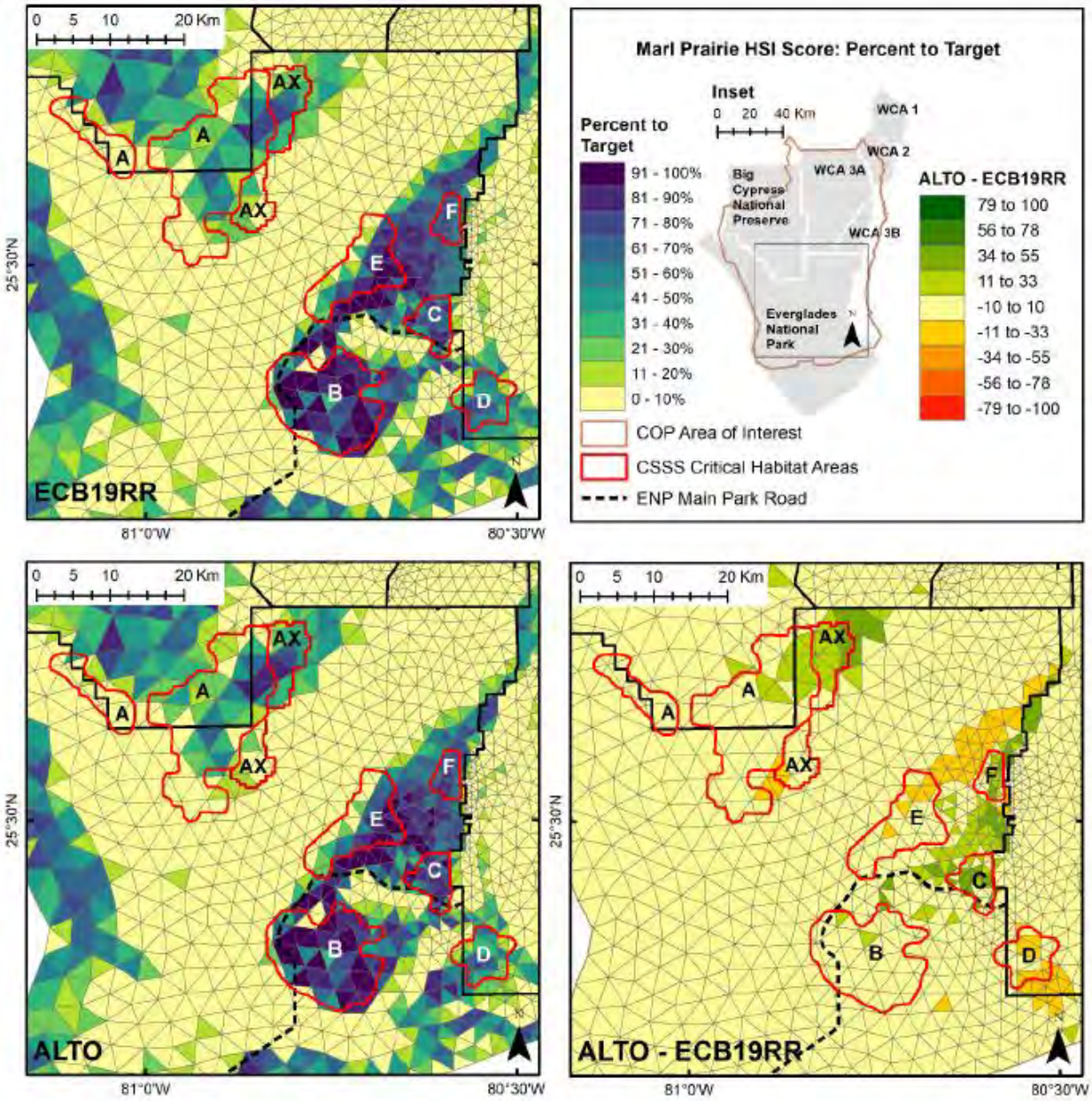

Figure 4-84. Marl prairie habitat suitability in ENP for ALTO.

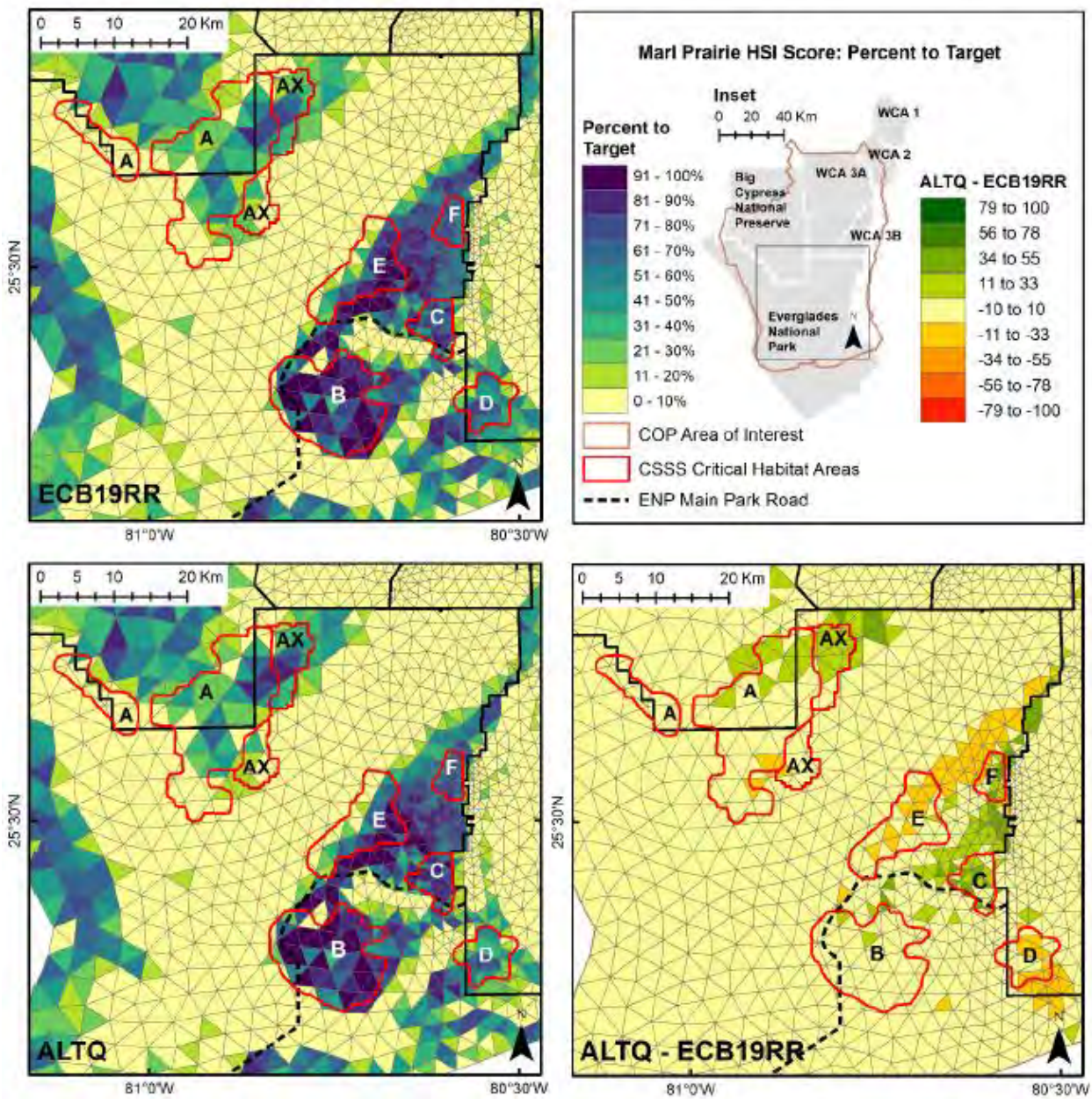

Figure 4-85. Marl prairie habitat suitability in ENP for ALTQ.

4.6.4 Mangrove Wetlands and Seagrass Beds

Florida Bay has a strong dependence on freshwater flow from the Everglades. Florida Bay is the main receiving water body of the central Everglades system and has been heavily influenced by historic upstream changes in the timing, distribution, and quantity of freshwater flows. Coastal lakes and marshes transition into dozens of coastal basins that are partially connected to Florida Bay. Salinity throughout Florida Bay depends on the relationship and interaction of several factors, such as weather patterns (e.g. temperature, precipitation), tides, connectivity/mixing with adjacent basins, freshwater groundwater input, and freshwater surface flow. Freshwater surface flow and upstream stage (which influences

groundwater input) are the most influential drivers affecting salinity, especially in the northern and eastern portions.

Restoration goals for salinity are: (1) to restore oligohaline and mesohaline salinity patterns in the near-shore environment; (2) lower the average salinity; (3) reduce the frequency, duration, magnitude, and spatial extent of hypersaline (>40 psu [practical salinity unit]) conditions throughout the bay, and; (4) restore seasonal deliveries of freshwater more typical of the natural system. Freshwater flows are a quarter to half of their pre-drainage levels (Marshall et al. 2009, Marshall and Wingard 2012). Water flowing into the South Dade Conveyance System and the northern reaches of ENP can reach Florida Bay through the following routes: (1) SRS surface water can enter Whitewater Bay and the coastal waters of the Gulf of Mexico, then wrap around Cape Sable and diffusely enter western Florida Bay; (2) surface water that flows north and west of the Rocky Glades may seep or, with very high water, flow into Taylor Slough and then flow to central and eastern Florida Bay, and (3) water derived from local rainfall or canals along the ENP eastern boundary can enter Florida Bay via Taylor Slough by surface and groundwater connections. Freshwater deliveries to Florida Bay through these routes have decreased with drainage of the Everglades over the last century. All three of these routes likely influence salinities in Florida Bay today. However, for an evaluation of potential impacts to Florida Bay, a statistical suite of performance measures that heavily weighs predicted salinity patterns to stages in upper SRS was used.

The COP modeling evaluations showed that alternatives have the potential to improve freshwater flows to Florida Bay. ALTN2, ALTO, and ALTQ increased flows toward Florida Bay across Transect T23 relative to ECB19RR. This east-west transect crosses southern Taylor Slough and the Northern ENP Panhandle, east of the slough. Average annual flow increases across this transect were found to range from 25,000 acre-feet for ALTN2 to 46,000 acre-feet for ALTO. ALTQ increased average annual flows by 36,000 acre-feet (**Table 4-26**). Most of the calculated increases in overland flow to Florida Bay were across transect T23C, through the Eastern Panhandle, accounting for all but 6,000 acr-feet flow increases across T23B for ALTO and ALTQ. Small increases in average annual flows were also observed across the more northerly Taylor Slough headwater transects TSH1 and TSH2 (**Table 4-26**). Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on Florida Bay is expected to be very similar to that of ALTQ with no significant change.

Performance of ALTN2, ALTO, and ALTQ in Florida Bay was measured by evaluating changes in salinity conditions in both the wet (June through November) and dry season (December through May) by utilizing the RECOVER Florida Bay performance measure (RECOVER 2012). Simulated hydrology results from RSM-GL for each of the COP alternative and ECB19RR were post-processed using multiple linear regression (MLR) statistical models to estimate salinity conditions at 17 marine monitoring network (MMN) stations in Florida Bay. These models do not capture the processes that deliver freshwater to Florida Bay. Instead, they indicate that conditions and processes that increase water depths in SRS Taylor Slough are correlated with the conditions and processes that change salinity in Florida Bay. Until a mechanistic model of flow patterns for this part of the ecosystem is available, this is the only tool currently available, and results should be cautiously considered when evaluating forecasts.

Results from the MMN stations are then aggregated into six zones of similarity within Florida Bay based on water quality characteristics. Zones evaluated include North Bay, East Bay, East Central Bay, Central Bay, South Bay, and West Bay. **Table 4-9** and

Table 4-10 depict the mean annual dry season and mean annual wet season salinities for ECB19RR in North Bay, East Bay, East Central Bay, Central Bay, South Bay, and West Bay. Percent differences shown in **Table 4-9** and

Table 4-10 are the decrease in salinity from ECB19RR to the alternative as a percent of ECB19RR absolute salinity. Decreases in mean wet salinity for ALTN2, ALTO, and ALTQ relative to ECB19RR were small (up to 0.61 psu) in all Florida Bay zones. For every case (each zone and alternative combination) decreases in dry season salinity exceeded decreases in wet season salinity, with dry season decreases up to 1.29 psu. While still small, these differences may be ecologically significant because they reflect long-term seasonal means and not short-term or even annual extremes (e.g., periods with hypersalinity). Also, the timing of lowered salinity, being more in the dry season, may be ecologically significant because salinity peaks with associated ecological damage are most common in the late dry season and early wet season if precipitation delays occur.

Among the alternatives, ALTO was observed to have the best dry season performance, with the largest decreases in salinity in all Florida Bay zones. Relative performance among alternatives was more spatially variable during the wet season. ALTN2 had the best performance in East-Central, Central, South, and West Florida Bay. ALTQ had the best performance in North Florida Bay and ALTO had the best performance in East Florida Bay. Decreases in mean seasonal salinity between each ALT were less than 5% compared to ECB19RR. While this resultant salinity decrease is desirable, the magnitude of the mean decrease is small relative to the natural variability of salinity in Florida Bay and seems unlikely to strongly influence the bay's seagrass or mangrove communities. Each alternative appears to have the potential to improve salinity conditions, but it remains to be tested via the implementation of COP, whether the estimates of seasonal means identified here will be accurate and whether hydrologic and salinity modifications yield ecological benefits in Florida Bay.

Table 4-9. Mean annual dry season salinity for ECB19RR and percent salinity decrease with ALTN2, ALTO, and ALTQ in Florida Bay zones.

Florida Bay Zone	Dry Season Mean Salinity ECB19RR (PSU)	Dry Season ALTN2 % Decrease from ECB19RR	Dry Season ALTO % Decrease from ECB19RR	Dry Season ALTQ % Decrease from ECB19RR
North	25.07	3.8%	5.1%	4.7%
East	29.88	2.2%	2.9%	2.8%
East Central	29.00	2.8%	3.0%	2.6%
Central	35.50	3.1%	3.4%	3.0%
South	34.71	2.4%	2.6%	2.2%
West	36.12	2.2%	2.4%	2.1%

Table 4-10. Mean annual wet season salinity for ECB19RR and percent salinity decrease with ALTN2, ALTO, and ALTQ in Florida Bay zones.

-	Wet Season Mean Salinity ECB19RR (PSU)	Wet Season ALTN2 % Decrease from ECB19RR	Wet Season ALTO % Decrease from ECB19RR	Wet Season ALTQ % Decrease from ECB19RR
North	18.30	3.2%	3.1%	3.3%
East	24.74	1.7%	2.2%	2.0%
East Central	27.60	1.6%	0.9%	1.2%
Central	32.61	1.8%	1.1%	1.4%
South	33.31	1.4%	0.8%	1.0%
West	34.81	1.1%	0.6%	0.8%

Alternative evaluations also estimated differences in water quantity and distribution patterns from the C-111 canal at the southern extremity of the SDCS between the S-18C and S-197. S-197 provides a gravity outlet for stormwater runoff, as well as water seepage from ENP, which is conveyed through the SDCS during high water and flood conditions. Water released through S-197 discharges into Manatee Bay. S-197 also acts as a barrier to prevent saltwater intrusion into the freshwater wetlands via the C-111 canal. Nearshore salinity conditions within the estuaries downstream of the southeast Everglades within ENP (Long Sound, Joe Bay, and northeast Florida Bay) and the Model Lands east of the ENP Panhandle (Manatee Bay, Barnes Sound, and Card Sound) are elevated much of the year as a result of the less than adequate freshwater flow deliveries. Overland flow of freshwater into these estuaries is preferred as compared with discharges through S-197. However, low volume releases to Manatee Bay through this structure are considered preferential to high volume releases that result in increased incidence of large salinity swings as well as increased nutrient load delivery. Releases at S-197 also have the potential to decrease flows to Taylor Slough, and subsequently Florida Bay. Currently, water that discharges from S-18C when S-197 is closed mostly flows over the scraped down canal banks into ENP's Eastern Panhandle toward the tidal creeks feeding into Long Sound and Joe Bay. Reference **Appendix G** (**Water Releases through S-197**) for further summary information on the potential effects of S-197 discharges in Manatee Bay and Barnes Sound. If high volume releases through S-197 contain excess nutrients and organic matter, the loading may trigger harmful algal blooms, shifts in phytoplankton community structure (species composition and biomass), and increased turbidity and light attenuation.

ALTN2, ALTO, and ALTQ decreased structure flow through S-197 and improved overbank flow into ENP's Eastern Panhandle relative to ECB19RR (**Table 4-11**). Annual flow decreases through S-197 were observed to range from 40,000 acre-feet on average for ALTN2 to 47,000 acre-feet on average for ALTO. ALTQ decreased annual flows by 41,000 acre-feet on average. Annual flow increases into ENP from C-111 between S-18C and S-197 were observed to range from 21,000 acre-feet on average for ALTN2 to 34,000 acre-feet on average for ALTO. ALTQ increased overbank flow by 25,000 acre-feet on average. Each alternative also decreased the number of days of no flow through S-197 (ALTN2 176 days; ALTO 195 days; ALTQ 175 days) and the number of days flow through S-197 ranged from 0 to 400 cfs (ALTN2 172 days; ALTO 193 days; ALTQ 174 days) relative to ECB19RR. ALTQ+ would result in similar effects as discussed under ALTQ.

Table 4-11. Modeled annual water outflow volumes from C-111 canal, via overbank flow between S-18C and S-197, releases through S-197, and S-197 daily flow distribution over the period of record (1965-2005) under the COP alternatives.

-	ECB19RR	ALTN2	ALTO	ALTQ
Average annual flow volume (thousand acre-feet) through S-197	60 KAC-FT	20 KAC-FT	13 KAC-FT	19 KAC-FT
Average annual flow volume (thousand acre-feet) overland between S-18C and S-197	76 KAC-FT	97 KAC-FT	110 KAC-FT	101 KAC-FT
Average Number of Days of No Flow through S-197	143 Days	319 Days	338 Days	318 Days
Average Number of Days Flow through S-197 ranged from 0 to 400 cfs	216 Days	44 Days	23 Days	42 Days
Average Number of Days Flow through S-197 ranged from 400 to 800 cfs	3 Days	0 Days	2 Days	4 Days
Average Number of Days Flow through S-197 greater than 800 cfs	4 Days	1 Day	1 Day	2 Days

The RECOVER salinity performance measure for the southern coastal systems does not currently extend past Florida Bay into Biscayne Bay and was therefore unavailable for an evaluation of this area. Under the existing condition, flows to Biscayne Bay predominantly enter the northern part of the Bay and occur during storm events when large volumes of water from WCA 3 are routed down the Miami canal to reduce flooding risks. The COP identified the opportunity to better balance flows across Biscayne Bay, by setting a goal to increase the volumes delivered to the southern portion of the Bay while decreasing the volumes delivered to the northern portion of the Bay. ALTN2, ALTO, and ALTQ slightly (less than 1.6%) decreased average annual flow from canals to the entirety of Biscayne Bay relative to ECB19RR. ALTN2 and ALTO decreased flows to North Bay relative to ECB19RR by approximately 10,000 acre-feet per year on average (**Table 4-12**). ALTQ decreased flows by approximately 21,000 acre-feet per year on average. Flows to Central Bay were essentially maintained under each ALT (with differences from ECB19RR of less than 2,000 acre-feet (=0.3%) in any ALT). ALTQ and ALTN2 increased average annual flows to South Bay by approximately 10,000 acre-feet (a 4% increase over ECB19RR) and 9,000 acre-feet (a 3.6% increase over ECB19RR). Flows to South Bay under ALTO were equivalent to ECB19RR. While ALTQ reduced overall flows to Biscayne Bay by less than 1.6% compared to ECB19RR, the reduction was accounted for entirely by changes to flow in the northern portion of Biscayne Bay which is receiving too much flow during storm events. Concurrently, ALTQ increases freshwater flow to southern Bay, the location of most of Biscayne National Park and CERP's Biscayne Bay Coastal Wetlands Project. This is an area of unnaturally high salinity

and increased freshwater flow can yield ecological benefits for this region. ALTQ+ would result in similar effects as discussed under ALTQ.

Table 4-12. Total average annual flow (thousand acre-feet) from canals to portions of Biscayne Bay over the period of record (1965-2005), with percentage changes relative to ECB19RR.

-	ECB19RR	ALTN2 (% Change Relative to ECB19RR)	ALTO (% Change Relative to ECB19RR)	ALTQ (% Change Relative to ECB19RR)
Biscayne Bay – North (S-25+S-25B+S-26+S-27+S-28+S-29)	509.3 KAC-FT	498.8 KAC-FT (-1.96%)	498.7 KAC-FT (-1.96%)	487.7 KAC-FT (-4.13%)
Biscayne Bay – Central (G-93+S-22+S-123)	106.9 KAC-FT	106.5 KAC-FT (-0.93%)	105.3 KAC-FT (-1.87%)	104.7 KAC-FT (-1.87%)
Biscayne Bay – South (S-20F+S-20G+S-21+S-21A)	248.9 KAC-FT	257.5 KAC-FT (3.61%)	248.7 KAC-FT (0%)	259.2 KAC-FT (4.02%)

Previous water management operations, along with sea level rise, have resulted in an inland migration of saline conditions in both groundwater and surface waters. This has caused the expansion of moderate to high salinity zones and has diminished the spatial extent of freshwater wetland habitats in the southern estuaries. Landward expansion of saltwater and mangrove wetlands, including low-productivity, sparsely vegetated dwarf mangrove communities typical of the hypersaline 'white zone' has also occurred in the southern estuaries. Longer hydroperiods and lower salinities in the southern Everglades marsh and adjacent estuaries from increased flows should mitigate saltwater intrusion and protect coastal wetland vegetation and soil stability in this region. A reduction in freshwater inflows into Florida Bay and alterations of the normal salinity balance is also a contributing factor to the die-off of seagrass beds.

Increased freshwater flows may decrease stress on seagrasses and assist in decreasing rates of saltwater intrusion and peat collapse, and also slow the expansion of mangrove further inland. Results from the southern coastal systems salinity performance measure indicate that negligible and less than significant effects are predicted on seagrass beds and mangrove community composition as a result of the COP. Yet the finding of increased flows to SRS and Taylor Slough, especially during the dry season, combined with the relatively larger salinity performance measure improvement during the dry season, lends promise that ecological benefits in portions of Florida Bay will be realized with implementation of the COP. Biscayne Bay may also benefit. It is expected that, for both Florida Bay and Biscayne Bay, ALTQ+ would result in similar effects as discussed under ALTQ.

4.7 Fish and Wildlife Resources

A comparison of potential effects on fish and wildlife resources is summarized below. Effects to state and federally listed species are described in further detail in **Section 4.8** (**Threatened and Endangered** Species).

4.7.1 Invertebrates

Important aquatic invertebrates of the freshwater marsh include Everglades crayfish (*Procambarus alleni*), slough crayfish (*Procambarus fallax*), riverine grass shrimp (*Palaemonetes paludosus*), amphipods (*Hyalleal aztecus*), Florida apple snail (*Pomacea paludosa*) and numerous species of aquatic insects. The abundance and distribution of aquatic invertebrates in the study area may change under the COP

depending upon location and species. Over drained areas in ENP are anticipated to be rehydrated. Aquatic invertebrates may rapidly colonize these newly re-hydrated areas. The influence of ALTN2, ALTO, ALTQ, and ALTQ+ on aquatic invertebrates is likely to be complex given the diversity of life histories in the study area and is dependent upon individual species preferences for longer or shorter hydrologic conditions.ALTN2, ALTO, ALTQ, and ALTQ+ increased overland flow, water depths and hydroperiods in portions of ENP, including NESRS and Taylor Slough. Reference **Section 4.2** (**Hydrology**). ALTN2, ALTO, ALTQ, and ALTQ+ have the potential for minor to moderate long-term beneficial effects in ENP on aquatic invertebrates, dependent upon longer hydrologic conditions. Increased water depths and resulting hydroperiods in ENP would promote wetland vegetation transition through contraction of sawgrass marshes and expansion of wet prairies, and in deeper regions, sloughs. Reference **Section 4.6** (**Vegetative Communities**). Periphyton is a community of cyanobacteria, algae, and zooplankton that is found wrapped around submerged aquatic vegetation. Periphyton is a primary component of invertebrate diets and is found throughout the low nutrient marshes of the study area. The formation of periphyton mats depends upon a healthy growth of submerged aquatic plants, which can only occur with high light penetration to the surface of the water column during wet, hot, summer months. Degraded periphyton mats are likely to be associated with exceptionally dense marsh vegetation and other alterations such as water quality. Periphyton mats form an important part of the foundation of the food web in freshwater marshes and sloughs. The mats are a food source for prey-base fish, and serve as habitat refuges for crayfish and other arthropods. Increased water depths and hydroperiods in ENP may effect periphyton as a result of improved conditions for marsh vegetation.

Reference **Section 4.8.1.5** (**Everglade Snail Kite**) for further information on potential effects to apple snails.

4.7.2 Fish

Abundance of marsh fishes has been correlated with the duration of surface flooding throughout the central Everglades. For the COP an ecological planning tool was available to evaluate potential effects on small sized fish density (defined as less than eight centimeters adult standard length) within the study area. The ecological planning tool or prey based freshwater fish density model estimates the densities of small-sized freshwater fish, primarily livebearers (*poeciliids*) and killifishes (*cyprinodontids* and *fundulids*). High-densities of these fish characterized the pre-drainage central Everglades ecosystem. Maximizing densities is an objective of many restoration scenarios. Because prey fish dominate the prey community in both biomass and abundance, they are an important energy source for higher-trophic levels, such as wading birds, alligators, and larger fish. Thus ecological planning tool estimations of prey fish can be used as a general measure of trophic conditions within the central Everglades. For more details reference Donalson, et al., 2010.

Figure 4-86 through **Figure 4-91** illustrates the percent change in mean daily total fish density for ALTN2, ALTO, and ALTQ relative to ECB19RR for a wet year (1995) and dry year (1989). Observed differences between each alternative and ECB19RR were most often not more than a ± 10% change. Differences greater than ± 10% were observed in a number of locations in portions of WCA 3 and NESRS during a wet year under each alternative. Increases in mean total fish density were observed in NESRS. Decreases were observed in portions of WCA 3A adjacent to the L-67A canal, in southern WCA 3A, and in WCA 3B. During a dry year, similar patterns were noted; however potential differences in mean total fish density were observed to be of a greater magnitude. An ecological planning tool was not utilized for ALTQ+ since a separate RSM-GL model simulation was not conducted for the alternative. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+

on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages.

Figure 4-92 illustrates the annual percent change in mean daily total fish density relative to ECB19RR over all of the locations (i.e. circles) depicted in **Figure 4-86** through **Figure 4-91.** The circles in these figures represent locations within the study area where small sized fish density is able to be predicted based on a long-term monitoring data set. ALTN2 and ALTO improved mean daily total fish density with the exception of three years in the 41-year period of record. ALTQ improved mean daily total fish density in all years of the 41-year period of record. ALTO was observed to improve mean daily total fish density to the greatest extent (highest value in 20 of the 41-year period of record) followed by ALTQ (highest value in 15 of the 41-year period of record) and ALTN2 (highest value in 6 of the 41-year period of record).

ALTN2, ALTO, ALTQ, and ALTQ+ increased overland flow, water depths, and resulting hydroperiods in portions of ENP having the potential for minor to moderate long-term beneficial effects on marsh fishes. Improved hydrologic conditions would result in improved habitat suitability for marsh fishes. In portions of WCA 3 where inundation duration would decrease, ALTN2, ALTO, ALTQ, and ALTQ+ would create negligible to minor long-term adverse effects. During dry years, lowering of water levels in WCA 3 may act to reduce the number or spatial extent of deeper water for large predatory fishes within WCA 3A, although canals will continue to provide refugia for these species. Although posing a negative impact on larger fish species, these events may enable smaller fish populations to increase due to “predator release” or removal of larger fish species. Drying of marsh vegetation may also act to release nutrients into the water column, causing an increase in primary productivity, and consequently, increasing the food source of smaller fishes. Too frequent of drying events, however may act to reduce fish populations. Increased opportunities within ENP anticipated as a result of the COP may offset any poor conditions that would occur from the COP within WCA 3. Introduction of non-native fish species due to water management operations under ALTN2, ALTO, ALTQ or ALTQ+ is not anticipated as new access points would not be created under the COP.

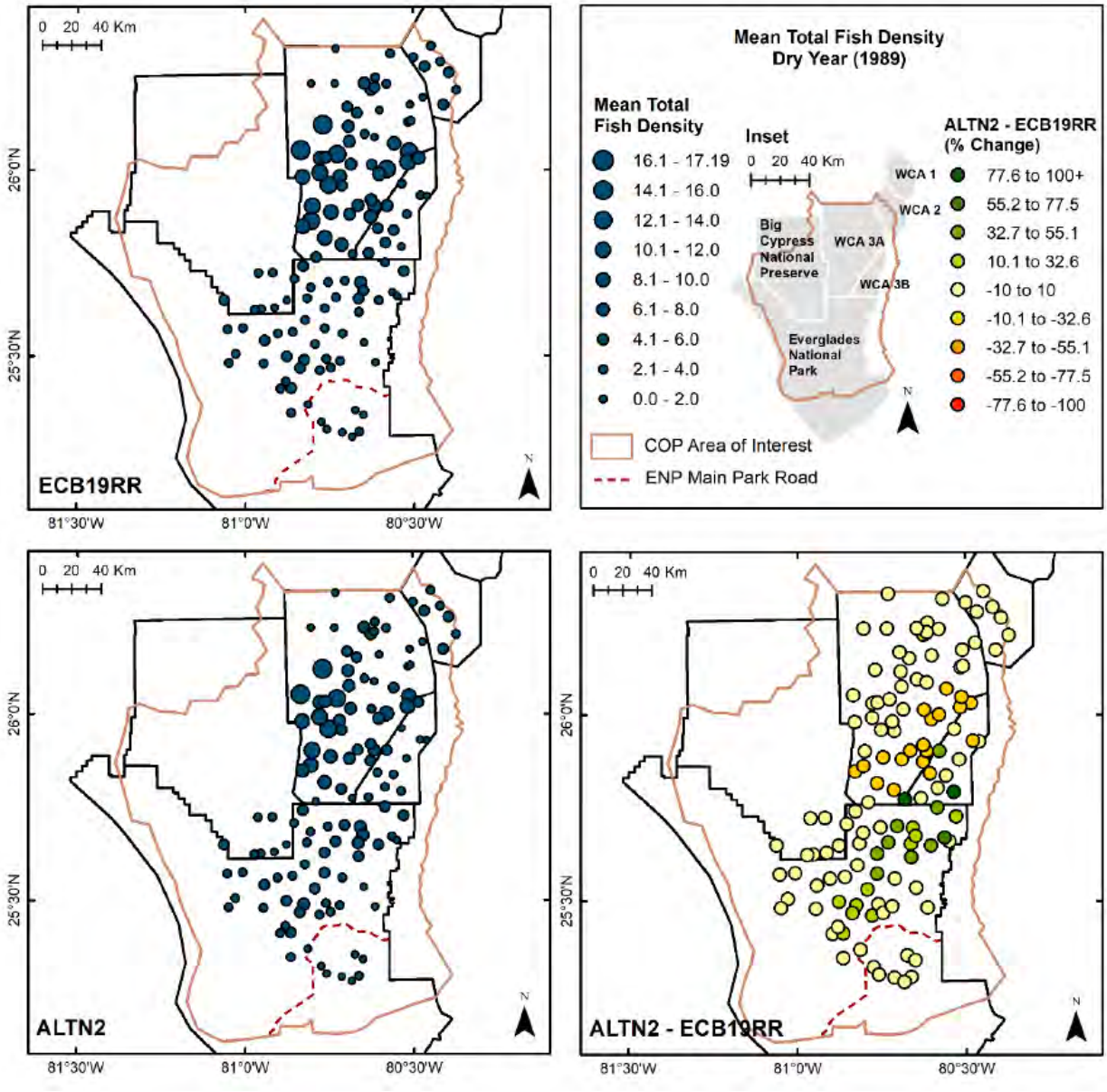

Figure 4-86. Mean total fish density for a dry year (1989) for ALTN2.

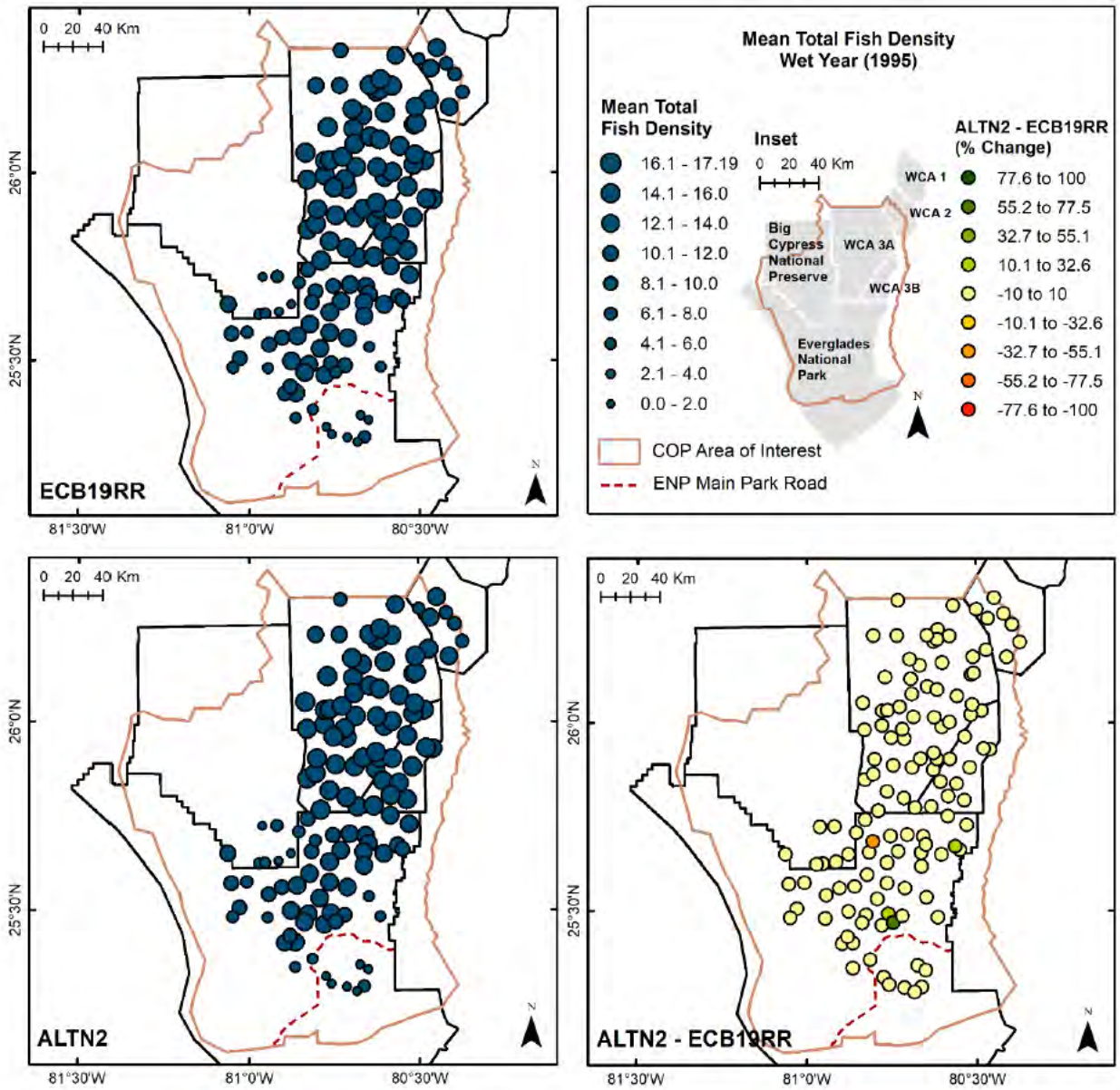

Figure 4-87. Mean total fish density for a wet year (1995) for ALTN2.

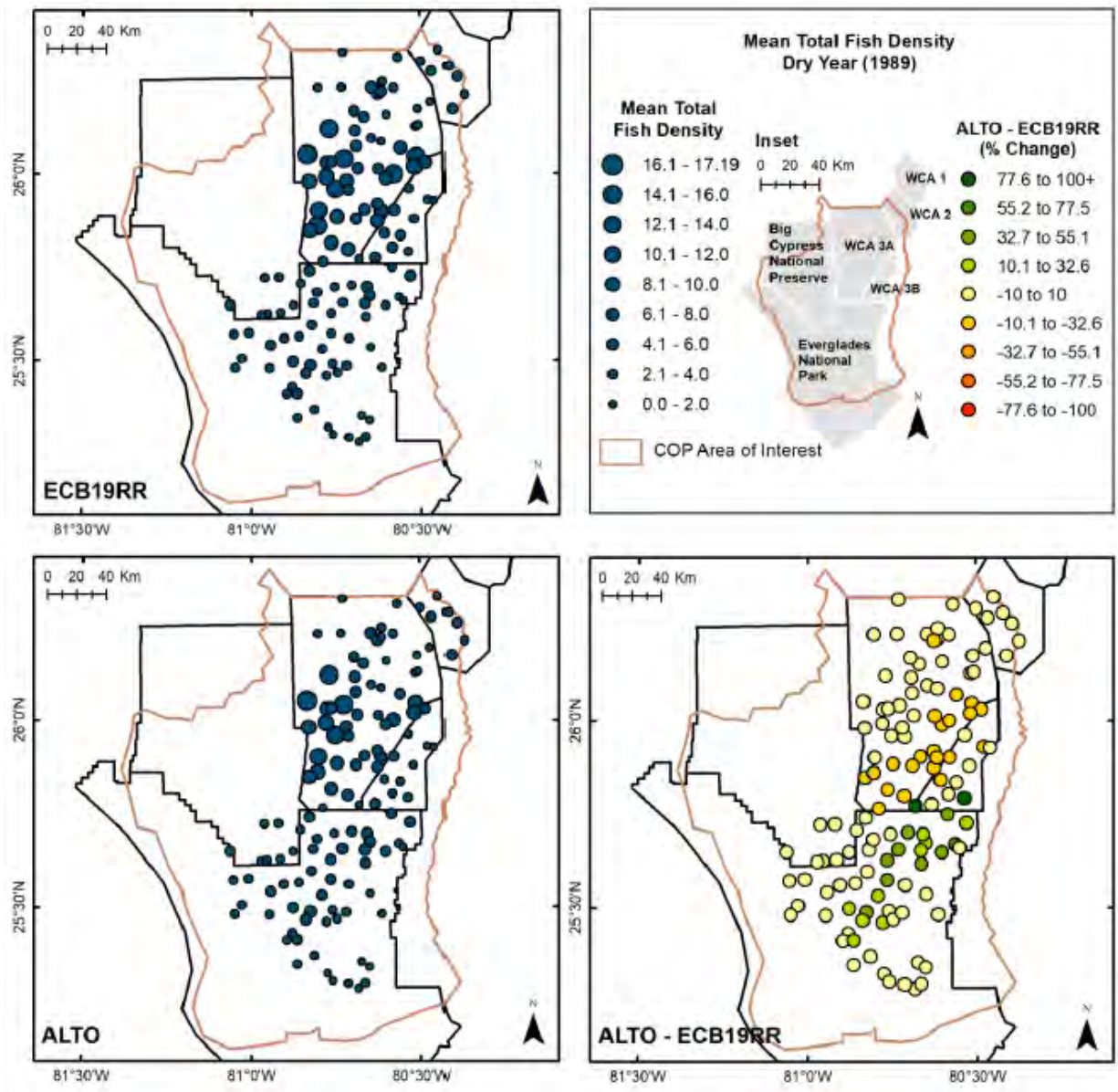

Figure 4-88. Mean total fish density for a dry year (1989) for ALTO.

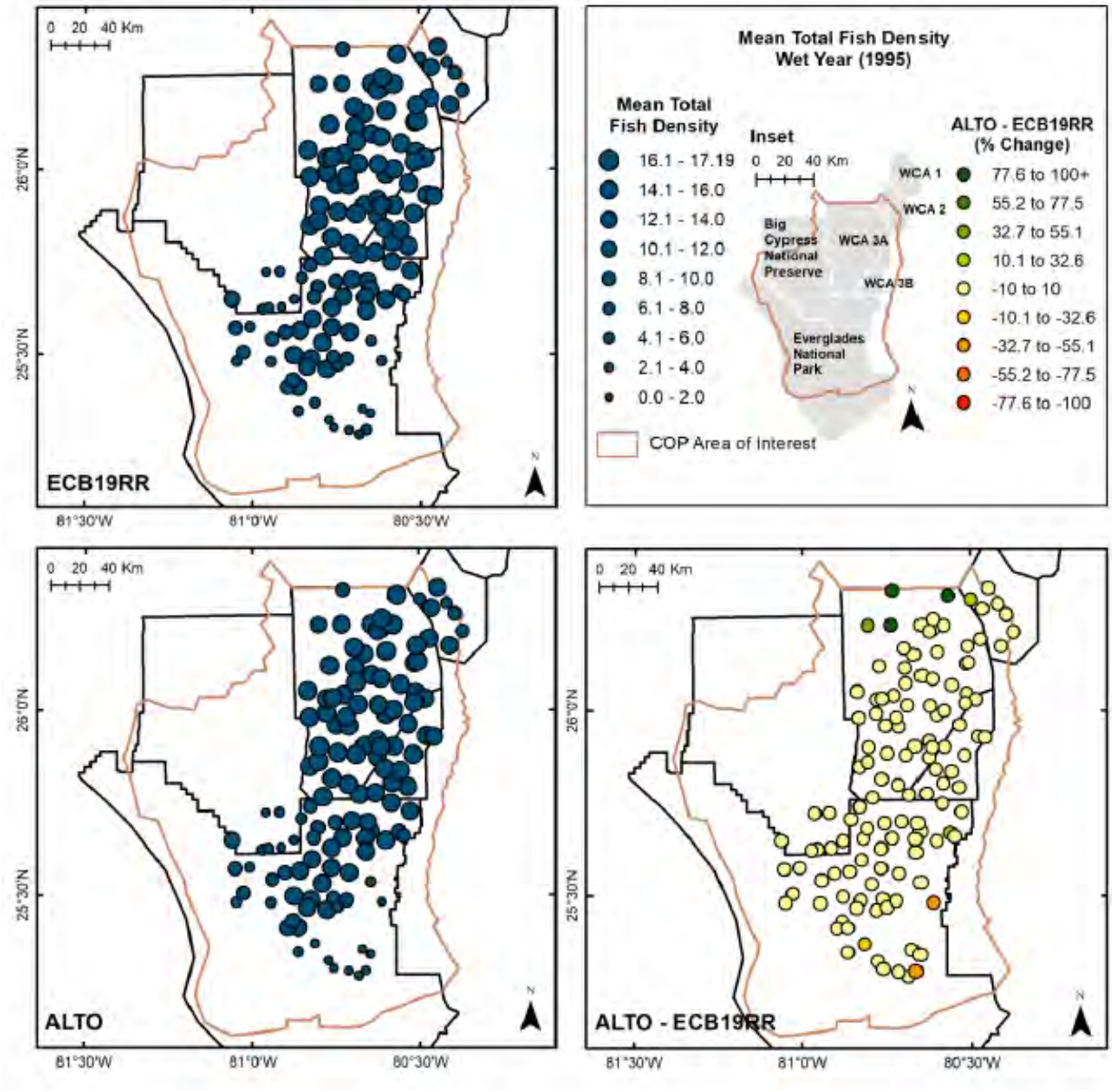

Figure 4-89. Mean total fish density for a wet year (1995) for ALTO.

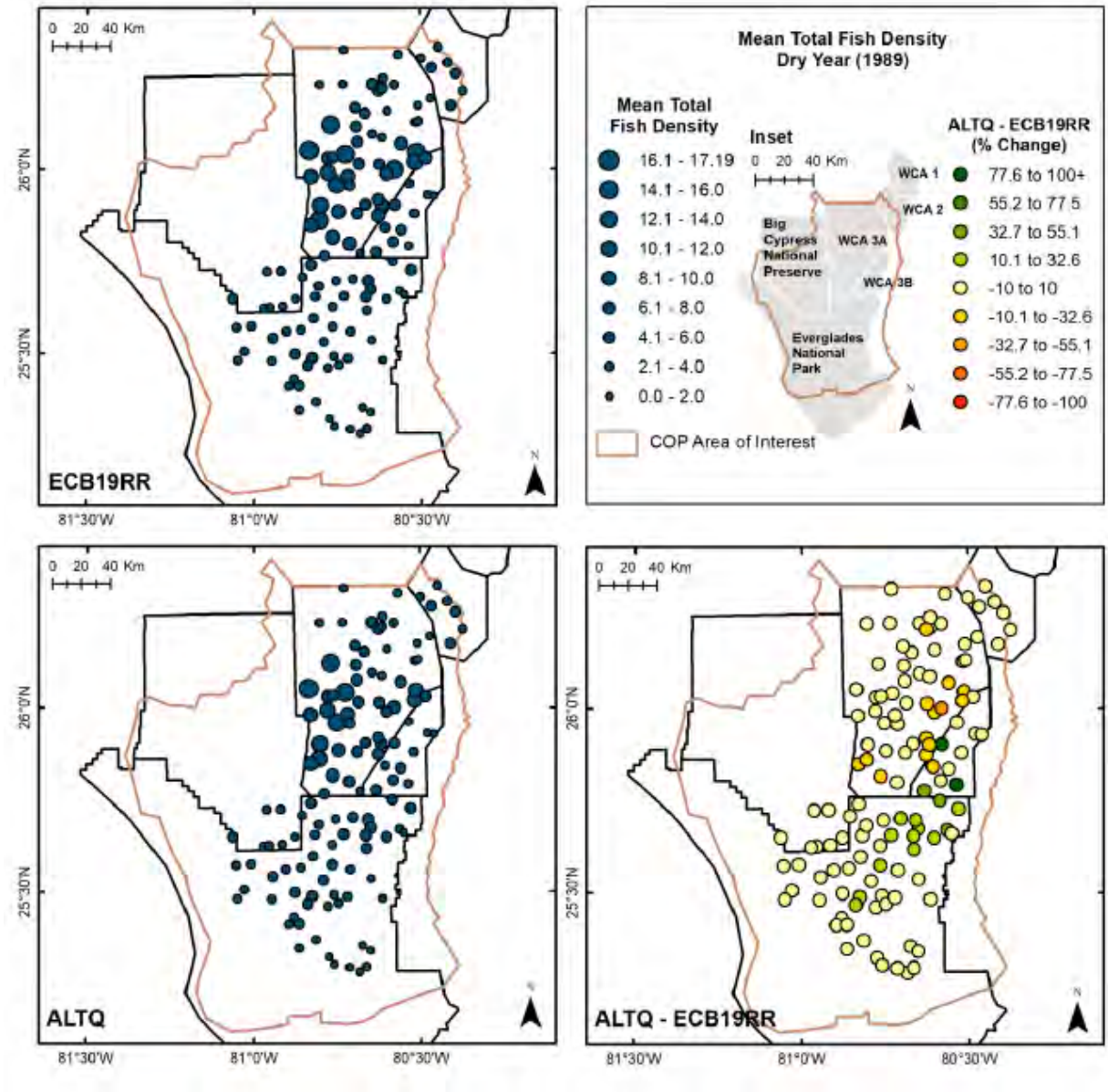

Figure 4-90. Mean total fish density for a dry year (1989) for ALTQ.

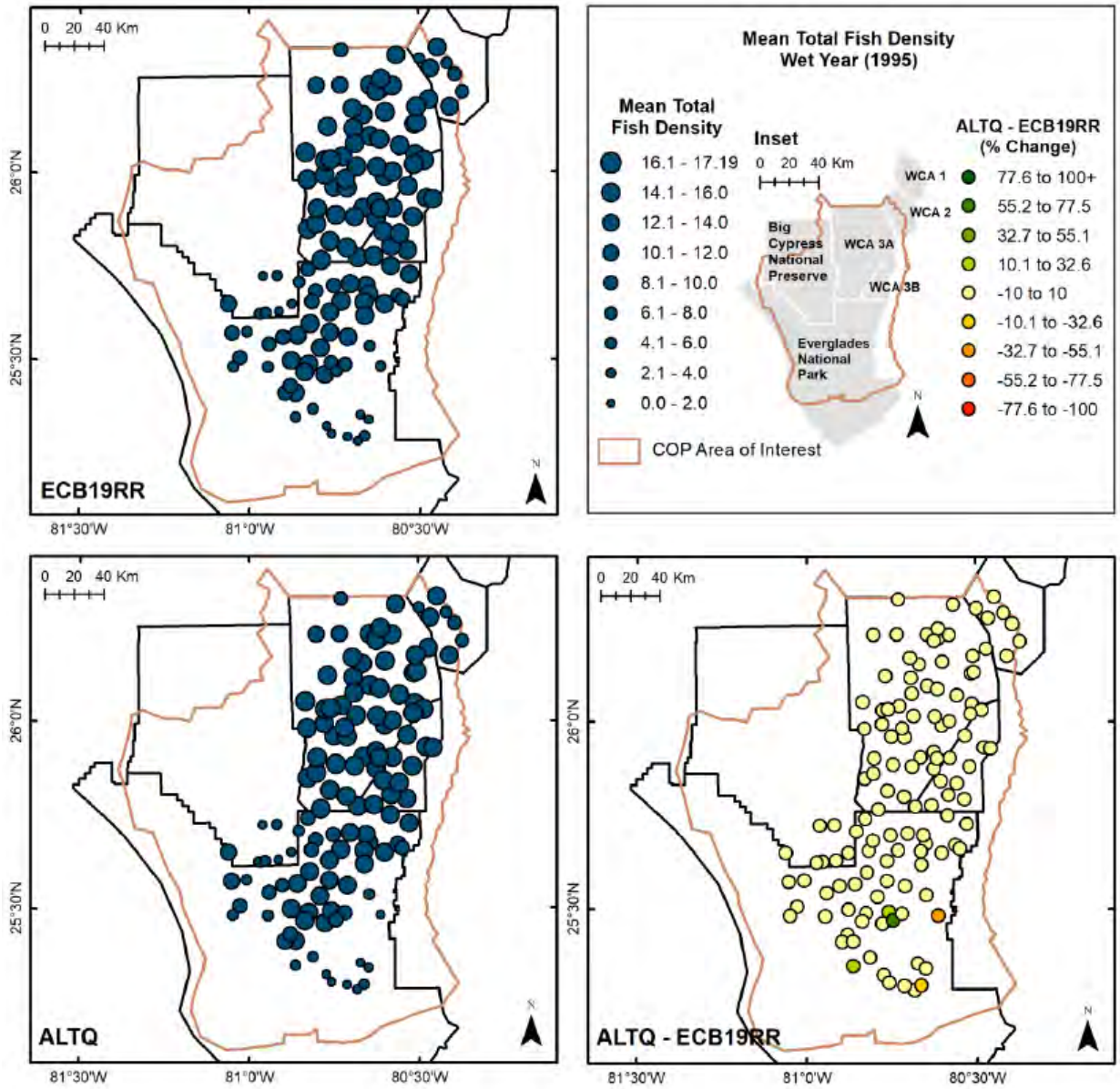

Figure 4-91. Mean total fish density for a wet year (1995) for ALTQ.

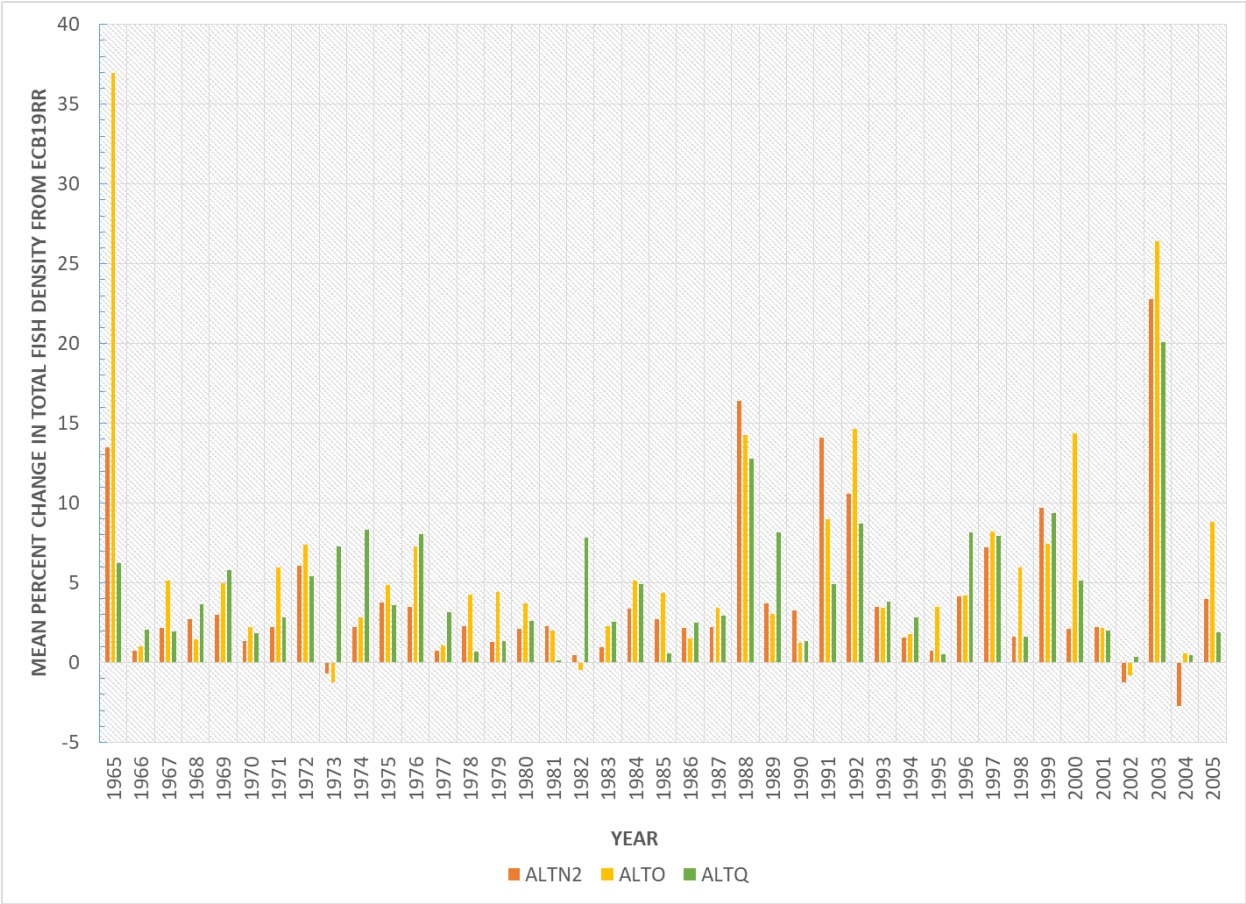

Figure 4-92. Mean percent change in total fish density from ECB19RR for each year in the period of record (1965-2005).

4.7.3 Amphibians and Reptiles

For the COP, an ecological planning tool was available to evaluate potential effects on the American alligator (*Alligator mississippiensis*) a keystone species within the Greater Everglades marsh systems, acting as predator and prey and structuring plant communities (Brandt and Mazzotti, 2000). Alligators are dependent on spatial and temporal patterns of water fluctuations that affect courtship and mating, nesting, and habitat use. Water management practices and other anthropogenic changes to the region have affected alligators, which historically were abundant in peripheral marshes of the Everglades (Craighead 1968) and are now most abundant in central sloughs (Kushlan 1990). Water management practices including drainage of peripheral wetlands has limited occurrence of American alligators in these habitats (Craighead 1968, Kushlan 1990, Mazzotti and Brandt 1994). A Habitat Suitability Index (HSI) for alligators was employed to predict potential effects of ALTN2, ALTO, and ALTQ relative to ECB19RR. The HSI measures habitat suitability annually for five components of alligator production: (1) land cover suitability, (2) breeding potential (female growth and survival from April 16 of the previous year - April 15 of the current year), (3) courtship and mating (April 16 – May 31), (4) nest building (June 15 – July 15), and egg incubation (nest flooding from July 01 – September 15). (Shinde et al. 2014). For more details please reference Brandt et. al. 2000, Craighead 1968, Kushlan 1990 and Shinde et. al. 2014.

The COP is expected to benefit ENP by increasing flows to NESRS and Taylor Slough and hydrating existing wetlands. **Figure 4-93** through **Figure 4-98** illustrates the difference in alligator breeding potential for ALTN2, ALTO, and ALTQ relative to ECB19RR for a representative average year (1978), dry year (1989), and wet year (1995) within the period of record (1965-2005). During a dry year, observed differences between each alternative and ECB19RR were most often not more than a ± 10% change across the majority of WCA 3 and ENP. During a wet year, increases in alligator habitat suitability greater than 10% were observed for ALTN2 in southern WCA 3A and in portions of southern ENP on the flanks of eastern SRS, however these same patterns were not observed for ALTO and ALTQ. Areas in southern WCA 3A in which alligator habitat suitability increased under ALTN2, were observed to decrease in suitability for ALTO or no change was observed under ALTQ in these same areas. Performance between ALTN2, ALTO, and ALTQ were more similar in an average year, where suitability was observed to decrease in the southern most extent of ENP and NESRS.

The light brown line noted as the COP area of interest in **Figure 4-93** through **Figure 4-98** was identified at the start of the planning efforts for the COP and was used to define the maximum acreage that could be potentially affected by the COP and was utilized in the calculations in **Figure 4-99**. **Figure 4-99** shows percent change in mean annual alligator habitat suitability index against ECB19RR. ALTN2, ALTO, and ALTQ improved conditions for alligators in 19, 18, and 17 years out of the 41-year period of record, respectively. Performance for ALTN2 ranged from a maximum percent of ~12% observed in a given year to a minimum percent change of ~-15% with an average cross years of ~ -2%. Performance for ALTQ ranged from a maximum percent of ~7% observed in given year to a minimum percent change of ~-18% with an average cross years of ~ -2%. An ecological planning tool was not utilized for ALTQ+ since a separate RSM-GL model simulation was not conducted for the alternative. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages.

Rehydration within previously dry areas may increase the spatial extent of suitable habitat for amphibians and aquatic reptiles. As hydrology improves it is expected that species richness will also change. However, declines in some species may be offset by favorable habitat conditions for other species. Increases in forage prey availability (i.e. crayfish and other invertebrates, fish) in areas rehydrated by the COP also have the potential to directly benefit amphibian and reptiles species. Improved hydroperiods under the COP alternatives may also facilitate the movement of small amphibians and aquatic reptiles across the landscape. Implementation of the COP may produce a variety of wetland habitats that would support conditions conducive to alligators and other aquatic reptiles.

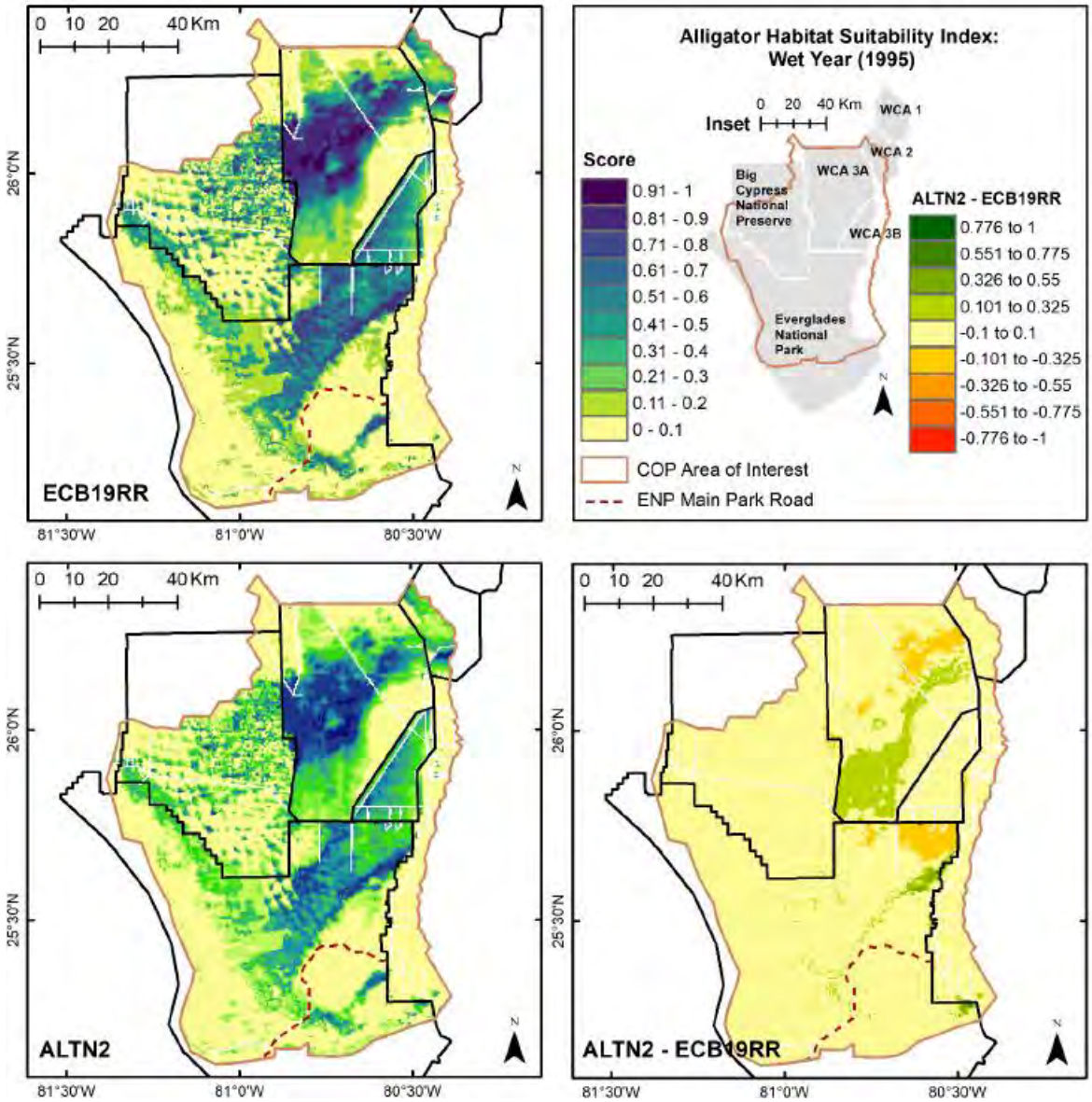

Figure 4-93. Alligator Habitat Suitability Index for a wet year (1995) for ALTN2.

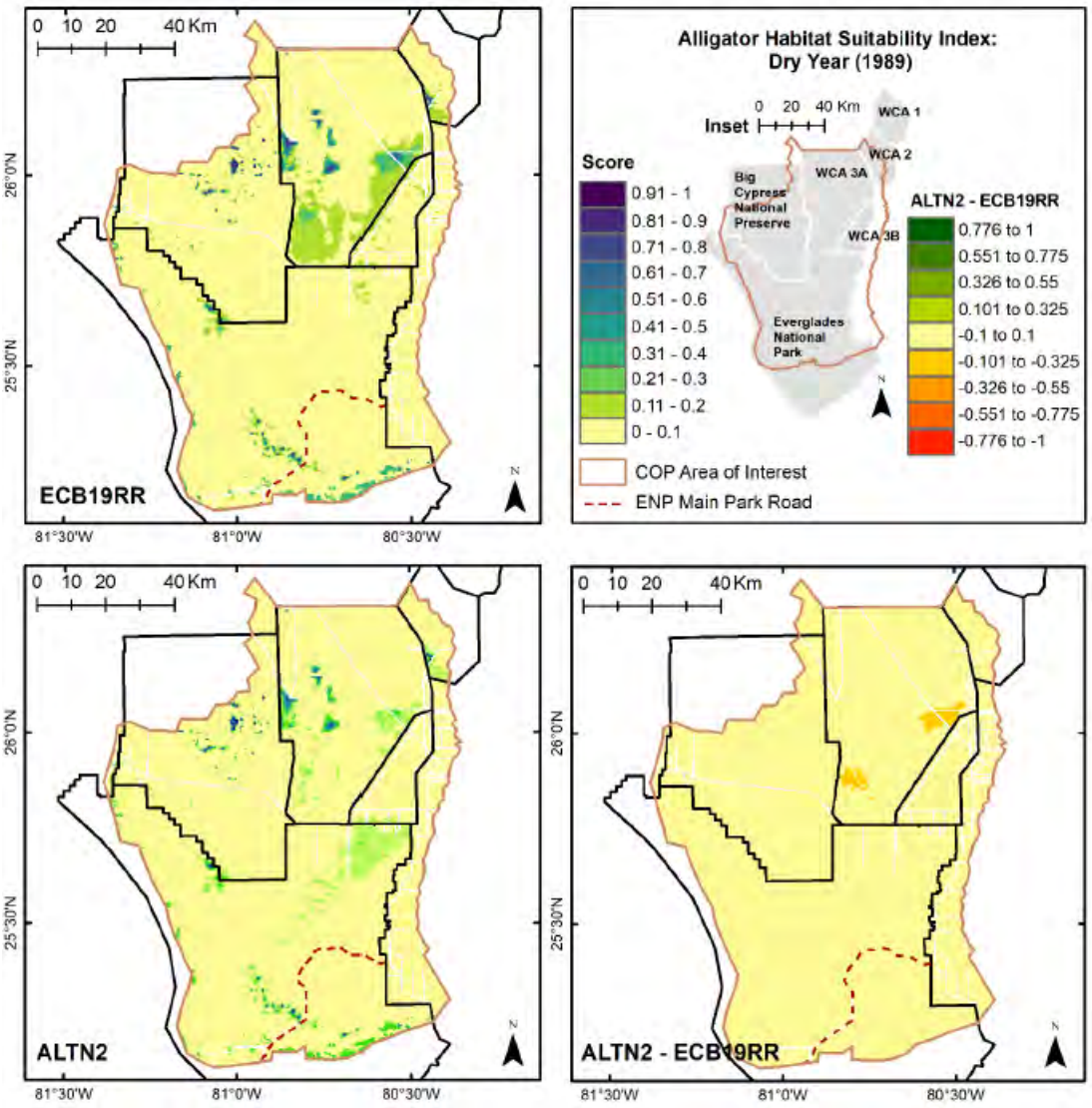

Figure 4-94. Alligator Habitat Suitability Index for a dry year (1989) for ALTN2.

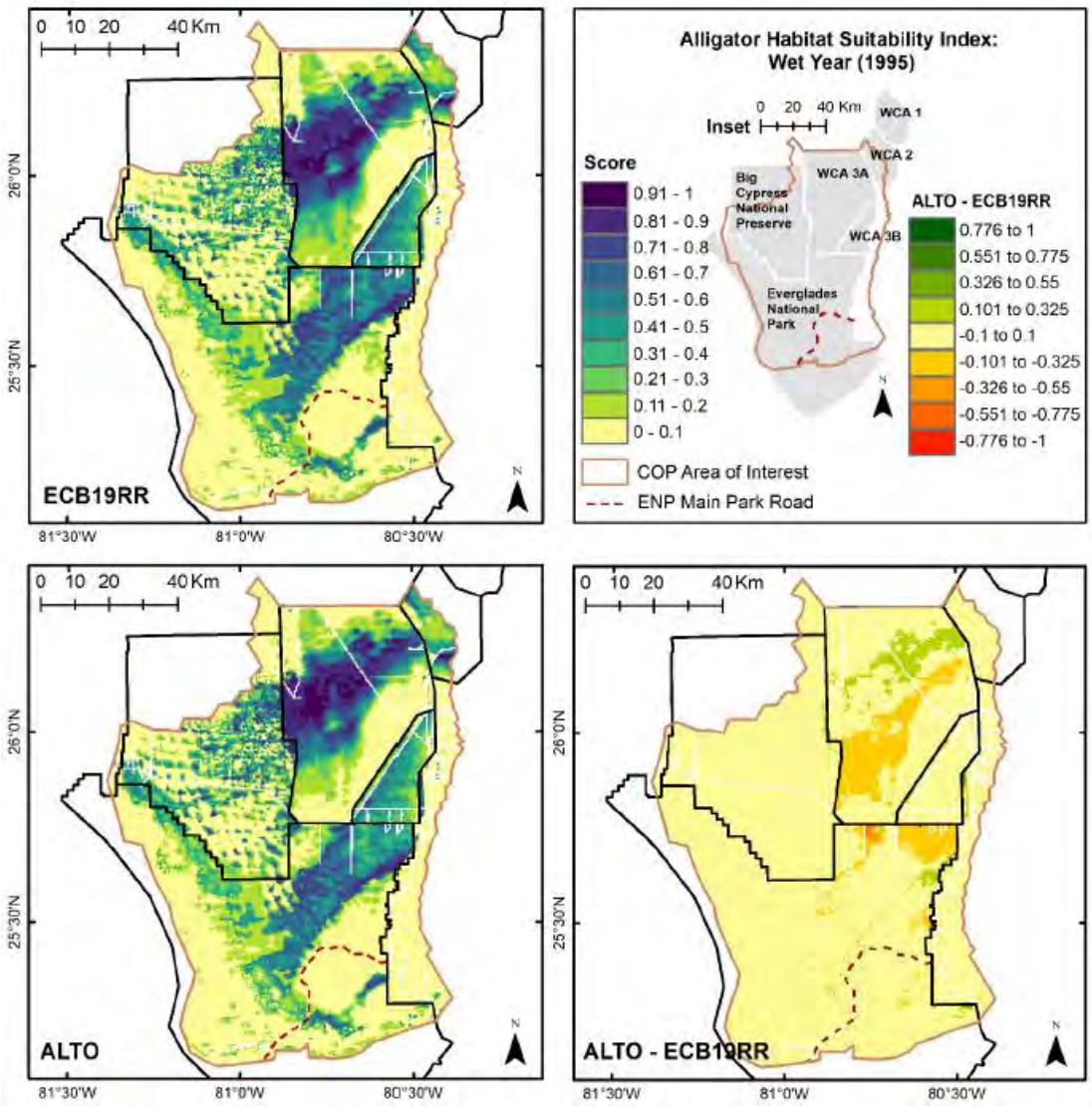

Figure 4-95. Alligator Habitat Suitability Index for a wet year (1995) for ALTO.

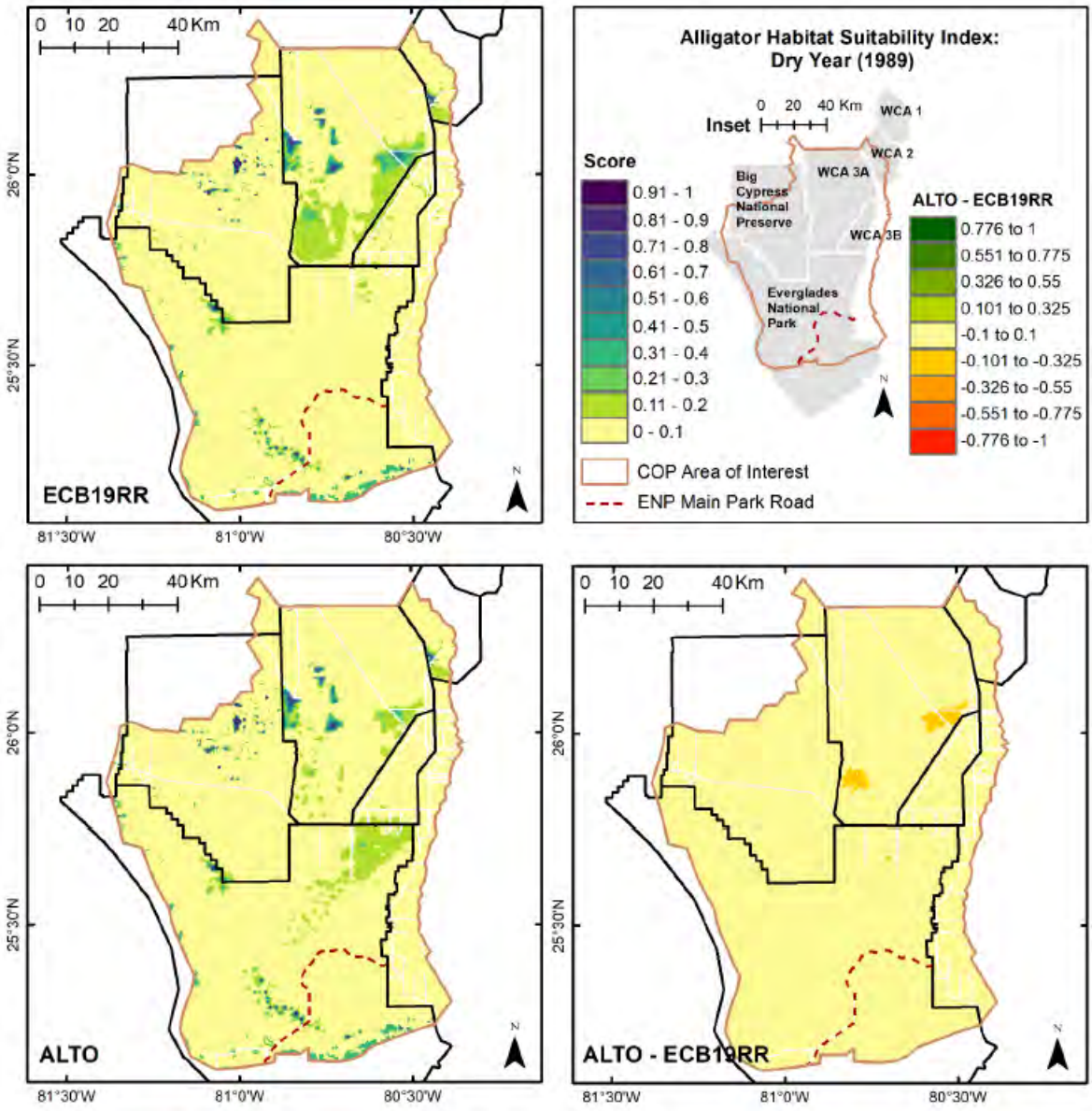

Figure 4-96. Alligator Habitat Suitability Index for a dry year (1989) for ALTO.

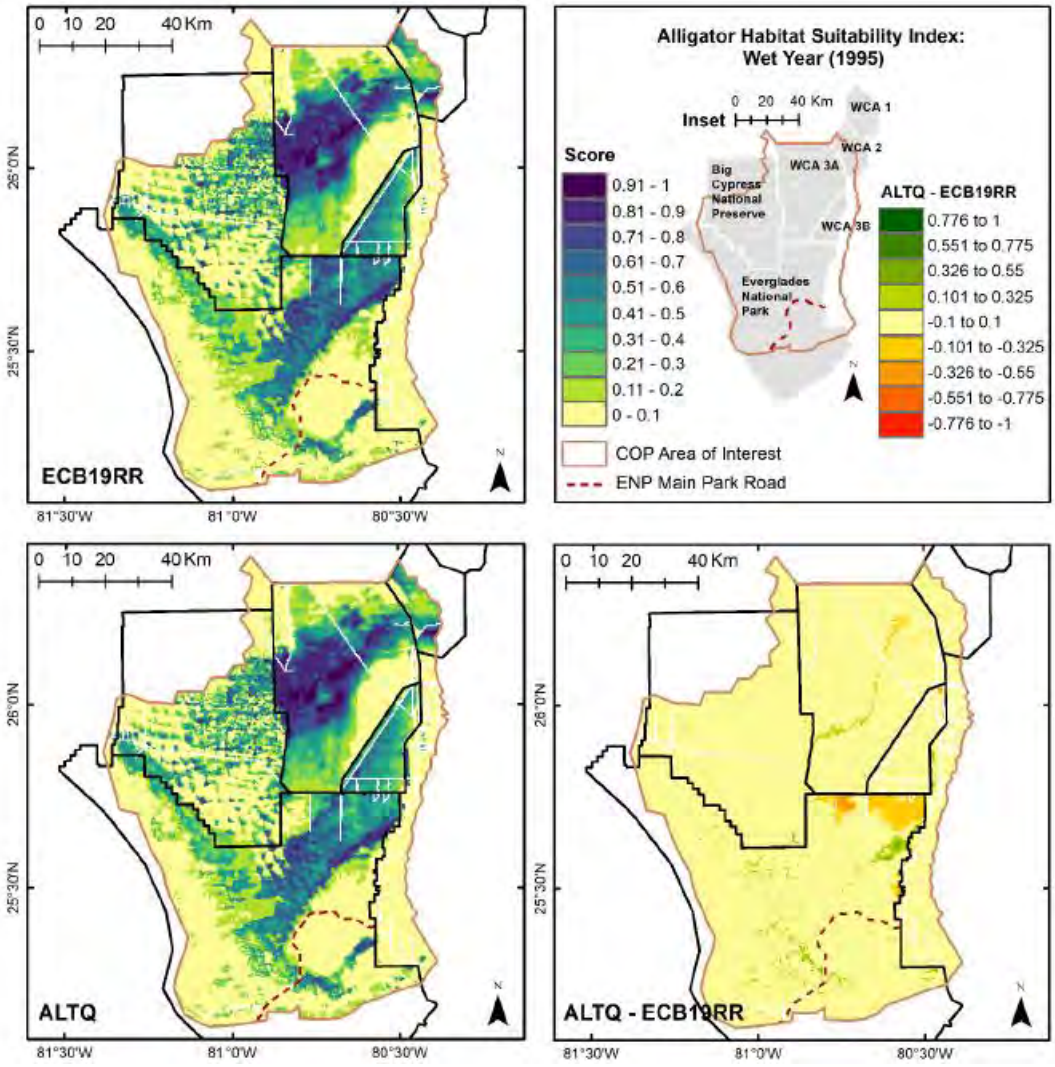

Figure 4-97. Alligator Habitat Suitability Index for a wet year (1995) for ALTQ.

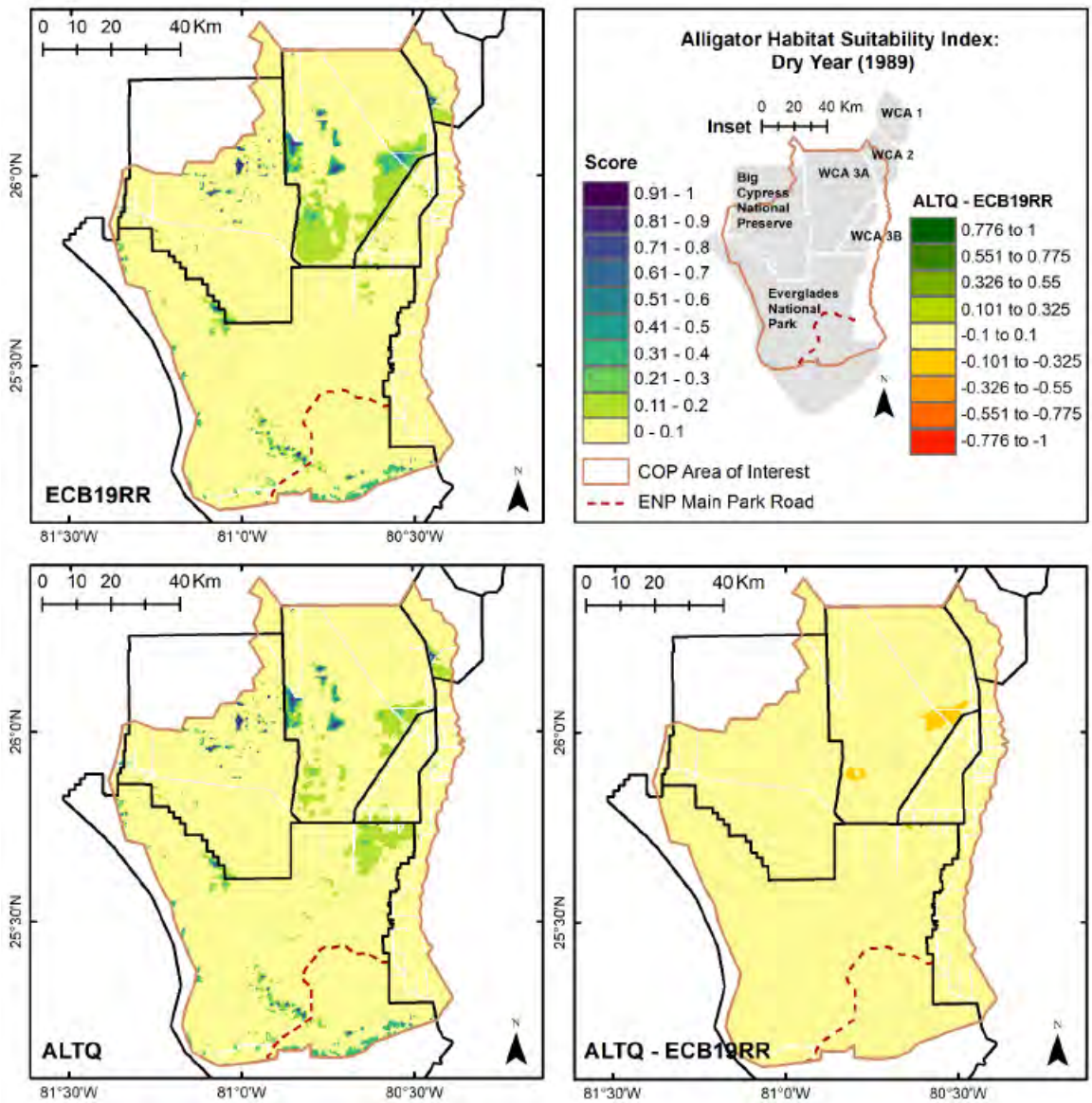

Figure 4-98. Alligator Habitat Suitability Index for a dry year (1989) for ALTQ.

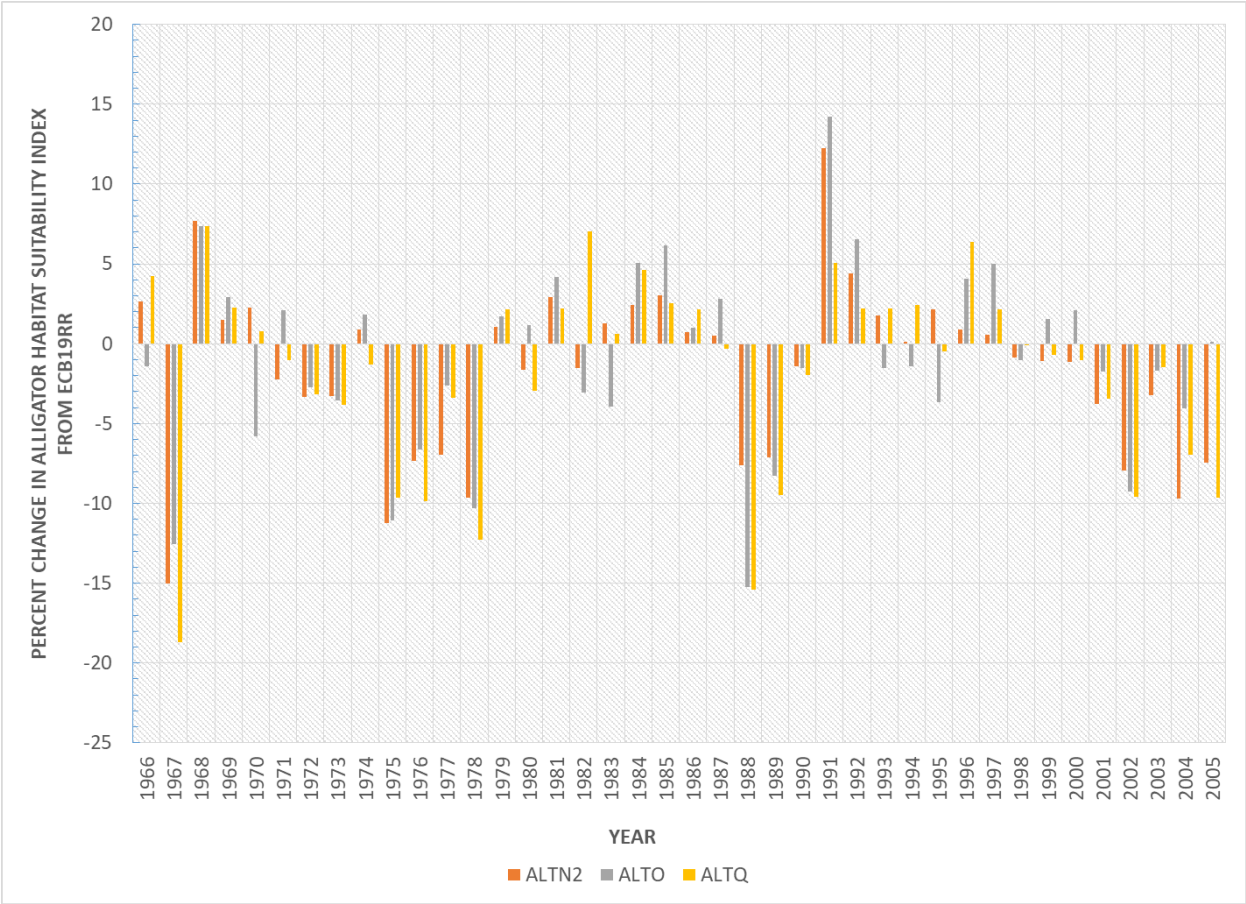

Figure 4-99. Percent change in alligator habitat suitability index from ECB19RR.

4.7.4 Birds

The freshwater wetlands of the Everglades are noted for their abundance and diversity of colonial wading birds. ALTN2, ALTO, ALTQ, and ALTQ+ increased overland flow, water depths and resulting hydroperiods in portions of ENP, including NESRS and Taylor Slough. Improved hydrologic conditions may result in improved habitat suitability for marsh fishes. Reference Section **4.7.2** (**Fish**). An increase in the abundance of marsh fishes may directly benefit higher trophic level predators such as wading birds.

For the COP, an ecological planning tool was available to evaluate potential effects on wading birds in the study area. The Wading Bird Distribution Evaluation Model (WADEM) was utilized to determine spatially explicit changes in high quality foraging conditions for wading birds for ALTN2, ALTO, and ALTQ relative to ECB19RR. WADEM uses a spatiotemporal species distribution model (SDM) framework to evaluate the foraging responses of great egrets, white ibises, and wood storks. Using a multi-model approach, a spatial foraging conditions model (SFC) predicts wading bird abundance over time at a fixed spatial scale (400 meter) and a temporal foraging conditions model (TFC) predicts daily abundance across space. The resulting indices represent proxies for different components of patch dynamics: patch quality within suitable depths is reflected by TFC and landscape patch abundance by SFC. The product of these two indices (area × quality; or foraging index) provides a metric to account for both processes. To evaluate the effects of the COP alternatives on wading bird patch quality and patch abundance, mean abundance (TFC) and mean quality (SFC) over the years 1975-2005 was calculated. Mapped results are shown overlaid with

locations of recent wood stork colonies. Colony locations were obtained from the USFWS. Additional colony locations were added based on ENP survey data of nesting activity in 2009 (SFWMD 2009), a banner year for wading bird nesting activity, and thus represent colonies with breeding activity potential. For more detailed information on WADEM, refer to Beerens et al 2015a, Beerens et al 2015b, and Cook and Kobza 2009.

Figure 4-100 through **Figure 4-102** show the mean spatial foraging conditions index over the months of March and April over the years 1975-2005 and the percent change between each alternative and ECB19RR for the wood stork. For the spatial foraging conditions index, the larger the value the better conditions for the specified wading bird. Observed differences between each alternative and ECB19RR were most often not more than a ± 10% change across the majority of WCA 3 and ENP. Improvements in foraging conditions were observed in NESRS under ALTN2, ALTO, and ALTQ relative to ECB19RR.

Figure 4-103 shows percent change in mean daily foraging index (SFC x TFC) for the wood stork for each year in the period of record. Yearly summaries were calculated such that a given year displays the mean value for the November – May breeding season (i.e., the value for 1999 shows the mean from November 1998 through May 1999). ALTO and ALTQ improved the mean daily foraging index with the exception of six years in the 31-year period of record. ALTN2 improved with the exception of five years in the 31-year period of record. ALTO was observed to improve conditions to the greatest extent (maximum percent change of ~9% observed in given year; average percent change ~ 2%; minimum percent change ~-1%) followed by ALTN2 (maximum percent change of ~8% in given year; average percent change ~2%; minimum percent change ~-1%) and ALTQ (maximum percent change of ~5% in given year; average percent change ~2%; minimum percent change~-1%). An ecological planning tool was not utilized for ALTQ+ since a separate RSM-GL model simulation was not conducted for the alternative. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages. Observed results indicate that ALTN2, ALTO, ALTQ, and ALTQ+ have the potential to provide minor to moderate beneficial long-term effects on wood storks in portions of ENP.

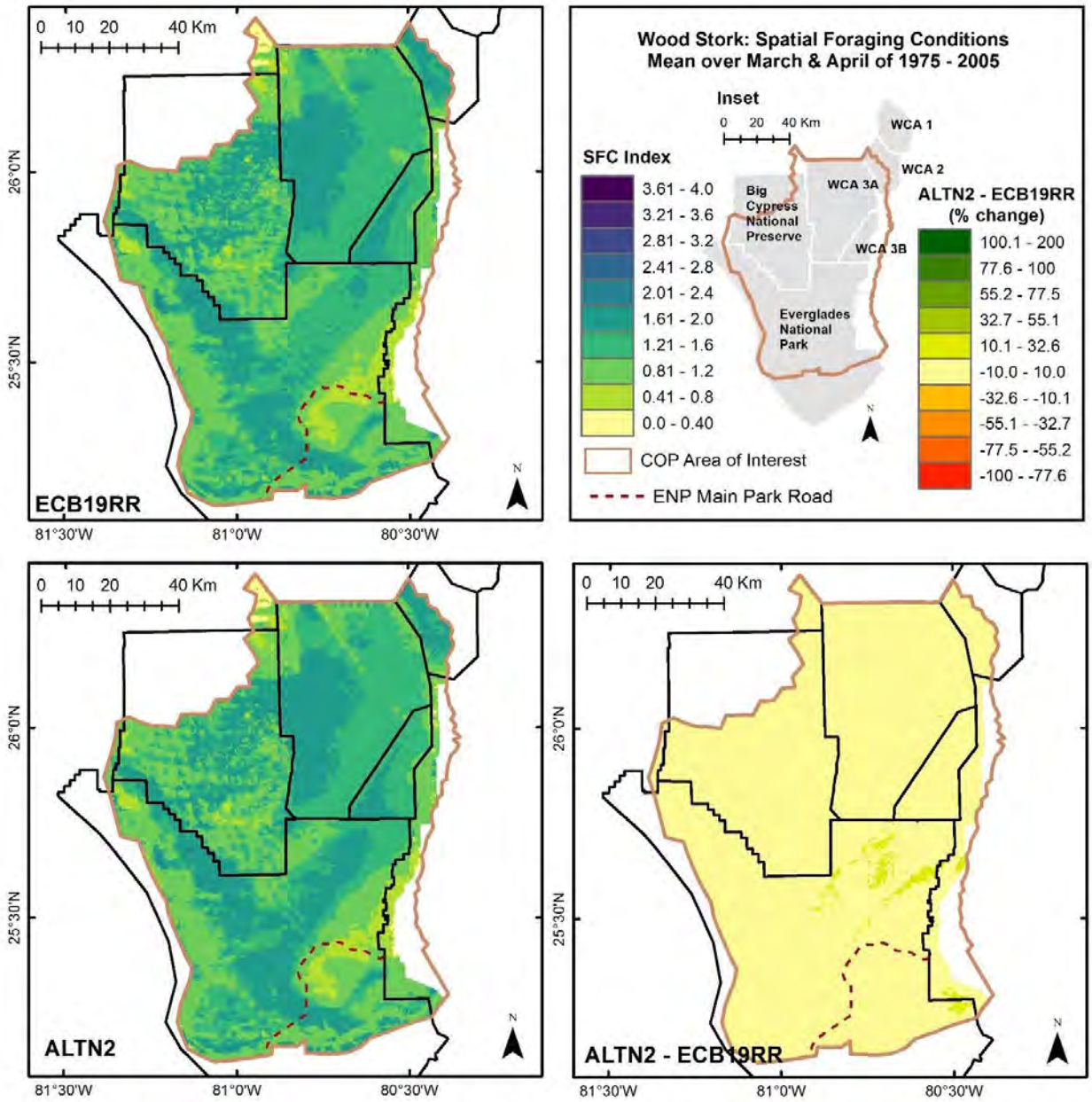

Figure 4-100. Spatial foraging conditions index for the wood stork for ALTN2.

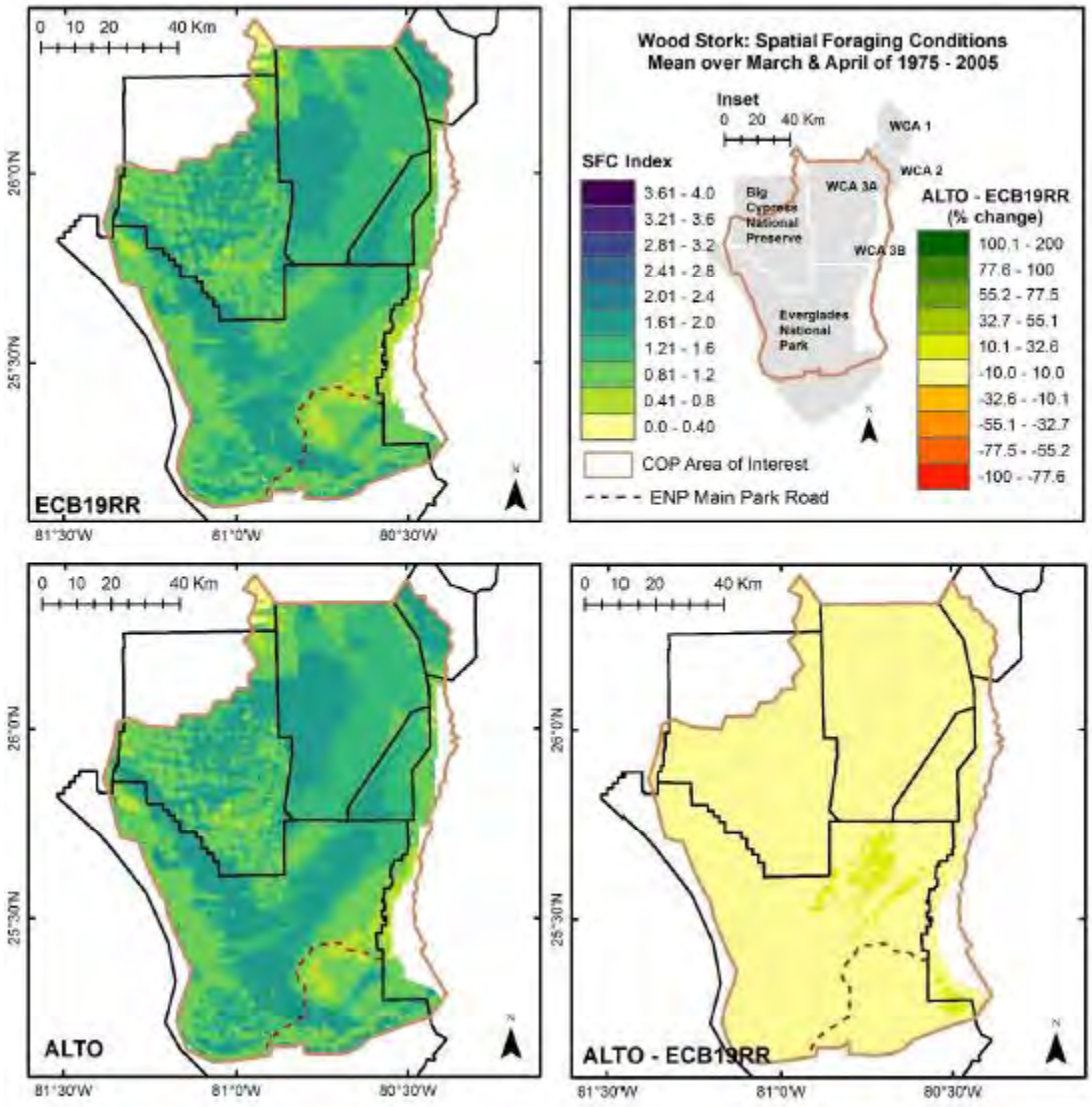

Figure 4-101. Spatial foraging conditions index for the wood stork for ALTO.

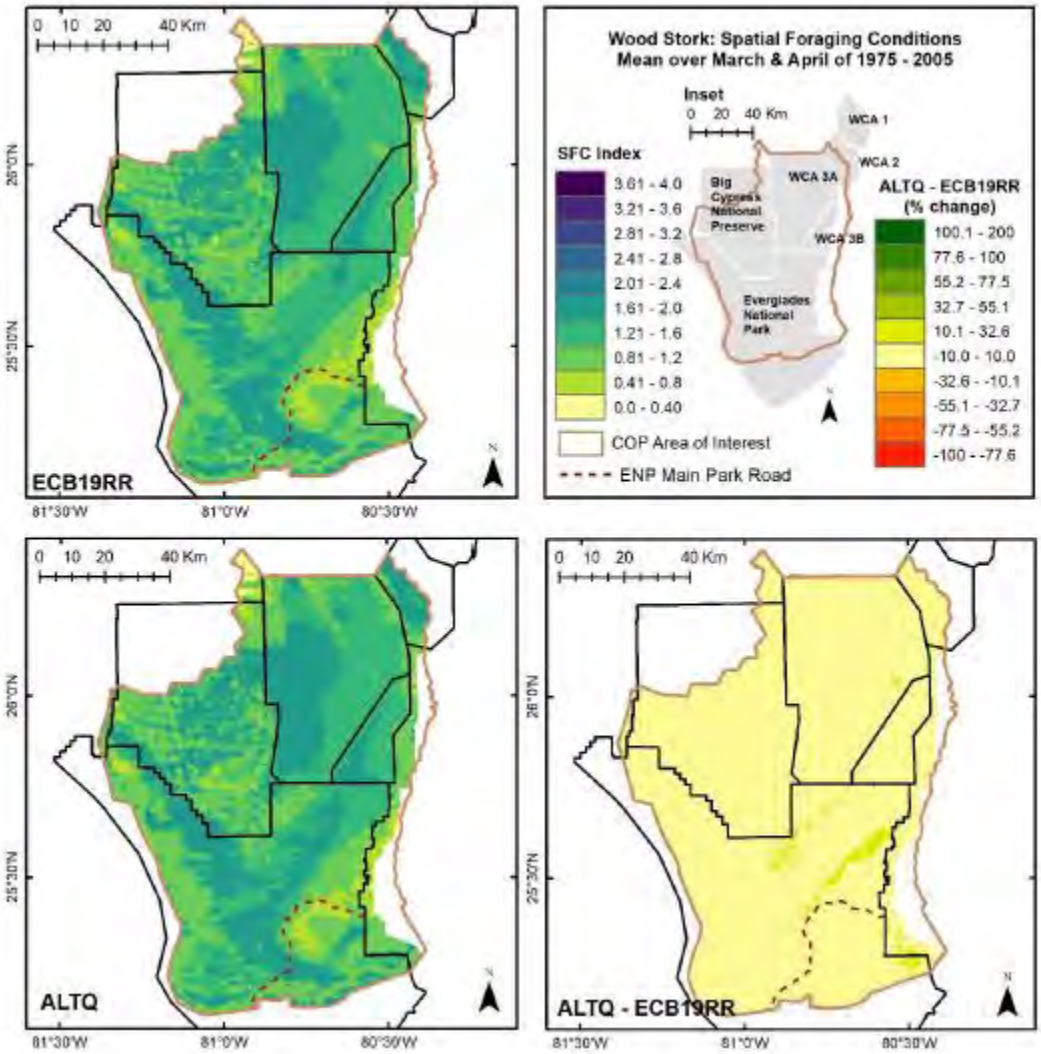

Figure 4-102. Spatial foraging conditions index for the wood stork for ALTQ.

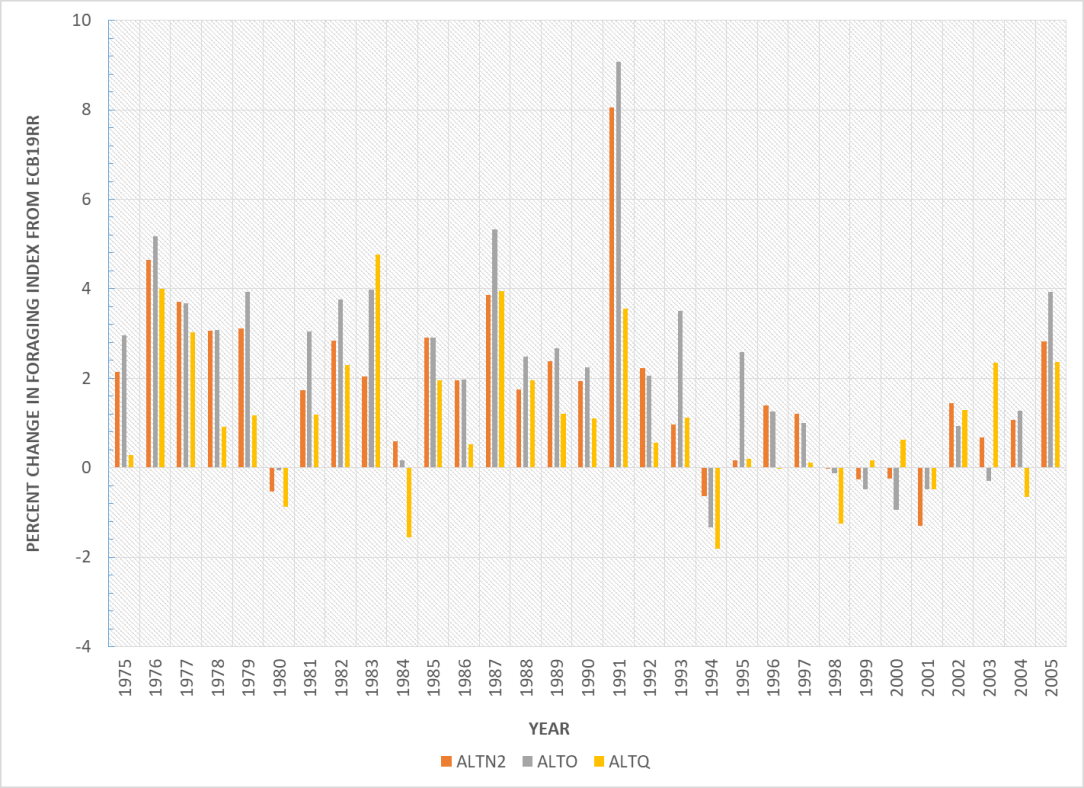

Figure 4-103. Wood stork foraging index. Percent from ECB19RR.

WADEM is a great tool for helping to predict wading bird patterns but, as with any model, it is limited and should be interpreted with a holistic understanding of wading bird responses. One limitation most pertinent to the planning effort is that the model is tied to foraging responses and was not designed to account for drying effects on nesting colonies. When depths surrounding a rookery island used for nesting, reach ground surface, terrestrial nest predators gain access to the colony's nesting wading birds. Additional drying of the Alley North super-colony (located in northeastern WCA 3A), which is currently at high risk for drying down to soil surface, needs to be considered independently of WADEM output. The depths necessary to create optimal foraging in the marshes surrounding Alley North are different than those required to protect the nesting birds during that season.

Examining ALTQ output for average annual stage and hydroperiod difference for all years (1965-2005) the model predicts a reduction in stage of 0.068 feet and a hydroperiod reduction of 10 days for the cell that contains Alley North (**Figure 4-104**).There is an increase in the probability that the colony will experience drier conditions (thus increased probability of no nesting or nest failure) as a result of operations but on average the change is small. However, during drier than average conditions the likelihood of a significant impact is much higher. A reduction in hydroperiod at Alley North of 30 days could have potential negative consequences for nesting wading birds. In an example dry year (2000), stage at the colony is further reduced under ALTQ by -0.17 feet compared to ECB19RR (**Figure 4-105**).

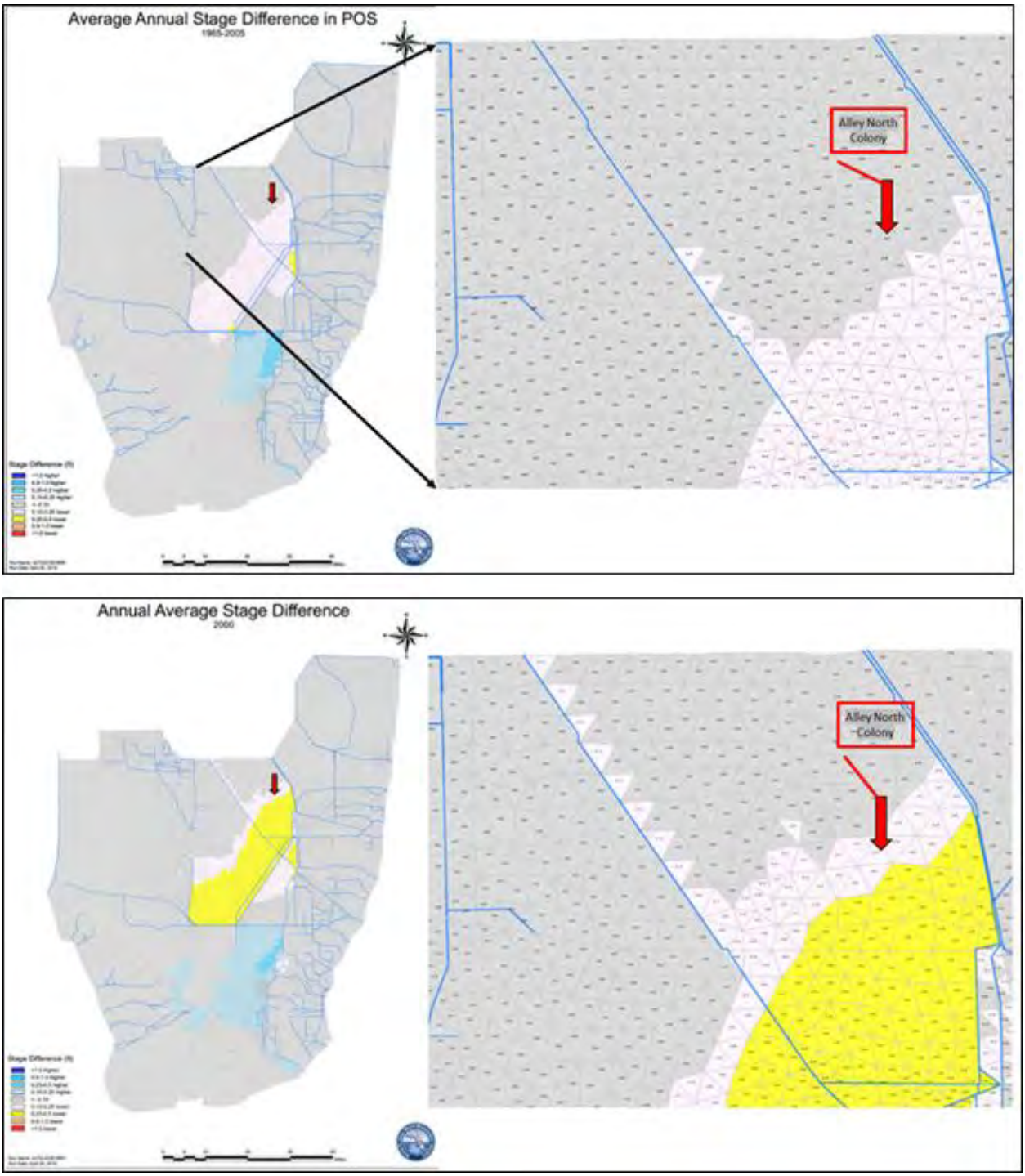

Figure 4-104. Comparison of stage reduction for ALTQ versus ECB19RR. Average (above) versus a dry year (below).

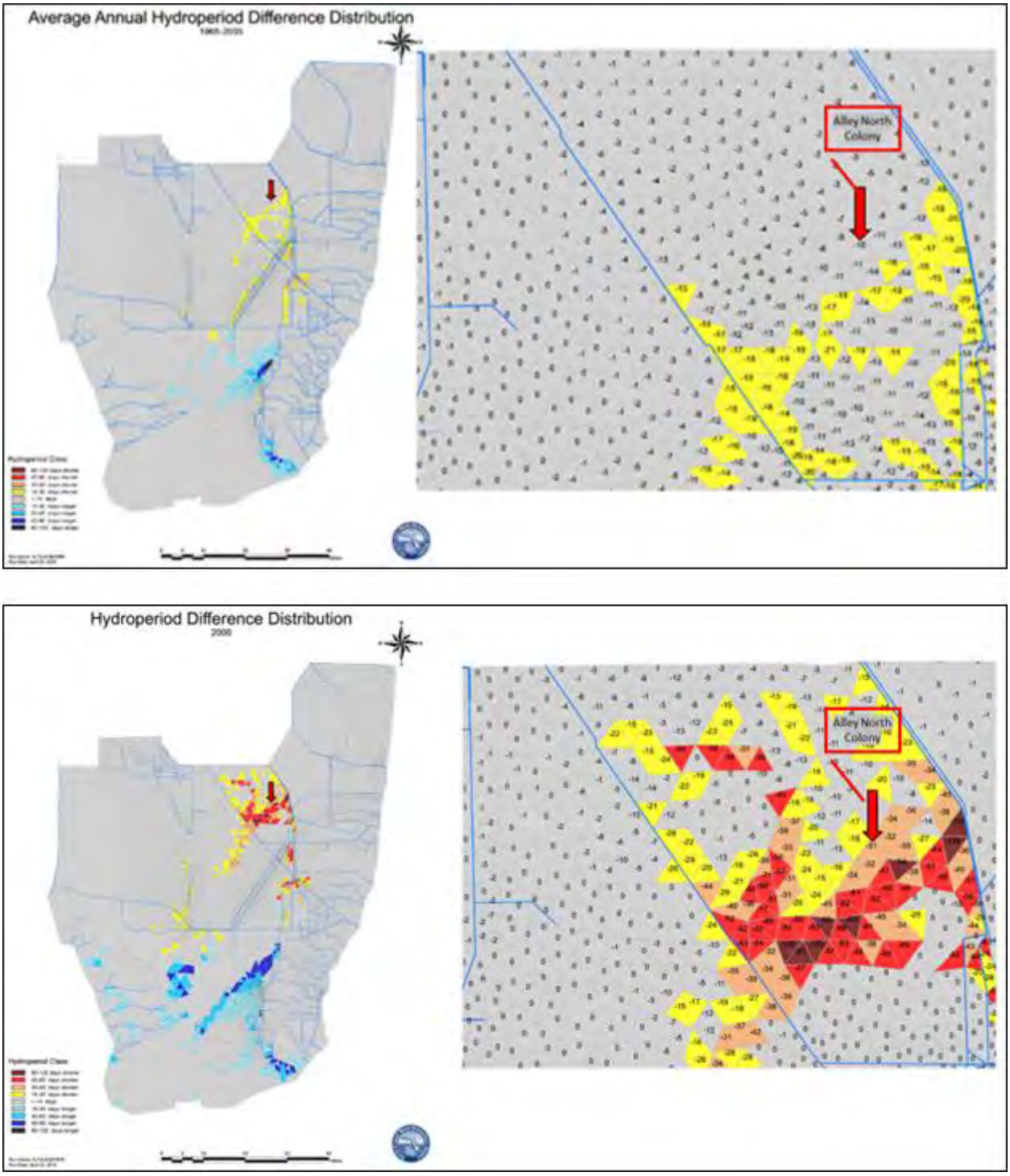

Figure 4-105. Comparison of hydroperiod differences for ALTQ versus ECB19RR. Average (above) versus a dry year (below).

Hydroperiod differences are similar with the cell containing the Alley North Colony experiencing an acreage reduction in hydroperiod (1965-2005) of 10 days. As with the stage difference output during drier

than average years the reduction in hydroperiod is highly significant. The model predicts a reduction of 31 days of hydroperiod for the year 2000 conditions.

For the cell that contains the Alley North colony ALTN2 model output in general predicts drier conditions than ALTQ. Reducing the annual average stage by 0.094 feet (**Figure 4-106**) and the annual average hydroperiod by 11 days (**Figure 4-107**), ALTN2 produces conditions slightly less desirable for nesting wading birds at the Alley North colony than ALTQ.

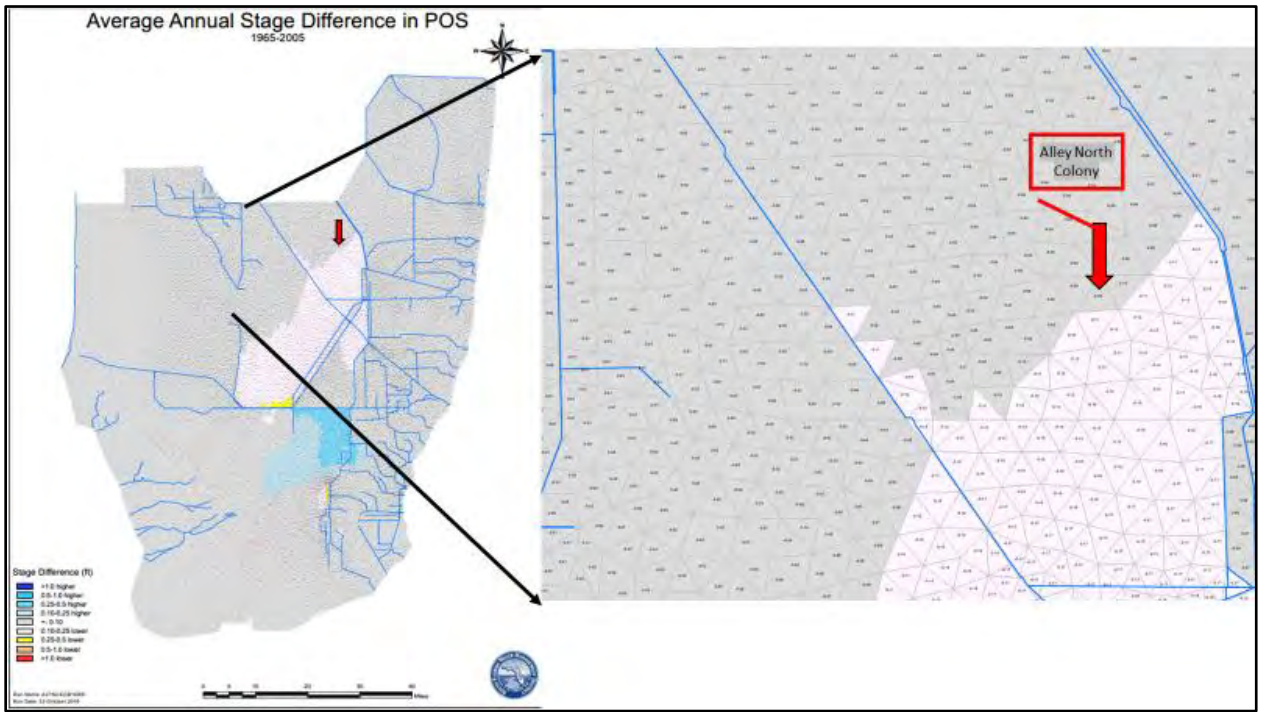

Figure 4-106. Comparison of average annual stage differences for ALTN2 versus ECB19RR.

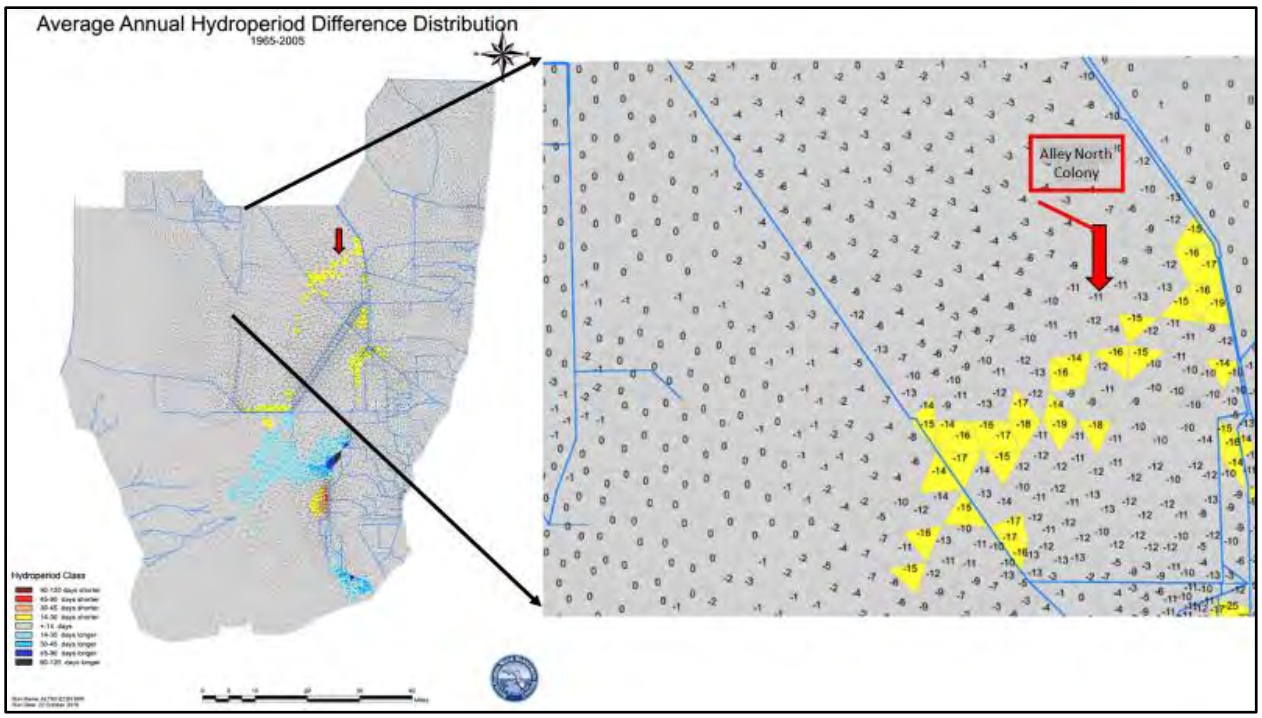

Figure 4-107. Comparison of average annual hydroperiod differences for ALTN2 versus ECB19RR.

For the cell that contains the Alley North colony on average ALTO model output in general predicts slightly wetter conditions than ALTQ. Reducing the annual average stage by only 0.026 feet (**Figure 4-108**) and the annual average hydroperiod by 6 days (**Figure 4-109**) as opposed to the loss of 10 days in ALTQ. Averaging the conditions across all years ALTO produces conditions slightly more desirable for nesting wading birds at the Alley North colony. However, looking at individual years that are below average in precipitation (**Figure 4-110**), ALTO elicits the same concern as ALTQ in that it dramatically shortens the hydroperiod at Alley North during dry years. In years with rainfall patterns like 1972, ALTO has a greater potential to negatively affect hydroperiod and nesting at the colony island than ALTQ. Given rainfall amounts and patterns from 1972 the ALTO model predicts a reduction in hydroperiod at the Alley North colony of 63 days.

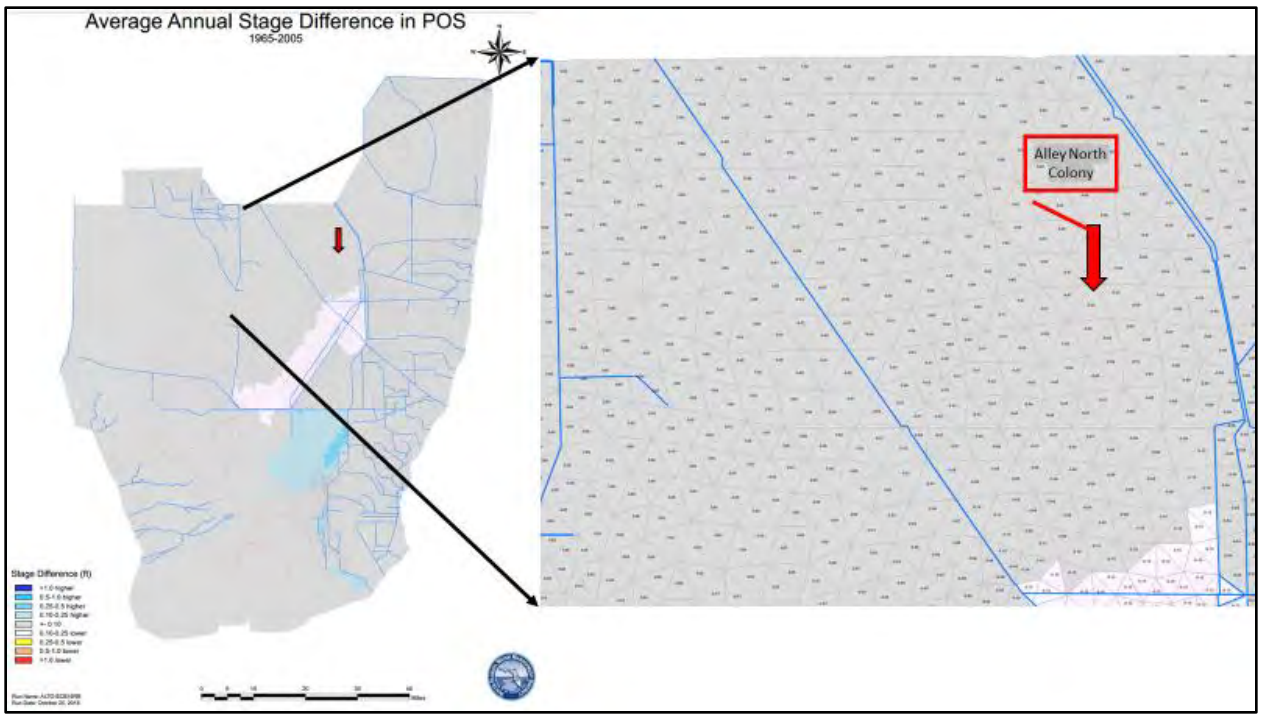

Figure 4-108. Comparison of average annual stage differences for ALTO versus ECB19RR.

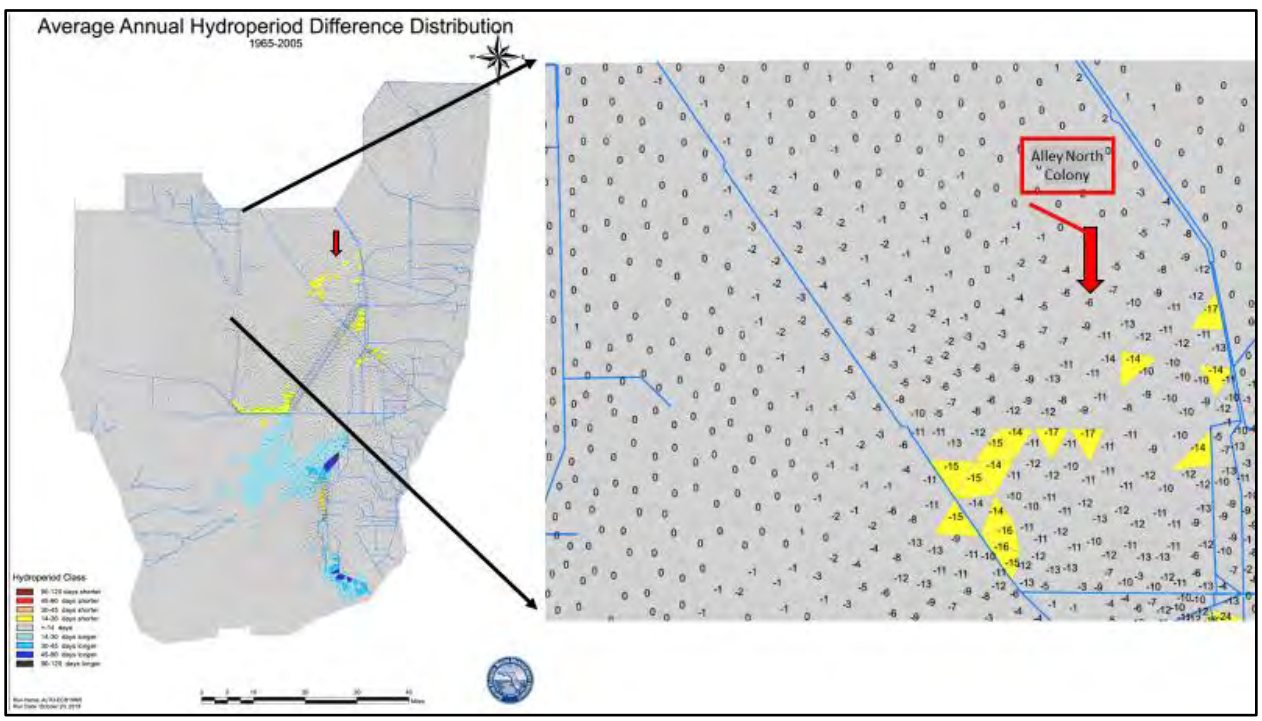

Figure 4-109. Comparison of average annual hydroperiod differences for ALTO versus ECB19RR.

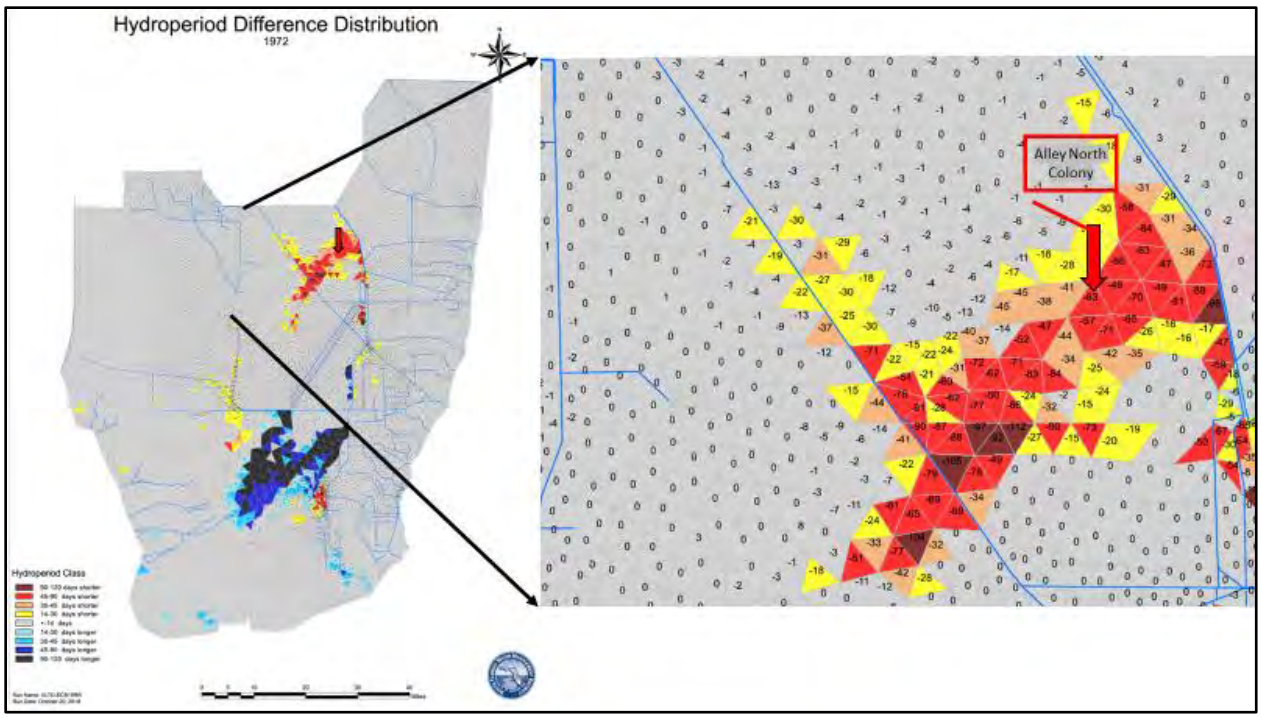

Figure 4-110. Comparison of average annual hydroperiod differences for ALTO versus ECB19RR for the year 1972.

4.7.5 Mammals

Significant adverse effects to mammals are not anticipated. Mammals occurring in the Everglades are adapted to naturally fluctuating water levels. ALTN2, ALTO, ALTQ, and ALTQ+ decreased overland flow, water depths, and resulting hydroperiods in portions of WCA 3 relative to ECB19RR. The greatest magnitude of decrease in water depths was observed in north central WCA 3A in areas located east of the Miami canal, in southern WCA 3A in areas adjacent to the L-67A/C and L-29, and in northern WCA 3B. Mammals that utilize upland habitat may benefit from the lowering of stages in these portions of the study area during high water events when sources of upland refugia become limited. ALTN2, ALTO, ALTQ, and ALTQ+ increased overland flow, water depths and resulting hydroperiods in ENP in NESRS and Taylor Slough. Reference **Section 4.2** (**Hydrology**). Over drained areas are anticipated to be rehydrated. Mammals utilizing areas that are currently dry may move to find adjacent suitable habitat; however the COP is not expected to convert upland habitat to wetlands where it currently exists in the study area. Small mammals including raccoons and river otters may benefit from increased abundance of marsh fishes and crayfish in rehydrated areas of ENP.

Section 4.17 (**Recreation**) provides information on when the Florida Fish and Wildlife Conservation Commission (FWC) considers closures in the Everglades and Francis S. Taylor Wildlife Management areas (EWMA) due to high water stages. High water events are threatening to deer in the Everglades as sources of upland refugia become limited. Significant adverse effects to recreation as a result of closures in the EWMA are not anticipated to occur under ALTN2, ALTO, ALTQ or ALTQ+. Differences in the number of days the FWC criteria were exceeded between each alternative and ECB19RR was less than a 2% period of record increase or decrease for the high water criteria. The number of high closures expected with each alternative did not significantly deviate from ECB19RR. Each alternative performed equivalent to ECB19RR

or either increased or decreased the number of high water or low water closures by no more than one event.

Furthermore, significant adverse effects to tree islands in WCA 3 and ENP are not anticipated under ALTN2, ALTO, ALTQ or ALTQ+. Tree islands are used for upland refugia for mammals. Reference **Section 4.6** (**Vegetative Communities**).

4.8 Threatened and Endangered Species

A comparison of potential effects on federally and state listed species within the COP study area are summarized below.

4.8.1 Federally Listed Species

The USACE acknowledges the potential usage and occurrence of threatened and endangered species and/or critical habitat within the study area (**Table 4-13**). **Figure 4-111** provides the location of federally listed threatened and endangered species with the potential to occur within the study area. Potential effects to federally listed species are summarized in **Table 4-13**. Additional information for those listed species which may be affected by the COP is provided below. Further details on the life history of each species and their effects determinations can be found in the Biological Assessment (BA) in **Appendix D.2** (**Endangered Species Act Compliance**). The USACE commits to avoiding and minimizing for adverse effects on federally listed species and would continue to coordinate with the USFWS and the NMFS as needed.

Table 4-13. Federally threatened and endangered species within the study area and species determination for the proposed action (E: Endangered; T: Threatened; C: Candidate; CH: Critical Habitat; SA: Similarity of Appearance)

Common Name (Scientific Name)	Federal Status	Potential Effects: ALTN2, ALTO, ALTQ, ALTQ+	May Affect Not Likely to Adversely Affect	May Affect	No Effect
Mammals	-	-	-	-	-
Florida panther (*Puma concolor coryi)*	E	Minor to moderate long-term beneficial effects on wetland hydrology and vegetation in ENP. ALTO and ALTQ/ALTQ+ maximized potential benefits relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3 relative to ALTN2. Potential for increases in wetland based prey items through improved hydrology; may contribute to improved foraging opportunities. The COP is not expected to convert upland habitat to wetlands where it currently exists in the study area.	X	-	-
Florida manatee *Trichechus manatus latirostris*	E, CH	ALTO and ALTQ/ALTQ+ maximized potential benefits relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3 relative to ALTN2. Change in freshwater flows to coast expected to have negligible and less than significant effects on feeding habits (seagrasses). Proposed action consists of an operational change to current water management operations and would not include construction of permanent structures or modifications to existing water management features. No construction is proposed (i.e. no canal modifications).	X	-	-
Florida bonneted bat *Eumops floridanus*	E	Minor to moderate long-term beneficial effects on wetland hydrology and vegetation in ENP. ALTO and ALTQ/ALTQ+ maximized potential benefits relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3 relative to ALTN2. Potential for increases in forage conditions through improved hydrology; may contribute to increases in insect populations. Proposed action consists of an operational change to current water management operations and would not include construction of permanent structures or modifications to existing water management features. Roost sites (snags, trees) would not be removed as no construction is proposed.	X	-	cl-
Birds	-	-	-	-	-
Cape Sable seaside sparrow *Ammodramus maritimus mirabilis*	E, CH	Minor to moderate long-term beneficial effects on wetland hydrology in ENP. ALTN2, ALTO, and ALTQ were observed to increase flow to NESRS and the eastern marl prairies relative to ECB19RR; however changes to the eastern marl prairies generally fell within a range of +/- 10% in those subpopulations currently inhabited by CSSS-B through CSSS-F. Marl prairie habitat suitability increased in the northern portion of CSSS-Ax under each alternative. Areas of decreased suitability were observed in portions of CSSS-E and CSSS-D; however these observed decreases were coupled with observed increases in suitability in areas directly east of CSSS-E and north and south of CSSS-F and CSSS-C. ALTQ+ would result in similar effects as discussed under ALTQ. Each alternative performed equivalent to or slightly less than ECB19RR with respect to dry nesting days and discontinuous hydroperiod metrics.	-	X	-
Everglade snail kite *Rostrhamus sociabilis plumbeus*	E, CH	Minor to moderate long-term beneficial effects on wetland hydrology in ENP. ALTO and ALTQ/ALTQ+ maximized potential benefits relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3 relative to ALTN2. Increases in apple snail populations observed in portions of southern WCA 3A and ENP during a wet year. Decreases observed during a dry year in portions of study area.	-	X	-
Piping plover *Charadrius melodus*	T	Inhabit sandy beaches, sand flats and mudflats along coastal areas. Potential habitat and known breeding populations located outside of immediate action area. The COP is not anticipated to affect shorelines.	-	-	X
Red-cockaded woodpecker *Picoides borealis*	E	Inhabit mature pine forests, specifically those with longleaf pines and loblolly pines. Primarily upland species, also inhabits hydric pine flatwoods. Potential habitat and known breeding populations located outside of immediate action area. The COP is not anticipated to affect pine forests.	-	-	X
Roseate tern *Sterna dougallii*	T	Inhabit sandy beaches, sand flats and mudflats along coastal areas. Potential habitat and known breeding populations located outside of immediate action area. The COP is not anticipated to affect shorelines.	-	-	X
Wood stork *Mycteria americana*	T	Minor to moderate long-term beneficial effects on wetland hydrology in ENP. ALTO and ALTQ/ALTQ+ maximized potential benefits relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3 relative to ALTN2. Potential for increases in forage conditions through improved hydrology; may contribute to increases in aquatic prey base. Wading bird suitability increased in ENP; potential decrease in portions of WCA 3. Sufficient opportunities in ENP may offset any poor conditions in WCA 3 and ENP.	-	X	-

Common Name (Scientific Name)	Federal Status	Potential Effects: ALTN2, ALTO, ALTQ, ALTQ+	May Affect Not Likely to Adversely Affect	May Affect	No Effect
Reptiles	-	-	-	-	-
American Alligator *Alligator mississippiensis*	T, SA	Minor to moderate long-term beneficial effects on wetland hydrology in ENP. ALTO and ALTQ/ALTQ+ maximized potential benefits relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3 relative to ALTN2. Alligator breeding potential increased in ENP; potential decrease in portions of WCA 3. Sufficient opportunities in ENP may offset any poor conditions in WCA 3 and ENP. Alligators may expand into adjacent areas of suitable habitat. Proposed action consists of an operational change to current water management operations and would not include construction of permanent structures or modifications to existing water management features. No construction is proposed (i.e. no canal modifications; canals often act as sites of refugia).	X	-	-
American crocodile *Crocodylus acutus*	T, CH	ALTO and ALTQ/ALTQ+ maximized potential benefits relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3 relative to ALTN2. Change in freshwater flows to coast expected to have negligible and less than significant effects on crocodile reproduction areas, including CH. Potential habitat and known breeding populations located outside of immediate action area. Proposed action consists of an operational change to current water management operations and would not include construction of permanent structures or modifications to existing water management features. No construction is proposed (i.e. no canal modifications).	X	-	-
Eastern indigo snake *Drymarchon corais couperi*	T	Minor to moderate long-term beneficial effects on wetland hydrology and vegetation in ENP. ALTO and ALTQ/ALTQ+ maximized potential benefits relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3 relative to ALTN2. Potential for increases in wetland based prey items through improved hydrology; may contribute to improved foraging opportunities. The COP is not expected to convert upland habitat to wetlands where it currently exists in the study area.	X	-	-
Gopher tortoise *Gopherus polyphemus*	C	Proposed action consists of an operational change to current water management operations and would not include construction of permanent structures or modifications to existing water management features. No construction is proposed (i.e. no levee modifications). The COP is not expected to convert upland habitat to wetlands where it currently exists in the study area.	-	-	X
Green sea turtle* *Chelonia mydas*	T	Tropical and subtropical waters; forage in nearshore seagrass habitats. Change in freshwater flows to coast are expected to have negligible and less than significant effects on sea turtle feeding habits. No suitable habitat for nesting to be affected by the COP. CH outside the immediate action area.	-	-	X
Hawksbill sea turtle* *Eretmochelys imbricate*	E; CH	Tropical and subtropical waters; forage in near hard bottom habitats. Change in freshwater flows to coast are expected to have negligible and less than significant effects on sea turtle feeding habits. No suitable habitat for nesting to be affected by the COP. CH outside the immediate action area.	-	-	X
Kemp's ridley sea turtle* *Lipodochelys kempii*	E	Tropical and subtropical waters; forage in near hard bottom habitats. Change in freshwater flows to coast are expected to have negligible and less than significant effects on sea turtle feeding habits. No suitable habitat for nesting to be affected by the COP.	-	-	X
Leatherback sea turtle* *Dermochelys coriacea*	E:CH	Tropical and subtropical waters; forage in nearshore habitats. Change in freshwater flows to coast are expected to have negligible and less than significant effects on sea turtle feeding habits. No suitable habitat for nesting to be affected by the COP. CH outside the immediate action area.	-	-	X
Loggerhead sea turtle* *Caretta caretta*	T: CH	Tropical and subtropical waters; forage in nearshore habitats. Change in freshwater flows to coast are expected to have negligible and less than significant effects on sea turtle feeding habits. No suitable habitat for nesting to be affected by the COP. CH outside the immediate action area.	-	-	X
Fish	-	-	-	-	-
Smalltooth sawfish* *Pristis pectinata*	E	ALTO and ALTQ/ALTQ+ maximized potential benefits relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3 relative to ALTN2. Change in freshwater flows to coast expected to have negligible and less than significant effects on small tooth sawfish feeding habits (forage in nearshore habitats), including CH. Potential habitat and known breeding populations located outside of immediate action area. Proposed action consists of an operational change to current water management operations and would not include construction of permanent	-	-	X

Common Name (Scientific Name)	Federal Status	Potential Effects: ALTN2, ALTO, ALTQ, ALTQ+	May Affect Not Likely to Adversely Affect	May Affect	No Effect
		structures or modifications to existing water management features. No construction is proposed (i.e. no canal modifications).			
Invertebrates	-	-	-	-	-
Elkhorn coral* *Acropora palmata*	T, CH	Change in freshwater flows to coast are expected to have negligible and less than significant effects on near shore habitats. No suitable habitat for nesting to be affected by the COP. CH outside the immediate action area.	-	-	X
Staghorn coral* *Acropora cervicornis*	T, CH	Change in freshwater flows to coast are expected to have negligible and less than significant effects on near shore habitats. No suitable habitat for nesting to be affected by the COP. CH outside the immediate action area.	-	-	X
Bartram's hairstreak butterfly *Strymon acis bartrami*	E, CH	Inhabits pine rocklands habitat in Long Pine Key in ENP and in several pineland fragments in Miami-Dade County. Potential habitat and known breeding populations located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Florida leafwing butterfly *Anaea troglodyta floridalis*	E, CH	Inhabits pine rocklands habitat in Long Pine Key of ENP. Potential habitat and known breeding populations located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Miami blue butterfly *Cyclargus thomasi bethunebakeri*	E	Inhabits tropical hardwood hammocks, beachside scrub, and occasionally rockland pine forests. Current distribution limited to portions of Florida Keys. Rare occurrence and known populations located outside of immediate action area.	-	-	X
Schaus swallowtail butterfly *Heraclides aristodemus ponceanus*	E	Inhabits tropical hardwood hammocks in Miami-Dade and Monroe counties. Currently in Florida Keys and Biscayne National Park. Rare occurrence and known populations located outside of immediate action area.	-	-	X
Stock Island tree snail *Orthalicus reses(not incl. nesodryas)*	T	Inhabits tropical hardwood hammocks. Endemic to Stock Island and Key West in Florida Keys. Introduced into ENP in rockland hammock(s) north of Long Pine Key. Previously recorded in ENP and BCNP; however currently believed to be declining or extirpated. Rare occurrence and known populations located outside of immediate action area.	-	-	X
Plants	-	-	-	-	-
Crenulate lead plant *Amorpha crenulata*	E	Previously inhabited pine rocklands habitat in ENP and pineland fragments in Miami-Dade County; current distribution in ENP not known. Potential habitat located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Deltoid spurge *Chamaesyce deltoidea spp. Deltoidei*	E	Previously documented to inhabit pine rocklands in Long Pine Key in ENP and portions of Florida Keys; considered extirpated in ENP. Potential habitat located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Garber's spurge *Chamaesyce garberi*	T	Inhabits pine rocklands habitat in Long Pine Key in ENP and portions of Florida Keys. Potential habitat located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Johnson's seagrass* *Halophila johnsonii*	E, CH	Inhabits coastal waters off the east coast of Florida, from just north of Sebastian Inlet south to Virginia Key in Biscayne Bay. Potential habitat located outside of immediate action area.	-	-	X
Okeechobee gourd *Cucurbita okeechobeensis ssp. okeechobeenis*	E	Inhabits habitat around southeastern shore of Lake Okeechobee. Potential habitat located outside of immediate action area.	-	-	X
Small's milkpea *Galactia smallii*	E	Previously documented to inhabit pine rocklands habitat in Long Pine Key in ENP and portions of Florida Keys; considered extirpated in ENP. Potential habitat located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Tiny polygala *Polygala smallii*	E	Species does not occur in ENP; considered extirpated in ENP. Potential habitat located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Big pine partridge pea *Chamaecrista lineata var. keyensis*	E	Inhabits pine rocklands habitat in portions of Florida Keys. Endemic to lower Florida Keys. Rare occurrence and known populations located outside of immediate action area.	-	-	X

Common Name (Scientific Name)	Federal Status	Potential Effects: ALTN2, ALTO, ALTQ, ALTQ+	May Affect Not Likely to Adversely Affect	May Affect	No Effect
Blodgett's silverbush *Argythamnia blodgettii*	T	Inhabits pine rocklands habitat in Long Pine Key in ENP and portions of Florida Keys. Potential habitat located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Cape Sable thoroughwort *Chromolaena frustrata*	E, CH	Inhabits coastal hardwood hammocks in ENP and portions of Florida Keys. Potential habitat, including CH, located outside of immediate action area. The COP is not expected to affect coastal rock berms and barrens within ENP where the species may occur.	-	-	X
Carter's small-flowered flax *Linum carteri var. carteri*	E, CH	Inhabits pine rocklands habitat on the Miami Rock Ridge outside of ENP. Potential habitat, including CH, located outside of immediate action area.	-	-	X
Everglades bully *Sideroxylon reclinatum spp. Austrofloridense*	T	Inhabits pine rocklands habitat in Long Pine Key in ENP and pineland fragments in Miami-Dade County in Collier County in BCNP; previously recorded in portions of Florida Keys. Potential habitat located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Florida brickell-bush *Brickellia mosieri*	E, CH	Inhabits pine rocklands habitat in Miami-Dade County; considered extirpated in ENP. Potential habitat, including CH, located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Florida bristle fern *Trichomanes punctatum spp. floridanum*	E	Inhabits pine rocklands habitat in Miami-Dade County; considered extirpated in ENP. Potential habitat located outside of immediate action area.	-	-	X
Florida pineland crabgrass *Digitaria pauciflora*	T	Inhabits pine rocklands habitat in Long Pine Key in ENP, pineland fragments in Miami-Dade County, and in BCNP. Potential habitat located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Florida prairie-clover *Dalea carthagenesis floridana*	E	Inhabits pine rocklands habitat in Long Pine Key in ENP, pineland fragments in Miami-Dade County and in BCNP. Potential habitat located outside of immediate action area. COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Florida semaphore cactus *Consolea corallicola*	E, CH	Inhabits rockland hammocks, coastal berm, and buttonwood forests in portions of Florida Keys and Biscayne Bay. Potential habitat, including CH, located outside of immediate action area.	-	-	X
Pineland sandmat *Chaemaesyce deltoidea pinetorium*	T	Inhabits pine rocklands habitat in ENP and pineland fragments in Miami-Dade County. Potential habitat located outside of immediate action area. The COP is not expected to change water levels within the pine rocklands of ENP.	-	-	X
Sand flax *Linum arenicola*	E	Inhabits pineland fragments in Miami Dade County and in portions of Florida Keys. Rare occurrence and known populations located outside of immediate action area.	-	-	X

*Species under the purview of the NMFS

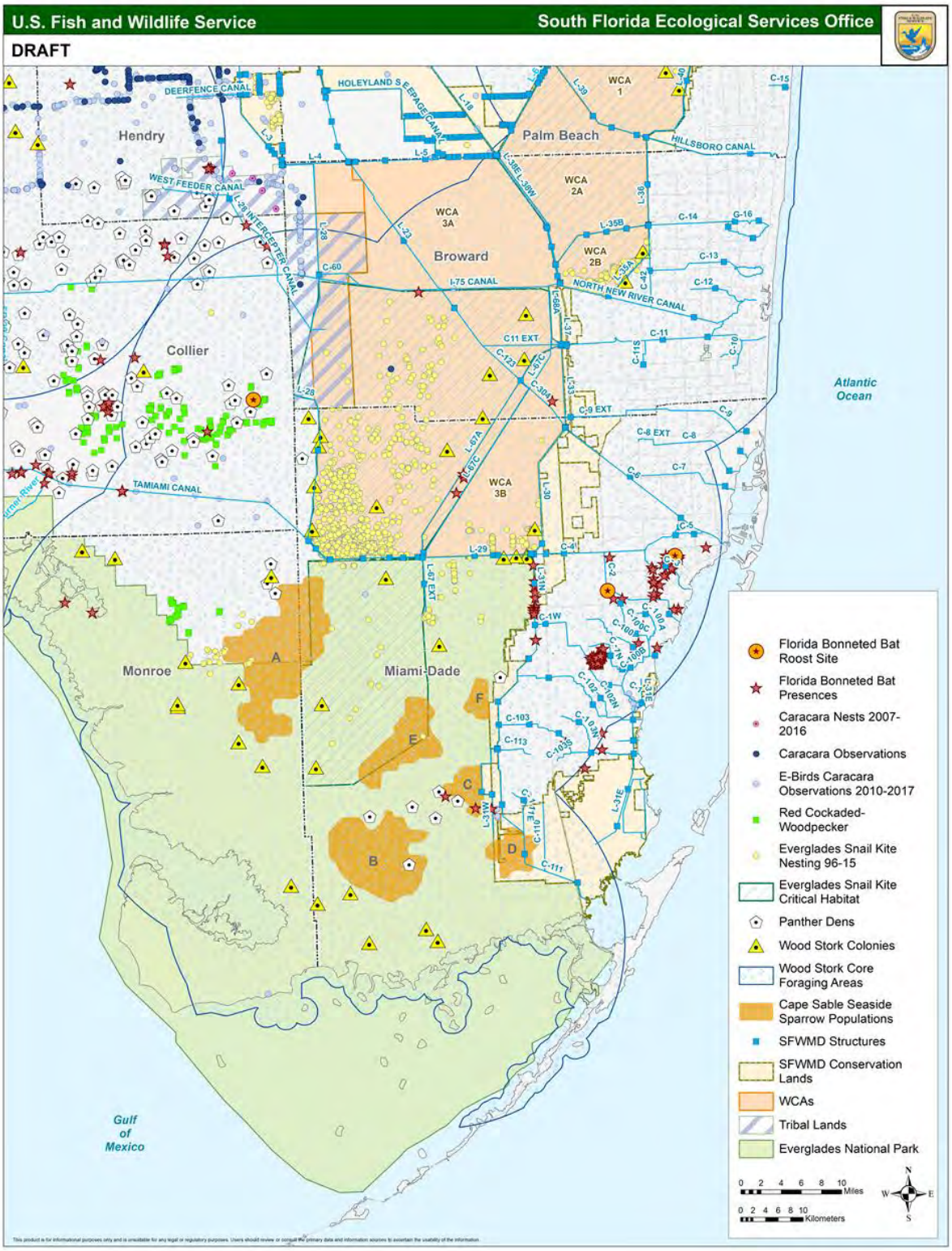

Figure 4-111. Location of federally threatened and endangered species with the potential to occur in the study area.

4.8.1.1 Florida panther

Preferred habitat of the Florida panther consists of cypress swamps, pine, and hardwood hammock forests. The main diet of the Florida panther consists of white-tailed deer, sometimes wild hog, rabbit, raccoon, armadillo, and birds. Florida panthers are solitary, territorial, and have large home ranges. Florida panthers presently inhabit lands in the study area. Florida panthers presently inhabit lands in WCA 3A and ENP. The COP is an operational plan to redistribute the amount and timing of releases from WCA 3A to ENP. The COP has the potential to affect both the Primary and Secondary Zones of the Service's "Focus Area" for the Florida panther. Reference **Figure D.2-14** in the COP BA in **Appendix D.2** (**Endangered Species Act Compliance**).

Panther prey density is an important factor in evaluating panther habitat. The type of prey available to the panther affects the health and distribution of the panther, as well as its ability to breed and support young. Due to increased water flow and changes in water distribution it is anticipated that currently over drained areas in ENP would be rehydrated. Since potentially suitable habitat occurs in the study area, increased water deliveries to ENP under ALTN2, ALTO, ALTQ, and ALTQ+ could affect Florida panther habitat. However, as lands in the study area become restored to their more historic natural values, improvements to prey may result in greater use by the Florida panther. Small mammals including raccoons and river otters would benefit from increased crayfish and small prey fish biomass in rehydrated areas in ENP as a result of the COP. In addition, by lowering portions of WCA 3A and WCA 3B more upland habitat may become available within the Florida panther's primary and secondary zone, directly benefiting the species. Based on this information, and the fact that Florida panther is a wide ranging species, the USACE has determined that the proposed action may affect, but is not likely to adversely affect the Florida panther. Consultation under the ESA will be initiated with the USFWS with submittal of a BA for this species. Reference **Appendix D.2** (**Endangered Species Act Compliance**).

4.8.1.2 West Indian Manatee

Florida manatees are large plant-eating aquatic mammals and can be found in freshwater, brackish, and marine habitats. Critical habitat for the Florida manatee includes but is not limited to both Florida Bay and Biscayne Bay. Reference **Figure D.2.3** in the COP BA in **Appendix D.2** (**Endangered Species Act Compliance**). No specific primary or secondary constituent elements were included in the critical habitat designation; however, researchers agree that essential habitat features for the Florida manatee include seagrasses for foraging, shallow areas for resting and calving, channels for travel and migration, warm water refuges during cold weather, and fresh water for drinking (FWS 2001). Florida manatees have been observed in nearshore seagrass beds throughout Florida Bay including all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee and Buttonwood sounds and along the southwestern coastal estuaries. The extensive acreages of seagrass beds in the southern estuaries provide important feeding areas for Florida manatees. Changes in freshwater flow in the headwaters of designated critical habitat for the Florida manatee were variable for each alternative depending upon the location.

An assessment on potential changes in hydrology to Florida Bay and Biscayne Bay are summarized in **Section 4** (**Hydrology**). **Section 4.6** (**Vegetative Communities**) provides an assessment on potential changes in salinity to these areas. ALTN2, ALTO, and ALTQ increased flows toward Florida Bay across transect T23 relative to ECB19RR. Average annual flow increases were found to range from 25,000 acre-feet for ALTN2 to 46,000 acre-feet for ALTO. ALTQ increased average annual flows by 36,000 acre-feet (**Table 4-26**). Results from the RECOVER performance measure indicate that significant adverse effects to seagrass beds are not anticipated due to the degree of observed salinity changes. Decreases in mean wet

salinity for ALTN2, ALTO, and ALTQ relative to ECB19RR were small in Florida Bay, however decreases in dry season salinity exceeded decreases in wet season salinity (**Table 4-9** and

Table 4-10). These differences may be ecologically significant because they reflect long-term seasonal means. Also, the timing of lowered salinity, being more in the dry season, may be ecologically significant because salinity peaks associated with harm are most common in the late dry season and early wet season if precipitation delays occur. The RECOVER performance measure does not extend past Florida Bay into Biscayne Bay and was therefore unavailable for an evaluation of this area; however ALTQ and ALTN2 increased average annual flows to South Bay (an area with unnaturally high salinity) by approximately 10,000 acre-feet (a 4% increase over ECB19RR) and 9,000 acre-feet (a 3.6% increase over ECB19RR). Flows to South Bay under ALTO were equivalent to ECB19RR. Reference **Table 4-12**. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**).

Florida manatees also depend upon canals as a source of freshwater and resting sites. Florida manatees may also depend on deep canals as a cold-weather refuge. The relatively deep waters of the canals respond more slowly to temperature fluctuations than shallow bay waters during the passage of winter cold fronts. **Figure D.2-16** and **Figure D.2-17** in the COP BA in **Appendix D.2** (**Endangered Species Act Compliance**), illustrates canals that Florida manatees have access to, some of which are in the COP study area. Florida manatees have been observed in conveyance canals in the study area, specifically in the lower C-111 canal just downstream of S-197 and in adjacent nearshore seagrass beds throughout Florida Bay including all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee and Buttonwood sounds. The COP is an operational plan to redistribute the amount and timing of releases from WCA 3A to ENP. No construction (i.e. canal removal/backfilling) is proposed in canals that Florida manatees have access to under COP.

Improvements in seasonal inflow deliveries to Florida Bay and southern Biscayne Bay has the potential to improve conditions suitable for seagrass survival. Seagrasses within Florida Bay and southern Biscayne Bay have long suffered from high salinities due to long-term reductions of freshwater flow. Increased freshwater flows to the coastal estuaries would improve salinity, therefore having the potential to reduce stress on sea grasses that are important to foraging manatees. The USACE has determined that the proposed action may affect, but is not likely to adversely affect the Florida manatee and its critical habitat. Consultation under the ESA will be initiated with the USFWS with submittal of a BA for this species. Reference **Appendix D.2** (**Endangered Species Act Compliance**).

4.8.1.3 Florida Bonneted Bat

Echolocation calls for the Florida bonneted bat have been recorded in a wide array of habitat types: pine flatwoods, pine rocklands, cypress, hardwood hammocks, scrubby flatwoods, mixed shrubs, mangroves, wetlands, swamps, rivers, lakes, ponds, canals, developed park lands, groves, tropical gardens, disturbed nonnative areas, rural lands, residential areas, and urban landscapes. The species roosts singly or in colonies consisting of a male and several females. Florida bonneted bats are capable of dispersing long distances from roost sites to foraging areas. In general, open, fresh water and wetlands provide prime foraging areas. The USFWS has defined consultation areas for the Florida bonneted bat in south Florida. Reference **Figure D.2.18** in the COP BA in **Appendix D.2** (**Endangered Species Act Compliance**). The Florida bonneted bat is restricted to south, southwest, and south-central Florida. The study area falls in the defined consultation area. The potential presence of Florida bonneted bats have been documented in the study area (**Figure 4-111**) along portions of the L-67A and L-67C canals and levees, as well as adjacent to

NESRS along the L-31N canal and levee. At present, no active, natural roost sites are known to occur in the study area.

Any actions that occur in areas known to be occupied by the Florida bonneted bat and result in the removal of potential roost sites (snags, trees) or impact foraging habitat (filling in of canals and ditches) are likely to have direct and indirect adverse effects to the Florida bonneted bat and its habitat. The COP is an operational plan to redistribute the amount and timing of releases from WCA 3A to ENP. No construction is proposed. Impacts to potential roost sites are not anticipated under ALTN2, ALTO, ALTQ or ALTQ+. Due to increased water flow and changes in water distribution it is anticipated that currently over drained areas in ENP would be rehydrated. The restoration of sheetflow is anticipated to help restore historic habitats which are used by the Florida bonneted bat for roosting, and also allow for natural fire and exotic plant management. Current wildfire conditions persist that damage the canopy available to the Florida bonneted bat for roosting sites, and exotic and nuisance plants that dominate in drained conditions presumably do not contribute to natural roosting or forage habitat conditions. The Florida bonneted bat is known to forage along wetlands and open water and roost within pine flatwoods and other forested habitats. This species forages for insects at night while flying over water. ALTN2, ALTO, ALTQ, and ALTQ+ may improve forage conditions in ENP by increasing the quality of existing wetlands which may contribute to increases in insect populations in the area. The USACE has determined that the proposed action may affect, but is not likely to adversely affect the Florida bonneted bat. Consultation under the ESA has been initiated with the USFWS with submittal of a BA for this species. Reference **Appendix D.2** (**Endangered Species Act Compliance**).

4.8.1.4 Cape Sable Seaside Sparrow

CSSS are non-migratory residents of freshwater to brackish marshes and their range is restricted to the lower Florida peninsula. Presently, the known distribution of CSSS is restricted to two areas of marl prairies east and west of Shark River Slough in the Everglades region (within ENP and BCNP) and the edge of Taylor Slough in the Southern Glades Wildlife and Environmental Area in Miami-Dade County. CSSS presently inhabit six separate subpopulations (CSSS-Ax, CSSS-B, CSSS-C, CSSS-D, CSSSS-E and CSSS-F with subpopulation CSSS-Ax as the only subpopulation west of Shark River Slough. CSSS-B, CSSS-C, CSSS-D, CSSS-E, and CSSS-F are designated as critical habitat units U1-U5, respectively. Reference **Figure D.2-19** in the COP BA in **Appendix D.2** (**Endangered Species Act Compliance**). CSSS appear to prefer mixed marl prairie communities that include muhly grass (*Muhlenbergia filipes*) for nesting. These short-hydroperiod prairies contain a mosaic of moderately dense, clumped grasses, interspersed with open space that permit ground movements by the sparrows (USFWS 1999). CSSS nest in the spring when the marl prairies are dry. While the majority of nesting activities have been observed between March 1 and July 15 when Everglades marl prairies are dry, nesting has been reported as early as late February and as late as early August. Successful CSSS breeding requires that breeding season water levels remain at or below ground level in the breeding habitat.

The two most critical performance metrics for maintaining and enhancing the chances for CSSS survival are the number of consecutive days during the CSSS nesting season (March 1 – July 15) when there is no surface water (i.e. dry nesting days) and the total number of days when there is water above ground surface during the year (i.e. annual discontinuous hydroperiod) (USFWS 2016). Since it takes the CSSS, a ground nesting bird (nests on average are 17 cm above ground), approximately 45 days to nest and fledge young, the 2016 ERTP BO RPA has set a target of providing at least 90 consecutive dry nesting days between March 1 and July 15, over at least 24,000 acres (equates to 40%) within and adjacent to CSSS-Ax, and across at least 40% of each of the eastern subpopulations (B-F) every year, to allow for multiple

broods during each nesting season in order to stabilize and potentially increase the population. Since, an average annual discontinuous hydroperiod of between 90 and 210 days, which normally occurs outside of the nesting season, is required to maintain suitable marl prairie habitat for the CSSS (USFWS 2016), the 2016 ERTP BO has set a target of providing a four year running average discontinuous hydroperiod of 90-210 days over at least 24,000 acres (equates to 40%) within and adjacent to CSSS-AX (with no 2 consecutive years failing to meet this target), and across at least 40% of each of the eastern subpopulations (B-F). If the number of days with surface water is consistently more than 210 days, the habitat will convert to sawgrass. If it is consistently too dry (less than 90 days), woody vegetation encroaches on the habitat and there is an increased risk of fire and predation on CSSS from aerial predators (raptors). To evaluate potential effects on the CSSS for the COP, the above mentioned metrics (i.e. dry nesting days and annual discontinuous hydroperiod) were evaluated at the request of the USFWS.

Table 4-14 through **Table 4-19** depicts the percentage of habitat within each of the six CSSS subpopulations (CSSS-Ax, CSSS-B, CSSS-C, CSSS-D, CSSS-E, and CSSS-F) that experienced > 90 consecutive dry days during the nesting season (defined as March 1 through July 15) for each year in the period of record (1965-2005). The average percentage over the period of record is shown as well as the number of individual years the target (40%) is met. The number of times an alternative was observed to be greater than or equal to ECB19RR, as well as the number of times an alternative was observed to be less than ECB19RR in a given year is also shown. An average percentage of greater than 40% was achieved over the period of record in CSSS-Ax and in the eastern subpopulations (CSSS-B, CSSS-C, CSSS-D, CSSS-E, and CSSS-F) under ECB19RR, ALTN2, ALTO, and ALTQ. Across the sub-populations, the difference in average percentage over the period of record for ALTN2, ALTO, and ALTQ relative to ECB19RR, ranged from a minimum difference of -7.70% to a maximum difference of 4.90%. Generally, each alternative was observed to score equal to or slightly less than ECB19RR. The greatest differences between ECB19RR and each alternative were observed in CSSS-E and CSSS-D in which decreases relative to ECB19RR were observed and in CSSS-C, in which increase relative to ECB19RR were observed.

Table 4-14. CSSS-Ax Nesting Season Statistics: Percent of Habitat within CSSS-Ax that met > 90 consecutive dry days during March 1 through July 15 of each year (USGS CSSS Viewer). Green coloration denotes target (40%) was met.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	48.3%	46.8%	50.7%	42.6%
1966	28.6%	25.0%	23.9%	25.0%
1967	65.9%	62.8%	60.9%	54.9%
1968	2.3%	2.1%	1.9%	2.1%
1969	23.0%	23.4%	22.5%	19.6%
1970	3.6%	4.7%	4.8%	4.0%
1971	96.9%	96.7%	96.5%	96.9%
1972	16.7%	16.7%	16.1%	16.8%
1973	61.7%	58.6%	58.3%	61.2%
1974	98.1%	98.1%	98.1%	98.1%
1975	67.1%	67.3%	67.3%	67.3%
1976	29.5%	28.2%	28.9%	29.9%
1977	91.3%	91.4%	90.8%	91.4%
1978	40.6%	41.8%	40.1%	42.8%

Year	ECB19RR	ALTN2	ALTO	ALTQ
1979	35.1%	34.2%	33.0%	31.4%
1980	14.3%	15.3%	14.7%	13.8%
1981	98.2%	97.4%	96.3%	98.0%
1982	21.4%	20.4%	20.3%	20.4%
1983	0.4%	0.5%	0.8%	0.5%
1984	37.8%	37.2%	32.1%	31.4%
1985	96.3%	95.9%	95.9%	96.1%
1986	47.0%	36.7%	33.8%	34.2%
1987	20.9%	18.9%	18.7%	18.8%
1988	57.3%	59.4%	60.3%	59.3%
1989	99.1%	99.1%	99.1%	99.2%
1990	91.0%	91.0%	91.2%	90.9%
1991	17.8%	17.9%	17.9%	17.9%
1992	60.9%	60.1%	58.2%	50.7%
1993	15.4%	17.0%	20.5%	16.5%
1994	32.4%	33.0%	32.6%	28.2%
1995	0.0%	0.1%	0.0%	0.0%
1996	21.8%	24.9%	22.5%	19.2%
1997	40.5%	39.0%	36.4%	36.3%
1998	13.4%	13.6%	17.4%	13.8%
1999	21.9%	20.2%	18.1%	18.3%
2000	22.3%	23.8%	23.9%	17.9%
2001	94.9%	93.8%	93.4%	95.3%
2002	56.4%	53.7%	54.2%	50.4%
2003	27.9%	27.3%	26.9%	27.7%
2004	80.8%	78.2%	75.6%	76.8%
2005	94.9%	94.6%	95.7%	95.8%
Average (Diff ECB19RR)	**46.2%**	**45.5% (-0.7%)**	**45.1% (-1.1%)**	**44.2% (-2.0%)**
Number of Times Period of Record Target (40%) Met	**20**	**18**	**18**	**18**
Number of Times ALT ≥ ECB19RR	**-**	**19**	**17**	**17**
Number of Times ALT < ECB19RR	**-**	**22**	**24**	**24**

Table 4-15. CSSS-B Nesting Season Statistics: Percent of Habitat within CSSS-B that met > 90 consecutive dry days during March 1 through July 15 of each year (USGS CSSS Viewer). Green coloration denotes target (40%) was met.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	92.0%	91.8%	92.1%	91.8%

Year	ECB19RR	ALTN2	ALTO	ALTQ
1966	82.8%	80.2%	80.5%	80.6%
1967	97.0%	96.1%	96.0%	94.9%
1968	3.7%	3.7%	3.7%	3.6%
1969	42.0%	40.9%	40.6%	39.6%
1970	60.8%	60.2%	62.0%	60.1%
1971	100.0%	100.0%	100.0%	100.0%
1972	62.4%	62.4%	62.3%	62.4%
1973	68.1%	65.8%	64.7%	67.3%
1974	100.0%	100.0%	100.0%	100.0%
1975	88.1%	88.1%	88.1%	87.9%
1976	96.3%	95.9%	96.1%	96.5%
1977	90.8%	90.3%	89.2%	89.7%
1978	41.6%	41.7%	41.3%	42.1%
1979	43.4%	41.4%	40.7%	39.7%
1980	91.7%	90.6%	90.8%	90.1%
1981	100.0%	100.0%	100.0%	100.0%
1982	17.6%	17.4%	17.1%	17.2%
1983	15.7%	15.5%	15.8%	15.5%
1984	86.4%	85.1%	84.2%	83.2%
1985	97.7%	97.2%	97.2%	97.6%
1986	91.3%	90.2%	89.8%	89.4%
1987	89.0%	87.8%	88.2%	87.4%
1988	92.0%	92.5%	92.2%	92.3%
1989	100.0%	100.0%	100.0%	100.0%
1990	100.0%	100.0%	100.0%	100.0%
1991	80.0%	80.1%	79.9%	80.0%
1992	95.8%	95.1%	95.2%	92.7%
1993	68.2%	67.3%	68.0%	67.0%
1994	77.4%	75.6%	74.7%	72.6%
1995	34.3%	31.4%	35.7%	32.4%
1996	71.3%	70.4%	70.2%	68.3%
1997	75.4%	74.3%	74.1%	74.0%
1998	66.2%	65.4%	67.6%	65.7%
1999	78.8%	79.3%	78.3%	77.9%
2000	78.5%	78.0%	78.2%	75.4%
2001	99.5%	98.7%	98.0%	99.7%
2002	91.8%	90.3%	91.5%	89.2%
2003	71.4%	70.9%	70.2%	71.4%
2004	100.0%	100.0%	100.0%	100.0%
2005	100.0%	100.0%	100.0%	100.0%

Year	ECB19RR	ALTN2	ALTO	ALTQ
Average (Diff ECB19RR)	**76.6%**	**75.9% (-0.7%)**	**76.0% (-0.6%)**	**75.5% (-1.1%)**
Number of Times Period of Record Target (40%) Met	**37**	**37**	**37**	**35**
Number of Times ALT ≥ ECB19RR	**-**	**14**	**15**	**14**
Number of Times ALT < ECB19RR	**-**	**27**	**26**	**27**

Table 4-16. CSSS-C Nesting Season Statistics: Percent of Habitat within CSSS-C that met > 90 consecutive dry days during March 1 through July 15 of each year (USGS CSSS Viewer). Green coloration denotes target (40%) was met.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	100.0%	100.0%	100.0%	100.0%
1966	100.0%	99.6%	99.6%	100.0%
1967	100.0%	100.0%	100.0%	100.0%
1968	1.6%	1.6%	2.0%	2.0%
1969	98.0%	96.4%	97.2%	96.4%
1970	62.5%	82.7%	96.4%	95.2%
1971	100.0%	100.0%	100.0%	100.0%
1972	96.0%	95.6%	95.6%	95.6%
1973	100.0%	100.0%	100.0%	100.0%
1974	100.0%	100.0%	100.0%	100.0%
1975	100.0%	100.0%	100.0%	100.0%
1976	100.0%	100.0%	100.0%	100.0%
1977	57.3%	65.3%	63.3%	55.2%
1978	95.6%	95.6%	95.6%	95.6%
1979	27.4%	34.3%	38.3%	37.1%
1980	100.0%	100.0%	100.0%	100.0%
1981	100.0%	100.0%	100.0%	100.0%
1982	91.9%	93.1%	94.8%	94.4%
1983	10.5%	12.1%	43.5%	33.5%
1984	90.7%	90.3%	91.5%	90.3%
1985	100.0%	100.0%	100.0%	100.0%
1986	83.9%	92.3%	94.0%	94.8%
1987	98.8%	98.8%	98.8%	98.8%
1988	100.0%	100.0%	100.0%	100.0%
1989	100.0%	100.0%	100.0%	100.0%
1990	97.6%	97.6%	97.6%	97.6%
1991	18.5%	19.0%	21.8%	21.8%
1992	100.0%	100.0%	100.0%	100.0%
1993	94.4%	98.8%	99.2%	99.2%

Year	ECB19RR	ALTN2	ALTO	ALTQ
1994	63.7%	81.5%	83.1%	71.8%
1995	11.7%	10.1%	47.6%	21.4%
1996	85.5%	82.7%	85.1%	81.5%
1997	99.2%	98.8%	96.4%	96.8%
1998	56.5%	69.4%	100.0%	99.6%
1999	100.0%	100.0%	100.0%	100.0%
2000	100.0%	100.0%	100.0%	99.6%
2001	100.0%	100.0%	100.0%	100.0%
2002	100.0%	100.0%	100.0%	100.0%
2003	99.6%	99.6%	99.2%	99.2%
2004	100.0%	100.0%	100.0%	100.0%
2005	100.0%	100.0%	100.0%	100.0%
Average (Diff ECB19RR)	**83.9%**	**85.7% (1.8%)**	**88.8% (4.9%)**	**87.3% (3.4%)**
Number of Times Period of Record Target (40%) Met	**36**	**36**	**38**	**36**
Number of Times ALT ≥ ECB19RR	**-**	**34**	**35**	**33**
Number of Times ALT < ECB19RR	**-**	**7**	**6**	**8**

Table 4-17. CSSS-D Nesting Season Statistics: Percent of Habitat within CSSS-D that met > 90 consecutive dry days during March 1 through July 15 of each year (USGS CSSS Viewer). Green coloration denotes target (40%) was met.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	93.8%	94.2%	93.5%	93.1%
1966	26.5%	20.4%	23.1%	26.2%
1967	94.2%	91.5%	78.5%	75.4%
1968	0.4%	0.4%	0.4%	0.4%
1969	20.4%	13.5%	16.2%	14.6%
1970	21.9%	10.8%	16.9%	14.2%
1971	100.0%	100.0%	100.0%	100.0%
1972	10.8%	11.2%	7.7%	10.4%
1973	88.1%	88.1%	86.5%	88.1%
1974	97.7%	97.7%	97.7%	96.2%
1975	88.8%	91.5%	90.4%	86.2%
1976	19.6%	21.2%	23.1%	21.5%
1977	7.7%	5.8%	5.8%	5.8%
1978	13.1%	12.7%	11.5%	10.8%
1979	0.0%	0.0%	0.0%	0.0%
1980	54.6%	39.6%	38.8%	32.7%
1981	95.4%	95.8%	97.3%	95.8%

Year	ECB19RR	ALTN2	ALTO	ALTQ
1982	8.5%	8.5%	9.2%	8.5%
1983	15.0%	5.0%	4.2%	4.2%
1984	10.4%	6.9%	5.4%	6.2%
1985	47.7%	59.2%	57.3%	50.8%
1986	32.7%	17.7%	11.2%	14.6%
1987	78.5%	49.6%	50.0%	53.5%
1988	87.3%	85.0%	82.7%	83.1%
1989	86.2%	86.5%	86.2%	86.2%
1990	46.2%	46.5%	50.8%	50.4%
1991	1.5%	1.5%	0.8%	1.2%
1992	89.6%	80.8%	72.7%	63.8%
1993	47.3%	25.4%	24.6%	25.4%
1994	12.3%	5.4%	10.0%	7.3%
1995	10.4%	3.5%	5.8%	4.6%
1996	63.8%	23.1%	27.7%	21.9%
1997	92.7%	92.3%	91.5%	91.5%
1998	66.2%	35.4%	57.3%	51.5%
1999	89.2%	67.7%	70.0%	68.8%
2000	86.9%	81.5%	82.3%	77.3%
2001	88.1%	93.8%	95.0%	93.8%
2002	89.2%	88.1%	53.8%	50.8%
2003	14.2%	13.1%	14.2%	15.8%
2004	93.5%	93.5%	93.1%	92.7%
2005	89.6%	90.0%	86.5%	89.6%
Average (Diff ECB19RR)	**53.2%**	**47.7% (-5.5%)**	**47.1% (-6.1%)**	**46.0% (-7.2%)**
Number of Times Period of Record Target (40%) Met	**24**	**20**	**21**	**21**
Number of Times ALT ≥ ECB19RR	**-**	**18**	**13**	**23**
Number of Times ALT < ECB19RR	**-**	**23**	**28**	**28**

Table 4-18. CSSS-E Nesting Season Statistics: Percent of Habitat within CSSS-E that met > 90 consecutive dry days during March 1 through July 15 of each year (USGS CSSS Viewer). Green coloration denotes target (40%) was met.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	88.9%	88.7%	92.6%	82.6%
1966	56.6%	41.5%	34.3%	34.3%
1967	93.3%	82.4%	80.7%	71.9%
1968	0.0%	0.0%	0.0%	0.0%
1969	34.0%	29.0%	21.9%	11.6%

Year	ECB19RR	ALTN2	ALTO	ALTQ
1970	5.8%	4.5%	6.7%	5.5%
1971	100.0%	100.0%	100.0%	100.0%
1972	32.6%	24.1%	19.4%	26.8%
1973	72.1%	66.8%	64.4%	69.9%
1974	100.0%	100.0%	100.0%	100.0%
1975	99.5%	99.1%	99.7%	99.1%
1976	79.3%	75.1%	76.2%	74.5%
1977	65.0%	60.0%	56.9%	58.3%
1978	54.9%	53.4%	48.1%	52.0%
1979	15.0%	12.5%	11.8%	9.4%
1980	51.7%	47.2%	46.4%	42.8%
1981	100.0%	99.7%	99.5%	100.0%
1982	34.3%	30.3%	28.7%	25.9%
1983	0.2%	0.2%	0.2%	0.2%
1984	22.4%	16.8%	15.7%	11.6%
1985	99.5%	99.4%	99.2%	99.4%
1986	43.7%	30.9%	21.3%	20.2%
1987	63.0%	55.8%	56.7%	53.9%
1988	82.3%	75.5%	77.0%	70.5%
1989	100.0%	100.0%	100.0%	100.0%
1990	100.0%	100.0%	100.0%	100.0%
1991	10.0%	10.7%	10.5%	10.7%
1992	74.9%	65.5%	63.0%	46.7%
1993	32.8%	28.8%	32.4%	25.1%
1994	28.8%	23.0%	22.6%	12.1%
1995	0.2%	0.0%	1.4%	0.0%
1996	43.4%	36.8%	32.9%	22.6%
1997	14.7%	9.7%	8.2%	8.8%
1998	8.8%	6.9%	20.5%	13.6%
1999	71.8%	57.7%	53.6%	54.2%
2000	51.6%	46.1%	50.3%	29.0%
2001	100.0%	100.0%	100.0%	100.0%
2002	79.0%	71.9%	68.0%	58.6%
2003	54.7%	52.0%	47.0%	50.3%
2004	99.7%	99.1%	99.1%	96.1%
2005	100.0%	99.8%	99.8%	100.0%
Average (Diff ECB19RR)	**57.7%**	**53.7% (-4.0%)**	**52.8% (-4.9%)**	**50.0% (-7.7%)**
Number of Times Period of Record Target (40%) Met	**27**	**25**	**24**	**23**

Year	ECB19RR	ALTN2	ALTO	ALTQ
Number of Times ALT ≥ ECB19RR	**-**	**8**	**13**	**11**
Number of Times ALT < ECB19RR	**-**	**33**	**28**	**30**

Table 4-19. CSSS-F Nesting Season Statistics: Percent of Habitat within CSSS-F that met > 90 consecutive dry days during March 1 through July 15 of each year (USGS CSSS Viewer). Green coloration denotes target (40%) was met.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	100.0%	100.0%	100.0%	100.0%
1966	100.0%	84.8%	64.2%	70.2%
1967	100.0%	100.0%	100.0%	100.0%
1968	0.0%	0.0%	0.0%	0.0%
1969	86.8%	89.4%	68.9%	57.0%
1970	0.0%	1.3%	8.6%	7.9%
1971	100.0%	100.0%	100.0%	100.0%
1972	64.2%	34.4%	27.8%	31.8%
1973	100.0%	100.0%	100.0%	100.0%
1974	100.0%	100.0%	100.0%	100.0%
1975	100.0%	100.0%	100.0%	100.0%
1976	100.0%	100.0%	100.0%	100.0%
1977	100.0%	100.0%	100.0%	100.0%
1978	100.0%	100.0%	100.0%	100.0%
1979	0.0%	0.0%	0.0%	0.0%
1980	94.0%	73.5%	85.4%	76.8%
1981	100.0%	100.0%	100.0%	100.0%
1982	74.2%	74.2%	74.2%	68.9%
1983	0.0%	0.0%	2.6%	1.3%
1984	0.7%	1.3%	4.6%	0.7%
1985	100.0%	100.0%	100.0%	100.0%
1986	0.0%	10.6%	9.9%	2.6%
1987	97.4%	89.4%	97.4%	92.1%
1988	100.0%	100.0%	100.0%	100.0%
1989	100.0%	100.0%	100.0%	100.0%
1990	100.0%	100.0%	100.0%	100.0%
1991	0.0%	0.0%	0.0%	0.0%
1992	100.0%	100.0%	100.0%	90.1%
1993	4.6%	31.8%	25.8%	23.2%
1994	6.0%	34.4%	66.9%	50.3%
1995	0.0%	0.0%	0.7%	0.0%
1996	90.1%	81.5%	72.8%	60.3%
1997	100.0%	100.0%	100.0%	100.0%

Year	ECB19RR	ALTN2	ALTO	ALTQ
1998	7.3%	10.6%	39.1%	35.8%
1999	94.0%	83.4%	82.8%	78.8%
2000	98.7%	98.0%	100.0%	90.7%
2001	100.0%	100.0%	100.0%	100.0%
2002	100.0%	100.0%	100.0%	100.0%
2003	86.1%	98.7%	98.7%	94.0%
2004	100.0%	100.0%	100.0%	100.0%
2005	100.0%	100.0%	100.0%	100.0%
Average (Diff ECB19RR)	**70.8%**	**70.7% (-0.1%)**	**71.5% (0.7%)**	**69.1% (-1.7%)**
Number of Times Period of Record Target (40%) Met	**30**	**29**	**30**	**30**
Number of Times ALT ≥ ECB19RR	**-**	**34**	**35**	**31**
Number of Times ALT < ECB19RR	**-**	**7**	**6**	**10**

Table 4-20 through **Table 4-25** depicts the percentage of habitat within each of the six CSSS subpopulations (CSSS-Ax, CSSS-B, CSSS-C, CSSS-D, CSSS-E, and CSSS-F) that experienced a four year running average discontinuous hydroperiod between 90 and 210 days for each year in the period of record (1965-2005). The mean four year hydroperiod for a named year is the average yearly days where the water level is > 0 for the previous four years (e.g. 1969 mean four year hydroperiod is the mean of 1965-1968). The average percentage of the four year running average over the period of record is shown as well as the number of times ECB19RR, ALTN2, ALTO, and ALTQ failed to meet the target (40%) in two consecutive years. The number of times an alternative was observed to be greater than or equal to ECB19RR, as well as the number of times an alternative was observed to be less than ECB19RR in a given year is also shown.

An average percentage of greater than 40% was not met in CSSS-Ax, however it was achieved in CSSS-B, CSSS-C, and CSSS-F for ECB19RR, ALTN2, ALTO, and ALTQ. Performance varied in CSSS-D and CSSS-E. An average of greater than 40% was met in CSSS-D and CSSS-E for ECB19RR and ALTN2. ALTO and ALTQ were 1-3% from the target. Across the sub-populations, the difference in average percentage over the period of record for ALTN2, ALTO, and ALTQ relative to ECB19RR, ranged from a minimum of -20.0% to a maximum of 7.0%. The greatest differences between ECB19RR and each alternative were observed in CSSS-C, CSSS-D, and CSSS-E. ALTO (7%) and ALTQ (4%) improved discontinuous hydroperiod relative to ECB19RR in CSSS-C. ALTN2 (-2%) was observed to perform slightly less than ECB19RR in this subpopulation. In CSSS-D each alternative was observed to perform less than ECB19RR (more so than in CSSS-C), with ALTO (-20%) and ALTQ (-20%) having a greater effect than ALTN2 (-11%). In CSSS-E each alternative was also observed to perform less than ECB19RR, each alternative performed similarly (ALTN2 (-4%), ALTO (-5%), ALTQ (-5%)).

Table 4-20. CSSS-Ax Discontinuous Annual Hydroperiod Statistics: Percent of habitat within CSSS-Ax to meet a four year running average discontinuous hydroperiod between 90 and 210 days. Green coloration denotes target (40%) was met in individual year.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	-	-	-	-

Year	ECB19RR	ALTN2	ALTO	ALTQ
1966	-	-	-	-
1967	-	-	-	-
1968	-	-	-	-
1969	16%	14%	14%	14%
1970	12%	12%	11%	12%
1971	8%	9%	10%	9%
1972	14%	15%	15%	14%
1973	18%	17%	17%	17%
1974	30%	28%	27%	30%
1975	47%	46%	43%	46%
1976	39%	40%	39%	41%
1977	45%	45%	45%	47%
1978	52%	52%	52%	52%
1979	49%	49%	49%	50%
1980	38%	36%	35%	33%
1981	28%	26%	25%	24%
1982	28%	27%	26%	25%
1983	30%	29%	28%	27%
1984	25%	25%	25%	26%
1985	22%	23%	23%	24%
1986	18%	19%	19%	20%
1987	18%	18%	18%	20%
1988	28%	26%	23%	23%
1989	27%	25%	24%	25%
1990	32%	30%	28%	30%
1991	47%	44%	44%	45%
1992	60%	60%	60%	61%
1993	61%	59%	59%	58%
1994	25%	25%	27%	23%
1995	11%	13%	14%	12%
1996	5%	7%	6%	6%
1997	5%	6%	6%	6%
1998	4%	6%	5%	5%
1999	3%	4%	4%	4%
2000	5%	6%	6%	6%
2001	11%	12%	12%	10%
2002	14%	15%	15%	14%
2003	18%	20%	18%	17%
2004	23%	24%	23%	21%
2005	30%	29%	28%	28%

Year	ECB19RR	ALTN2	ALTO	ALTQ
2006	28%	27%	26%	26%
Average (Diff ECB19RR)	**26%**	**26% (0%)**	**25% (1%)**	**25% (1%)**
Threshold not met in 2 Consecutive Years	**27**	**27**	**27**	**27**
Number of Times ALT ≥ ECB19RR	**-**	**23**	**22**	**20**
Number of Times ALT < ECB19RR	**-**	**15**	**16**	**18**

Table 4-21. CSSS-B Discontinuous Annual Hydroperiod Statistics: Percent of habitat within CSSS-B to meet a four year running average discontinuous hydroperiod between 90 and 210 days. Green coloration denotes target (40%) was met in individual year.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	-	-	-	-
1966	-	-	-	-
1967	-	-	-	-
1968	-	-	-	-
1969	62%	62%	61%	62%
1970	47%	46%	46%	46%
1971	43%	43%	43%	43%
1972	53%	53%	53%	52%
1973	47%	46%	46%	46%
1974	44%	44%	44%	44%
1975	58%	58%	58%	59%
1976	55%	55%	54%	55%
1977	66%	66%	65%	66%
1978	67%	66%	66%	67%
1979	58%	56%	56%	56%
1980	44%	43%	42%	42%
1981	42%	42%	40%	41%
1982	46%	45%	44%	44%
1983	54%	53%	53%	52%
1984	54%	54%	53%	54%
1985	56%	56%	56%	56%
1986	54%	53%	54%	53%
1987	55%	53%	54%	53%
1988	40%	38%	38%	38%
1989	50%	48%	49%	49%
1990	32%	30%	31%	31%
1991	47%	47%	47%	47%
1992	66%	66%	66%	66%
1993	62%	62%	62%	62%
1994	55%	54%	55%	54%

Year	ECB19RR	ALTN2	ALTO	ALTQ
1995	53%	53%	53%	52%
1996	49%	49%	48%	48%
1997	49%	49%	49%	48%
1998	47%	46%	46%	45%
1999	27%	27%	27%	27%
2000	36%	35%	35%	35%
2001	43%	43%	42%	42%
2002	50%	49%	50%	49%
2003	53%	54%	54%	54%
2004	50%	50%	50%	50%
2005	52%	52%	52%	53%
2006	46%	46%	45%	45%
Average (Diff ECB19RR)	**50%**	**50% (0%)**	**50% (0%)**	**50% (0%)**
Threshold not met in 2 Consecutive Years	**1**	**1**	**1**	**1**
Number of Times ALT ≥ ECB19RR	**-**	**22**	**17**	**16**
Number of Times ALT < ECB19RR	**-**	**16**	**21**	**22**

Table 4-22. CSSS-C Discontinuous Annual Hydroperiod Statistics: Percent of habitat within CSSS-C to meet a four year running average discontinuous hydroperiod between 90 and 210 days. Green coloration denotes target (40%) was met in individual year.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	NA	NA	NA	NA
1966	NA	NA	NA	NA
1967	NA	NA	NA	NA
1968	NA	NA	NA	NA
1969	94%	94%	96%	96%
1970	95%	94%	64%	68%
1971	92%	94%	85%	85%
1972	95%	96%	94%	94%
1973	78%	63%	79%	79%
1974	22%	8%	25%	18%
1975	6%	2%	7%	7%
1976	14%	10%	15%	15%
1977	18%	16%	21%	21%
1978	14%	12%	17%	17%
1979	14%	13%	18%	18%
1980	10%	10%	28%	27%
1981	2%	2%	5%	4%
1982	2%	2%	11%	7%
1983	10%	7%	33%	23%

Year	ECB19RR	ALTN2	ALTO	ALTQ
1984	86%	86%	85%	85%
1985	89%	88%	89%	89%
1986	86%	82%	81%	82%
1987	76%	66%	71%	71%
1988	11%	2%	20%	12%
1989	18%	3%	27%	23%
1990	11%	2%	17%	12%
1991	2%	1%	4%	4%
1992	34%	38%	45%	45%
1993	54%	67%	71%	70%
1994	79%	85%	87%	85%
1995	86%	87%	87%	82%
1996	69%	71%	76%	65%
1997	63%	65%	76%	68%
1998	50%	53%	63%	52%
1999	23%	25%	39%	34%
2000	78%	75%	75%	76%
2001	89%	89%	90%	90%
2002	85%	88%	88%	88%
2003	63%	65%	80%	77%
2004	20%	20%	65%	60%
2005	9%	6%	58%	38%
2006	5%	3%	38%	17%
Average (Diff ECB19RR)	**46%**	**44% (-2%)**	**53% (7%)**	**50% (4%)**
Threshold not met in 2 Consecutive Years	**15**	**15**	**12**	**12**
Number of Times ALT ≥ ECB19RR	**-**	**19**	**31**	**28**
Number of Times ALT < ECB19RR	**-**	**19**	**7**	**10**

Table 4-23. CSSS-D Discontinuous Annual Hydroperiod Statistics: Percent of habitat within CSSS-D to meet a four year running average discontinuous hydroperiod between 90 and 210 days. Green coloration denotes target (40%) was met in individual year.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	-	-	-	-
1966	-	-	-	-
1967	-	-	-	-
1968	-	-	-	-
1969	62%	38%	25%	24%
1970	33%	18%	15%	13%
1971	37%	19%	16%	14%
1972	50%	30%	23%	20%

Year	ECB19RR	ALTN2	ALTO	ALTQ
1973	56%	35%	27%	27%
1974	73%	72%	61%	69%
1975	77%	78%	79%	81%
1976	81%	82%	81%	83%
1977	82%	84%	84%	84%
1978	80%	82%	80%	81%
1979	68%	65%	51%	51%
1980	56%	38%	26%	26%
1981	56%	36%	20%	21%
1982	64%	37%	24%	23%
1983	75%	46%	26%	28%
1984	52%	30%	23%	21%
1985	54%	37%	25%	23%
1986	37%	28%	18%	16%
1987	40%	27%	17%	16%
1988	70%	68%	34%	32%
1989	70%	70%	37%	35%
1990	75%	74%	64%	62%
1991	78%	80%	83%	84%
1992	85%	88%	86%	87%
1993	85%	86%	84%	84%
1994	45%	25%	23%	22%
1995	28%	15%	14%	11%
1996	20%	10%	10%	10%
1997	21%	9%	12%	10%
1998	23%	10%	11%	12%
1999	22%	8%	8%	10%
2000	28%	15%	13%	11%
2001	36%	18%	18%	16%
2002	42%	25%	24%	24%
2003	64%	46%	24%	30%
2004	70%	58%	26%	34%
2005	79%	78%	54%	63%
2006	77%	78%	45%	54%
Average (Diff ECB19RR)	**57%**	**46% (-11%)**	**37% (-20%)**	**37% (-20%)**
Threshold not met in 2 Consecutive Years	**7**	**17**	**23**	**23**
Number of Times ALT ≥ ECB19RR	**-**	**9**	**6**	**6**
Number of Times ALT < ECB19RR	**-**	**29**	**32**	**32**

Table 4-24. CSSS-E Discontinuous Annual Hydroperiod Statistics: Percent of habitat within CSSS-E to meet a four year running average discontinuous hydroperiod between 90 and 210 days. Green coloration denotes target (40%) was met in individual year.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	-	-	-	-
1966	-	-	-	-
1967	-	-	-	-
1968	-	-	-	-
1969	50%	44%	37%	36%
1970	22%	13%	9%	10%
1971	22%	20%	14%	16%
1972	35%	32%	26%	27%
1973	44%	38%	33%	35%
1974	54%	49%	46%	51%
1975	71%	67%	67%	71%
1976	69%	67%	67%	70%
1977	77%	77%	77%	80%
1978	80%	75%	77%	78%
1979	54%	54%	54%	55%
1980	44%	40%	39%	38%
1981	34%	30%	32%	33%
1982	36%	35%	35%	35%
1983	45%	39%	41%	41%
1984	50%	44%	44%	44%
1985	34%	28%	28%	28%
1986	34%	29%	29%	28%
1987	36%	31%	30%	28%
1988	51%	41%	37%	35%
1989	57%	46%	42%	42%
1990	63%	51%	50%	49%
1991	60%	55%	59%	57%
1992	86%	84%	84%	86%
1993	87%	85%	84%	86%
1994	47%	43%	43%	37%
1995	28%	23%	23%	16%
1996	14%	11%	13%	9%
1997	12%	9%	11%	8%
1998	8%	7%	8%	6%
1999	4%	3%	4%	4%
2000	9%	8%	8%	8%
2001	24%	20%	18%	17%

Year	ECB19RR	ALTN2	ALTO	ALTQ
2002	33%	29%	30%	27%
2003	50%	47%	44%	42%
2004	48%	48%	46%	44%
2005	56%	54%	54%	54%
2006	50%	48%	49%	48%
Average (Diff ECB19RR)	**44%**	**40% (-4%)**	**39% (-5%)**	**39% (-5%)**
Threshold not met in 2 Consecutive Years	**13**	**14**	**16**	**17**
Number of Times ALT ≥ ECB19RR	**-**	**3**	**4**	**6**
Number of Times ALT < ECB19RR	**-**	**35**	**34**	**32**

Table 4-25. CSSS-F Discontinuous Annual Hydroperiod Statistics: Percent of habitat within CSSS-F to meet a four year running average discontinuous hydroperiod between 90 and 210 days. Green coloration denotes target (40%) was met in individual year.

Year	ECB19RR	ALTN2	ALTO	ALTQ
1965	-	-	-	-
1966	-	-	-	-
1967	-	-	-	-
1968	-	-	-	-
1969	100%	93%	83%	79%
1970	65%	56%	34%	25%
1971	47%	49%	26%	25%
1972	91%	83%	68%	67%
1973	99%	80%	79%	87%
1974	64%	52%	66%	66%
1975	5%	1%	8%	7%
1976	9%	7%	13%	12%
1977	11%	7%	11%	11%
1978	12%	7%	14%	15%
1979	22%	17%	29%	30%
1980	38%	36%	54%	58%
1981	12%	21%	32%	38%
1982	18%	28%	48%	51%
1983	57%	41%	58%	64%
1984	95%	83%	85%	85%
1985	85%	66%	64%	60%
1986	85%	76%	72%	66%
1987	84%	64%	52%	47%
1988	65%	53%	66%	65%
1989	64%	53%	70%	68%
1990	62%	52%	72%	74%

Year	ECB19RR	ALTN2	ALTO	ALTQ
1991	18%	11%	30%	28%
1992	59%	51%	68%	71%
1993	76%	79%	80%	89%
1994	86%	83%	66%	59%
1995	33%	40%	31%	22%
1996	10%	20%	21%	11%
1997	9%	18%	20%	9%
1998	9%	20%	20%	16%
1999	11%	15%	16%	14%
2000	43%	40%	36%	34%
2001	89%	83%	69%	58%
2002	91%	87%	86%	80%
2003	78%	77%	80%	81%
2004	60%	60%	76%	74%
2005	52%	53%	70%	67%
2006	54%	54%	72%	69%
Average (Diff ECB19RR)	**52%**	**48% (-4%)**	**51% (-1%)**	**50% (-2%)**
Threshold not met in 2 Consecutive Years	**11**	**10**	**10**	**10**
Number of Times ALT ≥ ECB19RR	**-**	**12**	**24**	**24**
Number of Times ALT < ECB19RR	**-**	**26**	**14**	**14**

In addition to the above, reference **Section 4.6.3** (**Wet Marl Prairies**) for a summary of results from the CSSS Marl Prairie ecological planning tool. CSSS are largely sedentary, occupy the prairie habitats year-round and are completely dependent on the condition of the prairies. Favorable nesting habitat requires short hydroperiod vegetation characteristic of mixed marl prairie communities. ALTN2, ALTO, and ALTQ were observed to increase flow to NESRS and the eastern marl prairies relative to ECB19RR; however changes to the eastern marl prairies generally fell within a range of +/- 10% in those subpopulations currently inhabited by CSSS-B through CSSS-F. Marl prairie habitat suitability increased in the northern portion of CSSS-Ax under each alternative. Areas of decreased suitability were observed in portions of CSSS-E and CSSS-D; however these observed decreases were coupled with observed increases in suitability in areas directly east of CSSS-E and north and south of CSSS-F and CSSS-C.

Table 4-26 lists the average annual overland flow volume in thousand acre-feet across the RSM-GL simulation period of record (1965-2005) for WCA 3A outlet structures and across transects in ENP. Flows through S-343A/B, S-344, and S-12A, S-12B, S-12C, and S-12D were reduced under each alternative relative to ECB19RR. Decreased flow was observed across Transect T17 for each alternative which is located west of the L-67 Extension in ENP. The observed decrease was coupled with an observed increase in flow across Transect T18 into NESRS. Increased flows to NESRS and Taylor Slough have the potential to affect the eastern marl prairies. The observed increase in flows across transect T20 (westward flow in north central ENP) may affect the amount of water potentially impacting the western marl prairies and CSSS-Ax. ALTN2, ALTO, and ALTQ increased flows in NESRS at Transect 18. Transect 18 is located west of theL-67 Extension. Annual flow increases were observed to range from an increase of 247,000 acre-feet

on average for ALTN2 to an increase of 214,000 acre-feet on average for ALTQ. ALTO increased annual flows in NESRS by 229,000 acre-feet on average per year.

Table 4-26. Average annual overland flow (K-ACFT) for ECB19RR and ALTN2, ALTO, and ALTQ, and differences in flow between ECB19RR and each alternative for WCA 3A outflow structures and across transects in ENP over the period of record (1965-2005).

Structure or Transect	ECB19RR	ALTN2	Difference ECB19RR – ALTN2	ALTO	Difference ECB19RR - ALTO	ALTQ	Difference ECB19RR – ALTQ
S-343 A/B	14.9	11.7	**- 3.2**	5.0	**- 9.9**	4.1	**- 10.8**
S-344	7.0	5.7	**- 1.3**	2.5	**-4.5**	2.1	**- 4.9**
S-12A	29.8	20.3	**- 9.5**	12.7	**- 17.1**	21.4	**- 8.4**
S-12A Weir*	5.9	4.3	**-1.6**	6.7	**0.8**	5.0	**- 0.9**
S-12B	34.9	25.2	**-9.7**	25.1	**- 9.8**	24.9	**- 10**
S-12B Weir*	4.7	3.6	**- 1.1**	5.4	**0.7**	4.0	**- 0.7**
S-12C	142.9	97.0	**- 45.9**	68.5	**- 74.4**	93.1	**- 49.8**
S-12D	218.6	162.7	**- 55.9**	194.9	**- 23.7**	172.9	**- 45.7**
T17	239	171	**- 68**	152	**- 87**	172	**- 67**
T18	332	579	**247**	546	**214**	561	**229**
T20	118	260	**142**	242	**123**	245	**127**
TSH1	20	21	**1**	24	**4**	24	**4**
TSH2	21	21	**0**	25	**4**	24	**3**
T23A	24	24	**0**	24	**0**	24	**0**
T23B	86	86	**0**	92	**6**	92	**6**
T23C	113	138	**25**	153	**40**	143	**30**

*S-12A/B weir is for flow over the top of the gates when the gates are closed.

ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages. ALTQ+ includes removal of seasonal closures for S-344 (included in RSM-GL Round 3 sensitivity simulation SRQ4). S-344 may discharge, up to the design capacity of 135 cfs, from WCA 3A to BCNP when WCA 3A is in Zone A of the WCA 3A Regulation Schedule. The annual average volume through S-344 was simulated to be 6,000 acre-feet for SRQ4 sensitivity run, versus 7,000 acre-feet for ECB19RR (corresponding to a WCA 3A stage difference of <0.02 feet). The difference in the simulated S-344 volumes is less than 1% of the total deliveries form WCA 3A. ALTQ+ also includes modifications to seasonal closures for S-332D based on coordination with the USFWS. For S-332D, calendar based CSSS restrictions will apply under ALTQ+ for southerly flows within the S-332 flow way (S-332DX1 releases are not counted against the S-332D discharge limits); however the pumping constraints (i.e. capacity) and dates associated with those constraints have been modified as described below, removing the previous seasonal limitation during the month of December.

Seasonal Constraints (ALTQ+):

- 15 July to 31 December: No capacity limit up to 575 cfs
- 01 January to 31 January: Limited to 325 cfs
- 01 February to 14 July: Limited to 250 cfs without the use of S-332DX1 or 375 cfs with S-332DX1 discharge of 125 cfs.

Seasonal Constraints (ALTQ):

- 15 July – 30 November: No capacity limit up to 575 cfs
- 01 December – 31 January: Limited to 325 cfs (Note modeling, if S-332DX1 is able to direct 75 cfs to the SDA, the effective S-332D discharge limit is raised to 375 cfs)
- 01 February – 14 July: Limited to 250 cfs (Note for modeling, if S-332DX1 is able to direct 75 cfs to the SDA, the effective S-332D discharge limit is raised to 325 cfs)

The removal of restrictions for the month of December was not explicitly modeled. However, the results for SRQ4, which included removal of seasonal restrictions for S-332D, indicated average December flow rates of 217.7 cfs, which is approximately 10% higher than the simulated average December flow rates for ALTQ, 197.8 cfs. The average monthly flow rate through S-332D is 132.4 cfs for ECB19RR. Therefore, the hydrologic conditions in Taylor Slough under ALTQ+ is expected to experience a slight improvement relative to ECB19RR conditions. SRQ4 performed similarly to ALTQ with respect to the CSSS metrics (i.e. dry nesting days and annual discontinuous hydroperiod). Reference **Appendix E.1**, **Figure E.1-31** and **Figure E.1-33** for CSSS metrics for SRQ4. No significant differences in the performance of CSSS-Ax and the eastern subpopulations are expected with modifications to seasonal closures for S-332D. The seasonal closures in ALTQ+ are more restricted than those modeled under SRQ4 which included full removal, and the estimated long-term increase corresponds to approximately 20-30 cfs per day for December (additional discussion is provided in **Section 4.2.5.4** (**Taylor Slough**).

The USACE has determined that the proposed action may affect the CSSS and its designated critical habitat. Consultation under the ESA has been initiated with the USFWS with submittal of a BA for this species. Reference **Appendix D**. The implementation of the COP is expected to influence wetland hydroperiods causing changes in nesting and marl prairie suitability for the CSSS. USACE proposes specific minimization as part of the COP including species and habitat monitoring to identify population trends for the CSSS currently being conducted in compliance with the 2016 ERTP BO (USFWS 2016). Reference the BA in **Appendix D** for further information. Under the COP, the USACE will continue to implement PSC to provide real-time assessment of conditions within the action area to ensure wildlife recommendations are considered during the water management decision process. Under the COP, the USACE will also continue to evaluate how water management operations within the flexibility available to the USACE may be conducted to maximize beneficial effects for the CSSS.

4.8.1.5 Everglade Snail Kite

Everglade snail kite habitat consists of freshwater marshes and the shallow vegetated edges of lake. Recent snail kite nesting locations within south Florida and the COP study area are depicted in **Figure 4-111**. The Everglade snail kite has a highly specialized diet typically composed of apple snails (*Pomacea paludosa*). Snail kite nesting primarily occurs from December to July, with a peak in February-June, but can occur year-round. Nesting substrates include small trees such as willow, cypress, and pond apple, and herbaceous vegetation such as sawgrass, cattail, bulrush, and reed. Snail kites appear to prefer woody vegetation for nesting when water levels are adequate to inundate the site (USFWS 1999). Nests are more

frequently placed in herbaceous vegetation during periods of low water when dry conditions beneath willow stands (which tend to grow at higher elevations) prevent Everglade snail kites from nesting in woody vegetation (USFWS 1999). Nest collapse is rare in woody vegetation but common in non-woody vegetation, especially on lake margins (USFWS 1999). In order to deter predators, nesting almost always occurs over water (Sykes et al. 1995). The persistence of the Everglade snail kite in Florida depends upon maintaining hydrologic conditions that support the specific vegetative communities that compose their habitat along with sufficient apple snail availability across their range each year (Martin et al. 2008). Critical habitat is depicted in **Figure D.2.5** in the COP BA in **Appendix D.2** (**Endangered Species Act Compliance**).

For the COP, an ecological planning tool was available to evaluate potential effects on the Everglade snail kite within the study area. The purpose of the ecological planning tool is to describe the dynamics of the apple snail population as a function of hydrology and temperature. The numbers and size distribution of snails are simulated and can be calculated for any day of a year with input data. Adult snails during a given year are a product of egg production, and thus environmental conditions, from the previous year. The ecological planning tool was developed using the Everglades Depth Estimation Network (EDEN) and therefore outputs begin starting in 1992. For more information on the apple snail population model, refer to Darby et al. 2015.

Figure 4-112 through **Figure 4-117** depicts apple snail adult population numbers for a wet year (1995) and a dry year (2004). Results are shown for adult snails (>20 mm) during the spring of a dry year (April 20), before that year's reproductive period. End of spring results are shown as this is the population of snails of the size class consumed by the Everglade snail kite. The top left panel of each graphic depicts ECB19RR. The bottom left panel depicts ALTN2, ALTO, and ALTQ, and the bottom right panel depicts the difference between each alternative relative to ECB19RR. Changes in apple snail population numbers were observed within the boundaries of designated critical habitat for the Everglade snail kite. Snail kite nesting is currently concentrated in southern portions of WCA 3A (**Figure 4-111**). During a wet year, each alternative would increase apple snail population numbers in portions of southern WCA 3A and ENP on the flanks of NESRS; however decreases were observed within the study area as well. During a dry year, similar patterns were observed; however potential decreases in apple snail population numbers appeared to be more severe, where they occurred within the study area. The ecological planning tool was not utilized for ALTQ+ since a separate RSM-GL model simulation was not conducted for the alternative. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages.

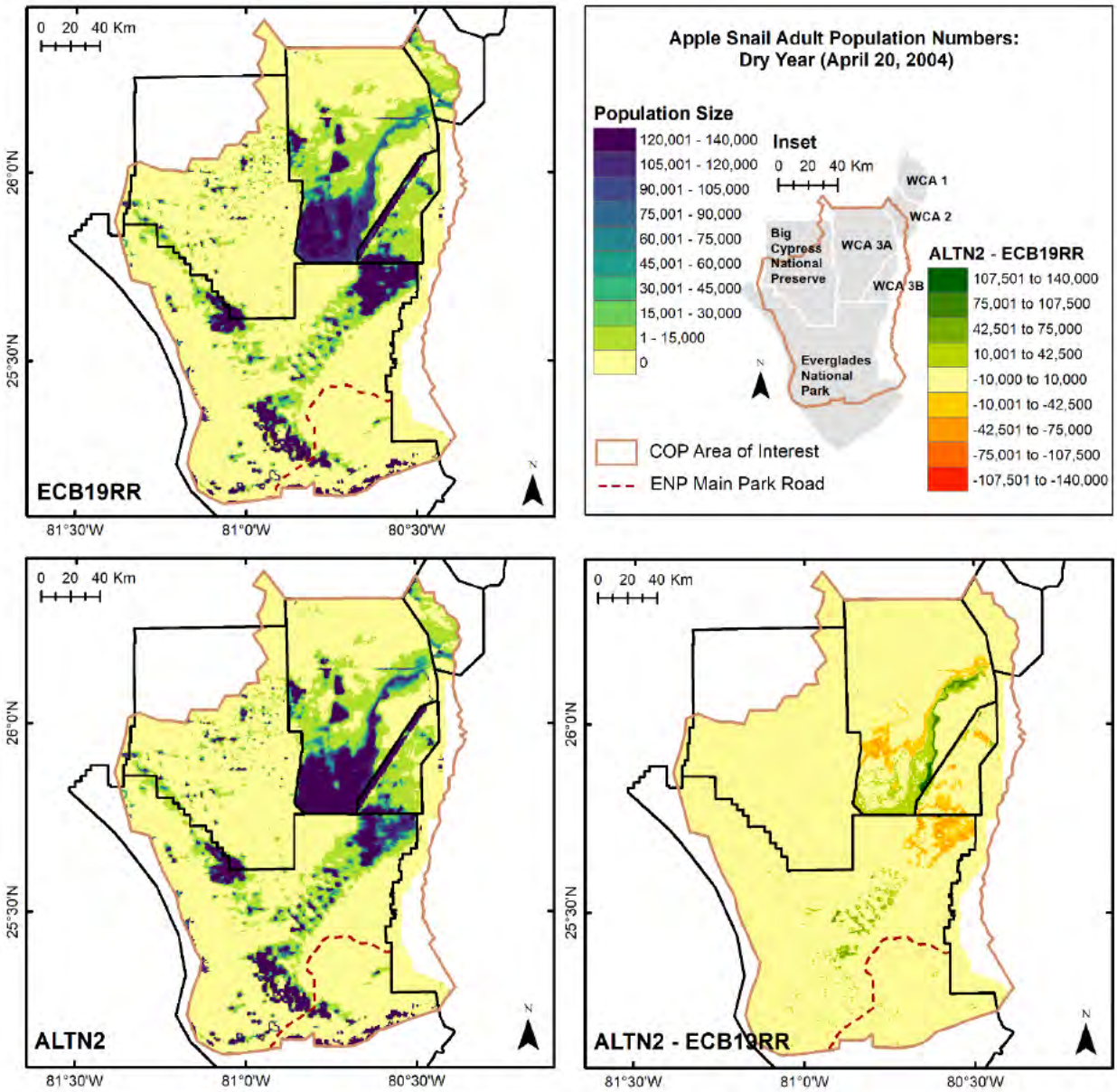

Figure 4-112. Apple snail adult population numbers for a dry year (April 20, 2004) ALTN2.

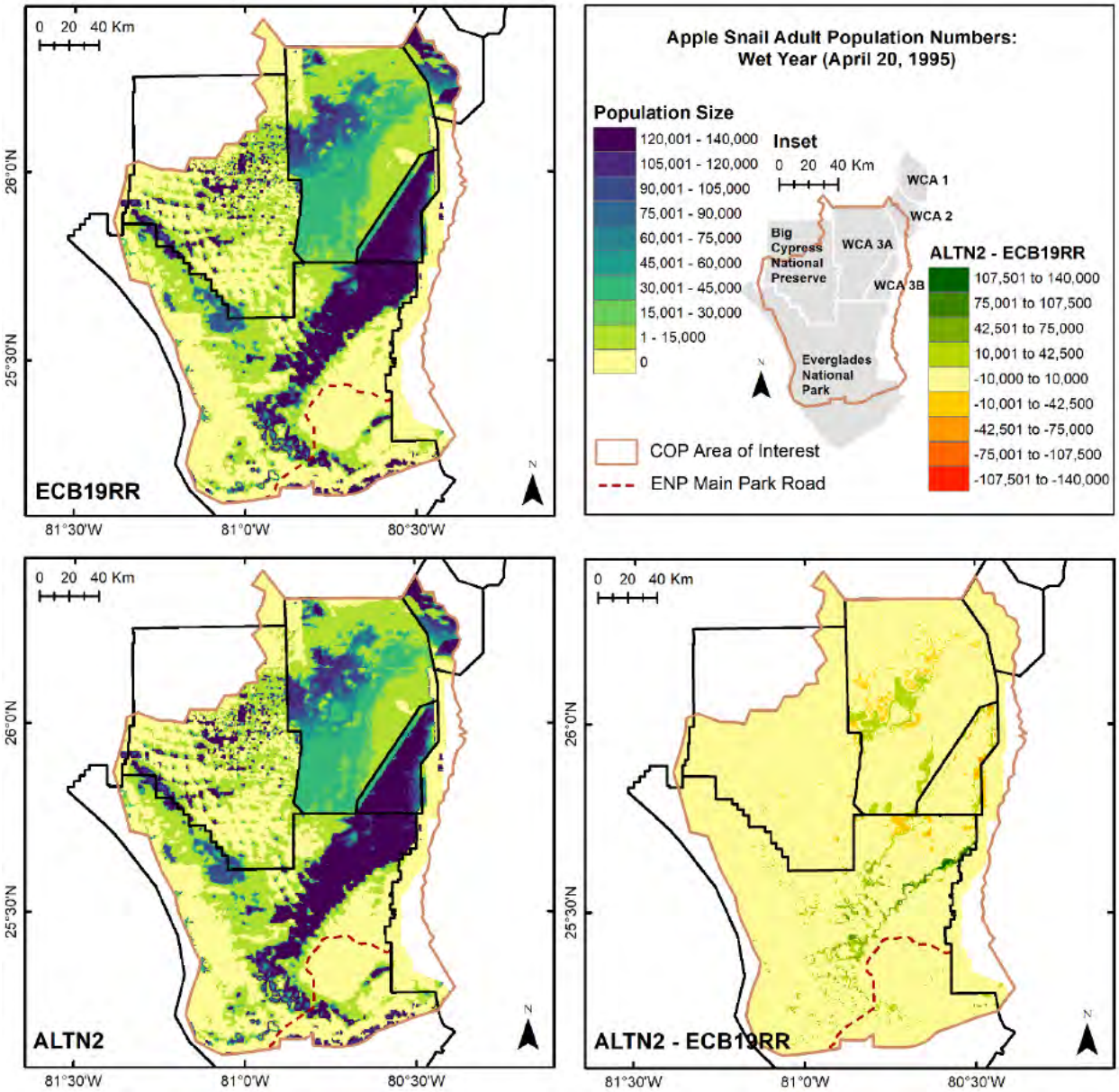

Figure 4-113. Apple snail adult population numbers for a wet year (April 20, 1995) ALTN2.

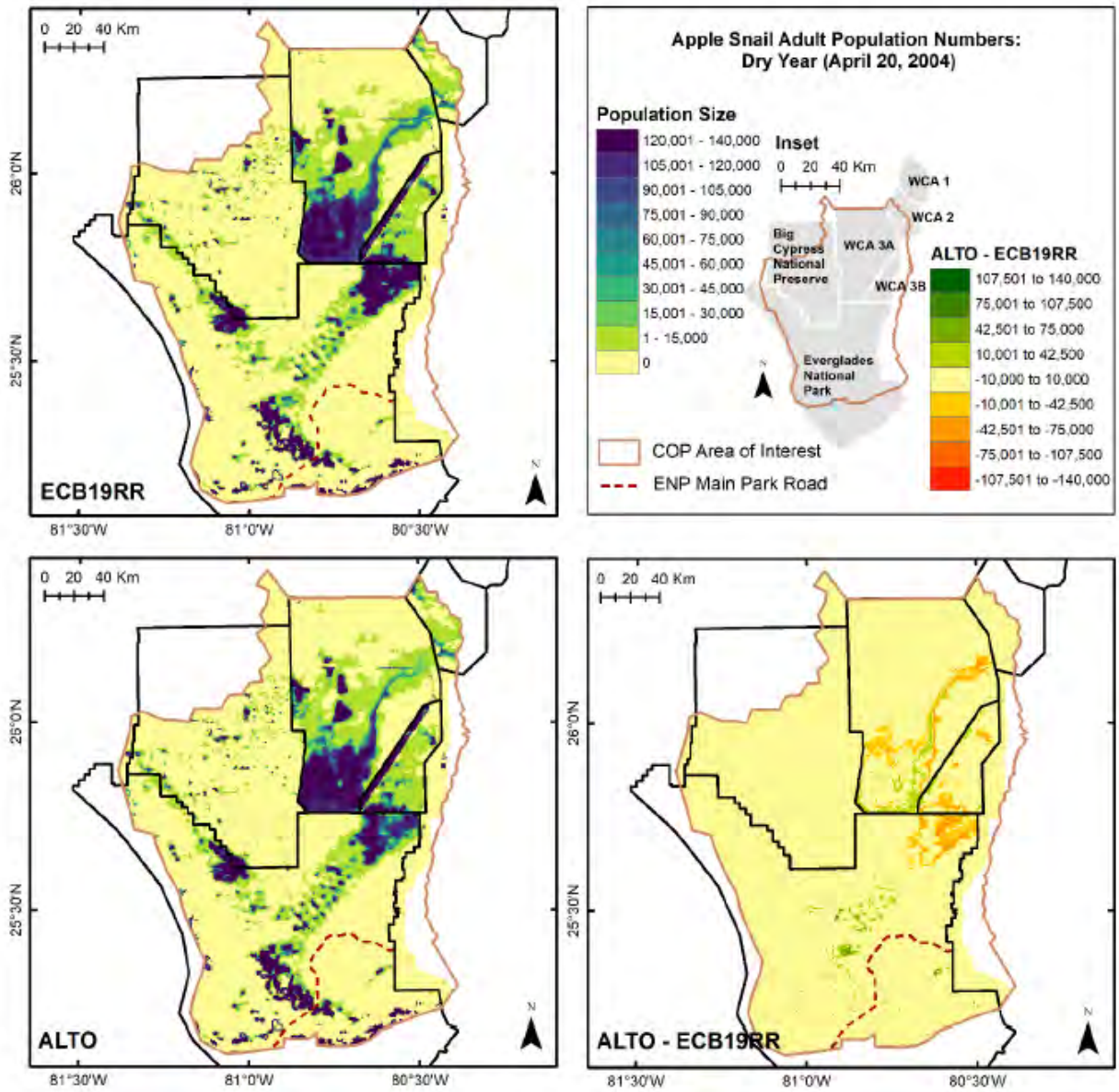

Figure 4-114. Apple snail adult population numbers for a dry year (April 20, 2004) ALTO.

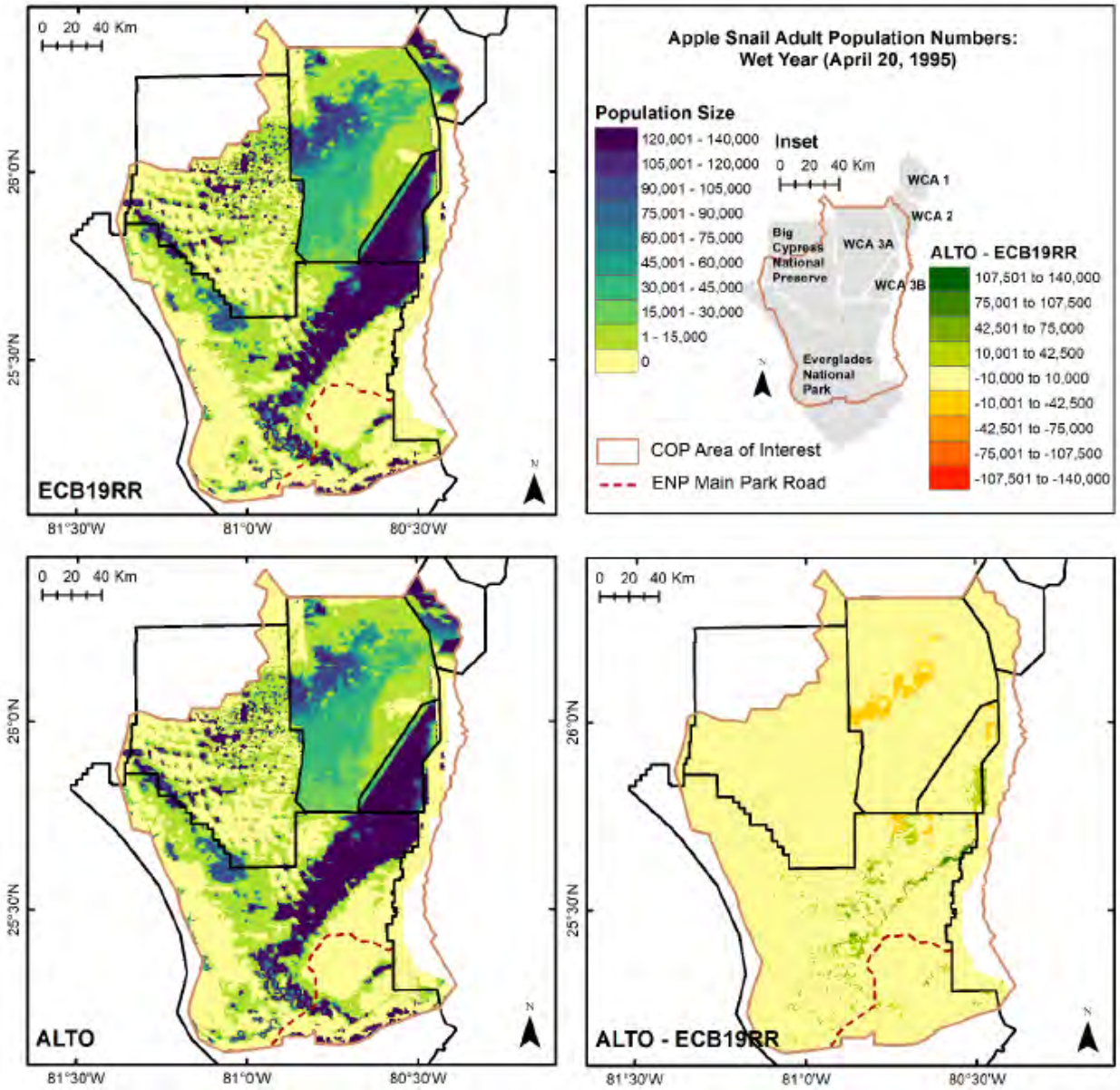

Figure 4-115. Apple snail adult population numbers for a wet year (April 20, 1995) ALTO.

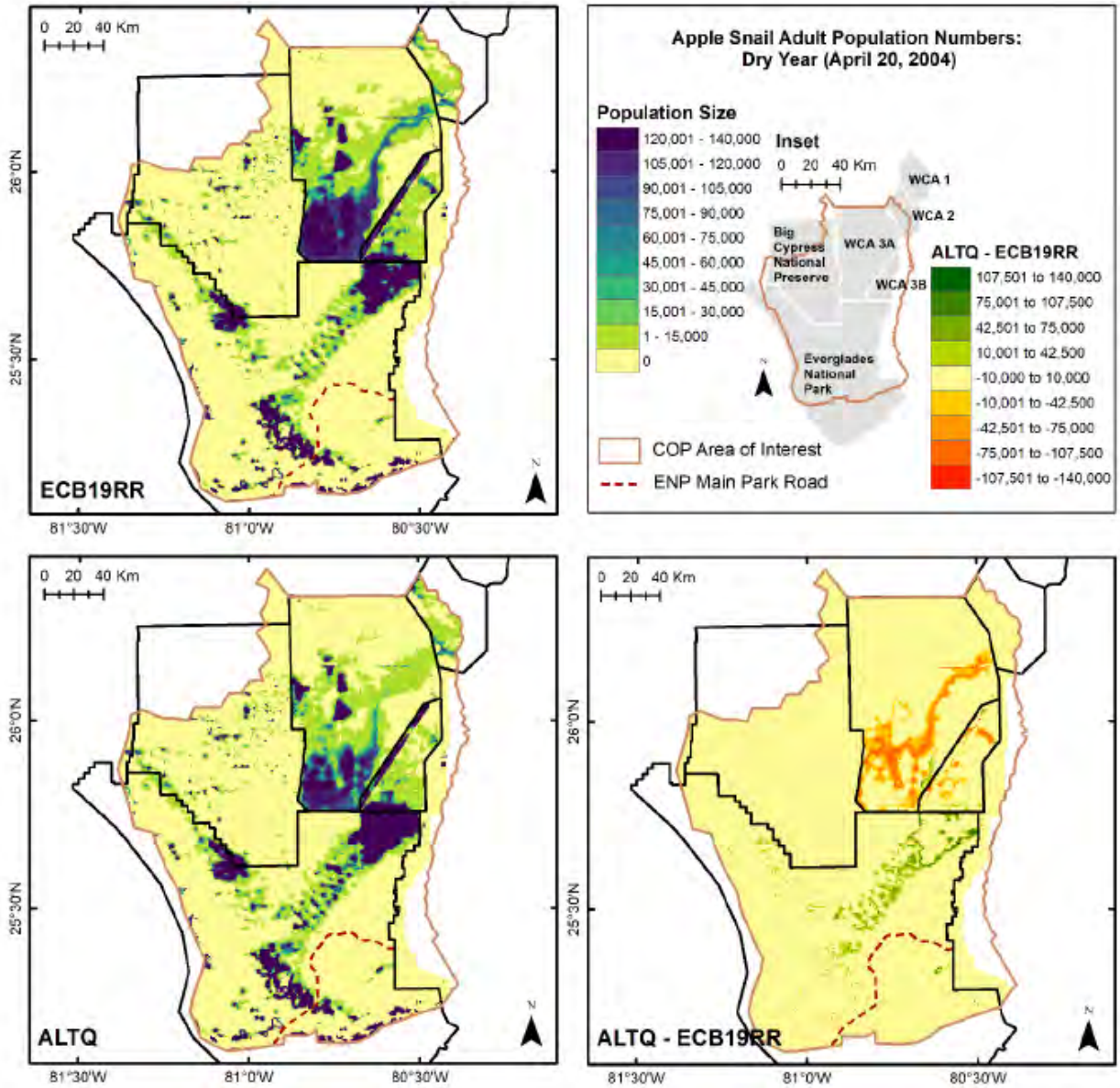

Figure 4-116. Apple snail adult population numbers for a dry year (April 20, 2004) ALTQ.

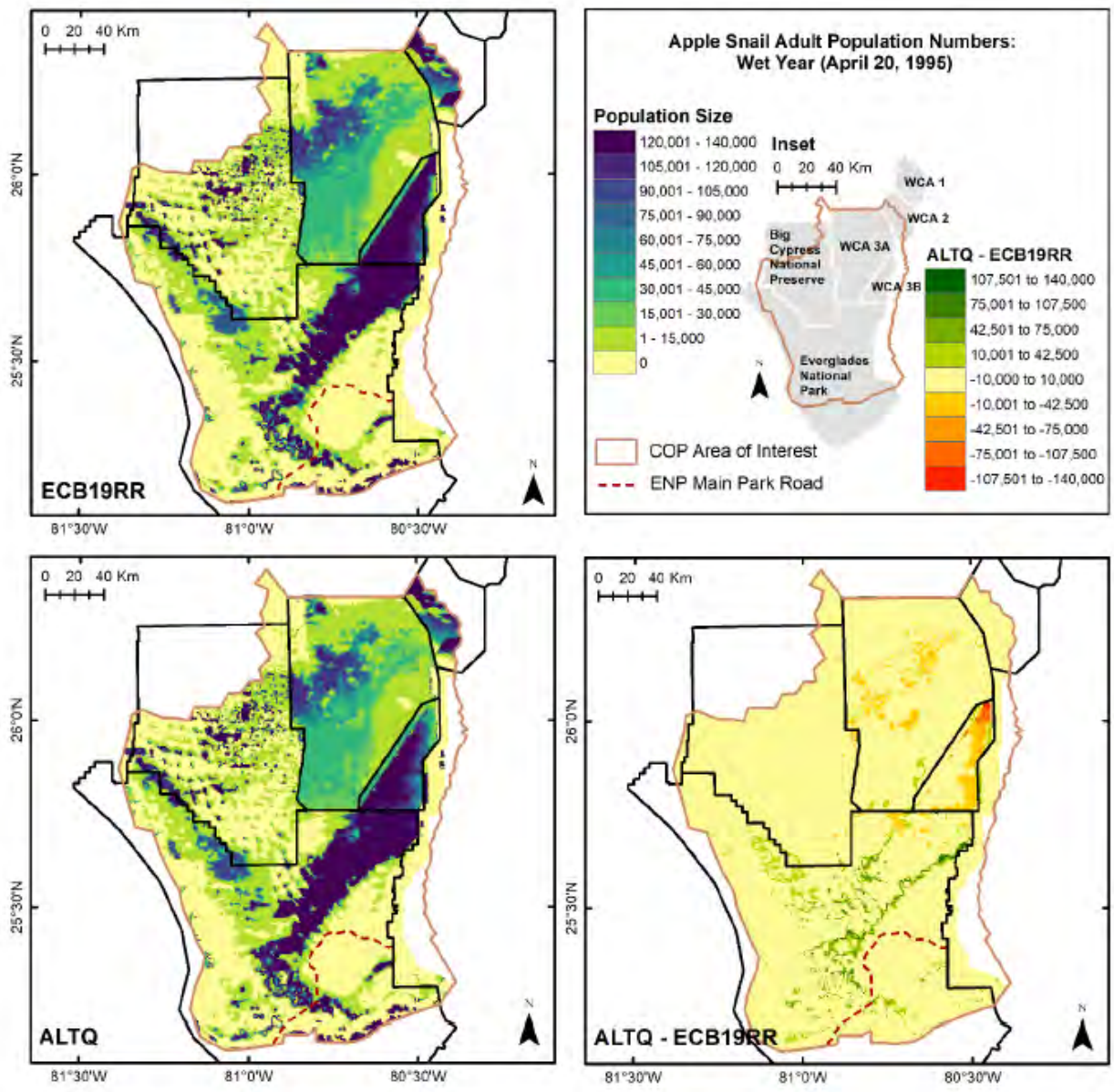

Figure 4-117. Apple snail adult population numbers for a wet year (April 20, 1995) ALTQ.

Figure 4-118 illustrates means of daily percent change in total apple snail population relative to ECB19RR by year for the COP area of interest (i.e. light brown line in **Figure 4-112** through **Figure 4-118**) for each year of the modeled simulation. Values start in 1995, giving the model three years to calibrate. ALTN2, ALTO, and ALTQ improved apple snail production in seven, three, and six out of the 11 years, respectively. Observed differences between each alternative and ECB19RR were most often not more than a ± 10% change (ALTN2 minimum to maximum percent change of -8.21% to 3.58%; ALTO minimum to maximum percent change of -12.15% to 1.94%; ALTQ minimum to maximum percent change of -13.60% to 3.61%).

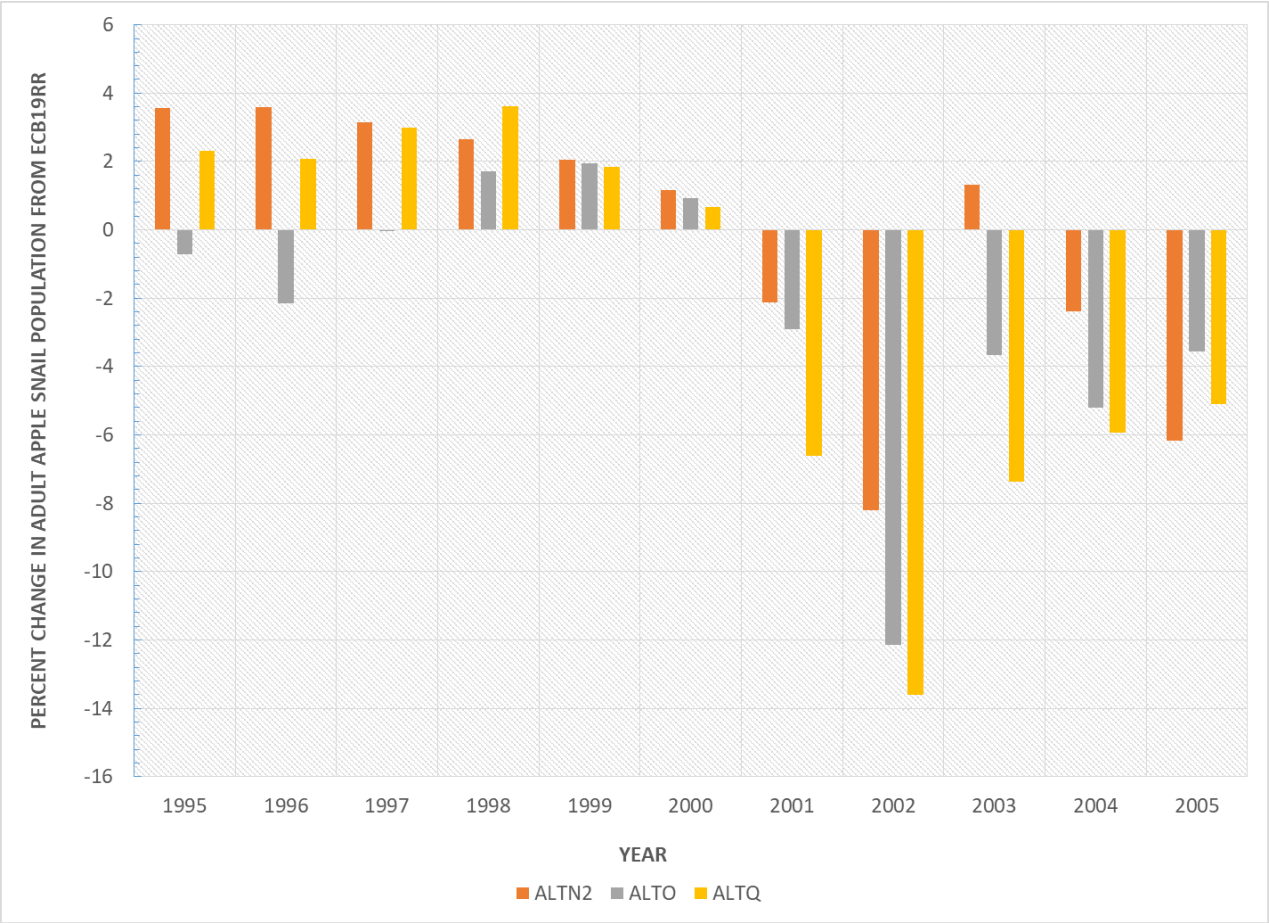

Figure 4-118. Mean percent change in adult apple snail population for each modeled year.

In addition to the apple snail population model, an ESA incidental take trigger developed during consultation between the USACE and the USFWS for the 2016 ERTP BO was also used to evaluate potential effects on the Everglade snail kite at the request of the USFWS. The 2016 ERTP BO includes exceedance criteria that are linked to habitat quality as a surrogate for incidental take of snail kites. Per the 2016 ERTP BO, those exceedance criteria are as follows: (1) Dry Season High Water: Number of days when maximum water levels exceed 9.2 feet, NGVD at gauge 3AS3W1 on or after April 15 in two consecutive years; (2) Wet Season High Water: Number of days maximum water levels exceed 10.5 feet, NGVD at gauge 3AS3W1 for 60 days in two consecutive years (June 1 – December 31); and (3) Recession Dry Season Amplitude: WCA 3A stage difference as measured at specific gages should not recede by more than 1.7 feet, NGVD from January 1 through May 31 or the onset of the wet season, whichever is sooner as measured in two consecutive years.

The USFWS requested that these exceedance criteria be utilized during the COP to understand potential effects on the Everglade snail kite within WCA 3A. High water stages may reduce the abundance, growth, and reproduction of apple snails and reduce woody vegetation that kites use for nesting and perch-hunting. Depending on the amount of lost snail productivity and the initial snail population size, a single year of high water during the dry season can result in long-term impacts to apple snail populations and decrease numbers of snail kite nest initiations, nest success, and juvenile survival in an area, as has been observed in WCA 3A. Rapid recession rates during the breeding season can also result in decreased nest success (through increased predation or decreased forage availability) and decreased juvenile survival

(due to decreased forage availability) (USFWS 2016). **Table 4-27** shows the number of times in the period of record (1965-2005) when maximum water levels exceed 9.2 feet, NGVD at gage 3AS3W1 on or after April 15 in two consecutive years. ALTN2, ALTO, and ALTQ reduced the number of years the threshold was exceeded relative to ECB19RR. ALTN2 and ALTQ decreased the exceedance criteria by three. ALTO decreased the exceedance criteria by two. The number of times in the period of record (1965-2005) when maximum water levels exceed 10.5 feet, NGVD at gage 3AS3W1 for 60 days (June 1-December 31) in two consecutive years with each alternative did not significantly deviate from ECB19RR (**Table 4-27**). ALTO and ALTQ performed equivalent to ECB19RR while ALTN2 decreased the exceedance criteria by one. ALTN2, ALTO, and ALTQ reduced the number of years over the period of record (1965-2005) the WCA 3A stage difference recedes by more than 1.7 feet, NGVD from January 1 through May 31 in a given year at gages 3AS3W1 and 3A-4, however the exceedance criteria was increased under each alternative at gages 3A28 and W2 (**Table 4-27**). Performance at each gage varied based on the alternative considered.

The ESA incidental take triggers were not available for ALTQ+. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages.

Table 4-27. Snail Kite exceedance criteria for ECB19RR, ALTN2, ALTO, and ALTQ.

Alternative	ECB19RR	ALTN2	ALTO	ALTQ
Dry Season High Water	7	4	5	4
Wet Season High Water	2	1	2	2
Recession: Dry Season Amplitude Gage 3A28	6	8	7	8
Recession: Dry Season Amplitude Gage 3A4	7	4	3	5
Recession: Dry Season Amplitude Gage 3AS3W1	8	5	6	5
Recession: Dry Season Amplitude Gage W2	4	6	6	8

The USACE has determined that the proposed action may affect the Everglade snail kite and its designated critical habitat. Implementation of the COP may produce a variety of wetland habitats that would support conditions conducive to apple snail production. During a wet year, each alternative increased apple snail population numbers in the study area thereby increasing the spatial extent of suitable foraging opportunities for snail kites providing a minor long-term beneficial effect. However, decreases in apple snail population numbers were observed during a dry year. In general, each alternative reduced the number of times exceedance criteria (2016 ERTP BO ESA incidental take trigger) for the snail kite were met. Consultation under the ESA has been initiated with the USFWS with submittal of a BA for this species. Reference **Appendix D.2** (**Endangered Species Act Compliance**). The COP is expected to influence wetland hydroperiods causing changes in potential nesting and apple snail production. The USACE proposes specific minimization as part of the COP including species and habitat monitoring to identify population trends for the Everglade snail kite currently being conducted in compliance with the 2016 ERTP BO (USFWS 2016). Reference the BA in **Appendix D.2** (**Endangered Species Act Compliance**) for further information. The PSCs will allow the USACE and its Tribal and governmental partners to discuss ecological, hydrological, and meteorological conditions to achieve the objective of managing water levels and releases for the protection of multiple species and their habitats, including the Everglade snail kite. Regularly scheduled interagency PSCs allow the USACE to gather input on desired long-term (annual and/or seasonal) conditions within the system. In addition, the PSCs occur on an as needed basis with the frequency of the calls determined based upon ongoing or anticipated conditions within the WCAs, SDCS, and ENP. The PSCs

focus on the status of a suite of species to allow for adaptive management of the system based upon the needs of multiple species and their habitats. Under the COP, the USACE will continue to implement PSCs to provide real-time assessment of conditions within the action area to ensure wildlife recommendations are considered during the water management decision process.

4.8.1.6 Wood Stork

The wood stork relies upon shallow, freshwater wetlands for foraging. Wood storks forage primarily within freshwater marsh and wet prairie vegetation types, but can be found in a wide variety of wetland types, as long as prey are available and the water is shallow and open enough to hunt successfully. Typical foraging sites include freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands such as stock ponds, shallow, seasonally flooded roadside or agricultural ditches, and managed impoundments. During nesting, these areas must also be sufficiently close to the colony to allow wood storks to efficiently deliver prey to nestlings. Wood stork nesting habitat consists of mangroves, cypress, and various other live or dead shrubs or trees located in standing water or on islands surrounded by relatively broad expanses of open water. Wood storks nest colonially, often in conjunction with other wading bird species, and generally occupy the large-diameter trees at a colony site. The same colony site will be used for many years as long as the colony is undisturbed and sufficient foraging habitat remains in the surrounding wetlands. Wood storks nest during the dry season, and rely on the drying wetlands to concentrate prey items. **Figure 4-111** illustrates the location of wood stork nests and core foraging areas currently located in the COP study area.

For the COP, an ecological planning tool was available to evaluate potential effects on wading birds in the study area. WADEM was utilized to determine spatially explicit changes in high quality foraging conditions for wading birds for each alternative. Reference **Section 4.7.4** (**Birds**). Observed differences between each alternative and ECB19RR were most often not more than a ± 10% change across the majority of WCA 3 and ENP. Improvements in foraging conditions were observed in NESRS under ALTN2, ALTO, and ALTQ relative to ECB19RR. ALTQ improved foraging conditions in ENP over a larger spatial area in comparison to ALTN2 and ALTO. An ecological planning tool was not utilized for ALTQ+ as this alternative was not modeled. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages. Observed results indicate that ALTN2, ALTO, ALTQ, and ALTQ+ have the potential to provide minor beneficial long-term effects on wood storks in portions of ENP.

In addition to WADEM, an ESA incidental take trigger developed during consultation between the USACE and the USFWS for the 2016 ERTP BO was utilized during plan formulation for the COP to understand potential effects on wood storks in WCA 3A. The 2016 ERTP BO includes a reinitiation trigger that evaluates water depths greater than 16 inches (41 cm) from March 1 through May 31 throughout WCA 3A as measured by the two gauge average (based upon a ground surface elevation of 8.4 feet NGVD) at gauges 3A-3 (Site 63) and 3A-4 (Site 64). Per the 2016 ERTP BO, incidental take will be exceeded if operations results in a water depth greater than 16 inches (41 centimeters) from March 1 through May 31 throughout WCA 3A for two consecutive years. The annual hydrologic pattern in south Florida is consistent, with water levels rising during the wet season (June through October), then receding gradually during the dry season (November to May). Wood storks nest during the dry season and rely on the drying wetlands to concentrate prey items for optimal foraging. Once the wetland has dried to where water levels are near the ground surface, the area is no longer suitable for wood stork foraging and will not be suitable again until water levels rise and the area is repopulated with fish. Wood storks prefer calm water,

approximately 2 to 16 inches deep and free of dense vegetation for foraging (Coulter and Bryan 1993). More recently, Beerens and Cook (2010) defined a foraging depth range of -0.31 to 1.34 feet (-9.33 to 41.26 cm) for wood storks feeding in WCA 3A. A water depth greater than 16 inches (41 cm) across WCA 3A during the nesting season would lower the suitability of foraging habitat to the point where the ability for wood storks to forage would be severely impaired and most likely result in widespread abandonment of nests and fledglings within the affected colony (USFWS 2016). **Table 4-28** shows the number of times in the period of record (1965-2005) when water depths exceeded 16 inches (41 cm) from March 1 through May 31 throughout WCA 3A in two consecutive years as measured by the two gage average (based upon a ground surface elevation of 8.4 feet NGVD) at gages 3A-3 and 3A-4. ALTN2, ALTO, and ALTQ reduced the number of times the threshold was exceeded relative to ECB19RR. ALTN2, ALTO, and ALTQ reduced the number of exceedance criteria by five, three and six times respectively. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages.

Table 4-28. Wood Storks and Wading Birds: Number of times in the period of record (1965-2005) when water depths exceeds 16 inches (41 cm) from March 1 through May 31 throughout WCA 3A in two consecutive years as measured by the two gage average (based upon a ground surface elevation of 8.4 feet NGVD at gage 3A-3 and 3A-4).

Alternative	ECB19RR	ALTN2	ALTO	ALTQ
Wood Stork Exceedance Criteria	12	7	9	6

The USACE has determined that the proposed action may affect the wood stork. Consultation under the ESA has been initiated with the USFWS with submittal of a BA for this species. Reference **Appendix D.2** (**Endangered Species Act Compliance**) The COP is expected to influence wetland hydroperiods causing changes in nesting and foraging suitability for the wood stork. Under the COP, the USACE will continue to evaluate how water management operations may be conducted to maximize beneficial effects for the wood stork. The USACE proposes specific minimization as part of the COP including species and habitat monitoring to identify population trends for the wood stork currently being conducted in compliance with the 2016 ERTP BO (USFWS 2016). Reference the BA in **Appendix D.2** (**Endangered Species Act Compliance**) for further information. Under the COP, the USACE will continue to implement PSC to provide real-time assessment of conditions in the study area to ensure wildlife recommendations are considered during the water management decision process.

4.8.1.7 American Alligator

For the COP, an ecological planning tool was available to evaluate potential effects on the American alligator. An HSI for alligators was employed to predict potential effects of ALTN2, ALTO, and ALTQ relative to ECB19RR. Reference **Section 4.7.3** (**Amphibians and Reptiles**). During a dry year, observed differences between each alternative and ECB19RR were most often not more than a ± 10% change across the majority of WCA 3 and ENP. During a wet year, increases in alligator habitat suitability greater than 10% were observed for ALTN2 in southern WCA 3A and in portions of southern ENP on the flanks of eastern SRS, however these same patterns were not observed for ALTO and ALTQ. Areas in southern WCA 3A in which alligator habitat suitability increased under ALTN2, were observed to decrease in suitability for ALTO or no change was observed under ALTQ in these same areas. Performance between ALTN2, ALTO, and ALTQ were more similar in an average year, where suitability was observed to decrease in the southern most extent of ENP and NESRS. The ecological planning tool was not utilized for ALTQ+ as the

alternative was not modeled. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages.

Implementation of the COP may produce a variety of wetland habitats that would support conditions conducive to alligators and other aquatic reptiles. The COP consists of an operational change to current water management operations and would not include construction of permanent structures or modifications to existing water management features. No construction is proposed (i.e. no canal modifications; canals often act as sites of refugia for American alligators). The USACE has determined that the proposed action may affect, but is not likely to adversely affect the American alligator. Consultation under the ESA has been initiated with the USFWS with submittal of a BA for this species. Reference **Appendix D.2** (**Endangered Species Act Compliance**).

4.8.1.8 American Crocodile

The American crocodile is found primarily in mangrove swamps and along low-energy mangrove-lined bays, creeks, and inland swamps. Natural nesting habitat includes sites with sandy shorelines or raised marl creek banks adjacent to deep water. Crocodiles also nest on elevated man-made structures such as canal berms and other places where fill has been introduced. The current distribution of the American crocodile is limited to extreme South Florida, including coastal areas of Miami-Dade, Monroe, Collier, and Lee counties. Along Florida's southwest coast, several small groups and individual crocodiles have been documented from Sanibel Island, Lee County, south to Collier Seminole State Park, Collier County. Crocodiles are regularly seen in ENP along the mainland shoreline of Florida Bay from the Cape Sable peninsula east to U.S. Highway 1, in mangrove habitats on North Key Largo from Blackwater Sound north to Ocean Reef Club, and at Florida Power and Light's Turkey Point Nuclear Electrical Generating Facility. There are three primary nesting populations in south Florida: (1) ENP (Cape Sable/Flamingo Area); (2) Turkey Point on Biscayne Bay and (3) Key Largo. Crocodile nesting populations have been documented in the cooling canals of Florida Power and Light's Turkey Point Nuclear Electrical Generating Facility (Mazzotti et al. 2007). These cooling canals offer nesting habitat because they satisfy the crocodile's two primary nesting requirements: suitable substrate above the normal high water level and adjacent deep-water refugia. While crocodiles prefer sandy substrates, they will often utilize canal spoil banks (Kushlan and Mazzotti 1989). Growth and survival of hatchling and juvenile crocodiles is influenced by salinity. Optimal salinity for these life stages is 0 to 20 psu in the wetlands and coastal creeks during the wet season and partway through the dry season (approximately June through January) (Moler 1992, Mazzotti 1999, Mazzotti et al. 2007). Changes in hydrology that would increase existing salinity conditions in the crocodile reproduction areas would degrade juvenile habitat for the American crocodile.

Critical habitat for the American crocodile includes but is not limited to both Florida Bay and Biscayne Bay. Reference **Figure D.2-6** in the COP BA in **Appendix D.2** (**Endangered Species Act Compliance**). Changes in freshwater flow in the headwaters of designated critical habitat for the American crocodile were variable for each alternative depending upon the location.

An assessment on potential changes in hydrology to Florida Bay and Biscayne Bay are summarized in **Section 4** (**Hydrology**). **Section 4.6** (**Vegetative Communities**) provides an assessment on potential changes in salinity to these areas. ALTN2, ALTO, and ALTQ increased flows toward Florida Bay across transect T23 relative to ECB19RR. Average annual flow increases were found to range from 25,000 acre-feet for ALTN2 to 46,000 acre-feet for ALTO. ALTQ increased average annual flows by 36,000 acre-feet

(**Table 4-26**). Results from the RECOVER performance measure indicate that significant adverse effects to Florida Bay are not anticipated due to the degree of observed salinity changes. Decreases in mean wet salinity for ALTN2, ALTO, and ALTQ relative to ECB19RR were small in Florida Bay, however decreases in dry season salinity exceeded decreases in wet season salinity (**Table 4-9** and

Table 4-10). These differences may be ecologically significant because they reflect long-term seasonal means. Also, the timing of lowered salinity, being more in the dry season, may be ecologically significant because salinity peaks associated with harm are most common in the late dry season and early wet season if precipitation delays occur. The RECOVER performance measure does not extend past Florida Bay into Biscayne Bay and was therefore unavailable for an evaluation of this area.; however ALTQ and ALTN2 increased average annual flows to South Bay (an area with unnaturally high salinity) by approximately 10,000 acre-feet (a 4% increase over ECB19RR) and 9,000 acre-feet (a 3.6% increase over ECB19RR). Flows to South Bay under ALTO were equivalent to ECB19RR. Reference **Table 4-12**. ALTQ+ would result in similar effects as discussed under ALTQ in Florida Bay and Biscayne Bay. Reference **Section 4.2.5** (**Alternative Q+**).

Improvements in seasonal inflow deliveries to Florida Bay and southern Biscayne Bay has the potential to improve salinity conditions that are more favorable for juvenile crocodile growth and survival. Nearshore salinity conditions within the coastal estuaries are elevated much of the year as a result of the less than adequate freshwater flow deliveries. The USACE has determined that the proposed action may affect, but is not likely to adversely affect the American crocodile and its critical habitat. Consultation under the ESA has been initiated with the USFWS with submittal of a BA for this species. Reference **Appendix D.2** (**Endangered Species Act Compliance**).

4.8.1.9 Eastern Indigo Snake

The Eastern indigo snake prefers drier habitats, but may be found in a variety of habitats including pine flatwoods, scrubby flatwoods, floodplain edges, sand ridges, dry glades, tropical hammocks, edges of freshwater marshes, muck land fields, coastal dunes, cabbage palm hammocks, and xeric sandhill communities. The COP is an operational plan to redistribute the amount and timing of releases from WCA 3A to ENP. Due to increased water flow and changes in water distribution it is anticipated that currently over drained areas in ENP would be rehydrated. This increase in hydroperiod is unlikely to significantly affect higher elevations or upland habitats preferred by this species. Since Eastern indigo snakes occur primarily in up-land areas, their presence within the Greater Everglades is somewhat limited, except within existing levees throughout the project area. ALTN2, ALTO, ALTQ, and ALTQ+ are not expected to result in the conversion of existing land use. Furthermore, no construction (i.e. levee removal) is proposed. The USACE has determined that the proposed action may affect but is not likely to adversely affect the eastern indigo snake. Consultation under the ESA has been initiated with the USFWS with submittal of a BA for this species. Reference **Appendix D.2** (**Endangered Species Act Compliance**).

4.8.2 State Listed Species

The study area provides habitat for several state listed species. State listed species with the potential to occur in the study area were determined based on a review of species and their ranges from the Florida Fish and Wildlife's Commissions (FWC) Florida's Imperiled Species Management Plan dated 2016–2026 (FWC 2016). While areas utilized by many of these species may be affected, ALTN2, ALTO, ALTQ, and ALTQ+ are not likely to adversely affect protected state species. State listed species with the potential to occur in the study area are listed in **Table 4-29**. The USACE commits to avoiding, minimizing or mitigating

for adverse effects during operations on state listed species and would coordinate with the FWC as needed.

Table 4-29. State listed species within the study area and species determination for the proposed action (Threatened).

Common Name	Scientific Name	Status	Potential Effects: ALTN2, ALTO, ALTQ, ALTQ+	May Affect	May Affect, Not Likely to Adversely Affect	No Effect
Mammals	-	-	-	-	-	-
Everglades mink	*Mustela vison evergladensis*	T	Inhabits southern Florida and in particular the shallow fresh water marshes of the Everglades and the Big Cypress Swamp region. Most sightings and specimens have come from either Collier or Dade County, but the Everglades mink presumably inhabits northern and eastern Monroe County as well (Smith 1980, Humphrey 1992). The diet of the Everglades mink primarily consists of crayfish, fish, small mammals, snakes, and insects (Humphrey 1992). Human disturbance and modifications to the wetlands that might impact minks include drainage, logging, dike construction, canal construction, road construction, reapportioning water for competing interests, the introduction of fire into the forest, and the introduction of pesticides into their habitat (Humphrey 1992; Humphrey and Zinn 1982). Changes in water levels within the marshes can lead to destruction of habitat and encroachment of exotic vegetation (Humphrey and Zinn 1982). ALTO and ALTQ/ALTQ+ have the potential to provide the greatest benefits to wetland hydrology relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3. ALTO and ALTQ/ALTQ+ improved the depth, distribution and duration of surface water over a larger spatial area and to a greater degree in comparison to ALTN2 in ENP. The increase in water availability and rehydration in portions of ENP have the potential to benefit the Everglades mink as a result of increased prey availability (forage fish). Due to changes in the distribution and timing of water entering ENP, minor to moderate long-term beneficial effects on aquatic invertebrates, amphibians and marsh fish would potentially occur under each of the COP alternatives; providing a long-term beneficial effect for this species.	-		X
Birds	-	-		-	-	-
Black skimmer	*Rynchops niger*	T	Inhabits coastal areas in Florida such as estuaries, beaches, and sandbars. Potential habitat and known breeding populations located outside of immediate action area. The COP is not anticipated to affect shorelines.	-	-	X
Least tern	*Sterna antillarium*	T	Inhabits coastal areas in Florida such as estuaries, beaches, and sandbars. Potential habitat and known breeding populations located outside of immediate action area. The COP is not anticipated to affect shorelines.	-	-	X
White-crowned pigeon	*Patagioenas leucocephalus*	T	Inhabit low-lying forest habitats with ample fruiting trees. Distribution restricted to Florida Bay, Biscayne Bay, and the Florida Keys. The COP is not anticipated to significantly affect tropical hardwood hammocks located in the southern reaches of the study area.	-	-	X
Little blue heron	*Egretta caerulea*	T	Inhabit fresh, salt, and brackish water environments in Florida including swamps, estuaries, ponds, lakes, and rivers. Minor to moderate long-term beneficial effects on wetland hydrology in ENP and potential for improved salinities in Florida Bay. ALTO and ALTQ/ALTQ+ maximized potential benefits relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3. ALTO and ALTQ/ALTQ+ improved depth, distribution and duration of surface water over larger spatial area and to greater degree in comparison to ALTN2 in ENP. Potential for increases in forage conditions through improved hydrology; may contribute to increases in aquatic prey base. Wading bird suitability increased in ENP; potential decrease in portions of WCA 3. Sufficient opportunities in ENP may offset any poor conditions in WCA 3.	-	X	-
Tricolored heron	*Egretta tricolor*	T	Inhabit fresh and saltwater marshes, estuaries, mangrove swamps, lagoons, and river deltas. Minor to moderate long-term beneficial effects on wetland hydrology in ENP and potential for improved salinities in Florida Bay. ALTO and ALTQ/ALTQ+ maximized potential benefits relative to ECB19RR in ENP while minimizing potential adverse impacts to WCA 3. ALTO and ALTQ/ALTQ+ improved depth, distribution and duration of surface water over larger spatial area and to greater degree in comparison to ALTN2 in ENP. Potential for increases in forage conditions through improved hydrology; may contribute to increases in aquatic prey base. Wading bird suitability increased in ENP; potential decrease in portions of WCA 3. Sufficient opportunities in ENP may offset any poor conditions in WCA 3.	-	X	-
Reddish egret	*Egretta rufescens*	T	Inhabit coastal areas, mainly on estuaries near mangroves, and lagoons, but also can be found on dredge spoiled islands. In mainland Florida, nest within Florida Bay and the Keys. Minor to moderate long-term beneficial effects and potential for improved salinities in Florida Bay. Potential for increases in forage conditions through improved hydrology	-	X	-

Roseate spoonbill	*Platalea ajaja*	T	Inhabit coastal areas, mainly on estuaries near mangroves, and lagoons, but also can be found on dredge spoiled islands Minor to moderate long-term beneficial effects and potential for improved salinities in Florida Bay. Potential for increases in forage conditions through improved hydrology	-	X	-
Florida sandhill crane	*Antigone canadensis pratensis*	T	Inhabit freshwater marshes, prairies, and pastures. Occur throughout peninsular Florida north to the Okefenokee Swamp in southern Georgia; less common at the northernmost and southernmost portions of this range. Florida's Kissimmee and Desoto prairie regions are home to the state's most abundant populations. Requires open upland habitat with low growth characteristics near permanent emergent wetland habitats. Primary habitat located outside of immediate action area. The COP is not anticipated to affect pastures.	-	-	X
Southeastern American kestrel	*Falco sparverius paulus*	T	Inhabits open woodlands, sand hill, and fire maintained savannah pine habitats. Within these habitats, kestrels will nest in cavities excavated in large dead trees. Potential habitat located outside of immediate action area. The COP is not anticipated to affect pine forests used for nesting.	-	-	X
Snowy plover		T				

4.8.3 Essential Fish Habitat

The National Marine Fisheries Service (NMFS) Southeast Region's Habitat Conservation Division (HCD) implements the Essential Fish Habitat (EFH) program in the coastal states from North Carolina south through Texas, as well as the territories of Puerto Rico and the U.S. Virgin Islands. One of the principal authorities for protecting and conserving marine fishery habitats is the EFH provisions of the Magnuson–Stevens Fishery Conservation and Management Act. The Magnuson-Stevens Act, defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." 16 U.S.C. § 1802 (10). The Magnuson-Steven's Act created regulatory fishery management councils to advise the NMFS on fishery management issues. Three regional fishery management councils exist within the area encompassed by the NMFS Southeast Region: (1) Gulf of Mexico; (2) South Atlantic and (3) Caribbean. Reference **Section 3** (**Affected Environment**) for a current list of managed species and those that potentially fall within the area affected by the COP.

An assessment on potential changes in hydrology to Florida Bay and Biscayne Bay are summarized in **Section 4.2** (**Hydrology**). **Section 4.6** (**Vegetative Communities**) provides an assessment on potential changes in salinity to these areas. ALTN2, ALTO, and ALTQ increased flows toward Florida Bay across transect T23 relative to ECB19RR. Average annual flow increases were found to range from 25,000 acre-feet for ALTN2 to 46,000 acre-feet for ALTO. ALTQ increased average annual flows by 36,000 acre-feet (**Table 4-26**). Results from the RECOVER performance measure indicate that significant adverse effects to seagrass beds are not anticipated due to the degree of observed salinity changes. Decreases in mean wet salinity for ALTN2, ALTO, and ALTQ relative to ECB19RR were small in Florida Bay, however decreases in dry season salinity exceeded decreases in wet season salinity (**Table 4-9** and

Table 4-10). These differences may be ecologically significant because they reflect long-term seasonal means. Also, the timing of lowered salinity, being more in the dry season, may be ecologically significant because salinity peaks associated with harm are most common in the late dry season and early wet season if precipitation delays occur. The RECOVER performance measure does not extend past Florida Bay into Biscayne Bay and was therefore unavailable for an evaluation of this area.; however ALTQ and ALTN2 increased average annual flows to South Bay (an area with unnaturally high salinity) by approximately 10,000 acre-feet (a 4% increase over ECB19RR) and 9,000 acre-feet (a 3.6% increase over ECB19RR). Flows to South Bay under ALTO were equivalent to ECB19RR. Reference **Table 4-12**. ALTQ+ would result in similar effects as discussed under ALTQ in Florida Bay and Biscayne Bay. Reference **Section 4.2.5** (**Alternative Q+**).

Previous water management operations have resulted in an inland migration of saline conditions in both groundwater and surface waters. This has caused the expansion of moderate to high salinity zones and has diminished the spatial extent of freshwater wetland habitats in the southern estuaries. Landward expansion of saltwater and mangrove wetlands, including low-productivity, sparsely vegetated dwarf mangrove communities typical of the hypersaline 'white zone' has also occurred in the southern estuaries. In areas, where the COP would improve freshwater delivery, implementation of the project may help to redistribute flow to saltwater wetlands and nearshore bay areas and result in favorable changes to salinity levels. Significant adverse effects to the nearshore communities or EFH downstream of the action area in Florida Bay and Biscayne Bay is not anticipated.

4.9 Water Quality

Potential effects to water quality were evaluated for each alternative by using predictive equations developed by the Department of the Interior (DOI) contractor (Dr. Bill Walker) to estimate nutrient loading to NESRS. These predictive equations were developed using data from 2002-2018. Water quality analyses performed for the preferred alternative identified potential water quality concerns for the NESRS inflows. Due to this situation, sensitivity runs were developed to evaluate water quality strategies to reduce potential water quality concerns. The adaptive management measures incorporating the water quality strategies and, developed to address potential water quality concerns, are only expected to be necessary until restoration strategies and CEPP features are completed and delivering additional water to NESRS. Implementation of Restoration Strategies and completion of CEPP features is expected to significantly improve water quality delivered to the ENP SRS eliminating the need for water quality adaptive management measures. Adaptive management implementation of the water quality strategies will be considered on a case by case basis and only if conditions warrant implementation.

Stages within WCA 3A and the location of the discharge points to NESRS are the primary Total Phosphorous (TP) drivers that the COP will change. Reductions in releases at the dry season to wet season conditions, shifting flows from S12D to S12C and reducing WCA 3A recession rates during the dry season under some conditions were modeled and showed improvements to water quality delivered to the ENP. Predicted TP levels estimate effects over long-term, but TP level predicted for individual events can vary considerably. Despite the strong relationships observed in the historical WCA 3 hydrologic data driving TP, there are uncertainties associated with the predicted TP levels. Relative comparisons of alternatives are the focus because they have less uncertainty/better use of modeling results. The detailed water quality analysis performed for ALTQ is applicable to ALTQ +. This is because the ALTQ flows delivered to the ENP SRS were identical to the ALTQ+ flows delivered to ENP SRS. The water quality analysis was focused on the ENP SRS. The C-111 system is expected to potentially see slight improvements from implementation of the COP due to the fact that bypasses to the South Dade System from WCA 3A are entirely eliminated under normal conditions. This will result in the water delivered to the C-111 South Dade/Taylor consisting of a higher percentage of clean seepage water from WCA 3A and the ENP.

The method of the water quality analysis used for the COP is intended to show comparative results between the different alternatives. The numeric results are not intended to provide a precise prediction of actual water quality concentrations. Several water quality factors were considered in the evaluation.

Water quality sensitivity runs were developed and evaluated to address water quality performance of ALTQ which had higher flow weighted mean (FWM) and higher loading delivered above 8 ppb as compared to ECB19RR. Reference **Section 2** (**Alternatives**) and **Appendix H**, **Annex 4** for a description of the sensitivity runs. A definition of the concepts evaluated for the sensitivity runs is presented in **Table 4-31**. Loading delivered at concentrations below 8 ppb are considered optimal to support the desired periphyton species (indicator species for the desired oligotrophic conditions) in the Everglades system.

It should be noted that there is a slight improvement trend for the water quality delivered to NESRS without implementation of any of the water quality strategies. See **Figure 4-119** for depiction of this trend below. The trend shown below is the reason water quality conditions for the 2018 and 2023 were modeled so that the improved performance of ALTQ+ with the implementation of the water quality strategies can be more easily identified.

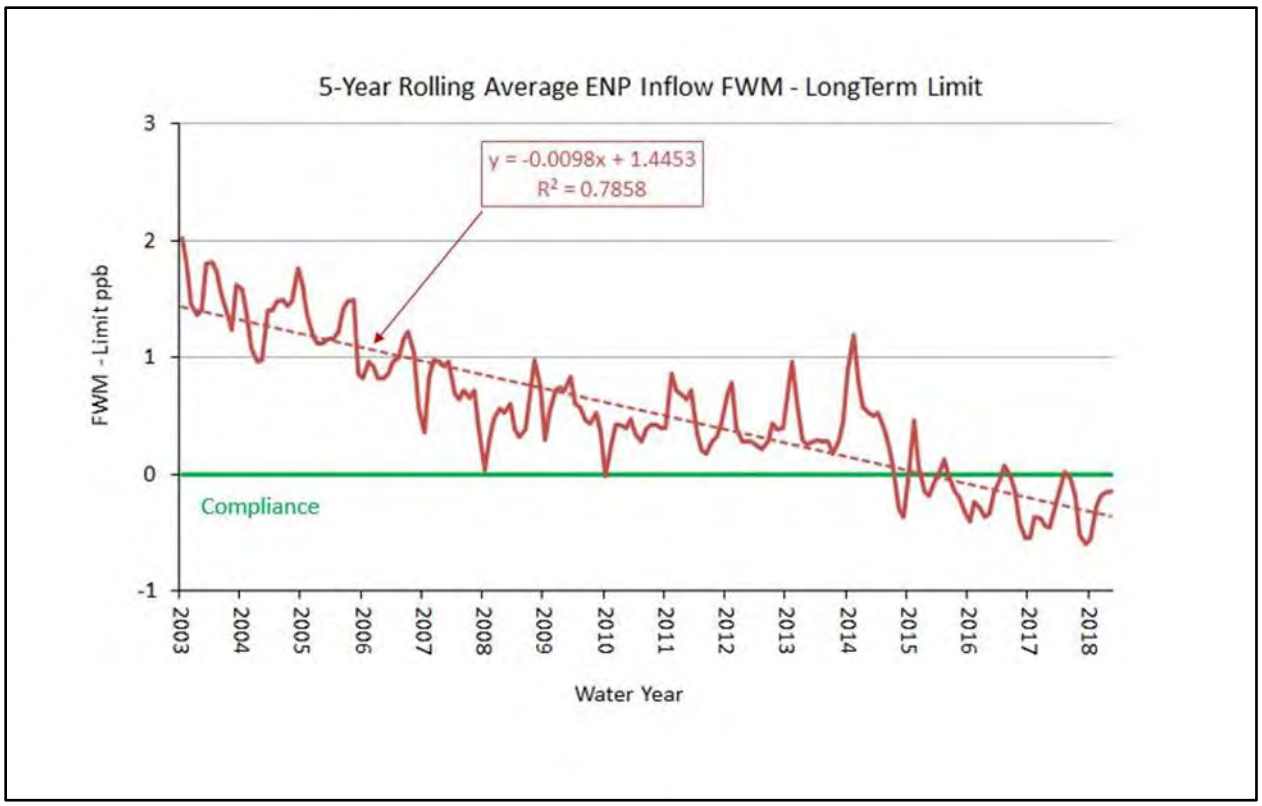

Figure 4-119. Five year rolling average ENP FWM long-term limit.

Using the assumptions for the alternatives and the baseline, the baseline was modeled for the time period of 2018. The sensitivity runs were modeled specifically for the 2018/2023 conditions (not the entire period of record) to provide a performance comparison to the baseline condition (2018 condition). This baseline analysis provides a nutrient condition to allow a relative comparison of the alternatives and the sensitivity runs. Using the assumptions and predictive equations used for all of the alternatives and sensitivity runs, the baseline was determined to have a FWM of 8.2 parts per billion (ppb) for the 2018 conditions. ALTN2 modeling indicated an increase in a FWM of 0.8 ppb above the baseline for flows into NESRS under 2018 conditions. ALTO modeling yielded an increase in a FWM of 0.9 ppb above the baseline for flows into NESRS under 2018 conditions. ALTQ indicated an increase of 1.1 ppb above the baseline for flows into NESRS under 2018 conditions. A more detailed water quality analysis was performed for ALTQ.

Table 4-30. Round 3 Scenarios: Timeframes reflect concentration predictions for 2018 and 2023.

Scenario	Concept A/B	Concept E	Concept G	Minimum Flow	Time Frames
ERTP 2012	N/A	N/A	N/A	N/A	2018
ECB19RR	N/A	N/A	N/A	N/A	2018
ALTQ	N/A	N/A	N/A	N/A	2018 and 2023
SRQ2_50	X	N/A	N/A	50 cfs	2018 and 2023
SRQ3_50	X	X	X	50 cfs	2018 and 2023
SRQ2	X	X		150 cfs	2018 and 2023

Scenario	Concept A/B	Concept E	Concept G	Minimum Flow	Time Frames
SRQ3		X	X	150 cfs	2018 and 2023

Table 4-31. COP water quality sensitivity run concepts, constraints and mechanisms.

Concept	Description	S-333 Stage Constraint for Reducing Flow	Season	Minimum Flow Constraint	Other Constraints	Mechanism: Allow time delay following marsh inundation prior to release to SRS	Mechanism: Relocate discharge point in hopes of reducing ENP inflow concentrations	Mechanism: Divert initial WCA 3A flush away from SRS	Mechanism: Reduce ENP inflow under stage conditions and when high P concentrations have been observed historically	Mechanism: Reduce P recycling from WCA 3A soils and vegetation by reducing spatial and temporal dry out frequency	Mechanism: Increase P uptake in WCA 3A marsh by increasing water depths
A	Do not discharge more than 150 cfs thru S-12D/S-333 when S-333 HW stage is below 8.2 feet, NGVD. RSM will automatically compensate for reduced dry season flow by increasing wet season flow, triggered by WCA 3A stage	< 8.2 feet	All	Total flows through S-12D + S-333 = Minimum (150 cfs Scheduled Flow)	-	-	-	-	X	X	X
B	Do not discharge more than 50 cfs thru S-12D/S-333 until S-333 HW stage rises above 9.2 feet, NGVD. Until stage > May 15 stage + 1.0 feet	< 9.2 feet and < 1.0 feet above May 15 stage	May 15 to June 30	Total flows through S-12D + S-333 = Minimum (150 cfs Scheduled Flow)	-	X	-	-	X	X	X
E	Shift 25% of S-12D discharge to S-12C. Account for structure flow capacities. Do not increase flow through S-12A/B	-	All	-	Structure Hydraulics Sparrow	-	X	-	-	-	-
G	Account for structure flow capacities. Do not increase flows thru S-12A/B. Stage objective long-term May average ≥ ECB19RR average (~7.7 feet) in years when December stage is ≤ 10 feet. Calibrate concept G reductions independently (without A or B constraints). Taper % reductions (higher in December, lower in May) to reduce impact on flows when stage is relatively low. Expected % reductions ~ 30% December to 6% in May; not accounting for seepage and ET losses. Maximum flow reduction of 50% on any day. Same % reductions for each structure (S-12A, S-12B, S-12C, S-12D, S-333) on given day.	-	December to May	Total flows through S-12D + S-333 = Minimum (150 cfs Scheduled Flow)	Exclude years when December 1 stage > 10 feet (low risk of dry out)	-	-	-	X	X	X

Table 4-32. Summary of COP Round 3 water quality analyses - relative scales.

Scenario	LTFWM-ppb	Average FWM Limit ppb	Excess P Load kg	SRS Impacted Area KAC > 4 ppb	SRS Impacted Area KAC > 6 ppb	SRS Impacted Area KAC > 8 ppb	WCA 3A Avg % Dry	NESRS2 Depth Frequency < 0.0 feet	NESRS2 Depth Frequency < 0.5 feet
ECB19RR	8.2	-0.1	1614	24.5	11.3	3.2	51%	9.3%	11.6%
Uncertainty	> 0.2	> 0.2	>36	>6	>3	>0.8	?	?	?
Increases vs. ECB19RR 2018 Forecasts: ALTQ	0.8	1.2	856	12.7	7.0	3.5	7%	-2.3%	-2.0%
Increases vs. ECB19RR 2018 Forecasts: SRQ2_50	0.3	0.5	108	7.9	3.8	1.3	4%	0.5%	1.1%
Increases vs. ECB19RR 2018 Forecasts: SRQ3_50	0.0	0.0	-182	5.6	2.2	0.2	2%	1.5%	2.5%
Increases vs. ECB19RR 2018 Forecasts: SRQ2	0.4	0.7	278	8.9	4.5	1.9	5%	-1.1%	-0.5%
Increases vs. ECB19RR 2018 Forecasts: SRQ3	0.5	0.8	463	9.1	4.9	2.5	4%	-1.5%	-1.4%
Increases vs. ECB19RR 2023 Forecasts: ALTQ	0.2	0.5	90	10.1	4.4	0.9	7%	-2.3%	-2.0%
Increases vs. ECB19RR 2023 Forecasts: SRQ2_50	-0.3	-0.2	-519	5.6	1.4	-1.1	4%	0.5%	1.1%
Increases vs. ECB19RR 2023 Forecasts: SRQ3_50	-0.5	-0.6	-753	3.4	0.0	-2.0	2%	1.5%	2.5%
Increases vs. ECB19RR 2023 Forecasts: SRQ2	-0.2	0.0	-368	6.5	2.1	-0.5	5%	-1.1%	-0.5%
Increases vs. ECB19RR 2023 Forecasts: SRQ3	-0.1	0.2	-188	6.7	2.6	0.1	4%	-1.5%	-1.4%

ALTQ+ for water quality evaluation consisted of series of sensitivity runs seeking to improve the water quality performance of ALTQ as compared to ECB19RR. SR Q2_50 (cfs) and SR Q3 50 (cfs) were determined to have undesirable impacts to NESRS (lower depths) within ENP. Due to some of the undesirable aspects of the 50 cfs runs, updated runs, SRQ2 and SRQ3, were evaluated using a higher minimum delivery of 150 cfs into NESRS. SRQ2 and SRQ3 addressed the lower stage concerns in NESRS presented by the initial runs with a minimum of 50 cfs. Sensitivity runs (2018 conditions) for SRQ2 and SRQ3 showed a 0.4 ppb and a 0.3 ppb improvement as compared to baseline. Sensitivity run (2023) conditions for SRQ2 and SRQ3 indicate a FWM improvement of 0.2 ppb and 0.1 ppb respectively as compared to baseline.

This analysis indicates that by 2023, with the use of adaptive management to implement the measures explored in the water quality sensitivity runs, the potentially negative impacts of ALTQ could be avoided and could result in a slight improvement to water quality (FWM TP) delivered to NESRS. This analysis also shows that through the use of adaptive management (incorporation of SRQ2 and SRQ3 concepts, described in section 2 and tables 4-30/4-31 above, into ALTQ+), the potential slight negative water impacts from ALTQ could be reduced before 2023.

4.10 Hazardous, Toxic or Radioactive Wastes

HTRW within the study area would not be expected to change from current conditions. ALTN2, ALTO, ALTQ, and ALTQ+ consist of an operational change to the 2012 Water Control Plan and would not include construction of permanent structures or structural modifications to existing C&SF Project features. ALTN2, ALTO, ALTQ, and ALTQ+ would not result in the discovery of HTRW since no excavation or other construction activities would occur. The risk for increased mobilization of existing HTRW where it might exist within the study area is low.

4.11 Air Quality

Air quality emissions associated with ECB19RR would occur from continued operation of diesel powered pump stations (S-331, S-332B, S-332C, S-332D) related to C&SF operations. Diesel exhaust includes gaseous compounds (e.g., carbon dioxide, oxygen, nitrogen, water vapor, carbon monoxide, nitrogen compounds, sulfur compounds, and numerous low molecular-weight hydrocarbons) and contains fine particulate matter, $PM_{2.5}$. Air quality within the study area as a result of implementation of ALTN2, ALTO, ALTQ, and ALTQ+ would be similar to that of ECB19RR. Emissions would occur during operation of the pump stations and would be limited to the immediate vicinity of the structures which are commonly located in remote rural areas. Emissions would not be expected to cause negative effects to human health.

4.12 Noise

Noise levels within the study area would not be expected to change from current conditions. Noise levels associated with ECB19RR would occur from continued operation of diesel powered pump stations related to C&SF operations. Noise levels within the study area as a result of implementation of ALTN2, ALTO, ALTQ, and ALTQ+ would be similar to that of ECB19RR. Increases in noise levels during operation of the pump stations would be limited to the immediate vicinity of the structures which are commonly located in remote rural areas. Increases in noise levels would be negligible. Sound levels would decrease with distance from the pump stations due to attenuation. Noise levels would not be expected to cause negative effects to human health.

4.13 Aesthetics

Aesthetics within the study area would not be expected to change from current conditions. ALTN2, ALTO, ALTQ, and ALTQ+ consist of an operational change to the 2012 Water Control Plan and would not include construction of permanent structures or structural modifications to existing C&SF Project features. As such, the existing landscape profile would not be altered.

4.14 Flood Risk Management

A summary of the anticipated long-term effects on flood risk management of ALTN2, ALTO, ALTQ and ALTQ+ is presented previously in **Table 4-1**. Additional supporting documentation for the effects characterization contained in **Table 4-1** is provided within this Section. The performance of each alternative is compared to the ECB19RR (No Action Alternative) which is described in **Section 3** (**Affected Environment**). The flood risk management (FRM) evaluation is focused principally on the urban and agricultural basins east of the WCAs and ENP (east of the East Coast Protective Levee), including LECSA 1 (Palm Beach County), LECSA 2 (Broward County), LECSA 3 (Miami-Dade County), and the 8.5 SMA. All alternatives lower the frequency and duration of high water stages in WCA 3A, which corresponds to further reduced public health and safety risk associated with the WCA 3A perimeter levee system. The summary of regional performance differences includes quantitative comparisons between the ECB19RR and the COP Action Alternatives based on the RSM-GL modeling representations of these operational scenarios. The period of simulation (1965-2005) used for the COP hydrologic modeling encompasses a wide range of historical climatologic and meteorologic conditions that are representative of south Florida hydrology.

The MD-RSM is a model designed to investigate current and future operational alternatives for flood control and water supply in South Miami Dade County. MD-RSM was designed to overcome some of the limitations of the RSM-GL model to simulate at a sub-daily time-step water supply and flood control operational strategies considered in the South Dade Conveyance System and the C-111 Spreader Canal Project. Since the MD-RSM simulation period includes only three representative water years for wet, average, and dry conditions, long-term performance trends are more readily evaluated using the RSM-GL. However, the MD-RSM was applied in the COP to assess the performance for flood protection for the C-111 basin by comparing each modeled alternative to the 1994 GRR C-111 base, which represents the level of flood protection authorized by the C-111 South Dade Project. The COP completed a comprehensive economic evaluation (**Appendix I** (**Socioeconomics**)) which compares the 1994 C-111 South Dade GRR authorized plan and the COP Action Alternatives. A summary of the ALTQ economic evaluation is provided in **Section 4.14.4** (**Alternative Q**); the reader is referred to **Appendix I** (**Socioeconomics**) for the detailed economic evaluation of the Round 2 alternatives, ALTN2 and ALTO. The MD-RSM was also applied in the COP to evaluate the COP constraint which requires maintenance of the authorized flood mitigation performance for the 1983 Base Condition, which represents the pre-project condition assumed for the 1992 MWD GDM plan development. A summary of the ALTQ flood mitigation evaluation for the 8.5 SMA is provided in Section 4.14.5; the reader is referred to **Appendix H**, **Annex H-6** for the detailed flood mitigation evaluation of the Round 2 alternatives, ALTN2 and ALTO.

4.14.1 No Action Alternative

The ECB19RR represents the operational criteria which would most reasonably be assumed to govern operations in the absence of implementation of the COP. Since the MWD Incremental Field Test operational criteria are themselves temporary planned deviations to the 2012 Water Control Plan (further

described in the 2012 ERTP Final EIS), operations would normally revert back to the previously approved Water Control Plan. However, in the case of the ECB19RR for the COP, because the USFWS issued a 2016 Jeopardy Biological Opinion for the CSSS on the 2012 Water Control Plan and since the terms and conditions of the Reasonable and Prudent Alternative identified by the USFWS were addressed with the operational criteria identified in the 2017 MWD Increment 1.1/1.2 Field Test, the MWD Increment 1.2 Field Test (with completion and full operation of the MWD 8.5 SMA and C-111 South Dade NDA features) established the assumed operational criteria for the ECB19RR. Evaluation of the temporary MWD Increment 2 Field Test criteria, which were first fully implemented with raising of the L-29 canal above 8.0 feet in September 2018 (following completion of the C-111 South Dade construction), continues to be conducted in parallel with the development of the COP and these operations were therefore inappropriate for the ECB19RR.

Due to the series of incremental operational changes along the South Dade Conveyance System during the MWD Incremental Field Tests and concurrent with the COP development, the FRM evaluation and interpretation of the COP hydrologic modeling results requires consideration of these operational changes. FRM performance for the urban and agricultural parcels adjacent to the L-31N and C-111 primary canals is principally based on the water level controls along these primary SDCS canals. **Table 4-33** provides a comparison of the operational ranges maintained along the L-31N canal and C-111 canal during the 2012 Water Control Plan (ERTP operational criteria for the SDCS were unchanged from the preceding 2002 and 2006 Interim Operational Plan, or IOP), Increment 1.2 (the assumed basis for the ECB19RR), and Increment 2 (in-place since February 2018, and fully implemented in September 2018).

The evaluation of FRM performance is based on a comparison between the ECB19RR and each respective Action Alternative. A comprehensive economic evaluation (**Appendix I** (**Socioeconomics**)) was also conducted which compares the 1994 C-111 South Dade GRR authorized plan and the COP Action Alternatives. A general overview of the hydrologic performance of the 1994 GRR plan versus ALTQ+ is provided in **Section 4.15** since the 1994 GRR FRM performance was identified as a constraint for the COP.

Table 4-33: South Dade Conveyance System, Primary Operational Stage Ranges for the 2012 Water Control Plan, 2019 Existing Condition Baseline, and the MWD Increment 2 Field Test.

Canal Reach	Structure	2012 WCP (ERTP)	2019 ECB (Increment 1.2; 2017-2018)	Increment 2 (2018-2020)
L-31N (S-335 to G-211)	S-356	S-356 Not Operated	5.5-5.8 (secondary priority if WCA 3A stage is above the EHWL)	Same as 2019 ECB
	G-211	5.5-6.0 under Normal Operations; 5.3-5.7 when regulatory inflows from WCA 3A (Column 2 operations)	Same as 2012 WCP	Same as 2019 ECB
L-31N (G-211 to S-331)	S-331	4.5-5.0 when LPG-2 stage is 5.5-6.0; 4.5-5.0 when LPG-2 stage is > 6.0 and C-357 is maintained < 6.2; 4.0-4.5 when LPG-2 stage is > 6.0 and C-357 is constrained > 6.2	5.0-5.5 when LPG-2 < 5.5; 4.0-4.5 when LPG-2 is between 6.0-6.5; 4.5-5.0 when LPG-2 is between 5.5-6.0; 3.5-4.0 when LPG-2 > 6.5	4.5-5.0 when LPG-2 > 7.0 (may be limited lowered if 8.5 SMA flood mitigation criteria are not being met); 5.0-5.5 when LPG-2 < 7.0

Canal Reach	Structure	2012 WCP (ERTP)	2019 ECB (Increment 1.2; 2017-2018)	Increment 2 (2018-2020)
L-31N (S-331 to S-176)	S-332B / S-332C	4.7-5.0 under Normal Operations; 4.5-4.8 when regulatory inflows from WCA 3A (Column 2 operations)	4.2-4.8 (may be lowered to 3.8 for CSSS targets)	Same as 2019 ECB
	S-332D	4.65-4.85	4.2-4.8	Same as 2019 ECB
	S-176	4.75-5.0 under Normal Operations; 4.7-4.9 when regulatory inflows from WCA 3A (Column 2 operations)	4.75-5.0	Same as 2019 ECB
C-111 (S-176 to S-177)	S-177	3.6-4.2	Same as 2012 WCP	Same as 2019 ECB
	S-199 / S-200*	3.6-4.0 (225 cfs capacity each; per 2011 PIR)	3.0-4.0 (300 cfs capacity each; revised 2016)	Same as 2019 ECB
C-111 (S-177 to S-18C)	S-18C	2.3-2.6 under Normal operations; 2.0-2.25 when regulatory inflows from WCA 3A (Column 2 operations)	Same as 2012 WCP	Same as 2019 ECB
C-111 (S-18C to S-197)	S-197	L1: Up to 800 cfs if S-177HW > 4.1 or S-18C HW > 2.8; L2: Up to 1600 cfs if S-177HW > 4.2 or S-18C HW > 3.1; L3: Up to 2400 cfs if S-177HW > 4.3 or S-18C HW > 3.3	L1: Up to 500 cfs if S-177HW > 4.1 or S-18C HW > 2.8; L2: Same as 2012 WCP; L3: Same as 2012 WCP; 250-400 cfs low-volume based on S-18C HW stage (higher for Column 2 operations)	Same as 2019 ECB

Note: Operational criteria are in units of feet, NGVD **C-111 Spreader Canal features: Maintained and Operated by SFWMD in accordance with FDEP Operating Permit*

Throughout the phased implementation of the MWD components during the MWD Incremental Field Tests, the 8.5 SMA flood mitigation performance has been evaluated relative to pre-project conditions in order to ensure continuous maintenance of the flood mitigation requirements for the 8.5 SMA. Detailed documentation of the assessment methodology used during the MWD Incremental Field Test is most recently provided in the hydrologic monitoring plan that accompanied the Increment 2 Field Test (Appendix C, Annex 2 of the February 2018 Environmental Assessment). The real-time monitoring protocols from the Field Test recognized that the COP development would utilize regional hydrologic modeling in order to balance the ecological restoration objectives of the MWD and C-111SD projects while demonstrating compliance with the project constraints, including requirements to maintain the mitigation for project-induced flood damages in the 8.5 SMA and to maintain the level of flood damage reduction associated with the 1994 C-111 GRR Recommended Plan within the South Dade basin. The COP modeling analysis was identified in order to quantitatively characterize the degree to which operational constraints for the Tamiami Trail roadway and/or the 8.5 SMA limit inflows and associated potential restoration benefits within Northeast Shark River Slough, if applicable. A comprehensive flood mitigation evaluation

(Appendix H, Annex H-6) was also conducted which compares the 1983 Base Condition and the COP Action Alternatives. A general overview of the hydrologic performance of the 1983 Base condition versus ALTQ+ is provided in section 4.14.5 since the 1983 Base condition FRM performance was identified as a constraint for the COP.

4.14.2 Alternative N2

The modeling of ALTN2 indicates no significant increases to regional groundwater stages during normal to wet conditions which would impact the levels of service for flood control within the LECSAs, as compared to ECB19RR (refer to **Figure 4-120**). No notable changes to groundwater stages were indicated within LECSA 1, consistent with the COP not modifying the Regulation Schedules for WCA 1 and WCA 2. LECSA 2 groundwater stages are slightly reduced by less than 0.1 feet along the Miami canal immediately east of WCA 3B, resultant from increased utilization of the L-30 canal and eastern WCA 3B to provide additional water deliveries to the South Dade Conveyance System to extend ENP hydroperiods adjacent to the C-111 South Dade NDA and SDA and to increase deliveries to Taylor Slough and toward Florida Bay. Minor increases to groundwater stages, up to 0.05 feet, are evident across most of western LECSA 3, extending up to 3 miles east of the East Coast Protective Levee proximal to the water control structures along the C-1W canal (S-338), C-102 canal (S-194), and C-103 canal (S-196). However, for approximately 15 square miles of LECSA located north and east of the S-331 pump station along the L-31N canal, there is a moderate local groundwater stage increase of 0.1-0.3 feet associated with the reduced utilization of the S-331 pump station to provide flood mitigation to the adjacent 8.5 SMA and the concurrent increased utilization of the MWD 8.5 SMA S-357 pump station. During wet years, such as 1995 and 1999, a larger spatial footprint of moderately increased stages (up to 0.4 feet) is indicated north and east of the S-331 pump station, and minor groundwater stage increases of approximately 0.1 feet are observed across approximately 10 square miles immediately east of the S-332B and S-332C pump stations along the L-31N canal; these trends are reflected in the average annual stage difference maps included in **Appendix H Annex 5** (**Section H-5.1.8**).

The L-30 canal stages (north of S-335) indicate no net change to flood control stages within the wettest 10% of hydrologic conditions, with moderate stage reductions of 0.1-0.2 feet for normal to wet conditions. The L-31N canal stages (north of G-211) indicate a minor increase of up to 0.05 feet during normal to wet conditions. The L-31N canal stages (between G-211 and S-331) indicate a significant (up to 0.4-0.5 feet) increase to flood control stages across the most hydrologic conditions from extreme wet to moderately dry conditions, with no significant change indicated for extreme dry conditions. The L-31N canal stages east of the C-111 South Dade NDA and SDA (between S-331 and S-176) indicate a moderate stage increase of 0.1-0.2 feet during normal to wet conditions, with no increase for extreme wet conditions within the wettest 5% of hydrologic conditions. Further south along the C-111 canal, for normal to wet hydrologic conditions, no significant changes are observed for the canal reach east of the SFWMD C-111 Spreader Canal Project (between S-176 and S-177) or for the canal reach between S-177 and S-18C.

Representative SDCS stage duration curves for the L-30 canal (north of S-335), L-31N canal (north of S-331), L-31 canal (north of S-176), and C-111 canal (north of S-177) for ALTN2 are provided in **Section 4.14.4** in support of the FRM performance evaluation for Alternative Q.

4.14.3 Alternative O

The modeling of ALTO indicates no significant increases to regional groundwater stages during normal to wet conditions which would impact the levels of service for flood control within the LECSAs, as compared

to the ECB19RR alternative (refer to **Figure 4-121**). No notable changes to groundwater stages were indicated within LECSA 1, consistent with the COP not modifying the Regulation Schedules for WCA 1 and WCA 2. Similar to ALTN2, LECSA 2 groundwater stages are slightly reduced by less than 0.05 feet along the Miami canal immediately east of WCA 3B, resultant from increased utilization of the L-30 canal and eastern WCA 3B to provide additional water deliveries to the South Dade Conveyance System to extend ENP hydroperiods adjacent to the C-111 South Dade NDA and SDA and to increase deliveries to Taylor Slough and toward Florida Bay. Minor increases to groundwater stages, up to 0.05 feet, are evident across most of western LECSA 3, extending up to 3 miles east of the East Coast Protective Levee proximal to the water control structures along the C-1W canal (S-338), C-102 canal (S-194), and C-103 canal (S-196). Different from ALTN2, there is no increase to groundwater stage results from the reduced utilization of the S-331 pump station to provide flood mitigation to the adjacent 8.5 SMA and the concurrent increased utilization of the MWD 8.5 SMA S-357 pump station because ALTO includes revised flood control operations at S-331 to maintain L-31N stages between 4.5 to 5.0 during the CSSS nesting window (14 February – 15 July) and between 4.3 to 4.6 during other times of the year; operational criteria were informed from the SFWMD South Dade Investigation study during 2015-2016. During wet years, such as 1995 and 1999, moderately increased stages up to 0.4 feet are indicated north and east of the S-331 pump station along the C-1W canal; these trends are reflected in the average annual stage difference maps included in **Appendix H Annex 5** (**Modeling Results Round 3**).

The L-30 canal stages (north of S-335) indicate a moderate reduction (0.1-0.2 feet) to flood control stages during normal to extreme wet conditions, with largest reductions within the wettest 10% of conditions. The L-31N canal stages (north of G-211) indicate no significant change during normal to wet conditions. The L-31N canal stages (between G-211 and S-331) indicate a moderate reduction (0.1-0.2 feet) to flood control stages during normal to extreme wet conditions. The L-31N canal stages east of the C-111 South Dade NDA and SDA (between S-331 and S-176) indicate a minor stage increase of up to 0.1 feet during normal to wet conditions, with no increase for extreme wet conditions within the wettest 5% of hydrologic conditions. Further south along the C-111 canal, for normal to wet hydrologic conditions, no significant changes are observed for the canal reach east of the SFWMD C-111 Spreader Canal Project (between S-176 and S-177) and a minor reduction of less than 0.05 feet is indicated for the canal reach between S-177 and S-18C.

Representative SDCS stage duration curves for the L-30 canal (north of S-335), L-31N canal (north of S-331), L-31 canal (north of S-176), and C-111 canal (north of S-177) for ALTO are provided in **Section 4.14.4** (**Alternative Q**) in support of the FRM performance evaluation for Alternative Q.

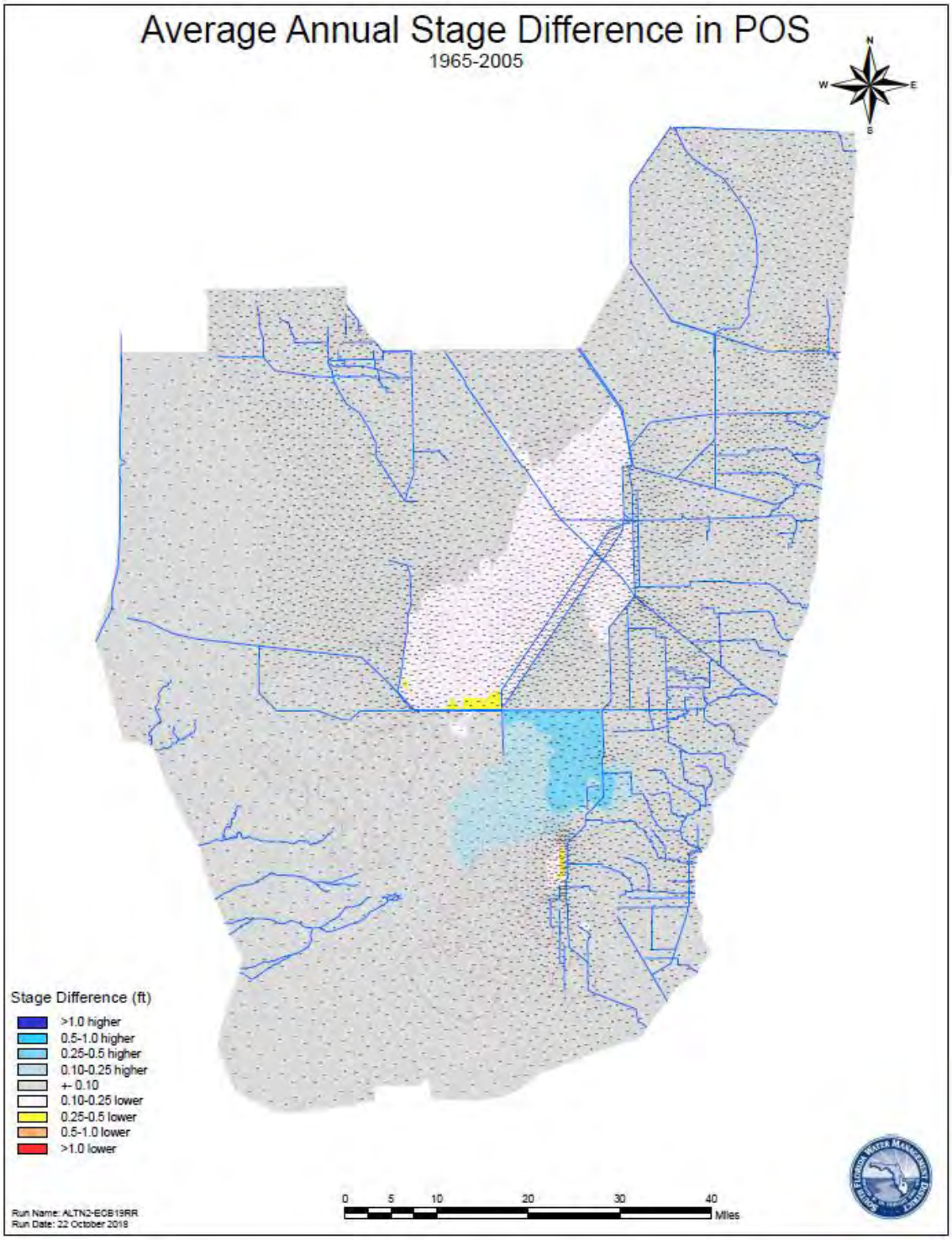

Figure 4-120. RSM-GL average annual stage difference map comparing ALTN2 versus ECB19RR.

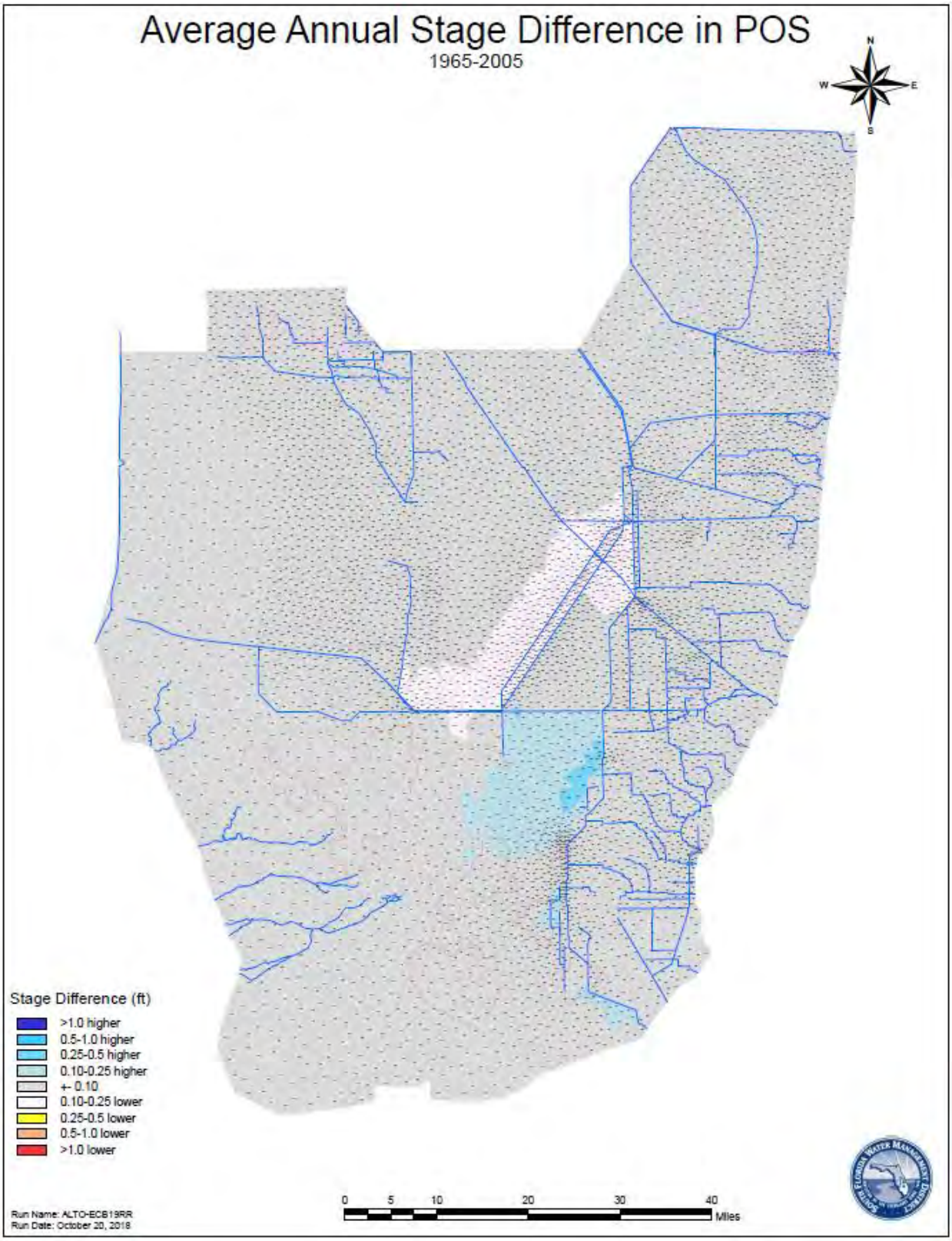

Figure 4-121. RSM-GL Average annual stage difference map comparing ALTO versus ECB19RR.

4.14.4 Alternative Q

The modeling of ALTQ indicates no significant increases to regional groundwater stages during normal to wet conditions which would impact the levels of service for flood control within the LECSAs, as compared to the ECB19RR. No notable changes to groundwater stages were indicated within LECSA 1, consistent with the COP not modifying the Regulation Schedules for WCA 1 and WCA 2. Similar to ALTN2, LECSA 2 groundwater stages are slightly reduced by less than 0.05 feet along the Miami canal immediately east of WCA 3B, resultant from increased utilization of the L-30 canal and eastern WCA 3B to provide additional water deliveries to the South Dade Conveyance System to extend ENP hydroperiods adjacent to the C-111 South Dade NDA and SDA and to increase deliveries to Taylor Slough and toward Florida Bay. Minor increases to groundwater stages, up to 0.05 feet, are evident across most of western LECSA 3, extending up to 3 miles east of the East Coast Protective Levee proximal to the water control structures along the C-1W canal (S-338), C-102 canal (S-194), and C-103 canal (S-196). Different from ALTN2, there is no increase to groundwater stage results from the reduced utilization of the S-331 pump station to provide flood mitigation to the adjacent 8.5 SMA and the concurrent increased utilization of the MWD 8.5 SMA S-357 pump station because ALTQ includes revised flood control operations at S-331 to maintain L-31N stages between 4.5 to 5.0 during the CSSS nesting window (14 February – 15 July) and between 4.3 to 4.6 during other times of the year; operational criteria were informed from the SFWMD South Dade Investigation study during 2015-2016. During wet years, such as 1995 and 1999, moderately increased stages up to 0.4 feet are indicated north and east of the S-331 pump station along the C-1W canal; these trends are reflected in the average annual stage difference maps included in **Appendix H Annex 5**. **Figure 4-123** and **Figure 4-124** show the stage difference maps for the 1995 calendar year (average annual stage difference) and October 1995 (average monthly stage difference at the end of the wet season), respectively.

The L-30 canal stages (north of S-335) indicate a moderate reduction (0.1-0.2 feet) to flood control stages during normal to extreme wet conditions (refer to **Figure 4-125**). L-30 canal stages are slightly lower than ALTO. The L-31N canal stages (north of G-211) indicate no significant change during normal to wet conditions, similar to ALTO (refer to **Figure 4-126**). The L-31N canal stages (between G-211 and S-331) indicate a moderate reduction (0.1-0.2 feet) to flood control stages across during normal to extreme wet conditions, unchanged from ALTO (refer to **Figure 4-127**). The L-31N canal stages east of the C-111 South Dade NDA and SDA (between S-331 and S-176) are slightly lower than ALTO with increased use of the S-332 pump station to deliver water toward Taylor Slough; the L-31N canal stages indicate a minor stage increase during moderately wet conditions between the 5 and 15 percent stage exceedance, with no increase for extreme wet conditions within the wettest 5% of hydrologic conditions or during normal to wet conditions. Further south along the C-111 canal, for normal to wet hydrologic conditions, no significant changes are observed for the canal reach east of the SFWMD C-111 Spreader Canal Project (between S-176 and S-177; refer to **Figure 4-132**) or for the canal reach between S-177 and S-18C.

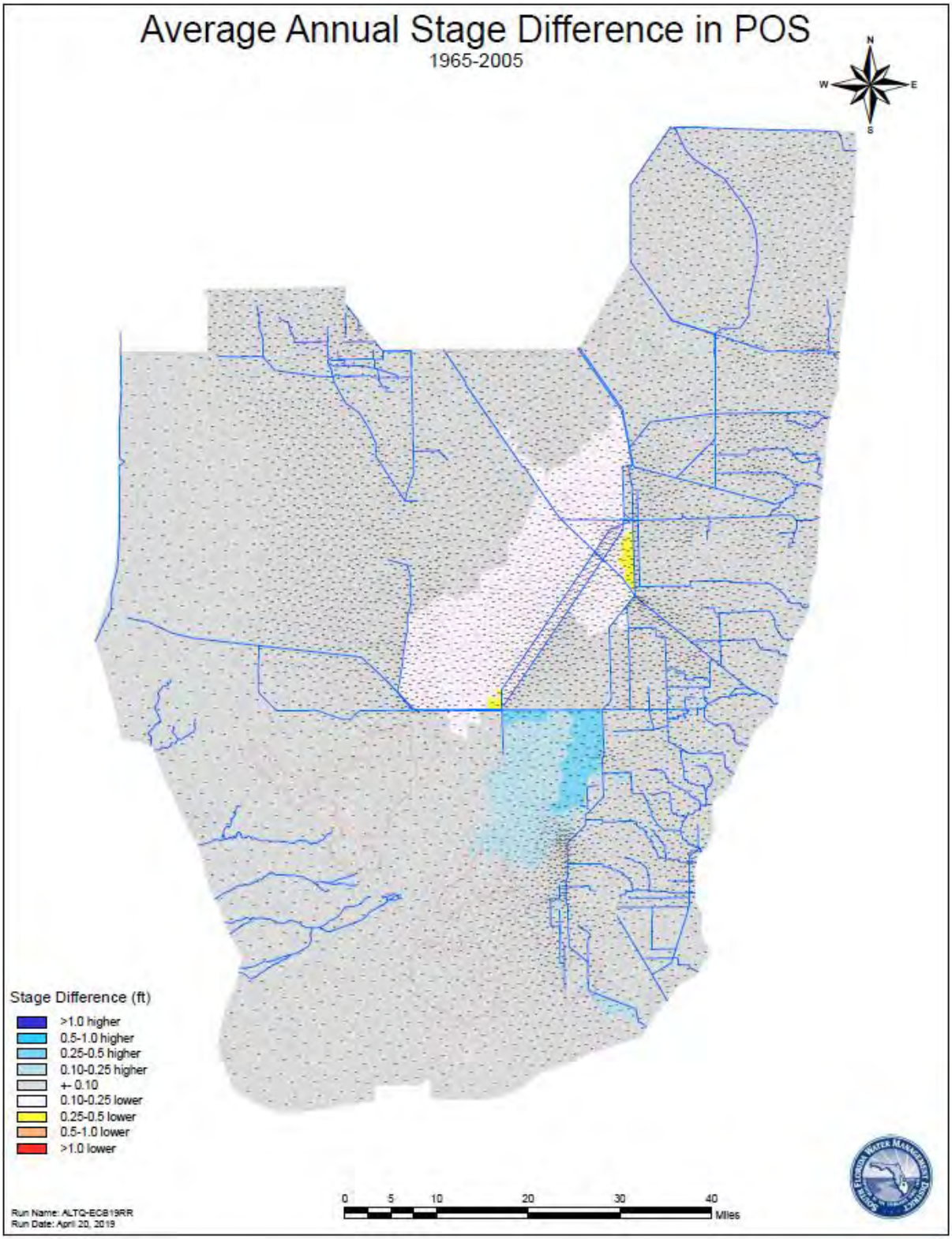

Figure 4-122. RSM-GL average annual stage difference map comparing ALTQ versus ECB19RR.

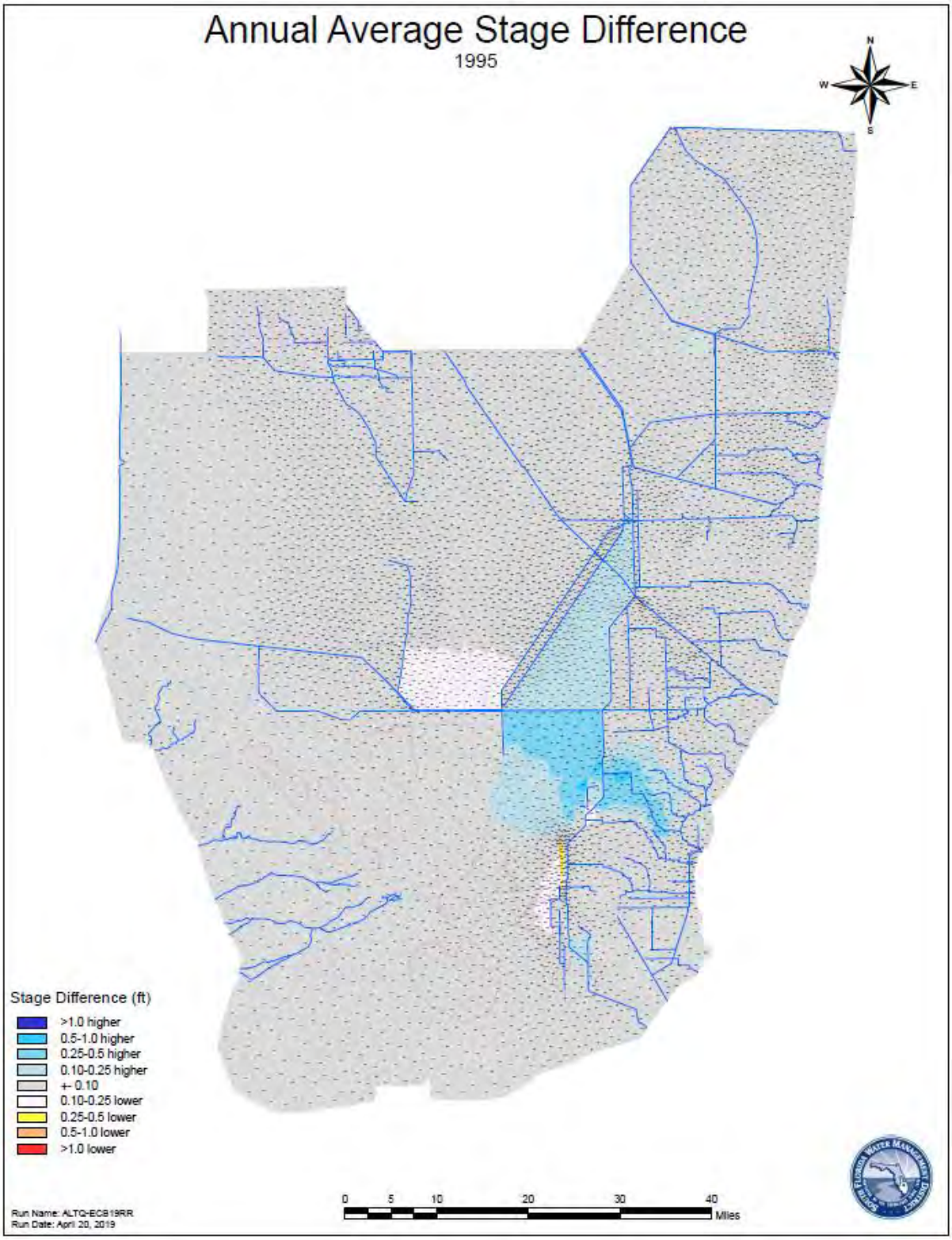

Figure 4-123. RSM-GL annual stage difference map comparing ALTQ versus ECB19RR for 1995.

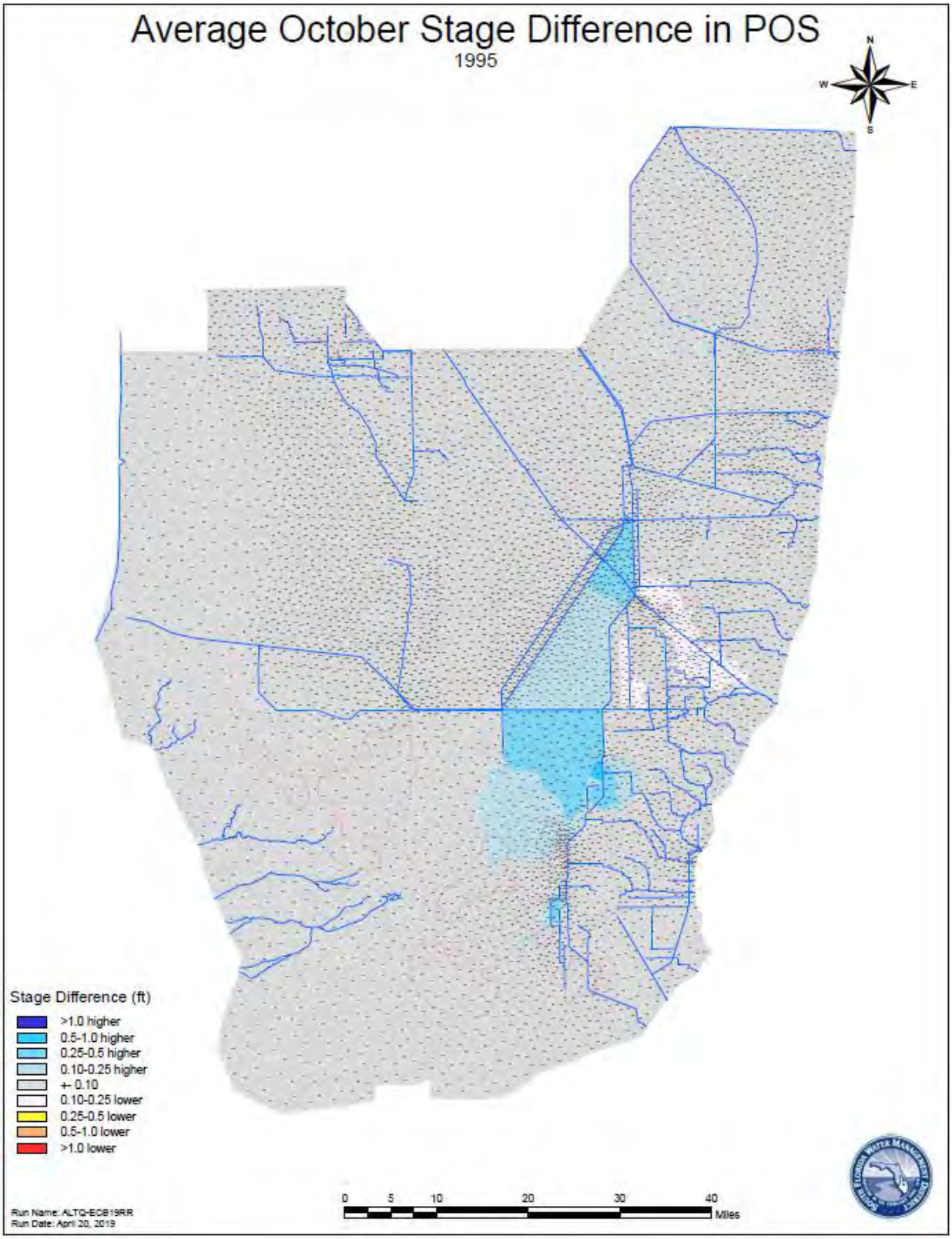

Figure 4-124. RSM-GL monthly stage difference map comparing ALTQ versus ECB19RR for October 1995.

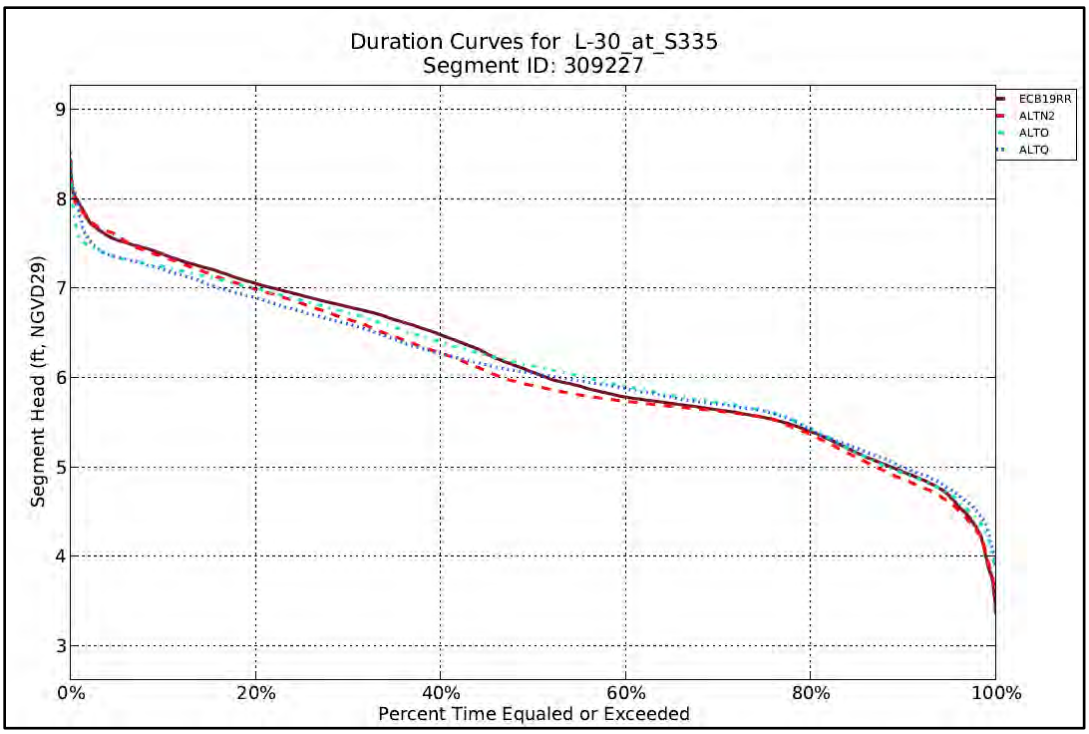

Figure 4-125. RSM-GL Stage Duration Curve for the L-30 canal, Upstream of the S-335 Water Control Structure, for the simulation period of record 1965-2005.

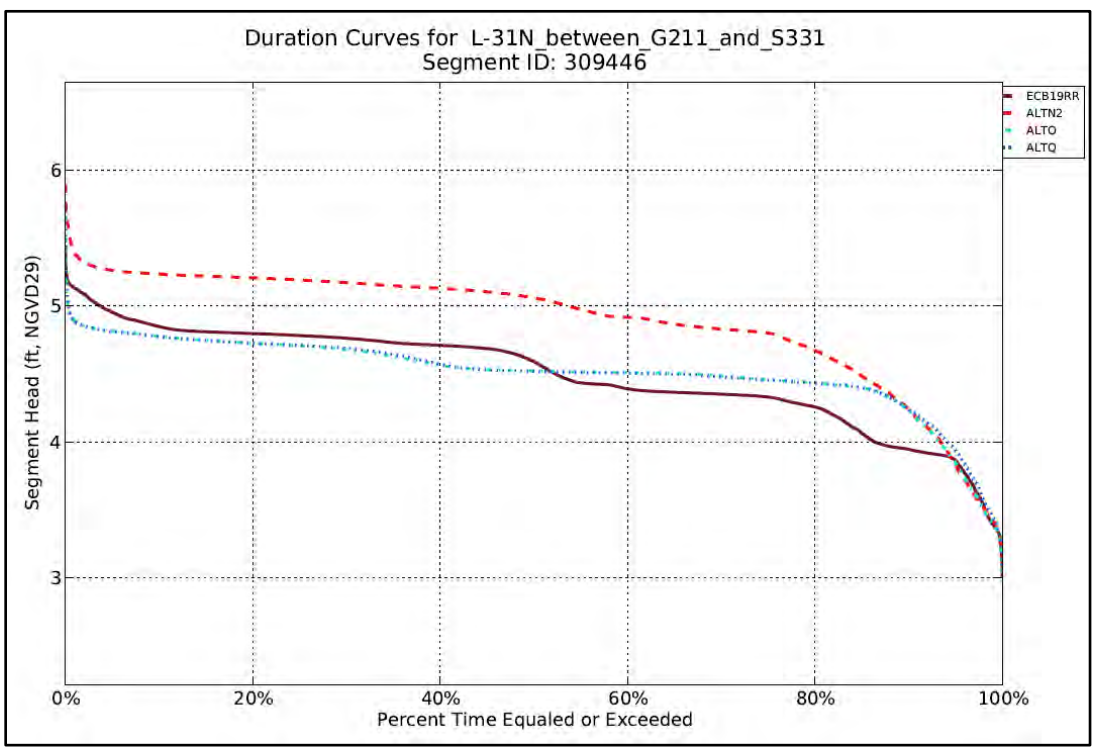

Figure 4-126. RSM-GL Stage Duration Curve for the L-31N canal, Upstream of the S-331 Water Control Structure, for the simulation period of record 1965-2005.

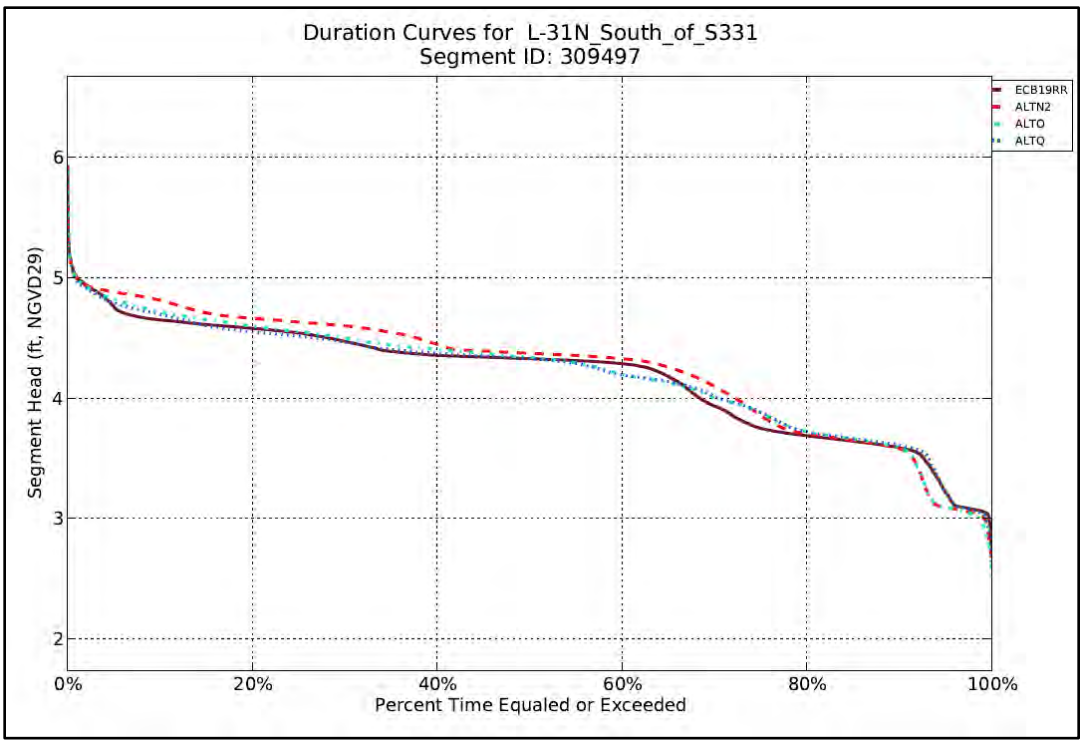

Figure 4-127. RSM-GL Stage Duration Curve for the L-31N canal, Upstream of the S-176 Water Control Structure, for the simulation period of record 1965-2005.

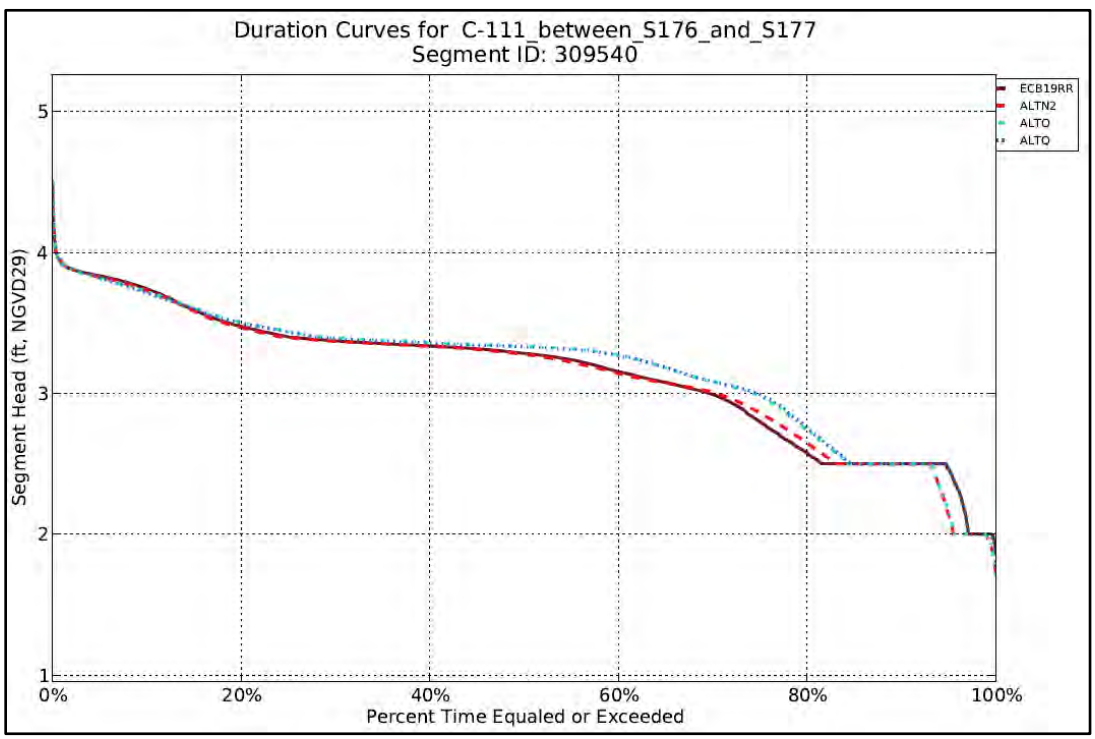

Figure 4-128. RSM-GL Stage Duration Curve for the L-31N canal, Upstream of the S-177 Water Control Structure, for the simulation period of record 1965-2005.

As further detailed in the Economic evaluation in **Appendix I** (**Socioeconomics**), of the three years simulated with the MD-RSM, the highest potential residual risk for economic damages within the South Dade basin is observed during the 2005-2006 wet year. Stage duration curves for the 2005-2006 MD-RSM wet year simulation are shown in **Figure 4-129** through **Figure 4-132**, which illustrate that the SDCS primary canal stages during the wet season peak stage events (upper 10-20 percent of the stage duration curves) are significantly lower than the operational levels identified in the 1994 C-111 South Dade GRR and supports the conclusion in **Appendix I** (**Socioeconomics**) that the 1994 GRR FRM constraint requirement is successfully met with Alternative Q and the variants of Alternative Q. The operational criteria identified with the authorized 1994 C-111 South Dade GRR are detailed in **Appendix H**, **Annex H-3**.

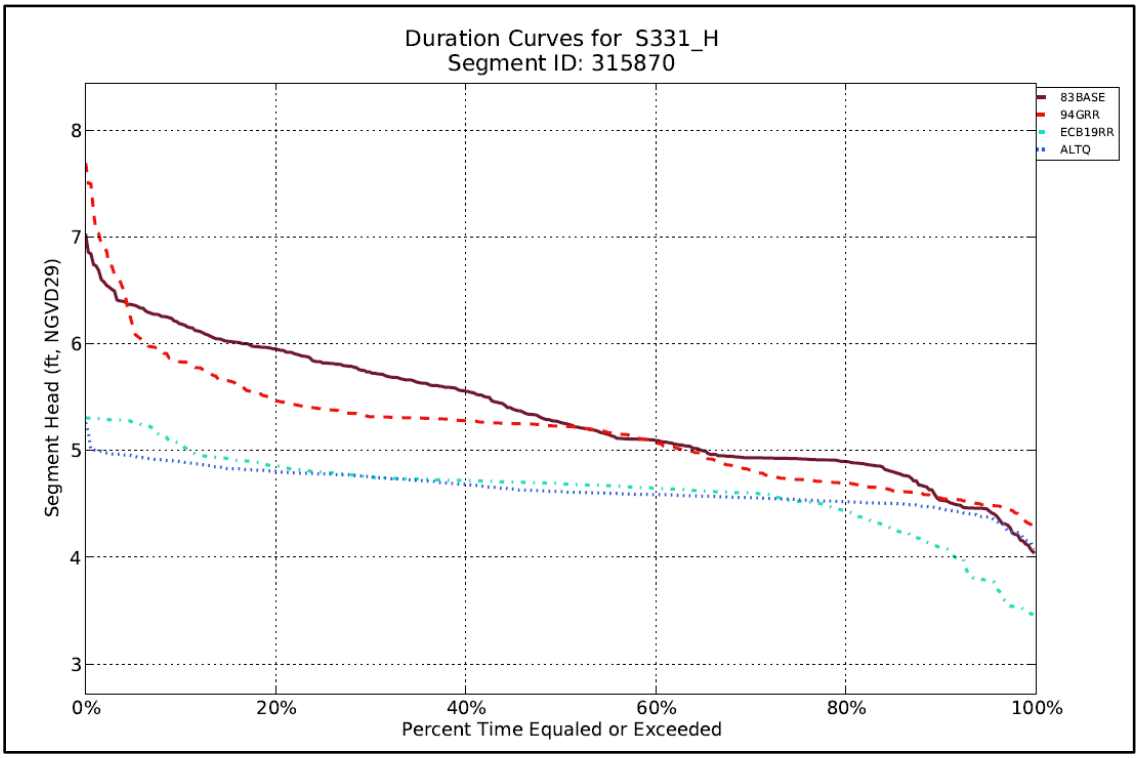

Figure 4-129. MD-RSM Stage Duration Curve for the S-331 structure, for the 2005-2006 Wet Year.

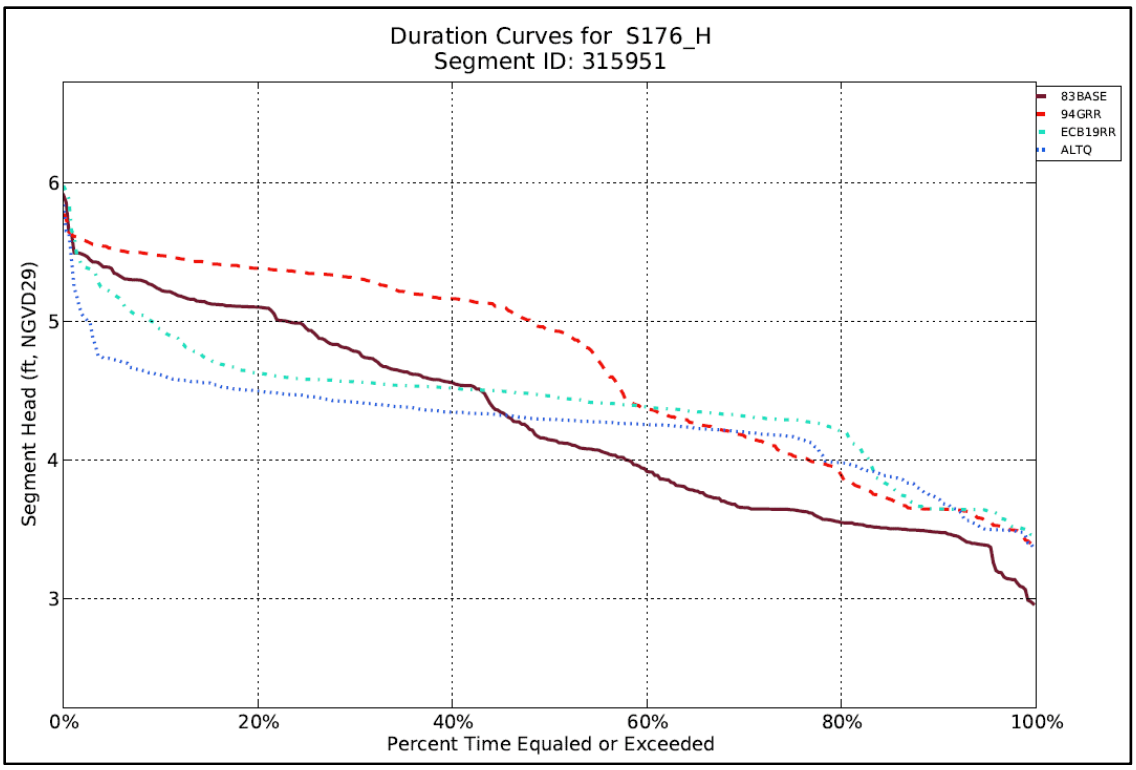

Figure 4-130. MD-RSM Stage Duration Curve for the S-176 structure, for the 2005-2006 Wet Year.

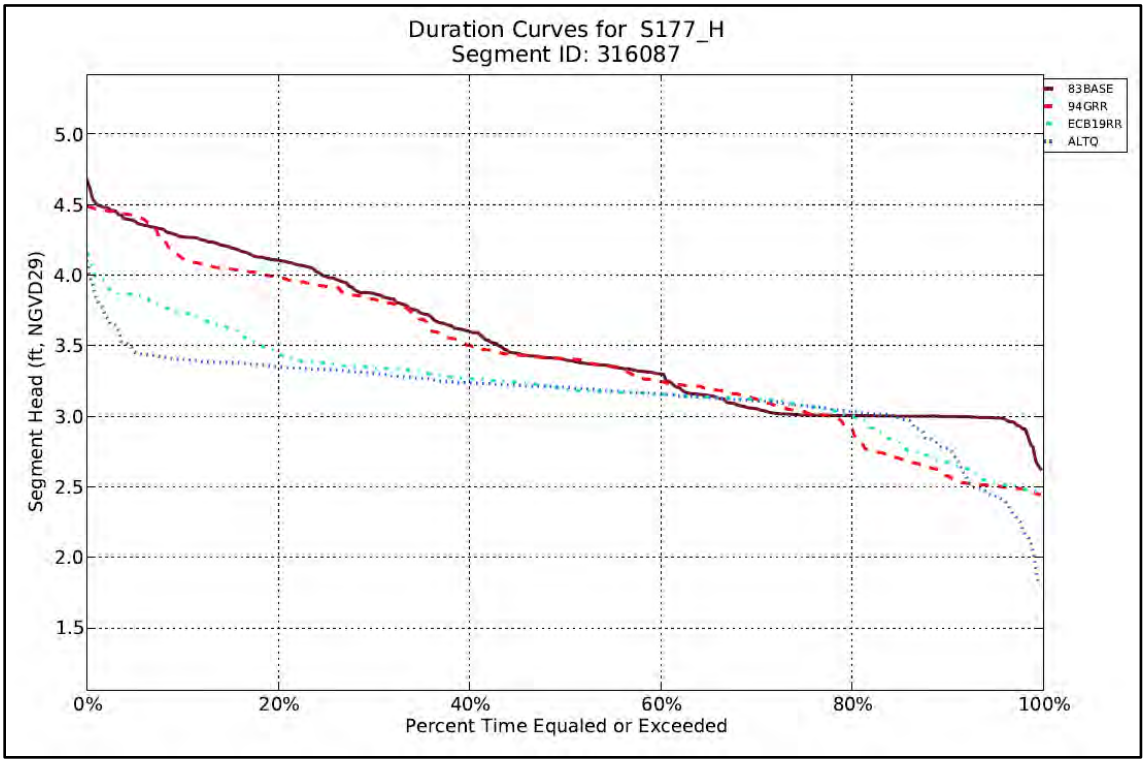

Figure 4-131. MD-RSM Stage Duration Curve for the S-177 structure, for the 2005-2006 Wet Year.

Figure 4-132. MD-RSM Stage Duration Curve for the S-18C structure, for the2005-2006 Wet Year.

8.5 SMA flood mitigation FRM performance is also evaluated using the MD-RSM. The initial MD-RSM ALTQ simulation did not include use of S-357 and S-331 to minimum range when G-3273 > 7.5 feet NGVD and LPG-2 > 6.7 feet NGVD; although these event-driven operations were included in Alternative Q documentation developed by the project formulation team, as informed from real-time operations during the MWD Incremental Field Tests, these operations had not previously been included in the COP MD-RSM modeling since the Round 2 performance evaluations indicated compliance with the 8.5 SMA flood mitigation constraints. Following the completion of the Round 3 ALTQ modeling and presentation of the results to the COP PDT on 21 May 2019, initial review of the results by the USACE indicated that non-inclusion of these operations would result in non-compliance with the COP 8.5 SMA Flood Mitigation Criteria. The source of this performance issue was derived from a previously unidentified error with the MD-RSM Round 2 alternative modeling (this error was not present for the RSM-GL Round 2 modeling) in which only the WCA 3A associated with the Tamiami Trail Flow Formula (TTFF) were delivered into NESRS via the S-333 gated spillway; specifically, WCA 3A Regulatory discharges, which supplement the TTFF environmental deliveries when WCA 3A stages exceed Zone A of the Regulation Schedule, were included in the RSM-GL Round 2 modeling but these supplemental inflows to NESRS were not included in the MD-RSM modeling of the Round 2 alternatives. The result of this error correction with Round 3 modeling of ALTQ was an average stage increase of approximately 0.3 feet for NESRS across the entire 2005-2006 wet year, with a more localized increase of approximately 0.5 feet within the L-29 canal prior to the significant rainfall event associated with Hurricane Katrina in late August 2005 (during the 2005-2006 MD-RSM wet year simulation); further details and illustrative graphics are provided in Appendix H, Annex H-6, Section H-6.6.

This initial assessment led to additional informational modeling coordinated by the COP modeling team concurrent with PDT review of the ALTQ RSM-GL results and the initial ALTQ MD-RSM results during May

2019. A sequential progression of MD-RSM simulations was coordinated with the COP Modeling sub-team to more completely represent ALTQ operations during high water conditions within NESRS, adjacent to 8.5 SMA (S-357/S-331 floor ops), with the additional effort required to confirm the capability of Alternative Q to meet the COP 8.5 SMA constraint. The end-result of these supplemental modeling investigations was confirmation that achievement of the 8.5 SMA flood mitigation constraint requires limited use of the S-331 pump station to provide additional pumping during local rainfall events when high water conditions are already present within NESRS. Due to the coarse representation of the MWD 8.5 SMA features within the RSM-GL, these event-based operations are only simulated with the MD-RSM and were not able to be effectively evaluated using the RSM-GL that provided the principal characterization for hydrologic and ecological changes provided by the COP in WCA 3A and ENP. The MD-RSM assessment for 8.5 SMA flood mitigation performance, however, included a detailed evaluation of the potential effects of the event-based operations on the water stages within adjacent NESRS, which confirmed that the 8.5 SMA event-based would result in no significant change to the water stages within NESRS and no further limitations on inflows to NESRS compared to the additional inflows quantified for ALTQ. Results for the comprehensive flood mitigation evaluation comparing the 1983 Base Condition and the COP Action Alternatives are provided in Appendix H, Annex H-6. A general overview of the hydrologic performance of the 1983 Base condition versus ALTQ+ is provided in **Section 4.14.5** since the 1983 Base condition FRM performance was identified as a constraint for the COP.

4.14.5 Alternative Q+

The overall flood risk management performance of ALTQ+ is the same as described for ALTQ, as characterized using the ALTQ simulation results with the regional RSM-GL model.

Due to the series of incremental operational changes along the South Dade Conveyance System during the MWD Incremental Field Tests and concurrent with the COP development, the FRM evaluation and interpretation of the COP hydrologic modeling results requires consideration of these operational changes. FRM performance for the urban and agricultural parcels adjacent to the L-31N and C-111 primary canals is principally based on the water level controls along these primary SDCS canals. **Table 4-34** provides a comparison of the operational ranges maintained along the L-31N canal and C-111 canal during Increment 1.2 (the assumed basis for the ECB19RR) and the proposed ALTQ (same as ALTQ+).

The evaluation of FRM performance is based on a comparison between the ECB19RR and ALTQ. A comprehensive economic evaluation (**Appendix I** (**Socioeconomics**)) was also conducted which compares the 1994 C-111 South Dade GRR authorized plan and the COP Action Alternatives, including ALTQ+.

Table 4-34: South Dade Conveyance System, Primary Canal Operational Stage Ranges for the 2019 Existing Condition Baseline and ALTQ+.

Canal Reach	Structure	2019 ECB (Increment 1.2; 2017-2018)	COP Alternative Q & Alternative Q+
L-31N (S-335 to G-211)	S-356	5.5-5.8 (secondary priority if WCA 3A > EHWL)	5.5-5.8 (priority over S-333)
	G-211	Same as 2012 WCP	5.5-6.0

Canal Reach	Structure	2019 ECB (Increment 1.2; 2017-2018)	COP Alternative Q & Alternative Q+
L-31N (G-211 to S-331)	S-331	3.5-4.0 when LPG-2 > 6.6; 4.0-4.5 when LPG-2 is been 6.0-6.6; 4.5-5.0 when LPG-2 is between 5.5-6.0	4.3-4.6 from 01 AUG through 31 DEC; 4.5-5.0 from 14 FEB through 31 JUL; 3.0-3.5 when G-3273 stage > 7.5 and 8.5 SMA flood mitigation criteria are not projected to be met
L-31N (S-331 to S-176)	S-332B / S-332C	4.2-4.8 (may be lowered to 3.8 for CSSS targets)	3.8-4.4 from 01 AUG through 31 DEC; 4.0-4.8 from 14 FEB through 31 JUL (includes transition period)
	S-332D	4.2-4.8	Same as S-332B and S-332C
	S-176	4.75-5.0	4.5-5.0
C-111 (S-176 to S-177)	S-177	3.6-4.2	Same as 2019 ECB
	S-199 / S-200*	3.0-4.0 (300 cfs capacity each; revised 2016)	Same as 2019 ECB
C-111 (S-177 to S-18C)	S-18C	Same as 2012 WCP	Same as 2019 ECB
C-111 (S-18C to S-197)	S-197	L1" Up to 500 cfs if S-177HW > 4.1 or S-18C HW > 2.8; L2: Up to 1600 cfs if S-177HW > 4.2 or S-18C HW > 3.1; L3: Up to 2400 cfs if S-177HW > 4.3 or S-18C HW > 3.3; 250-400 cfs low-volume based on S-18C HW stage (higher for Column 2 operations)	L1: Up to 200 cfs if S-18C HW > 2.7; L2: Up to 800 cfs if S-18C HW > 2.9; L3: Up to 2400 cfs if S-18C HW > 3.3

Note: Operational criteria are in units of feet, NGVD

**C-111 Spreader Canal features: Maintained and Operated by SFWMD in accordance with FDEP Operating Permit*

Additional FRM performance information is provided in the remainder of this section for the 8.5 SMA, based on the results of MD-RSM modeling to most appropriately represent the expected operational criteria for ALTQ+ within the COP Water Control Plan.

ALTQ, as well as the other action alternatives, did not specifically model in RSMGL the operational capability to use the S-331 pump station to assist the S-357 pump station in providing 8.5 SMA flood mitigation during periods when the ENP G-3273 stage exceeds 7.5 feet NGVD (this generally corresponds to L-29 canal stage above 8.3 feet NGVD) if the 8.5 SMA interior monitoring station at LPG-2 is projected to exceed the prescribed flood mitigation criteria (detailed within **Appendix C.6** of the COP AMMP). During these conditions at G-3273, which are anticipated to be experienced for a maximum of 30% of the period of record (during the late wet season months and extending into the dry season, approximately 1 in every 3 years), additional discharges from S-331 will be sent to the lower L-31N canal basin and storage within the C-111 South Dade NDA and SDA. The potential effects of the 8.5 SMA event-based operations and resultant increased discharges during 8.5 SMA high water events was evaluated using the MD-RSM, including comparison of the overall socio-economic performance against the 1994 C-111 South Dade GRR

scenario which represents the level of flood protection authorized by the C-111 South Dade Project (for the detailed economic evaluation, refer to **Appendix I** (**Socioeconomics**).

Results for the comprehensive flood mitigation evaluation comparing the 1983 Base Condition and the COP Action Alternatives are provided in **Appendix H**, **Annex H-6**. A modified version of the initial MD-RSM ALTQ simulation, labeled as ALTQm (Q modified), was completed with the following event-based operations assumed for the 8.5 SMA:

- (a) Simulation includes use of S-357 to minimum range (2.3-3.0 feet NGVD) when G-3273 > 7.5 feet NGVD and LPG-2 > 6.7 feet NGVD (included in Alternative Q documentation shared with PDT)
    - When G-3273 > 7.5 feet NGVD and LPG2 is ABOVE 6.7 feet NGVD, S-357 HW will be lowered to 2.3 to 3.0 feet NGVD until LPG2 can be lowered to 6.2 feet NGVD. Operated at Maximum capacity 575 cfs (match the FDEP ops permit issued to the SFWMD). [NOTE: Alternative Q documentation indicates exit criteria when "LPG-2 can be maintained between 6.2-6.6 feet NGVD"; simulation reflects maximum duration for S-357 criteria]
    - Five days prior to Katrina (August 2005), pre-storm operations force all four S-357 pumps to turn on until the storm passes.
- (b) Simulation includes use of S-331 to minimum range (2.8-3.5 feet NGVD) when G-3273 > 7.5 feet NGVD and LPG-2 > 6.7 feet NGVD (included in Alternative Q documentation shared with PDT)
    - When G-3273 > 7.5 feet NGVD and LPG2 is ABOVE 6.7 feet NGVD, S-3331 HW will be lowered to 2.8 to 3.5 feet NGVD until LPG2 can be lowered to 6.2 NGVD. [NOTE: Alternative Q documentation indicates exit criteria when "LPG-2 can be maintained between 6.2-6.6 feet NGVD"; simulation reflects maximum duration for S-331 criteria]

The expected performance for the 8.5 SMA and the South Dade basin (which receives additional volume discharged using S-331) is effectively bracketed between ALTQ (with inclusion of minimum C-357 canal operations at S-357 during high-water events) and ALTQm. ALTQm is the most appropriate MD-RSM modeling representation of the COP Recommended Plan (Alternative Q+) following the COP PDT Round 3 technical evaluations. Based on review of the COP Round 3 MD-RSM simulation results, the following conclusions summarize the performance of ALTQ+ and the potential Alternative Q scenario if the FDOT constraint for the L-29 canal is removed (SR Qm1, which includes the event-based operations at S-357 and S-331) with respect to the 8.5 SMA flood mitigation constraint.

- 8.5 SMA Congressionally authorized Flood Mitigation constraint compliance is achieved for all interior 8.5 SMA locations, consistent with methodology applied for the 2000 GRR
    - Hydrologic conditions are not unchanged for all areas, but circumstances are globally improved
        - 61% of 8.5 SMA Leveed Area (6.0 mi^2, excluding flowage easement areas) indicated periodic surface inundation for the modeled 1983 Base (wet year)
        - 12% of 8.5 SMA Leveed Area (6.0 mi^2) indicated periodic surface inundation for the modeled ALTQ+ (wet year)
    - Hydro-period durations above ground surface elevation are less than the 1983 Base for wet, average, dry years
    - Maximum consecutive days of inundation duration are less than the 1983 Base for wet, average, dry years

- Peak stages are less than the 1983 Base Peak stage for all depth classes over 98-99% of the 8.5 SMA Leveed Area
    - 1-2% of the 8.5 SMA Protected Area indicates a temporary increase in peak stage (up to 0.4 ft.), with these locations receiving a reduction in inundation duration of 66-74% (LPG-2/LPG-16) – refer to center panel of **Figure 4-133** or location.
    - Uncertainty with MD-RSM model predictions and topography warranted further constraint checks at LPG-2 (e.g. consideration of new monitoring wells installed during the Increment 2 Field Test at LPG-16, LPG-17); LPG-2 is 0.25-0.50 feet below average adjacent ground elevations
    - Simulated peak stages of 7.8 feet NGVD remain > 2.0 feet lower than Average First-Floor Elevations in 8.5 SMA (estimated ~2.0-2.5 feet above the Base Flood Elev. of 8.0 feet NGVD, based on available data)

- Significant hydro-period extensions are evidenced at ENP and buffer locations immediately west of the 8.5 SMA
    - Ecological effects observed from alternatives (including ALTQ) have assumed retention of the L-29 FDOT constraint throughout Round 1, Round 2 and Round 3 modeling
    - Modeling indicates hydroperiod durations and water stages west of 8.5 SMA are not adversely diminished by event-based 8.5 SMA operations during NESRS high-water conditions
- Further assessment was conducted for the Round 3 modeling and concurrent Water Control Plan development activities, including consideration of the following:
    - SR Q1 with annual operation of the L-29 canal up to 8.5 feet NGVD does not demonstrate compliance with the complete suite of 8.5 SMA flood mitigation constraint metrics for all interior locations
        - 2-3% of the 8.5 SMA Protected Area indicates an temporary increase in peak stage (up to 0.5 ft.), with these locations receiving no significant reduction in inundation duration – refer to right panel on **Figure 4-132** for location
    - SR Q1 may be partially or fully implementable if the 8.5 SMA effectiveness is both under-estimated in the COP modeling and the L-29 canal FDOT constraints are revised or later removed (e.g. TTNS)
        - The COP Water Control Plan will incorporate Real-time monitoring in an effort to further increase the frequency and duration of L-29 canal operations above 8.25 feet NGVD, while continuing to balance system-wide performance and maintaining compliance with constraints
    - Real-time flood mitigation tracking metrics will be developed for the COP Water Control Plan, informed by 2017-2019 MWD Incremental Field Test operations and the 1983 Base Condition MD-RSM modeling
        - Continued efforts to monitor LPG-16 and LPG-17, which were fully instrumented in September 2019 following completion of the COP Round 3 modeling.

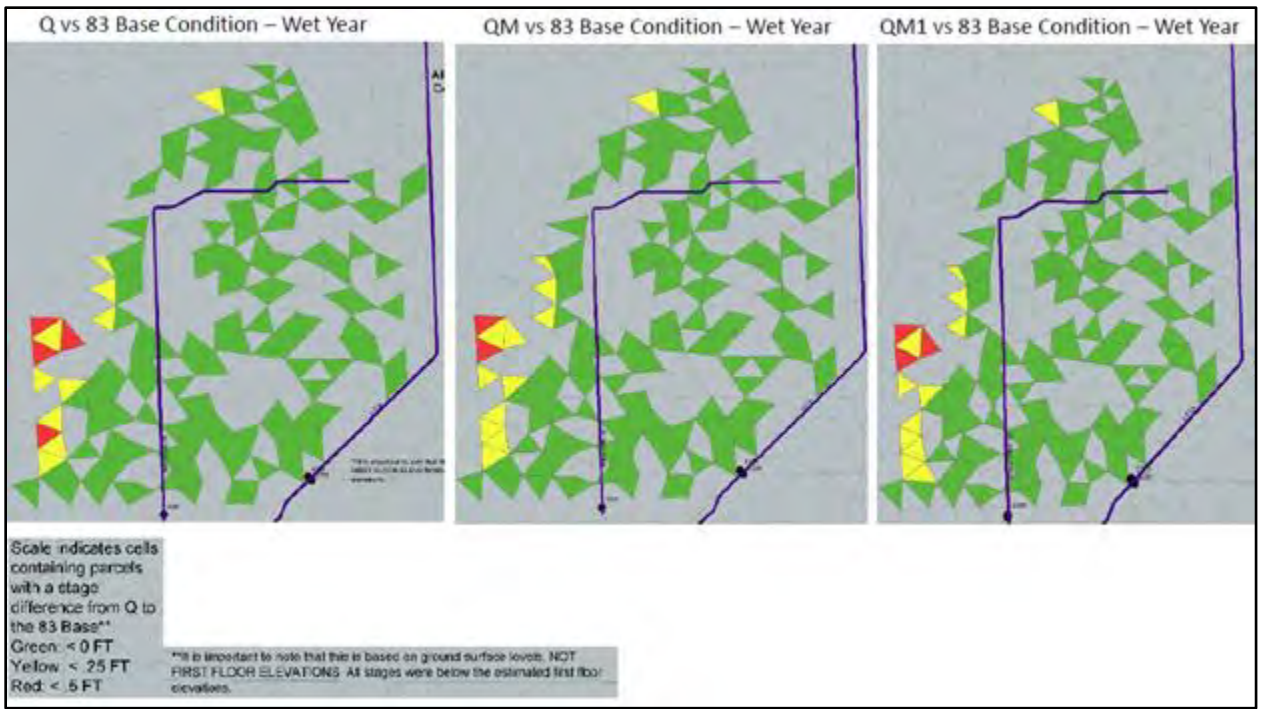

Figure 4-133. 8.5 SMA Locations indicating Increased Peak Stages with ALTQ+ compared to the 1983 Base Condition, generated from MD-RSM simulation results for the 2005-2006 wet year.

4.15 Socioeconomics

There are various planning objectives, constraints, and considerations under the COP based on previous authorized studies which provide the framework and scope for this socioeconomic evaluation. The purpose of COP is to define the water management operations for the C-111 and Modified Water Deliveries projects that would be consistent with their respective project purposes as defined by the authorizing legislation and further refined by subsequent general design memoranda (GDM) and general reevaluation reports (GRR). From these reports levels of flood mitigation are obtained and define the constraints under which the COP must operate. More specifically, the 1994 C-111 South Dade GRR, hereafter referred to as the 1994 GRR, defines the level of flood mitigation required for the South Dade area and the 2000 8.5 Square Mile Area (SMA) GRR Record of Decision (ROD) establishes the constraints for the 8.5 SMA, hereafter referred to as the 1983 Base. The primary purpose of this socioeconomic analysis is to verify that these constraints are not violated with respect to the current land use in the study areas (i.e. agricultural or residential/commercial). The existing condition baseline, or no action alternative (ECB19RR), was used as a comparison point in order to evaluate our planning consideration of "enhancing flood protection" when possible.

The 1994 GRR and 1983 Base conditions provided a starting point for understanding the socioeconomic risk to both agricultural parcels as well as residential/commercial parcels. Two distinct approaches were taken in identifying these risks since there were two different hydrologic models utilized during the COP alternative development process. A brief explanation of both approaches is as follows (more details on the evaluation methodology, assumptions, and spatial considerations are available in the Socioeconomic-Appendix):

In using the RSM-GL model, risks were calculated using specific indicator model cells[1] (i.e., the spatial location at which a given stage is calculated) and various threshold stage levels, measured each day in the 41-year period of record (POR), for several different crop types as well as for residential/commercial properties. For agricultural parcels the thresholds were based on root zone inundation (i.e., the belowground point at which damage to crops is estimated to occur) and for residential/commercial properties the threshold was based on a single representative estimation for the aboveground first-floor elevation (FFE). Once the threshold was exceeded in the POR it was calculated to be a "potential damaging event" and marked. For agriculture the threshold stages are based on the most susceptible crop within each crop type and are represented as a stage below the ground surface (i.e. a 12" threshold indicates the stage is 12" below the ground surface). The three different crop types and their thresholds are as follows: Row Crops[2] (2", 12", 18", 24"); Fruit Crops (24"); Container Crops (0"). For residential/commercial properties the single FFE threshold was 18" as this was considered to be a reasonable estimation of FFEs in the study area based on GIS imagery and previous USACE studies in the area. Each consecutive day above these threshold values was not subsequently calculated since the damage was assumed to be complete upon initial breach of the threshold. Each potential damaging event in all alternatives were calculated in the POR and compared to each other. This level of analysis was considered screening level since neither the 1994 GRR nor the 1983 Base condition (i.e. the constraints) were available to be modeled. The 2012 Water Control Plan was modeled and was used as a primary comparison point for the alternatives since it was thought to be the best available, though not perfect, representation of the constraint conditions. The risk estimation results based on the RSM-GL model, along with a more detailed description of the methodology and assumptions, can be found in **Appendix I** (**Socioeconomics**).

With the second model, MD-RSM, risks were calculated using a simulation period covering a single wet, dry, and average year using a sub-hourly time step. Specific output provided by the model (i.e. a raster file with peak stage data at each cell across the entire spatial domain for all three event years) allowed for interface with the Hydrologic Engineering Center's Flood Impact Analysis (HEC-FIA) economic model to produce a more precise estimation of dollar damages using depth-damage functions for both agriculture and residential parcels. Under this model the constraint conditions, the 1994 GRR and the 1983 Base, were introduced for modeling.

In the following subsections each of the alternatives will be summarized with their respective changes in risk as compared to the appropriate and available base conditions as estimated using the MD-RSM and HEC-FIA results. The results for estimating risk using the RSM-GL model are available in the Socioeconomic Appendix but will not be displayed here as these were considered to be screening-level modeling efforts and would be a redundant appendage to the HEC-FIA results. Also, only the results from the agricultural analysis will be displayed since risk to residential/commercial structures in the impact analysis area were

[1] Indicator cells were selected by the COP Flood Risk Sub-Team to best represent the various crop types and elevation variance in each affected watershed. More detailed information on how these indicator cells were selected are available in the Socioeconomic Appendix.

[2] Row Crops had four different thresholds due to the uncertainty surrounding when damage would actually occur. Since there was no way to calculate risk on a continuum the four discrete thresholds were used to identify potentially unique risks at each level.

minimal[3]. ALTQ+, had a more detailed analysis conducted for the 8.5 SMA which is presented in **Section 4.14** (**Flood Risk Management**).

It is also important to note that these alternatives were analyzed under distinct modeling rounds and the assumption formulation was an iterative process. Some assumptions (e.g. damage functions for crops, model reaches) were fine-tuned when moving from Round 2 (Alternatives N2 and O) into Round 3 (Alternative Q+). As a result the baseline condition damage estimates change slightly based on these refinements. However, the changes were minimal and did not impact the optimization between rounds to form the next set of alternatives and the results still allow for comparison across rounds to an appropriate degree.

4.15.1 Round 2 Modeling – Alternatives N2 and O

Dollar damages are estimated for each of the dry, average, and wet years for each of the alternatives and base conditions and aggregated by model reach. The reaches specific to the Round 2 economic modeling[4] are displayed below in **Figure 4-134** as the grey boxes and labeled in red text. In the figure there are various water control features drawn and labeled in black to give a spatial orientation to the economic reaches. It is important to note that the peak stage for each cell in the dry year was actually higher than that of the average year and, as a result, damages will be higher in the dry than the average. This may seem counterintuitive but since damages were modeled on the peak stage and not an average stage across the year or season it was not impossible for this to occur. Each year is still an appropriate measure of potential risk in the system. The damages are summarized in six tables and figures below.

[3] In most economic reaches, the damage estimation to residential/commercial was zero. In the MD-RSM wet year there were some estimated damages but when comparing the alternatives the estimated differences were not statistically significantly different from zero. This is also true even when introducing the design storm events. Please refer to the Socioeconomic Appendix for complete details.

[4]During Round 2 a larger spatial extent was modeled with more reaches than were modeled in later rounds. Much of the additional spatial extent modeled under Round 2 was considered noise and was condensed to form finalized reaches used during Round 3.

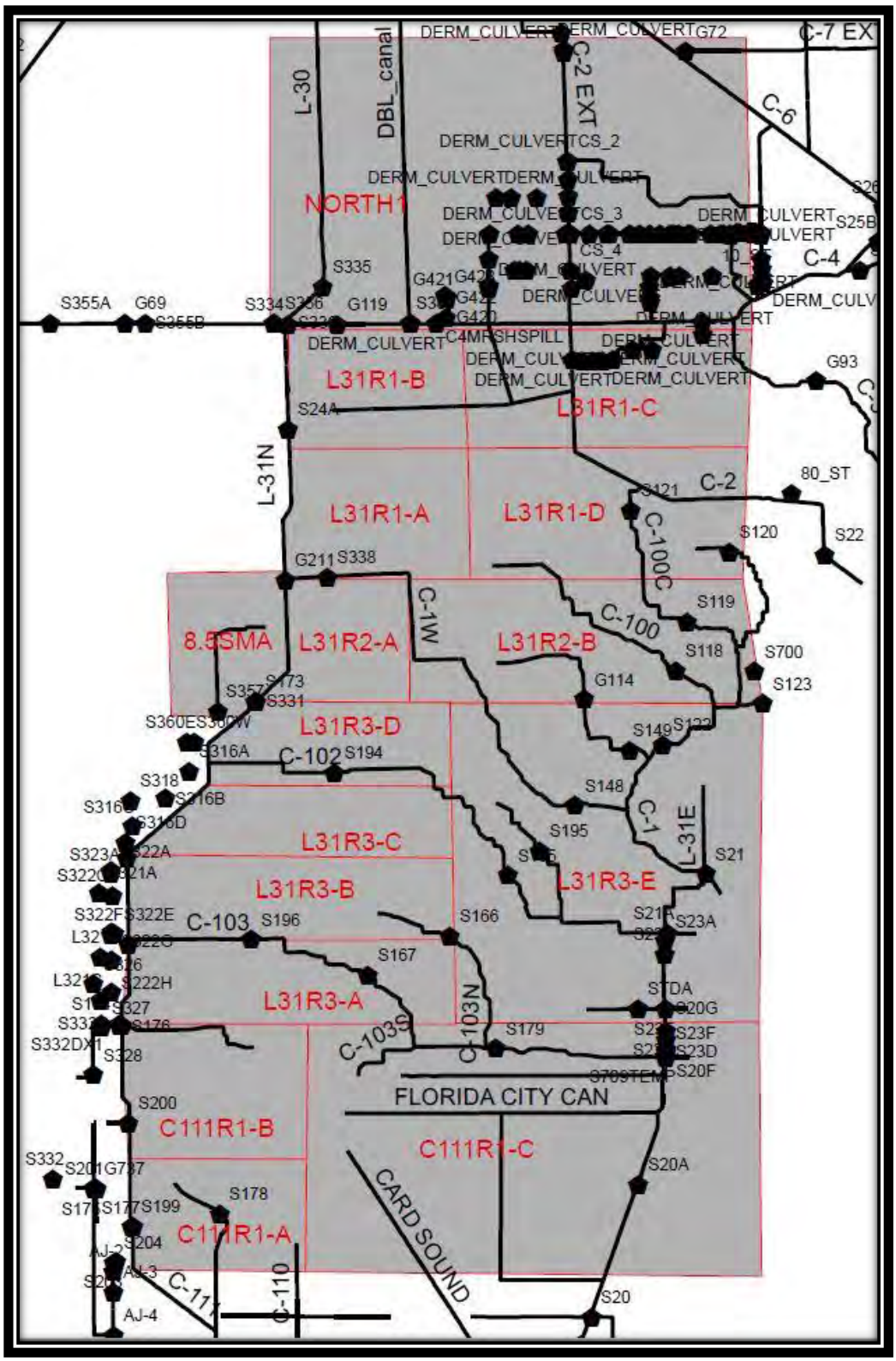

Figure 4-134: Round 2 economic modeling reaches.

Table 4-35: MD-RSM/HEC-FIA Round 2 dollar damages (FY19, $1,000) for average year.

Reaches	94Base_Avg	ECB19_Avg	N2_Avg	O_Avg
C111R1-A	$ 9,144	$ 7,197	$ 7,375	$ 7,771
C111R1-B	$ 8,813	$ 5,398	$ 5,856	$ 6,324
C111R1-C	$ 10,006	$ 9,762	$ 9,813	$ 9,799
L31R1-A	$ 6,403	$ 5,536	$ 6,284	$ 5,969
L31R1-D	$ 1	$ 1	$ 1	$ 1
L31R2-A	$ 2,965	$ 1,119	$ 2,258	$ 2,167
L31R2-B	$0	$0	$0	$0
L31R3-A	$ 1,683	$ 901	$ 960	$ 931
L31R3-B	$ 6,890	$ 3,719	$ 4,252	$ 4,146
L31R3-C	$ 6,956	$ 4,044	$ 4,592	$ 4,608
L31R3-D	$ 7,636	$ 4,654	$ 5,609	$ 5,652
L31R3-E	$ 4,810	$ 4,756	$ 4,778	$ 4,783
Total	***$ 65,308***	***$ 47,086***	***$ 51,777***	***$ 52,150***

Table 4-36: MD-RSM/HEC-FIA Round 2 dollar damages (FY19, $1,000) for dry year.

Reaches	94Base_Dry	ECB19_Dry	N2_Dry	O_Dry
C111R1-A	$ 14,737	$ 13,348	$ 13,512	$ 13,690
C111R1-B	$ 11,016	$ 9,170	$ 9,567	$ 9,515
C111R1-C	$ 11,728	$ 11,673	$ 11,657	$ 11,666
L31R1-A	$ 8,149	$ 7,226	$ 7,987	$ 7,890
L31R1-D	$ 5	$ 5	$ 5	$ 6
L31R2-A	$ 2,980	$ 1,216	$ 2,192	$ 1,922
L31R2-B	$0	$0	$0	$0
L31R3-A	$ 3,631	$ 2,417	$ 2,791	$ 2,248

Reaches	94Base_Dry	ECB19_Dry	N2_Dry	O_Dry
L31R3-B	$ 9,596	$ 7,090	$ 7,530	$ 6,666
L31R3-C	$ 6,106	$ 4,091	$ 4,643	$ 3,779
L31R3-D	$ 5,749	$ 3,726	$ 4,567	$ 3,275
L31R3-E	$ 6,440	$ 6,323	$ 6,453	$ 6,397
Total	***$ 80,138***	***$ 66,287***	***$ 70,904***	***$ 67,053***

Table 4-37: MD-RSM/HEC-FIA Round 2 dollar damages (FY19, $1,000) for wet year.

Reaches	94Base_Wet	ECB19_Wet	N2_Wet	O_Wet
C111R1-A	$ 19,605	$ 19,088	$ 18,958	$ 19,171
C111R1-B	$ 31,506	$ 30,644	$ 30,320	$ 30,639
C111R1-C	$ 12,666	$ 12,638	$ 12,629	$ 12,636
L31R1-A	$ 11,491	$ 11,171	$ 11,436	$ 11,253
L31R1-D	$ 6	$ 6	$ 6	$ 6
L31R2-A	$ 24,109	$ 19,168	$ 23,331	$ 20,319
L31R2-B	$ 44	$ 32	$ 49	$ 36
L31R3-A	$ 12,636	$ 11,655	$ 11,354	$ 11,461
L31R3-B	$ 25,504	$ 23,927	$ 23,845	$ 23,742
L31R3-C	$ 15,794	$ 14,893	$ 14,995	$ 14,863
L31R3-D	$ 17,567	$ 15,728	$ 16,361	$ 15,664
L31R3-E	$ 8,221	$ 8,103	$ 8,310	$ 8,133
Total	***$ 179,148***	***$ 167,054***	***$ 171,594***	***$ 167,922***

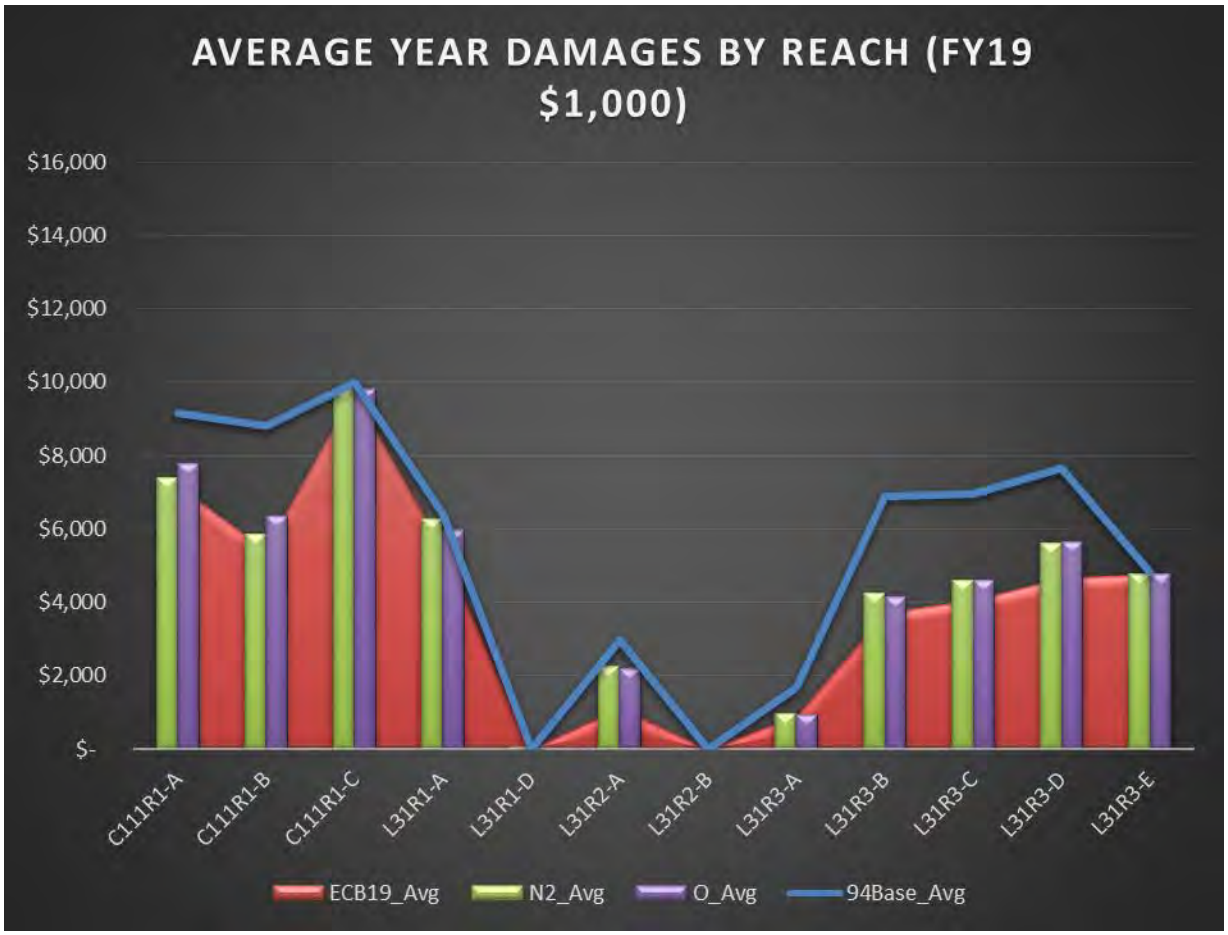

Figure 4-135: Round 2 average year damages (FY19, $1000) by reach and operating condition.

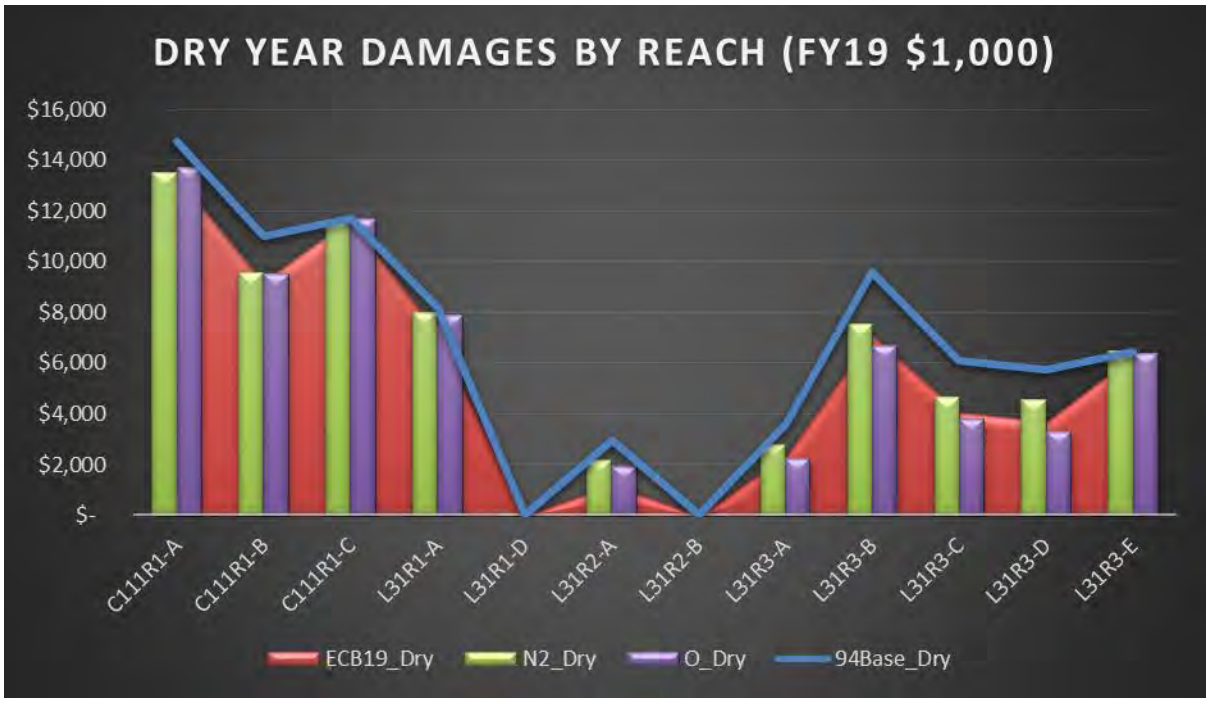

Figure 4-136: Round 2 dry year damages (FY19, $1000) by reach and operating condition.

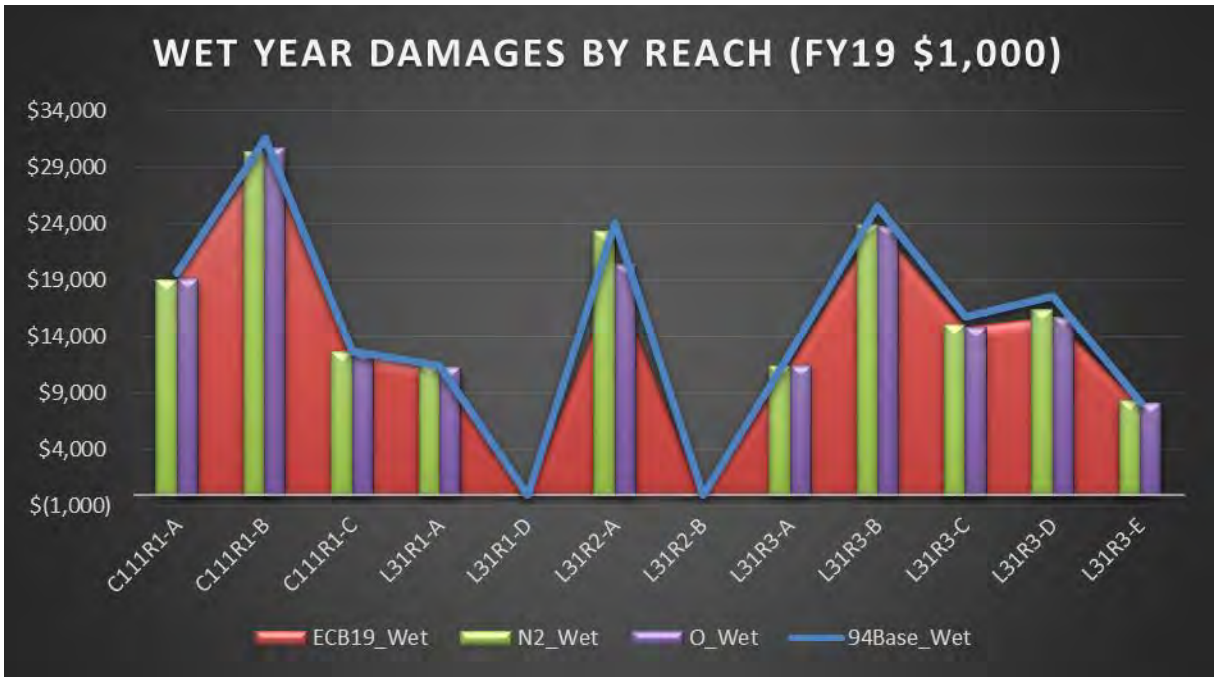

Figure 4-137: Round 2 wet year damages (FY19, $1000) by reach and operating condition.

The largest damages in each of the event years is estimated to come from the constraint operating condition, the 94Base. Unsurprisingly, a large amount of damage is attributable to the wet year as a large swath of crops are estimated to be damaged based on the depth-damage functions for Fruit Crops and Row Crops. As one can see from **Figure 4-137**, the differences between each of the conditions in the wet

year is very minimal, indicating very little room for separation amongst the alternatives. However, in the other two event years there are several reaches in which the alternatives operate vastly better than the 94Base condition. Iit's important to note that in nearly all reaches the alternatives satisfy the constraint and improve upon the estimated damages. The exception is one reach (L31R2-B) in the wet year for ALTN2 where there is an increase of $5,000 in estimated damages. However, this reach was one of the reaches where the cells with agricultural parcels were very far removed from the COP operations and were condensed and/or removed in future modeling rounds as described in Footnote 4 above. The following three tables demonstrate to what extent the alternatives reduced risk compared to the constraint[5]

Table 4-38: Round 2 agriculture constraint confirmation – alternatives compared to 1994 base condition for average year ($1,000 FY19).

Reaches	ALTN2 Damage Increase / Decrease	ALTN2 Percent Change	ALTO Damage Increase / Decrease	ALTO Percent Change
C111R1-A	$ (1,769)	-19%	$ (1,374)	-15%
C111R1-B	$ (2,957)	-34%	$ (2,489)	-28%
C111R1-C	$ (193)	-2%	$ (208)	-2%
L31R1-A	$ (119)	-2%	$ (435)	-7%
L31R1-D	$ (0)	-3%	$ 0	-
L31R2-A	$ (708)	-24%	$ (798)	-27%
L31R2-B	$0	-	$0	-
L31R3-A	$ (723)	-43%	$ (751)	-45%
L31R3-B	$ (2,638)	-38%	$ (2,744)	-40%
L31R3-C	$ (2,364)	-34%	$ (2,348)	-34%
L31R3-D	$ (2,027)	-27%	$ (1,984)	-26%
L31R3-E	$ (33)	-1%	$ (27)	-1%
Total	**$ (13,531)**	**-21%**	**$ (13,158)**	**-20%**

Table 4-39: Round 2 agriculture constraint confirmation – alternatives compared to 1994 base condition for dry year ($1,000 FY19).

Reaches	ALTN2 Damage Increase / Decrease	ALTN2 Percent Change	ALTO Damage Increase / Decrease	ALTO Percent Change
C111R1-A	$ (1,225)	-8%	$ (1,047)	-7%
C111R1-B	$ (1,449)	-13%	$ (1,501)	-14%
C111R1-C	$ (71)	-1%	$ (62)	-1%
L31R1-A	$ (162)	-2%	$ (259)	-3%
L31R1-D	$ 0	0%	$ 0	-
L31R2-A	$ (788)	-26%	$ (1,058)	-36%
L31R2-B	$ -	-	$ 0	-

[5] A negative number indicates reduced risk (i.e. damage reduction)

Reaches	ALTN2 Damage Increase / Decrease	ALTN2 Percent Change	ALTO Damage Increase / Decrease	ALTO Percent Change
L31R3-A	$ (840)	-23%	$ (1,382)	-38%
L31R3-B	$ (2,066)	-22%	$ (2,930)	-31%
L31R3-C	$ (1,463)	-24%	$ (2,327)	-38%
L31R3-D	$ (1,183)	-21%	$ (2,474)	-43%
L31R3-E	$ 13	0%	$ (44)	-1%
Total	**$ (9,235)**	**-12%**	**$ (13,085)**	**-16%**

Table 4-40: Round 2 agriculture constraint confirmation – alternatives compared to 1994 base condition for wet year ($1,000 FY19).

Reaches	ALTN2 Damage Increase / Decrease	ALTN2 Percent Change	ALTO Damage Increase / Decrease	ALTO Percent Change
C111R1-A	$ (647)	-3%	$ (435)	-2%
C111R1-B	$ (1,186)	-4%	$ (867)	-3%
C111R1-C	$ (38)	0%	$ (31)	0%
L31R1-A	$ (55)	0%	$ (238)	-2%
L31R1-D	$ (0)	0%	$ (0)	-
L31R2-A	$ (778)	-3%	$ (3,790)	-16%
L31R2-B	$ 5	-	$ (8)	-
L31R3-A	$ (1,281)	-10%	$ (1,175)	-9%
L31R3-B	$ (1,659)	-7%	$ (1,761)	-7%
L31R3-C	$ (799)	-5%	$ (930)	-6%
L31R3-D	$ (1,206)	-7%	$ (1,903)	-11%
L31R3-E	$ 89	1%	$ (88)	-1%
Total	**$ (7,554)**	**-4%**	**$ (11,226)**	**-6%**

Since ALTO clearly outperformed N2 in the wet and dry years and was virtually the same in the average year, a deeper dive was taken into ALTO's results. A spatial comparison was made to the ECB19RR in order to identify potential areas of enhanced flood risk reduction where possible. The following three figures show ALTO increases/decreases in damages by MD-RSM cell in each of the event years.

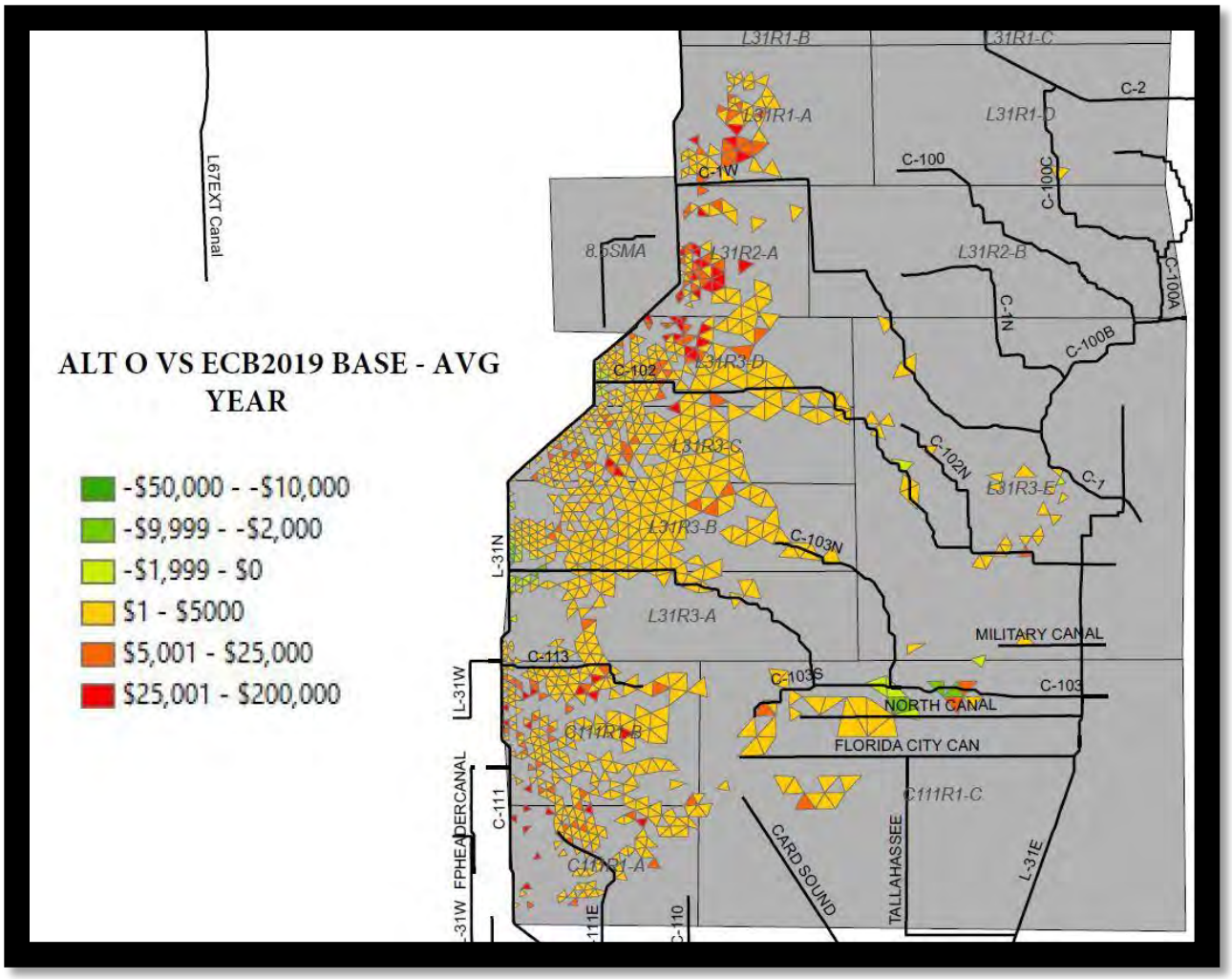

Figure 4-138: Round 2 agriculture spatial summary – ALTO vs ECB19 average year.

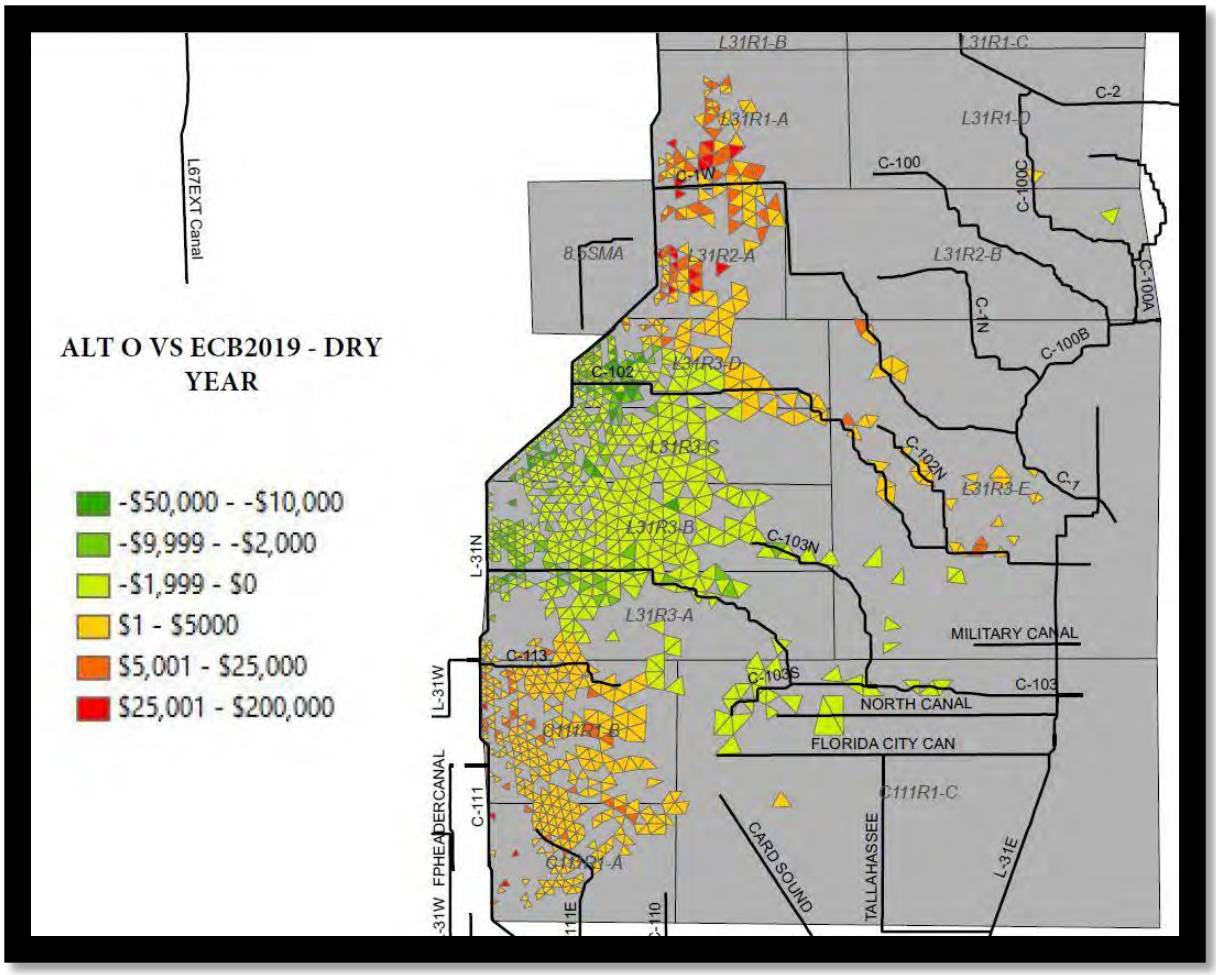

Figure 4-139: Round 2 agriculture spatial summary – ALTO vs ECB19 dry year.

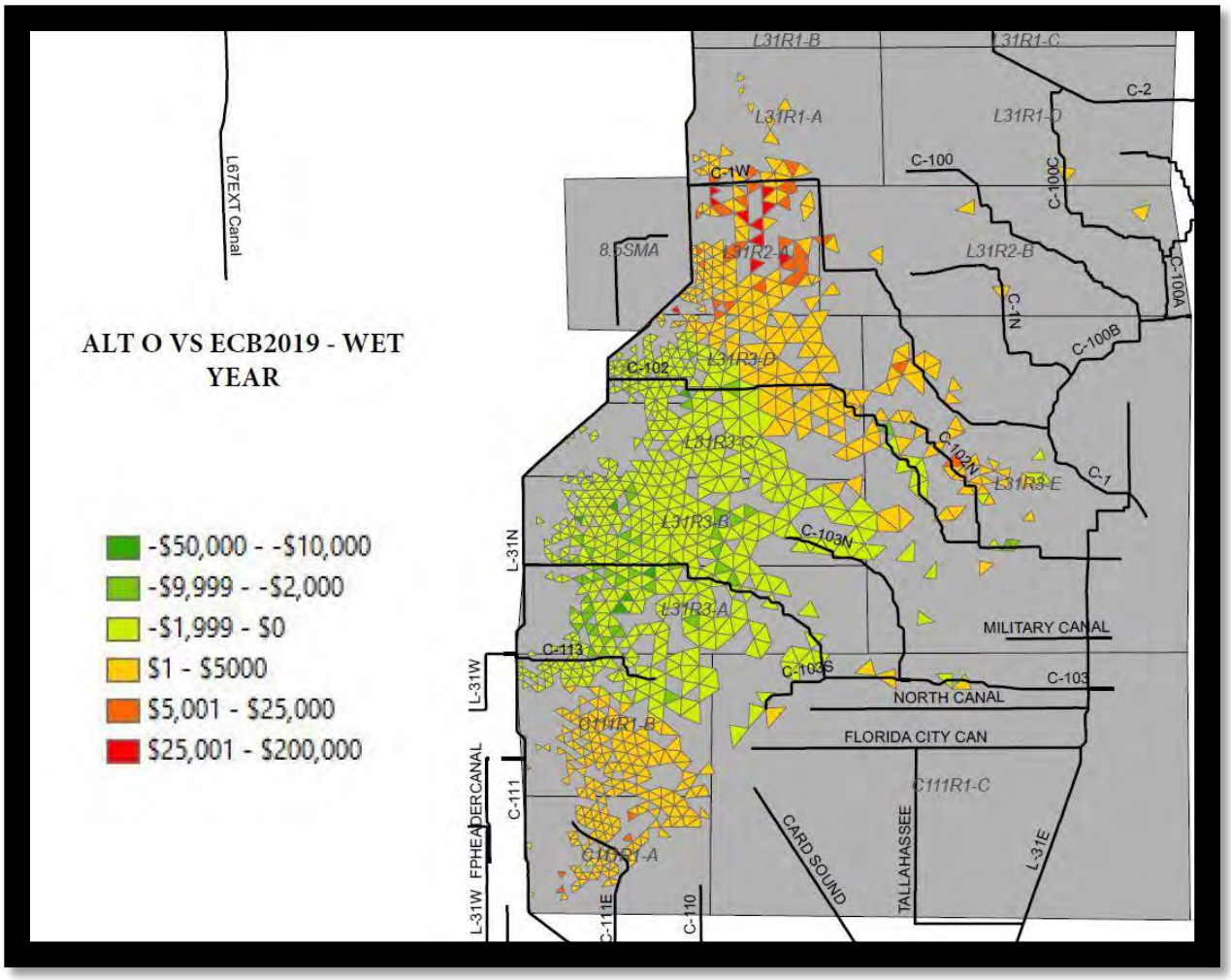

Figure 4-140: Round 2 agriculture spatial summary – ALTO vs ECB19 wet year.

A clear pattern emerges from the spatial analysis in which the northern and southern portions of the system are showing increased flood risk whereas the central portion of the domain shows a decreased risk. The increase in risk in the northern area as compared to the ECB19RR can be explained by the incidental benefits received in this area by the intentional drawdown of flows during construction periods in the existing condition. So, though it is clear that ALTO outperforms ALTN2 and provides a significant enhancement of flood risk reduction, there is still residual risk with this alternative as compared to the ECB19RR. This information was used during PDT discussions to formulate the PPA, ALTQ+, and to explore opportunities to enhance flood risk mitigation without compromising ecological benefits.

4.15.2 Round 3 Modeling – Alternative Q and Q+

The alternatives from Round 2 were reviewed from a flood risk and ecological enhancement point of view and the PDT decided on operations that formed ALTQ, which largely tracks ALTO. Additional sensitivity runs (Qm and Qm1) were modeled as the basis for the PPA ALTQ+. As was mentioned above, the economic reaches were altered slightly from Round 2 and are displayed in **Figure 4-141**. ALTs Q, Qm, and Qm1 each performed well overall in terms of agricultural risk reduction. In the wet year, each alternative reduced the estimated damages by approximately 10% when compared to the 1994 GRR. For the average and dry

years the reduction was even greater with a nearly 30% reduction and approximately 20% reduction respectively. The overall results can be seen in **Table 4-41.** The damage reduction capacity of ALTs Q, Qm, and Qm1 compared to the 1994 GRR condition is true across all reaches as well (i.e. no single reach is pulling the average reduction up) as can be seen in **Table 4-42, Table 4-43** and **Table 4-44 .** When compared to the ECB19RR there are also many reaches in which the alternatives show substantial risk reduction, though, there are some reaches where residual risk remains a concern. This pattern is best viewed in the spatial summary of the alternatives as compared to the baseline conditions which are shown in **Figure 4-142** through **Figure 4-147.** As one can see, the residual risk is concentrated mostly in the northern and southern tails of the study area when compared to the ECB19RR. In wet conditions there is also some residual risk in the central portion of the study area immediately adjacent to the L-31 canal and extending partially eastward. From this analysis it is clear that the constraint is met under each of the ALTQ variants but attention must be paid to the central portion of the system under wet conditions. Another takeaway from the tables and figures below is that there is very little difference, in terms of flood risk, between ALTs Q, Qm, and Qm1 and as such any operational criteria within the alternatives would be acceptable with respect to the 1994 GRR constraint.

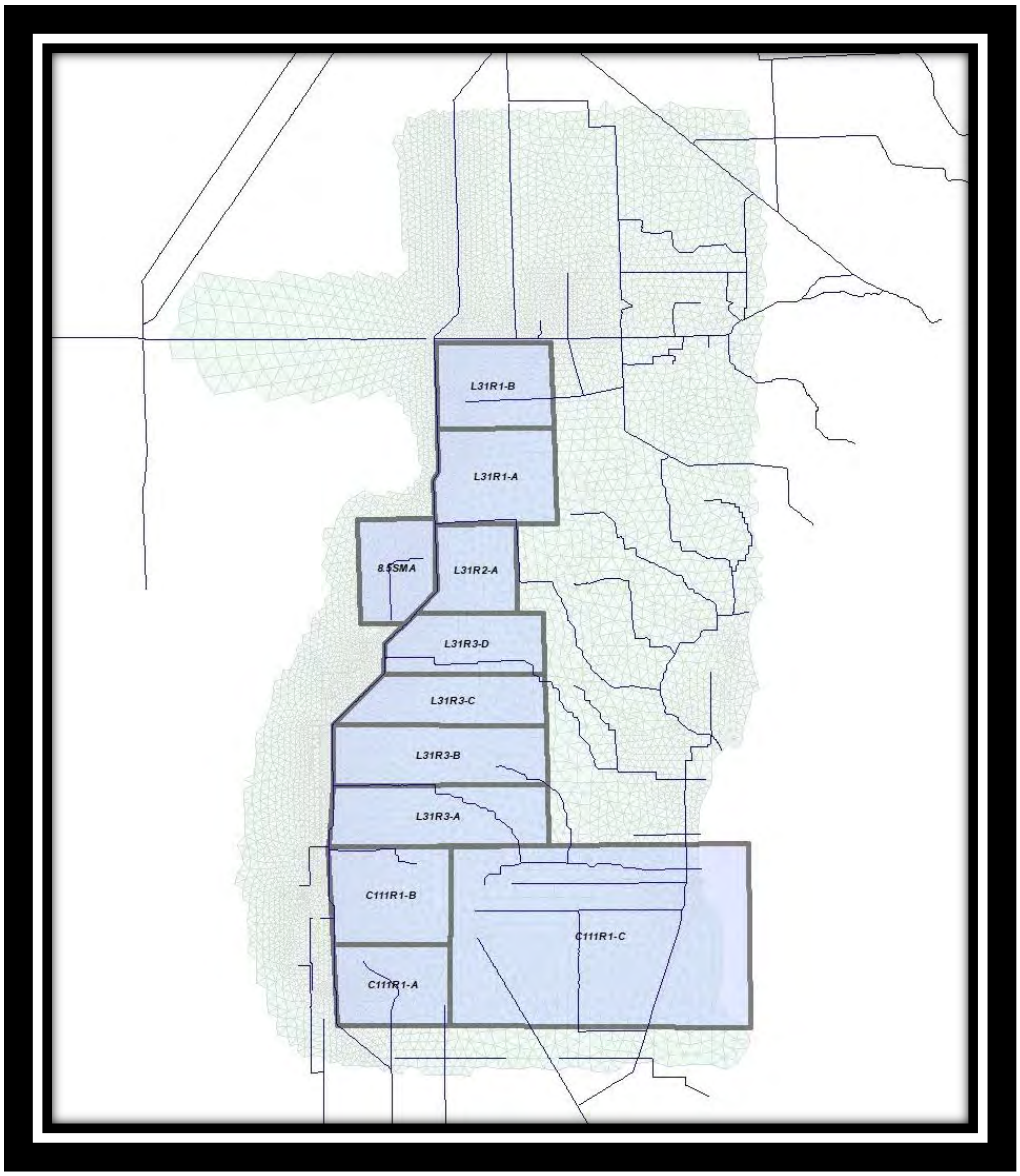

Figure 4-141: HEC-FIA Round 3 Economic Modeling Reaches.

Table 4-41: Round 3 agriculture damage summary – all operating conditions for each MD-RSM event year.

Reaches	Total Damage Wet ($1,000 FY19)					Total Damage Average ($1,000 FY19)					Total Damage Dry ($1,000 FY19)				
	1994 GRR	ECB19	AltQ	AltQm	AltQm1	1994 GRR	ECB19	AltQ	AltQm	AltQm1	1994 GRR	ECB19	AltQ	AltQm	AltQm1
C111R1-A	$ 22,016	$ 21,353	$ 21,407	$ 21,429	$ 21,470	$ 10,151	$ 8,635	$ 8,392	$ 8,395	$ 8,415	$ 16,535	$ 15,041	$ 15,212	$ 15,259	$ 15,327
C111R1-B	$ 34,171	$ 33,027	$ 32,861	$ 33,535	$ 33,677	$ 9,480	$ 6,696	$ 6,007	$ 6,146	$ 6,241	$ 11,984	$ 9,976	$ 9,881	$ 10,235	$ 10,414
C111R1-C	$ 14,566	$ 14,539	$ 14,490	$ 14,526	$ 14,527	$ 11,510	$ 11,277	$ 11,201	$ 11,215	$ 11,225	$ 13,499	$ 13,423	$ 13,405	$ 13,413	$ 13,422
L31R1-A	$ 13,298	$ 12,872	$ 13,068	$ 12,923	$ 12,852	$ 7,399	$ 6,369	$ 6,742	$ 6,742	$ 6,756	$ 9,760	$ 8,699	$ 9,119	$ 8,969	$ 8,962
L31R2-A	$ 27,722	$ 21,604	$ 22,289	$ 20,745	$ 19,490	$ 3,127	$ 1,159	$ 1,356	$ 1,350	$ 1,361	$ 3,513	$ 1,570	$ 1,894	$ 1,472	$ 1,294
L31R3-A	$ 13,631	$ 12,258	$ 11,766	$ 11,780	$ 11,935	$ 1,794	$ 1,013	$ 874	$ 886	$ 892	$ 3,964	$ 2,864	$ 2,122	$ 2,235	$ 2,391
L31R3-B	$ 27,304	$ 25,418	$ 24,598	$ 24,984	$ 25,098	$ 7,423	$ 4,123	$ 3,702	$ 3,706	$ 3,717	$ 10,569	$ 7,906	$ 6,510	$ 6,692	$ 6,951
L31R3-C	$ 16,792	$ 15,758	$ 15,422	$ 15,829	$ 15,851	$ 7,339	$ 4,284	$ 4,091	$ 4,090	$ 4,102	$ 6,747	$ 4,523	$ 3,536	$ 3,600	$ 3,723
L31R3-D	$ 18,985	$ 16,776	$ 16,072	$ 15,386	$ 15,202	$ 7,937	$ 4,817	$ 4,485	$ 4,472	$ 4,490	$ 6,169	$ 4,215	$ 3,140	$ 3,083	$ 3,068
Total	$ 188,483	$ 173,605	$ 171,972	$ 171,138	$ 170,103	$ 66,160	$ 48,372	$ 46,849	$ 47,002	$ 47,199	$ 82,740	$ 68,216	$ 64,819	$ 64,957	$ 65,551
Percent Change From Base Conditions	% Change From ECB19		-1%	-1%	-2%	% Change From ECB19		-3%	-3%	-2%	% Change From ECB19		-5%	-5%	-4%
	% Change From 1994 GRR		-9%	-9%	-10%	% Change From 1994 GRR		-29%	-29%	-29%	% Change From 1994 GRR		-22%	-21%	-21%

Table 4-42: Round 3 risk assessment by reach – ALTS Q, Qm, Qm1 wet year.

Reaches	Alternatives Vs 1994 Base			Alternatives Vs ECB19			**Percent Change from Base Conditions**					
	ALTQ VS 1994 GRR ($1,000 FY19)	ALTQm VS 1994 GRR ($1,000 FY19)	ALTQm1 VS 1994 GRR ($1,000 FY19)	ALTQ VS ECB19 ($1,000 FY19)	ALTQm VS ECB19 ($1,000 FY19)	AltQm1 Vs ECB19 ($1,000 FY19)	AltQ vs 94Base	AltQm vs 94Base	AltQm1 vs 94Base	AltQ vs ECB19	AltQm vs ECB19	AltQm1 vs ECB19
C111R1-A	$ (608)	$ (587)	$ (546)	$ 54	$ 76	$ 117	-3%	-3%	-2%	0%	0%	1%
C111R1-B	$ (1,310)	$ (636)	$ (494)	$ (166)	$ 509	$ 651	-4%	-2%	-1%	-1%	2%	2%
C111R1-C	$ (76)	$ (40)	$ (39)	$ (49)	$ (13)	$ (12)	-1%	0%	0%	0%	0%	0%
L31R1-A	$ (230)	$ (375)	$ (445)	$ 196	$ 51	$ (19)	-2%	-3%	-3%	2%	0%	0%
L31R2-A	$ (5,433)	$ (6,977)	$ (8,232)	$ 685	$ (858)	$ (2,114)	-20%	-25%	-30%	3%	-4%	-10%

Reaches	Alternatives Vs 1994 Base			Alternatives Vs ECB19			Percent Change from Base Conditions					
	ALTQ VS 1994 GRR ($1,000 FY19)	ALTQm VS 1994 GRR ($1,000 FY19)	ALTQm1 VS 1994 GRR ($1,000 FY19)	ALTQ VS ECB19 ($1,000 FY19)	ALTQm VS ECB19 ($1,000 FY19)	AltQm1 Vs ECB19 ($1,000 FY19)	AltQ vs 94Base	AltQm vs 94Base	AltQm1 vs 94Base	AltQ vs ECB19	AltQm vs ECB19	AltQm1 vs ECB19
L31R3-A	$ (1,865)	$ (1,850)	$ (1,696)	$ (492)	$ (477)	$ (323)	-14%	-14%	-12%	-4%	-4%	-3%
L31R3-B	$ (2,706)	$ (2,320)	$ (2,205)	$ (820)	$ (434)	$ (319)	-10%	-8%	-8%	-3%	-2%	-1%
L31R3-C	$ (1,370)	$ (963)	$ (941)	$ (337)	$ 70	$ 93	-8%	-6%	-6%	-2%	0%	1%
L31R3-D	$ (2,913)	$ (3,599)	$ (3,783)	$ (704)	$ (1,390)	$ (1,574)	-15%	-19%	-20%	-4%	-8%	-9%
Total	***$ (16,511)***	***$ (17,346)***	***$(18,380)***	***$ (1,632)***	***$ (2,467)***	***$ (3,501)***	***-9%***	***-9%***	***-10%***	***-1%***	***-1%***	***-2%***

Table 4-43: Round 3 risk assessment by reach – ALTS Q, Qm, Qm1 average year.

Reaches	Alternatives Vs 1994 Base			Alternatives Vs ECB19			Percent Change from Base Conditions					
	ALTQ VS 1994 GRR ($1,000)	ALTQm VS 1994 GRR ($1,000)	ALTQm1 VS 1994 GRR ($1,000)	ALTQ VS ECB19 ($1,000)	ALTQm VS ECB19 ($1,000)	AltQm1 Vs ECB19 ($1,000)	AltQ vs 94Base	AltQm vs 94Base	AltQm1 vs 94Base	AltQ vs ECB19	AltQm vs ECB19	AltQm1 vs ECB19
C111R1-A	$ (1,759)	$ (1,756)	$ (1,736)	$ (243)	$ (240)	$ (220)	-17%	-17%	-17%	-3%	-3%	-3%
C111R1-B	$ (3,474)	$ (3,334)	$ (3,239)	$ (689)	$ (550)	$ (455)	-37%	-35%	-34%	-10%	-8%	-7%
C111R1-C	$ (309)	$ (295)	$ (285)	$ (76)	$ (62)	$ (52)	-3%	-3%	-2%	-1%	-1%	0%
L31R1-A	$ (657)	$ (657)	$ (642)	$ 373	$ 373	$ 387	-9%	-9%	-9%	6%	6%	6%
L31R2-A	$ (1,771)	$ (1,777)	$ (1,767)	$ 197	$ 192	$ 202	-57%	-57%	-56%	17%	17%	17%
L31R3-A	$ (920)	$ (908)	$ (902)	$ (139)	$ (127)	$ (121)	-51%	-51%	-50%	-14%	-13%	-12%
L31R3-B	$ (3,721)	$ (3,717)	$ (3,707)	$ (421)	$ (417)	$ (407)	-50%	-50%	-50%	-10%	-10%	-10%
L31R3-C	$ (3,248)	$ (3,249)	$ (3,236)	$ (193)	$ (194)	$ (181)	-44%	-44%	-44%	-5%	-5%	-4%
L31R3-D	$ (3,453)	$ (3,466)	$ (3,447)	$ (332)	$ (345)	$ (326)	-44%	-44%	-43%	-7%	-7%	-7%
Total	***$ (19,312)***	***$ (19,158)***	***$ (18,961)***	***$ (1,523)***	***$ (1,370)***	***$ (1,173)***	***-29%***	***-29%***	***-29%***	***-3%***	***-3%***	***-2%***

Table 4-44 : Round 3 risk assessment by reach – ALTs Q, Qm, Qm1 dry year.

Reaches	Alternatives Vs 1994 Base			Alternatives Vs ECB19			Percent Change from Base Conditions					
	ALTQ VS 1994 GRR ($1,000)	ALTQm VS 1994 GRR ($1,000)	ALTQm1 VS 1994 GRR ($1,000)	ALTQ VS ECB19 ($1,000)	ALTQm VS ECB19 ($1,000)	AltQm1 Vs ECB19 ($1,000)	AltQ vs 94Base	AltQm vs 94Base	AltQm1 vs 94Base	AltQ vs ECB19	AltQm vs ECB19	AltQm1 vs ECB19
C111R1-A	$ (1,324)	$ (1,276)	$ (1,208)	$ 170	$ 218	$ 286	-8%	-8%	-7%	1%	1%	2%
C111R1-B	$ (2,103)	$ (1,749)	$ (1,569)	$ (96)	$ 259	$ 438	-18%	-15%	-13%	-1%	3%	4%
C111R1-C	$ (94)	$ (86)	$ (77)	$ (17)	$ (9)	$ (1)	-1%	-1%	-1%	0%	0%	0%
L31R1-A	$ (641)	$ (792)	$ (799)	$ 420	$ 270	$ 263	-7%	-8%	-8%	5%	3%	3%
L31R2-A	$ (1,619)	$ (2,041)	$ (2,219)	$ 324	$ (98)	$ (276)	-46%	-58%	-63%	21%	-6%	-18%
L31R3-A	$ (1,842)	$ (1,729)	$ (1,573)	$ (742)	$ (629)	$ (473)	-46%	-44%	-40%	-26%	-22%	-17%
L31R3-B	$ (4,059)	$ (3,878)	$ (3,618)	$ (1,396)	$ (1,215)	$ (955)	-38%	-37%	-34%	-18%	-15%	-12%
L31R3-C	$ (3,211)	$ (3,146)	$ (3,024)	$ (987)	$ (923)	$ (800)	-48%	-47%	-45%	-22%	-20%	-18%
L31R3-D	$ (3,029)	$ (3,086)	$ (3,101)	$ (1,075)	$ (1,132)	$ (1,147)	-49%	-50%	-50%	-26%	-27%	-27%
Total	***$ (17,921)***	***$ (17,783)***	***$ (17,189)***	***$ (3,398)***	***$ (3,260)***	***$ (2,665)***	***-22%***	***-21%***	***-21%***	***-5%***	***-5%***	***-4%***

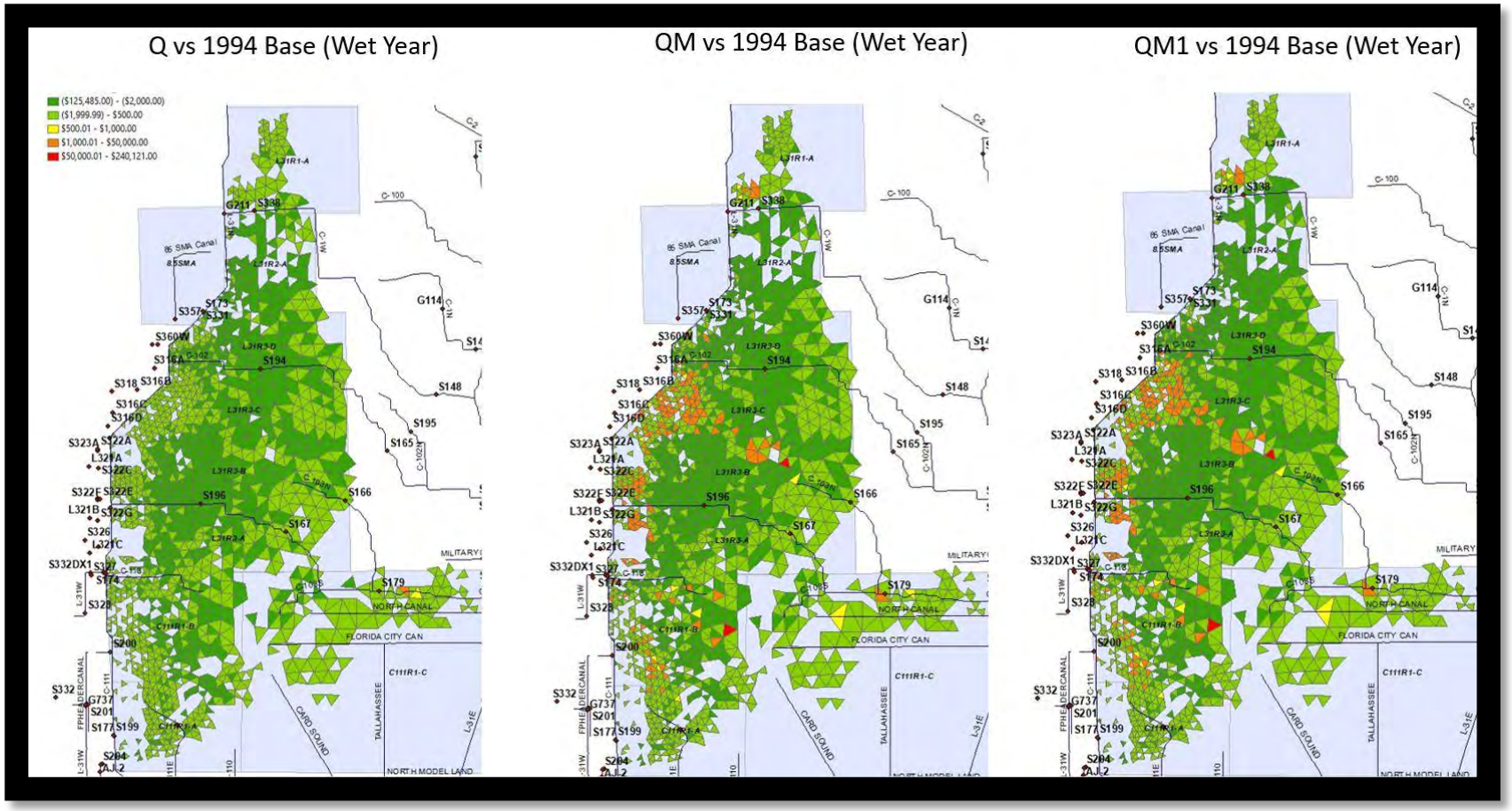

Figure 4-142: Round 3 risk map – ALTs compared to 1994 base condition – wet year.

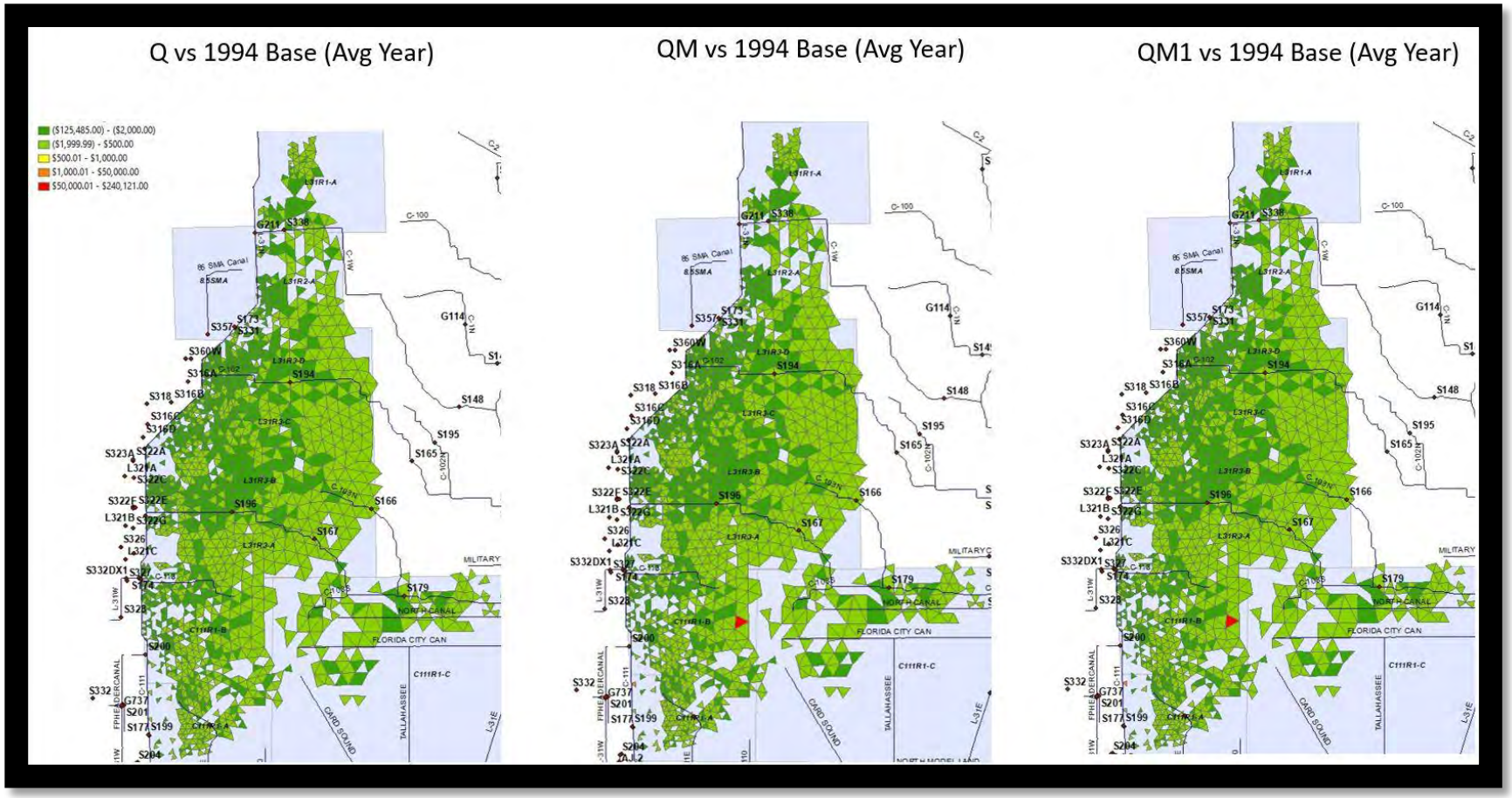

Figure 4-143: Round 3 risk map – ALTs compared to 1994 base condition – average year.

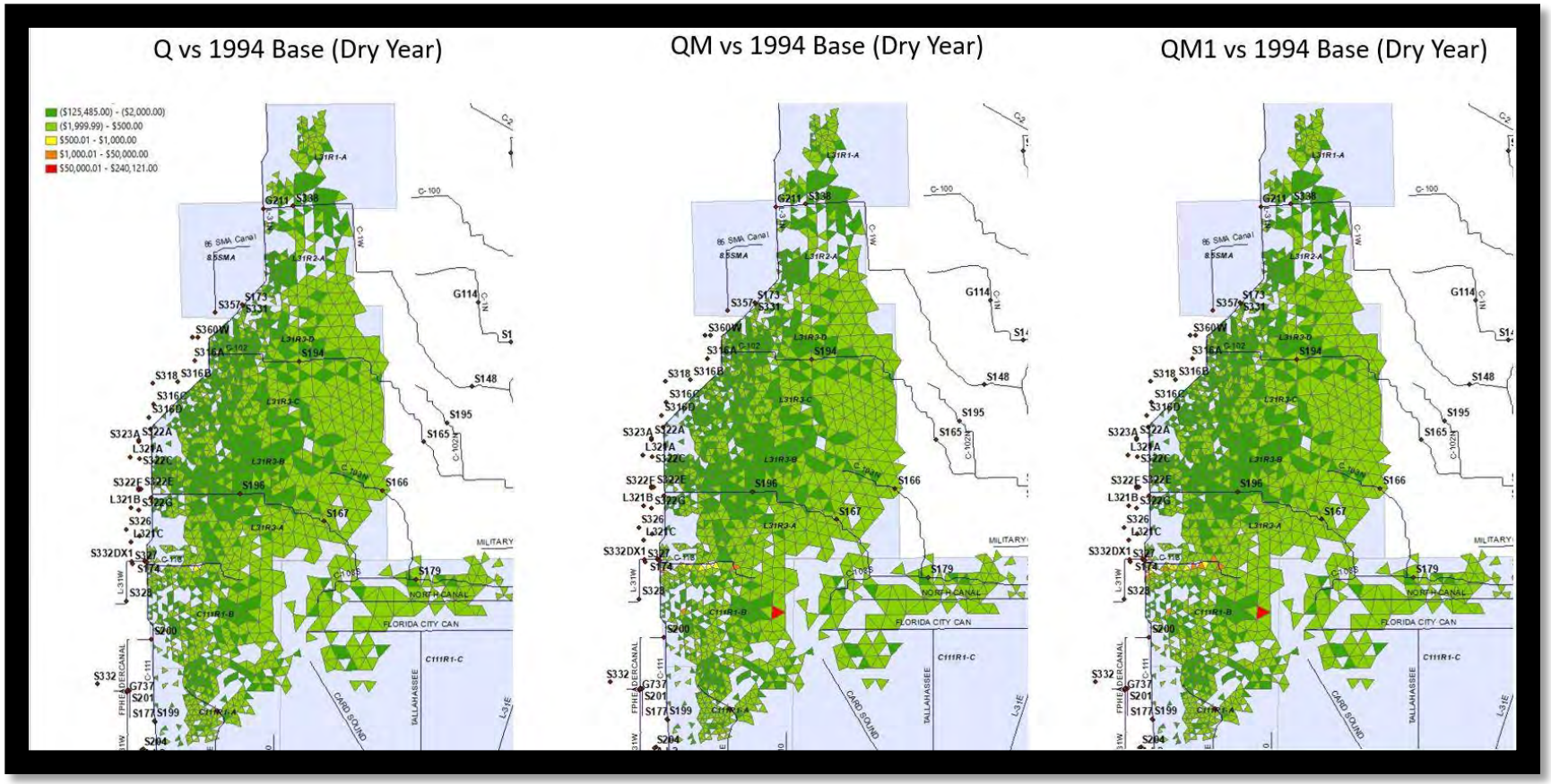

Figure 4-144: Round 3 risk map – ALTs compared to 1994 base condition – dry year.

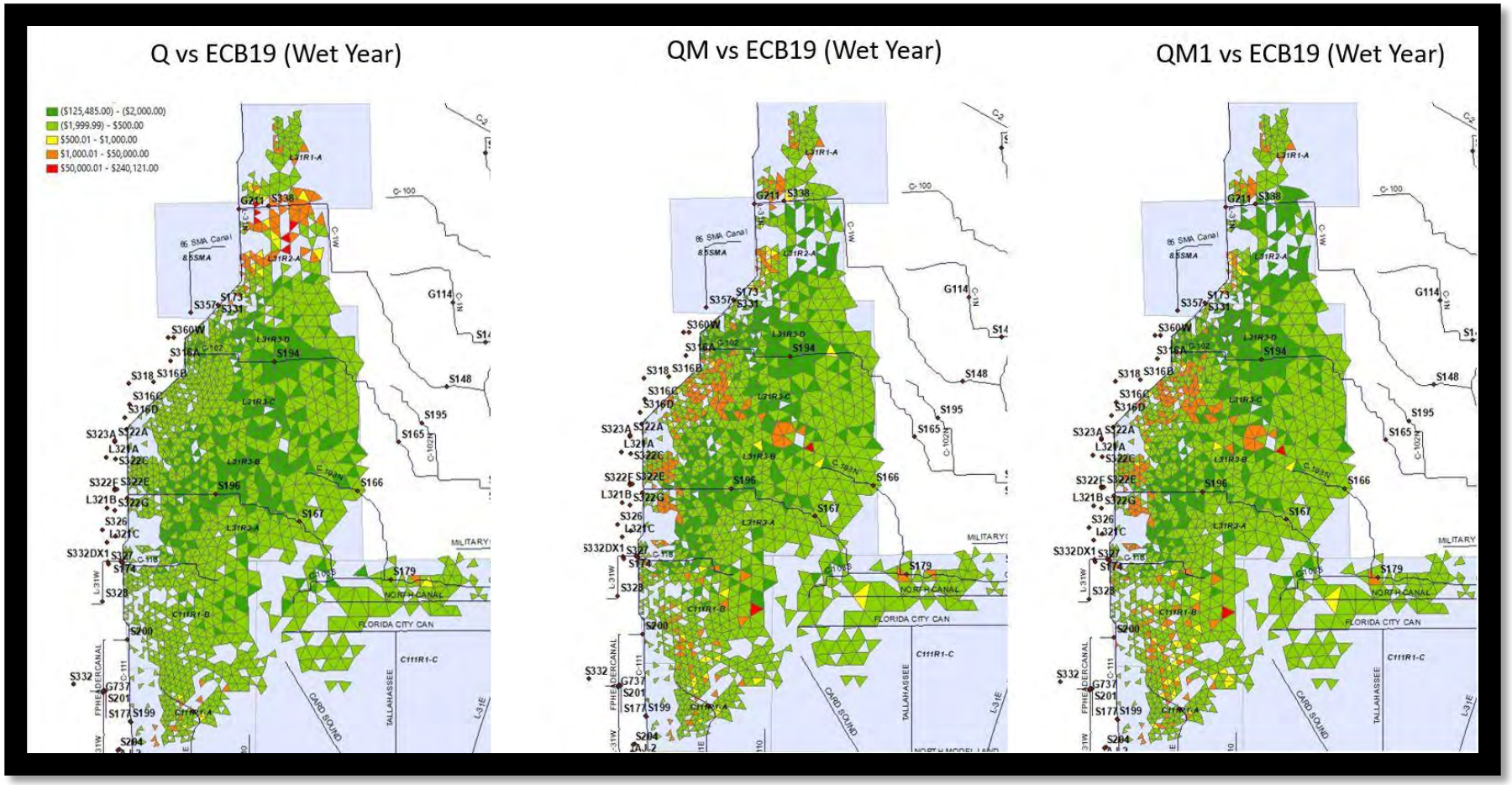

Figure 4-145: Round 3 risk map – ALTs compared to ECB19 – wet year.

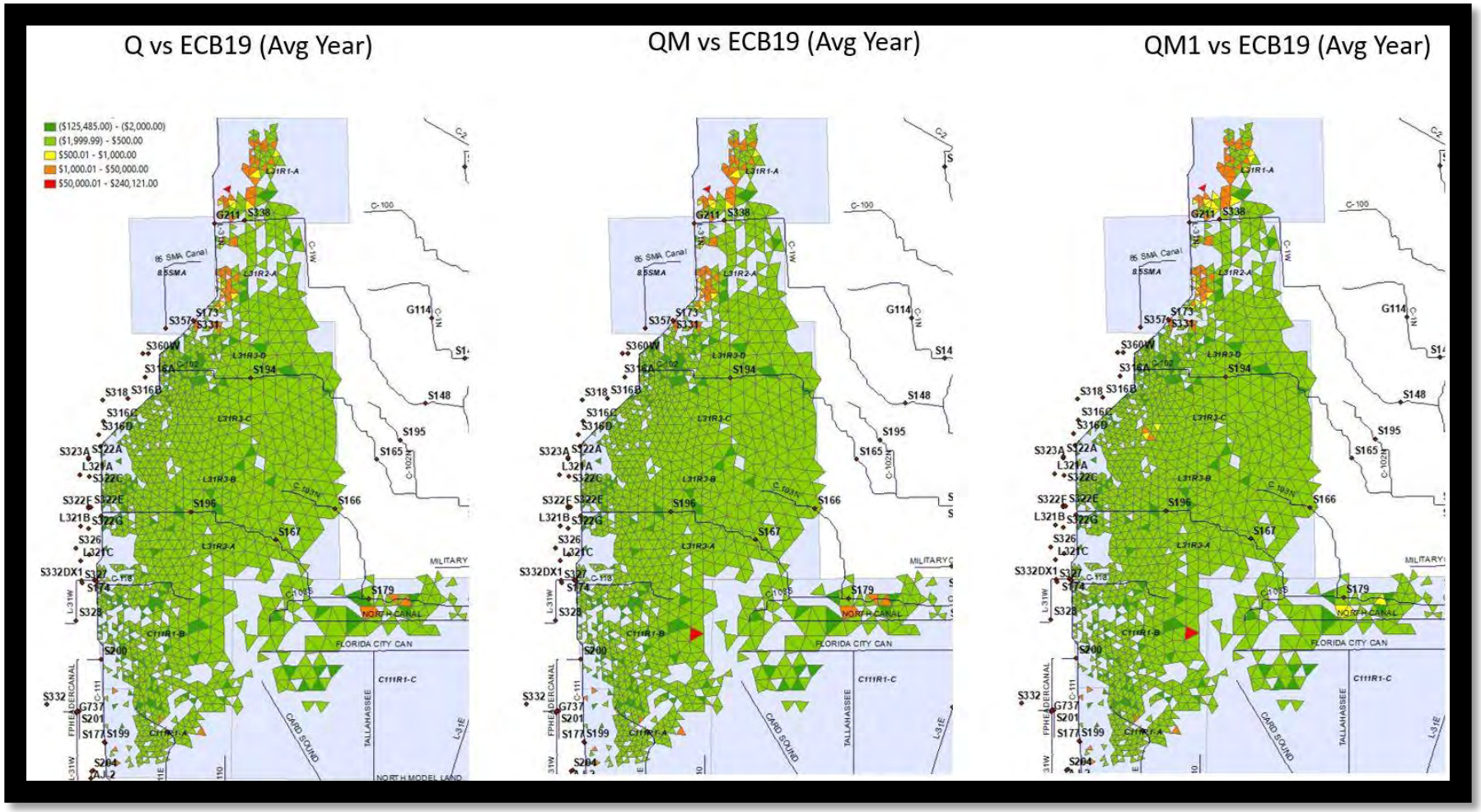

Figure 4-146: Round 3 risk map – ALTs compared to ECB19 – average year.

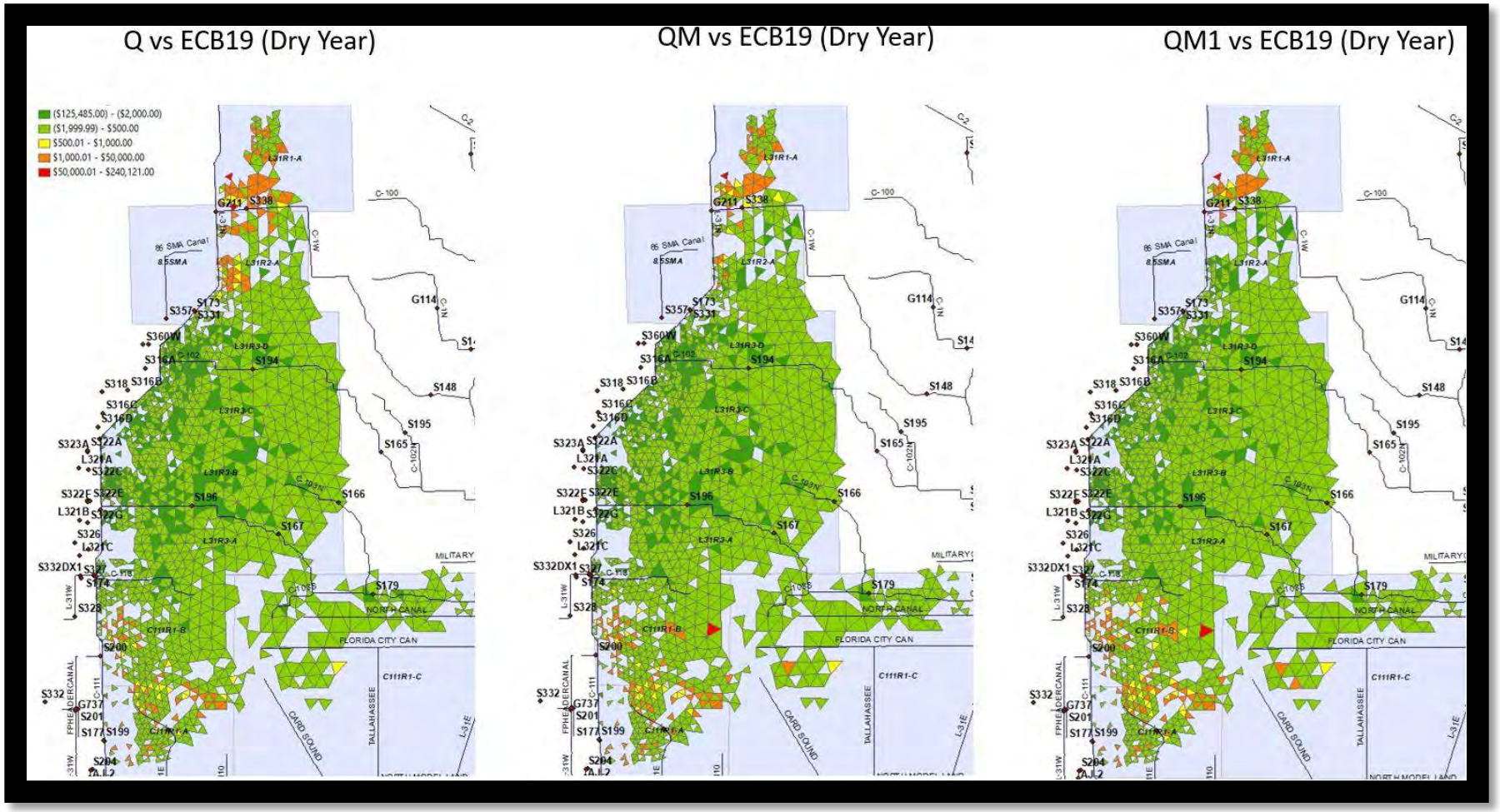

Figure 4-147: Round 3 risk map – ALTs compared to ECB19 – dry year.

For the 8.5 SMA, there were no impacts measured using the actual estimated first floor elevations (FFEs) for the structures. However, since the stage duration curves indicated that ALTQ had a slightly higher peak stage at some of the gauges nearest the property parcels, a sensitivity was conducted where the first floor was artificially lowered to be equal to the ground surface elevation. Once this artificial lowering occurred the HEC-FIA scenario was rerun to measure the differences. Since the FFE was artificially lowered the impacts were not quantified in terms of dollar damages but instead in terms of stage differences measured at the MD-RSM cell level[6]. The maximum difference in stage was roughly .4-feet for all of the cells estimated and that was during the wet event year. The cells were placed into bins where those at highest risk fell between .25-feet and .5-feet, medium risk between 0-feet and .25-feet, and decreased risk (i.e. benefit) anything greater than 0-feet as measured by the difference in ALTQ stage and the 1983 Base stage. In the dry year, seven of the model cells containing residential parcels were counted where the stage increases between 0 and .25 feet under ALTQ as compared to the 1983 Base and are spatially shown in **Figure 4-148**. Under the average year, there are no cells in which the stage increases beyond that measured in the 1983 Base condition (**Figure 4-149**). In the wet year, there are 10 cells registering increases between 0 and .25 feet and four cells where the increase is between .25 and .5 feet (**Figure 4-150**). Of the 20 total cells impacted in the dry and wet years the average increase in stage from the 83Base is .2 feet. For the remaining cells that are showing a risk reduction the average decrease in peak stage is approximately .7 feet. This analysis shows that there is some increase in risk of nuisance flooding in select cells but that flood waters do not impact the first floors of the residential properties contained within the cells and that the majority of the residential properties are experiencing a sizeable decrease in the peak stage. An important note that is not visible here in this analysis of the peak stage is the duration of the elevated stage. Under ALTQ the elevated stage actually recedes faster than it does under the 1983 Base condition, meaning the nuisance flooding would be of a shorter duration. These results are almost identical under ALTs Qm and Qm1 as well. So in summary, there is a very minor increase in the peak stage for these parcels but the duration is much shorter[7].

[6] Only cells containing residential parcels were modeled.

[7] See engineering appendix for stage duration curves.

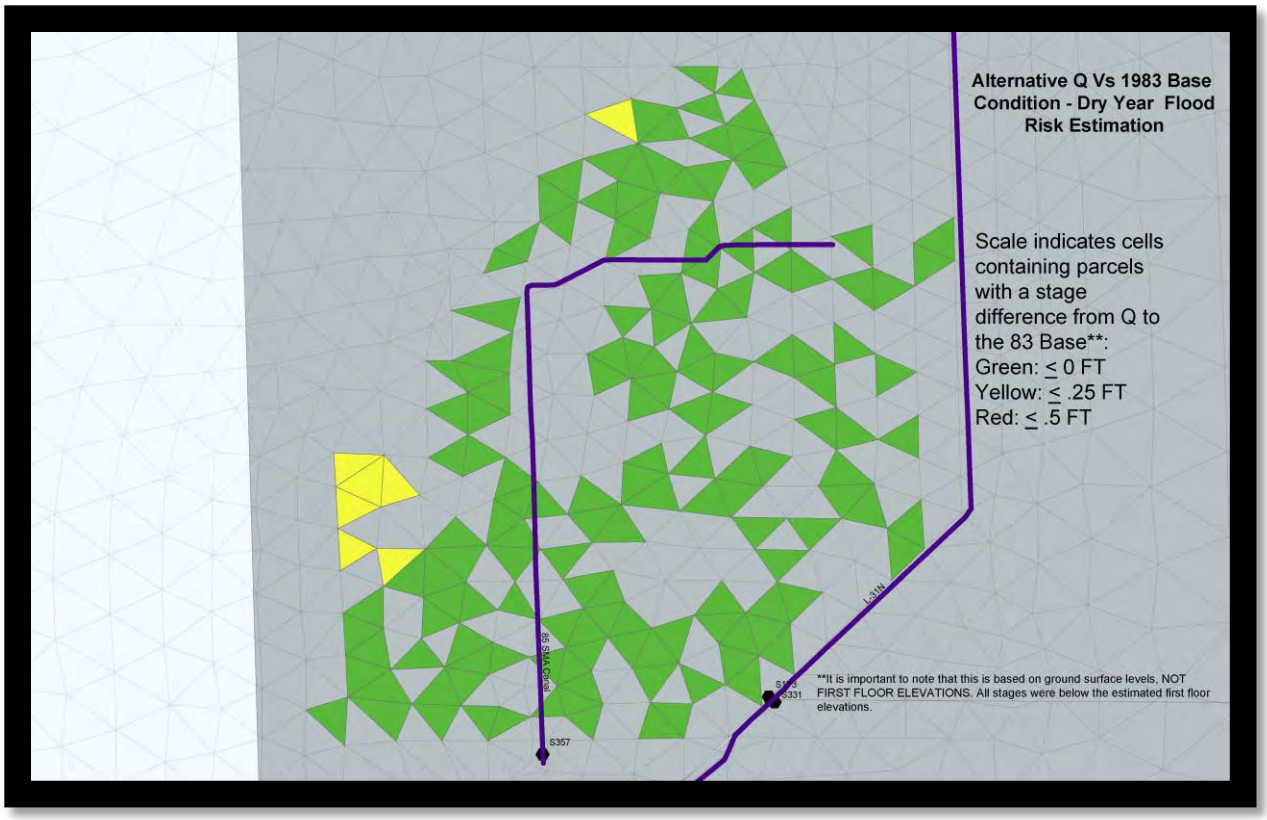

Figure 4-148: 8.5 SMA dry year stage differences between ALTQ and 1983 base.

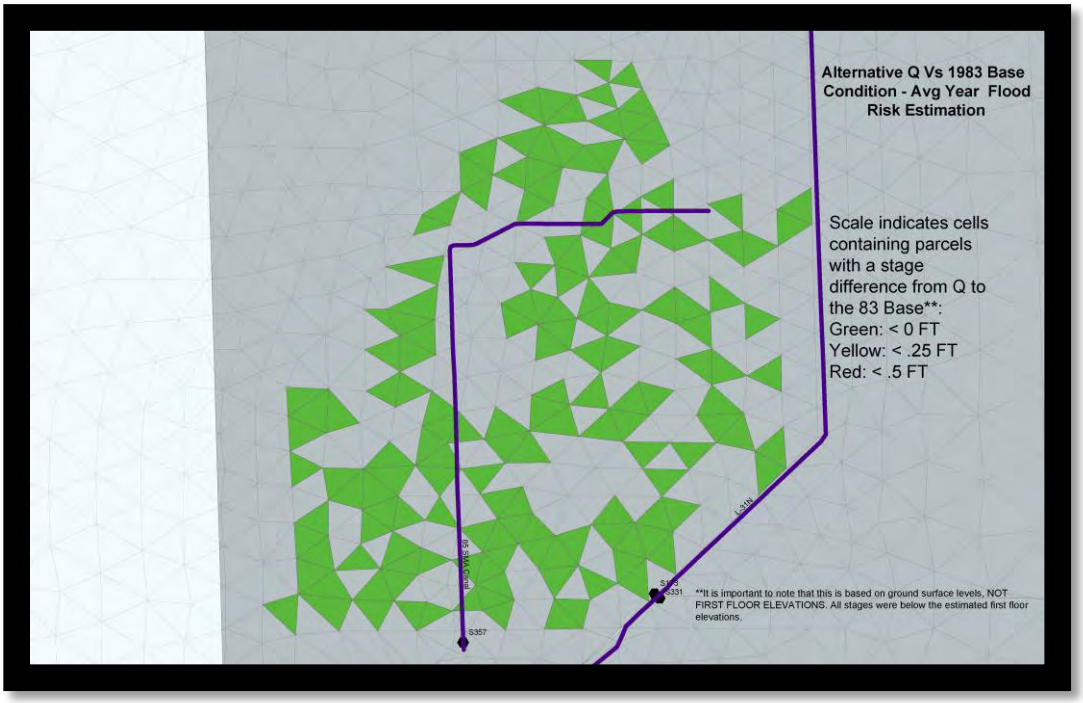

Figure 4-149: 8.5 SMA average year stage differences between ALTQ and 1983 base.

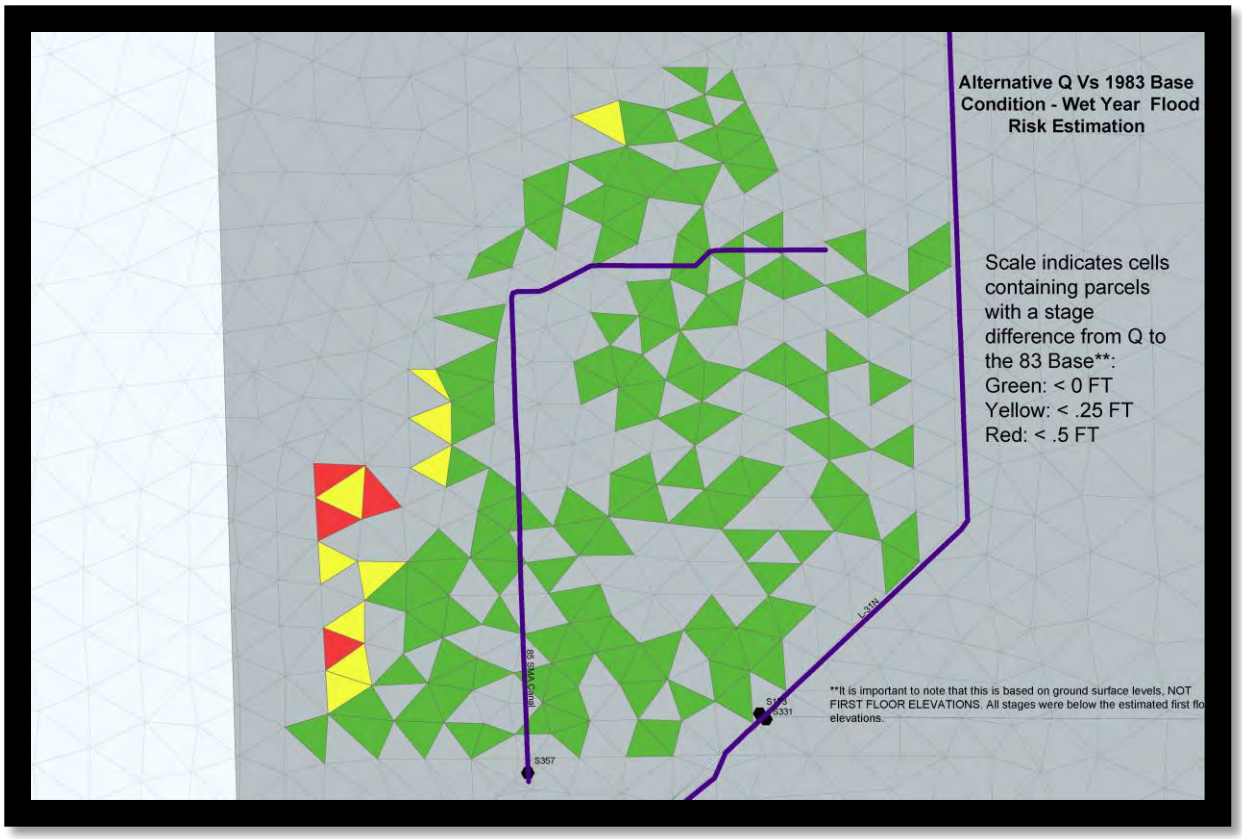

Figure 4-150: 8.5 SMA wet year stage differences between ALTQ and 1983 base.

4.15.3 Socioeconomic Summary of the Preliminary Preferred Alternative (ALTQ+)

Based on all of the results it is clear that ALTs Q, Qm, and Qm1 all satisfy the constraint conditions. For the agricultural parcels, not only are the constraints satisfied, but there is an overwhelming benefit on the aggregate when comparing each variant of ALTQ to the 1994 GRR. The estimated damage reduction for crop parcels in all event conditions for each of the ALTQ variants is large, averaging almost $18M. There are some specific areas of increased risk when the ALTQ variants are compared to the ECB19RR, but even then the aggregate is a decrease in risk with an estimated average damage reduction of approximately $2.3M. In terms of residential parcels ALTQ also meets, and improves upon, the constraint condition for the greater South Dade area. When focusing on the 8.5 SMA again we see that the majority of parcels experience a risk reduction. Those parcels that do see some increase in the potential for nuisance flooding also experience a decreased duration of the nuisance flooding so a tradeoff is present. Based on these modeling results the PPA of ALTQ+ has satisfied all of the constraints and has also improved upon the ECB19RR.

4.16 Environmental Justice

Environmental justice (EJ) analysis involves identifying and addressing, as appropriate, disproportionately high or adverse human health or environmental effects of federal programs, policies, and activities on minority and/or low-income populations. Executive Order 12898 requires an analysis of environmental effects, including human health, economic, and social effects of federal actions, and effects on minority and/or low-income communities, when such analysis is required by the NEPA. Several communities were

identified in the project area as having a potential to be affected. Several communities located east of the L-31 canal have income defined as low or moderate and there are many census blocks that are majority minority residents. Another community that could be affected by the project is the Miccosukee Tribe, which represents tribal nation lands along the L-29 canal and specifically within WCA 3A. Reference **Section 3.20** (**Environmental Justice**) for specific details on the methodology for identifying these communities as well as a map for their locations within the study area. The summary of environmental justice criteria and the determination if there is a potential disproportionate or adverse impact to an environmental justice community is summarized in **Table 4-45**. A more detailed summary of the flood risk analysis performed under the socioeconomic impact analysis, as well as the analysis conducted to estimate risk to airboat access to WCA 3A by the Miccosukee Tribe are presented below.

Table 4-45. Summary of environmental justice criteria.

Environmental Justice Criteria	Concern	Potential Intensity of Impact	Avoidance/Minimization/Mitigation Measures	Disproportionate Adverse Impact to Environmental Justice Community
Aesthetics (Reference Section 4.13 for further information)	Aesthetic effects refer generally to impacts on the visual qualities of the environment. The concern includes the potential for disruption of the view shed to an EJ community or Native American Tribe.	No significant effect. Aesthetics would not be expected to change. ALTN2, ALTO, ALTQ, and ALTQ+ consists of an operational change to the 2012 Water Control Plan. No construction is proposed. The existing landscape profile would not be altered.	Not applicable. Reference preceding column (Potential Intensity of Impact).	No. There is not a higher aesthetics impact to an EJ community as compared to other communities.
Air Quality (Reference Section 4.11)	The air quality concern includes the potential for increased emissions due to use of water management structures to an EJ community or Native American Tribe.	No significant effect. Air quality emissions would not be expected to change. Emissions would occur during operation of pump stations and would be limited to the immediate vicinity of the structures. ALTN2, ALTO, ALTQ, and ALTQ+ consists of an operational change to the 2012 Water Control Plan. No construction is proposed Emissions would not be expected to cause negative effects to human health.	Not applicable. Reference preceding column (Potential Intensity of Impact).	No. There is not a higher air quality impact to an EJ community as compared to other communities.

Environmental Justice Criteria	Concern	Potential Intensity of Impact	Avoidance/Minimization/Mitigation Measures	Disproportionate Adverse Impact to Environmental Justice Community
Native Americans and Cultural Resources (Reference Section 0 and 4.19)	Potential to impact airboat access to areas of cultural and religious practice by to Miccosukee Tribe.	Decreases in water levels in WCA 3A may limit airboat access to tree islands by the Miccosukee Tribe during extremely dry periods. Tree islands are the center for Miccosukee tribal cultural and religious practices. WCA 3A conditions are highly dependent on weather. Access to these islands would be limited to other means during times of below average rainfall. Overall effects to tree islands and their associated cultural resources as a result of ALTN2, ALTO, ALTQ, and ALTQ+ are expected to be beneficial or not adverse.	The COP AMMP has been included in the Draft EIS. The primary objective of the COP AMMP is to identify the monitoring necessary to inform decision-makers, the COP partner agencies, and the public on progress toward achieving restoration success, as well as address uncertainties related to project performance. Regularly scheduled interagency PSCs allow the USACE to gather input on desired long-term (annual and/or seasonal) conditions within the system. In addition, the PSCs occur on an as needed basis with the frequency of the calls determined based upon ongoing or anticipated conditions within the WCAs, SDCS, and ENP and provides a forum for consideration of increased low-water stages within WCA 3A, including along the western L-29 canal between S-12A and S-333. This forum would provide an opportunity to discuss concerns related to decreases in water levels in WCA 3A during implementation of the COP, and would provide a forum for recommendations, if needed, to address those concerns."	No. There is not a higher impact to an EJ community as compared to other communities.

Environmental Justice Criteria	Concern	Potential Intensity of Impact	Avoidance/Minimization/Mitigation Measures	Disproportionate Adverse Impact to Environmental Justice Community
Water Supply (Reference Section 4.9 for further information)	Impact to existing users to maintain existed legal water supply sources	Water supply performance was quantified for ENP and the C-111 Canal South Dade Projects for ALTN2, ALTO, ALTQ, and ALTQ+ compared to ECB19RR. Analysis of the model results indicated that only ALTQ and Q+ maintain the pre-project levels of service for water supply, consistent with the requirements of the WRDA 2000 and Section 373.1501, F.S.	Not applicable. Reference preceding column (Potential Intensity of Impact).	No. There is not a higher impact to an EJ community as compared to other communities.
Seepage and Restricted Drainage (Reference Section 4.15 for further information)	Seepage and elevated groundwater impacting crops and residential and commercial property.	Minimal adverse impact when compared to the No Action Alternative and a beneficial reduction in risk when compared to the constraint baseline condition8.	Groundwater monitoring and adaptive management monitoring (COP AMMP).	No. The USACE analysis shows that, when viewing the study area holistically, a large portion of adverse impacts occur outside of EJ communities.

[8] Please refer to the Socioeconomic Appendix for a detailed explanation on the importance, relevance, and modeling of the constraint baseline condition.

Environmental Justice Criteria	Concern	Potential Intensity of Impact	Avoidance/Minimization/Mitigation Measures	Disproportionate Adverse Impact to Environmental Justice Community
Private Land Acquisition	The concern includes the potential for land acquisition from the proposed action to an EJ community. Converting private land to public may decrease ad valorem tax contributions to respective county governments.	No significant effect. Land acquisition is not required under ALTN2, ALTO, ALTQ, and ALTQ+. ALTN2, ALTO, ALTQ+ consists of an operational change to the 2012 Water Control Plan.	Not applicable. Reference preceding column (Potential Intensity of Impact).	No. There is not a higher impact to an EJ community as compared to other communities.

4.16.1 Flood Risk Analysis of Environmental Justice Effects

Appendix I (**Socioeconomics**) has a detailed flood risk analysis conducted in order to determine potential adverse impacts of the COP across the entire modeled domain of Miami-Dade County and review of that appendix is required for a thorough understanding of this EJ analysis. The two models used were the hydrologic model MD-RSM and the economic model HEC-FIA. The MD-RSM simulation period covered a single wet, dry, and average year using a sub-hourly time step (i.e. stage data was produced for every model cell at 15-minute increments across the entire event year). The stage data produced by the MD-RSM model was used within the HEC-FIA economic model to estimate dollar damages and compare the impacts of the baselines against the alternatives.

Each of the modeled alternatives performed very similarly with respect to the pattern (i.e. intensity and spatial location) of adverse flood risk impacts and thus impacts under ALTQ will be displayed in this EJ analysis in order to qualify the proportion of which befall the EJ communities outlined in **Section 3.20** (**Environmental Justice**)[9]. The flood risk impact analysis focused on residential/commercial parcels and agricultural parcels separately and this section will also address the adverse impacts to each separately. The damages to parcels were estimated for the alternatives and each base condition and then compared to each other to estimate the impacts where a decrease in damages (i.e. negative number) represents a potential beneficial reduction in flood risk and an increase in damages (i.e. positive number) represents a potential increase in flood risk.

For residential/commercial property no statistically significant impacts were recorded for any residential/commercial properties as outlined in **Table 4-46** below. Based on that table, Reach L31R1-A had a minor increase in flood risk recorded but given the fact that over 44,000 structures were modeled using more than 14,000 discrete stage points and an overall structure inventory valuation of more than $7B, the $390 estimated increase in damages is not statistically significantly different from zero. Therefore, with respect to residential/commercial properties there are no adverse impacts to EJ communities from any of the alternatives including ALTQ+ as modeled and shown below. Again, a more thorough demonstration showing the estimated neutral risk impacts to residential/commercial for all alternatives over the various modeling rounds can be found in the **Appendix I** (**Socioeconomics**).

Table 4-46: Residential damages for all event years ($1,000 FY19) – ALTQ vs baseline conditions (ECB19RR & 1994 GRR).

Reaches	Wet Year Damages		Average Year Damages		Dry Year Damages	
-	Qv1994 GRR	QvECB19RR	Qv1994 GRR	QvECB19RR	Qv1994 GRR	QvECB19RR
8.5SMA	$ -	$ -	$ -	$ -	$ -	$ -
C111R1-A	$ -	$ -	$ -	$ -	$ -	$ -
C111R1-B	$ (5.35)	$ (2.14)	$ -	$ -	$ -	$ -
C111R1-C	$ (0.08)	$ -	$ -	$ -	$ -	$ -
L31R1-A	$ (3.21)	$ 0.39	$ -	$ -	$ -	$ -

[9] Confirmation of similar flood risks across each alternative, and therefore justification of displaying only ALTQ in this section, can be found in the socioeconomic appendix.

Reaches	Wet Year Damages		Average Year Damages		Dry Year Damages	
-	Qv1994 GRR	QvECB19RR	Qv1994 GRR	QvECB19RR	Qv1994 GRR	QvECB19RR
L31R2-A	$ -	$ -	$ -	$ -	$ -	$ -
L31R3-A	$ (497.45)	$ (335.08)	$ -	$ -	$ -	$ -
L31R3-B	$ -	$ -	$ -	$ -	$ -	$ -
L31R3-C	$ -	$ -	$ -	$ -	$ -	$ -
L31R3-D	$ (2.87)	$ -	$ -	$ -	$ -	$ -
Total	**$ (508.95)**	**$ (336.83)**	**$ -**	**$ -**	**$ -**	**$ -**

The impacts to agriculture are to a different magnitude than those to residential for each of the alternatives. However, the spatial pattern is similar amongst all of the alternatives so again ALTQ was reviewed for the EJ impacts[9]. Also, since the MD-RSM wet year showed the largest adverse impact it was that event year which was used for the EJ analysis. The other years, average and dry, had adverse impacts in the same spatial location (i.e. to the same communities) but to a lesser degree. The differences in damage to agriculture are shown in **Table 4-47**. The estimated adverse impacts from ALTQ are localized to reaches C111R1-A, L31R1A, and L31R2-A, whereas the remaining reaches have estimated beneficial risk reduction impacts. These results are also demonstrated spatially and to a more specific degree in **Figure 4-151**. Using GIS mapping tools the model cells showing potential adverse impacts were isolated and superimposed over the EJ community map to get a sense of where potential adverse impacts were occurring with respect to EJ communities and that map is shown in **Figure 4-152**. Using this overlay it was possible to determine the portion of adverse impacts borne by these EJ communities. Of all the increased risk of flood damages, only 15% of the total occurs to agriculture parcels in EJ communities. This is not a disproportionate amount. Further, as mentioned in **Section 4.16** (**Environmental Justice**) a particular difficulty exists when assessing EJ impacts to agricultural parcels using census block data since it is not entirely clear that the ownership of the agricultural parcels is held by members of the community. It may be the case that these agricultural parcels are held by large corporations and are independent operators of the communities in which they exist. Since there were nearly 6,000 separate parcels of agricultural land it was not possible to obtain ownership information for each parcel. Nevertheless, it would seem that since only 15% of adverse impacts are borne by these EJ communities there is no disproportionate impact. Further, there are many remaining EJ communities pictured in areas where risk reduction occurs (green cells in **Figure 4-152**), meaning there is a potential beneficial condition for these communities.

Table 4-47: Damage reduction summary for ALTQ – MD-RSM wet year ($1,000 FY19).

Reaches	ALTQ VS 1994 GRR ($1,000 FY19)	ALTQ VS ECB19 ($1,000 FY19)
C111R1-A	$ (608)	$ 54
C111R1-B	$ (1,310)	$ (166)
C111R1-C	$ (76)	$ (49)
L31R1-A	$ (230)	$ 196
L31R2-A	$ (5,433)	$ 685
L31R3-A	$ (1,865)	$ (492)
L31R3-B	$ (2,706)	$ (820)
L31R3-C	$ (1,370)	$ (337)

Reaches	ALTQ VS 1994 GRR ($1,000 FY19)	ALTQ VS ECB19 ($1,000 FY19)
L31R3-D	$ (2,913)	$ (704)
Total	***$ (16,511)***	***$ (1,632)***

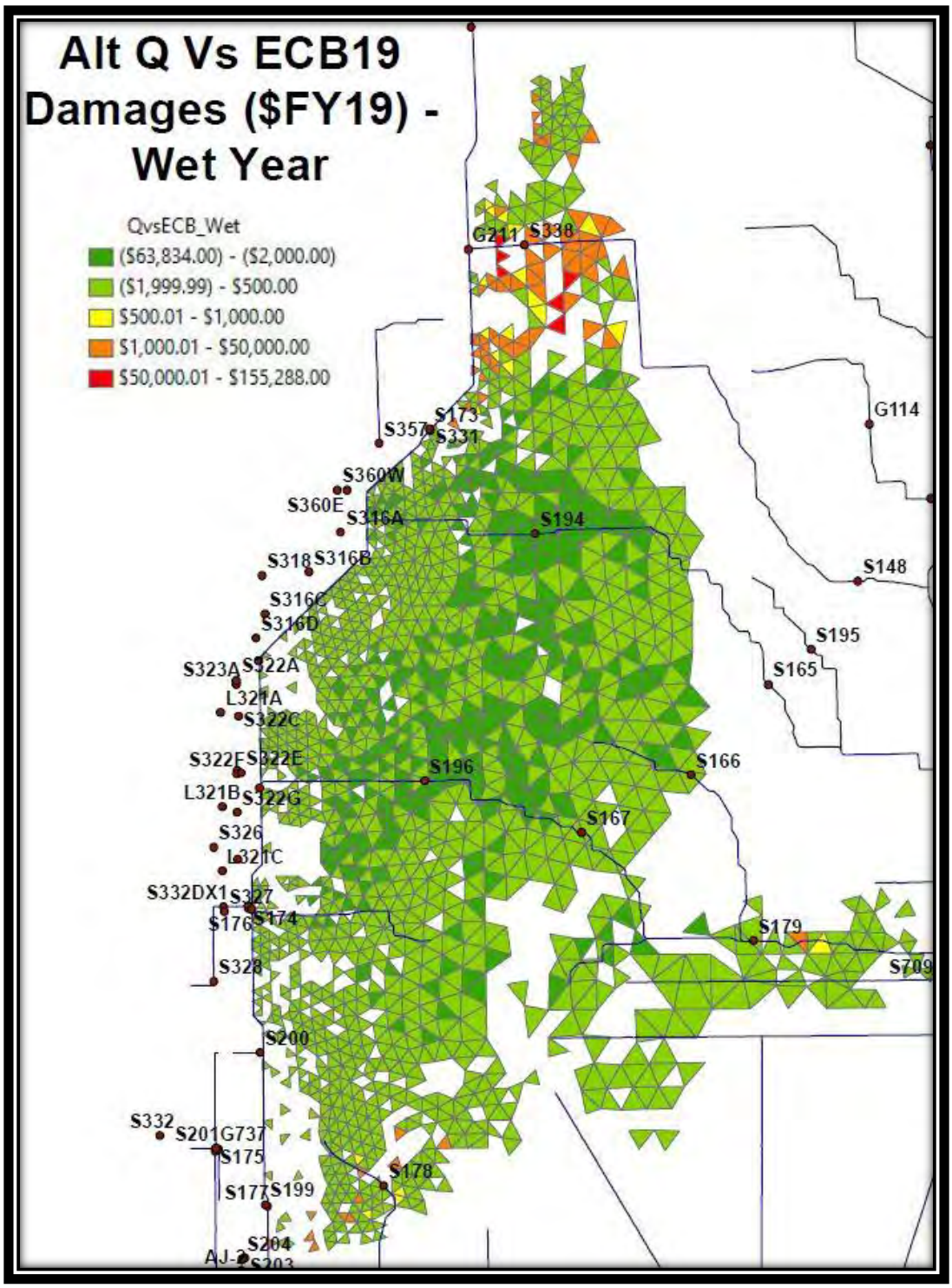

Figure 4-151: Spatial representation of agricultural flood risk in wet year – ALT Q vs ECB19RR.

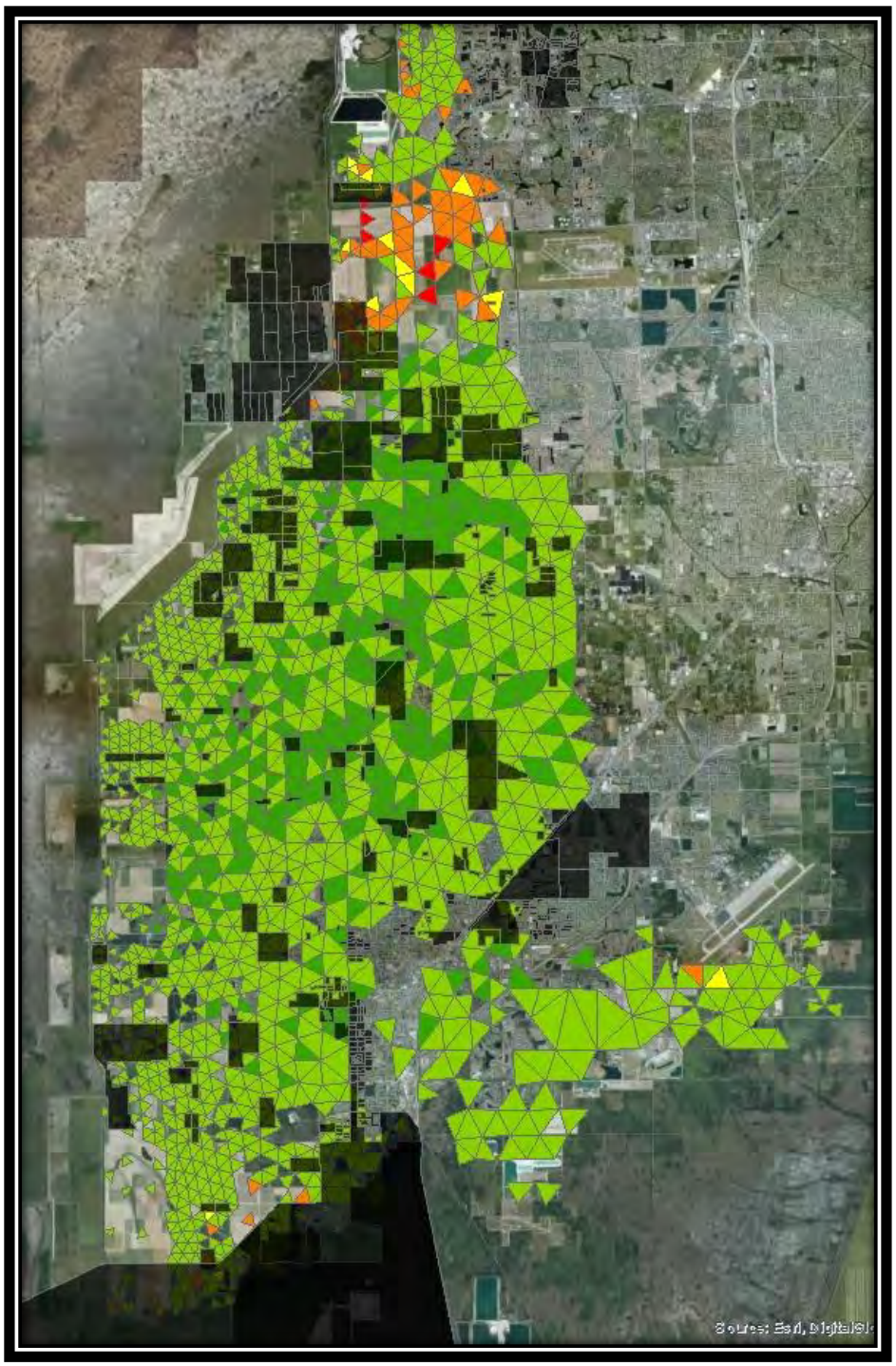

Figure 4-152: Flood risk impacts to environmental justice communities.

4.16.2 Environmental Justice Impacts to Airboat Concessionaires

As was outlined in **Section 3.20** (**Environmental Justice**) the Miccosukee Tribe requested an analysis be conducted to identify potential risks to airboat concessionaires along the Tamiami Trail in southern WCA 3A. The potential risk posed by the COP alternatives would be the reduction in surface water depths to

the point in which airboats would not be able to launch from docks along Tamiami Trail. PDT members met with tribal representatives to establish at which stage impacts would begin to prevent airboat access and it was determined that 12" of surface water was required for airboats to have access. As a result, the RSM-GL model was used in each of the cells along Tamiami Trail where airboats gain access to WCA 3A in order to estimate stage levels across the entire period of record (POR) from 1965-2005 (14,975 days in total) for the ECB19RR, ALTQ, ALTN2, and ALTO. The daily stage levels were then compared and any day in the POR where stage levels fell below 12" a "potential impact day" was recorded for all operational schemes. The potential impact days were then compared to determine if any of the alternatives had a greater or lesser number than the ECB19RR. The spatial summary of the results for ALTQ are shown in **Figure 4-153** with all of the model cells analyzed and their cell identification numbers shown along with the HAED USGS elevation of that cell. Water control features are also shown in order to spatially orient the results. From this summary it can be seen that ALTQ slightly increases the risk of potential impact days (i.e. stage levels fell below 12') which may impact access for airboats in southern WCA 3A. **Figure 4-154** shows how the potential impact days relate to the entire POR as a percentage for each of the alternatives as well as the ECB19RR. When analyzing the total POR, the average percent increase in ALTQ across all cells is 6% of the POR, 5% for ALTO, and 4% for ALTN2. **Figure 4-155, Figure 4-156,** and **Figure 4-157** takes the increase in the number of potential impact days in each of the cells north of Tamiami Trail and averages them by year for each potential alternative. The purpose of these figures is to demonstrate the temporal nature of the potential increase in risk. It is clear that the distribution of impacts is not consistent and shows that the potential for risk is concentrated in years where there is already a decreased average amount of rainfall (i.e. dry years) and ALTQ and ALTN2 are estimated to potentially increase risk to a statistically significant degree in approximately one of four years in the POR whereas ALTO potentially increases risk in one in three years.

The fact that not every year shows an increase in risk indicates that the future impacts of the COP on airboat access are not certain. If the trend under implementation of ALTQ is toward below average rainfall, there is the potential for increased risk to airboat access in southern WCA 3A. However, if the trend is toward wetter than average rainfall the potential risk to airboat operations is neutralized. Additionally, airboat operators to the west of the L-67 canal (i.e. tribally owned) are potentially adversely impacted to a greater degree than those east of the L-67 (i.e. non-tribal operators). This would indicate a potentially disproportionate impact amongst tribally owned airboat operations specifically, however, when analyzing the effects of the COP holistically there is no disproportionate impact to the Miccosukee Tribe. Risks to airboat access are elevated only in dryer than average conditions. ALTQ increases risk to agricultural parcels in the study area in wet, dry, and average years when compared to the ECB19RR. Based on all the information presented in this report and the various appendices it would seem that, holistically, the risks inherent with ALTQ operations are shared amongst the various stakeholders (i.e. EJ communities and non-EJ communities) and are not disproportionately borne by one community.

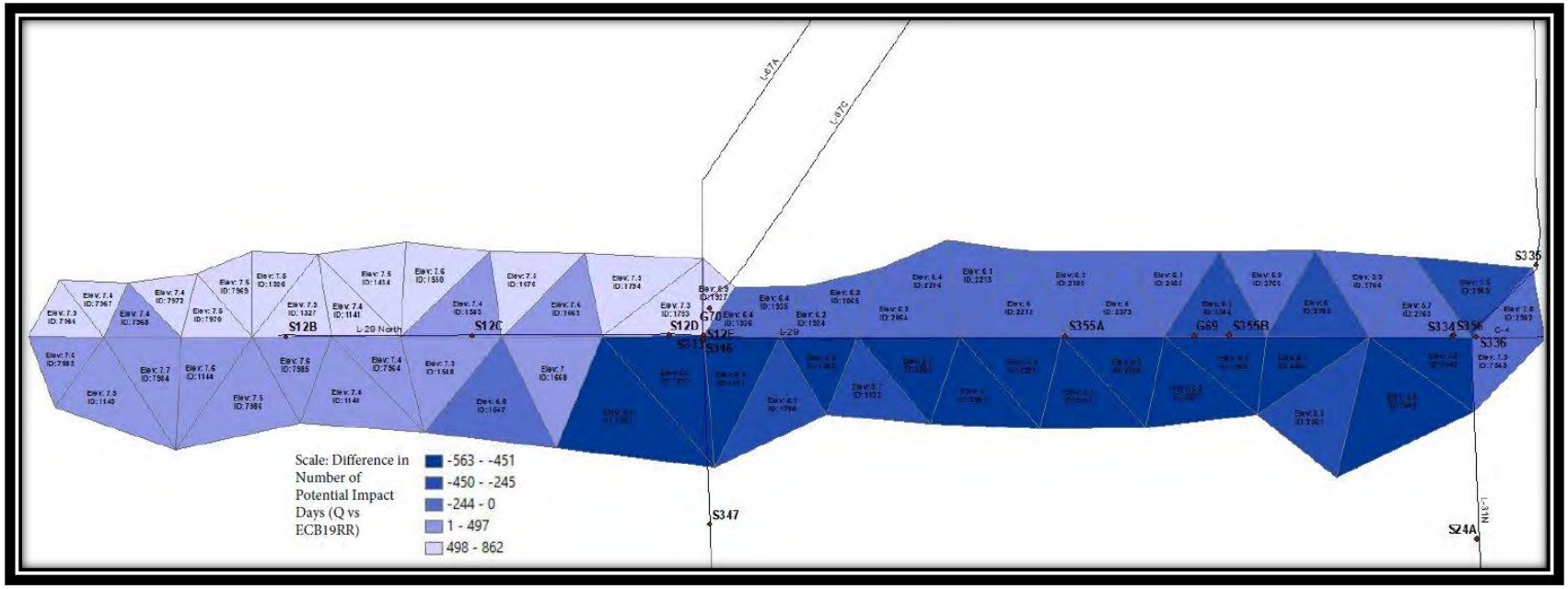

Figure 4-153: Potential Impact days to airboat concessionaires – ALT Q vs ECB19RR.

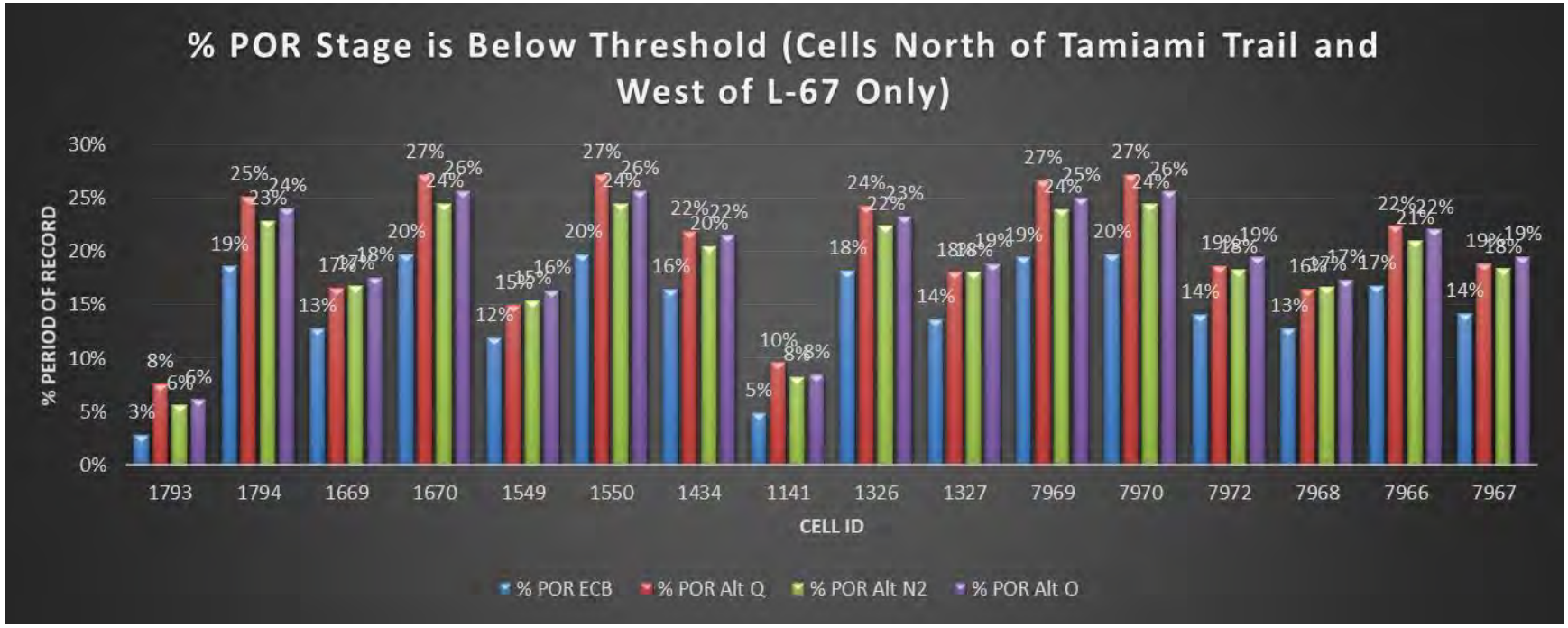

Figure 4-154: Percent period of record with potential impact days for airboat operations – all potential operating conditions.

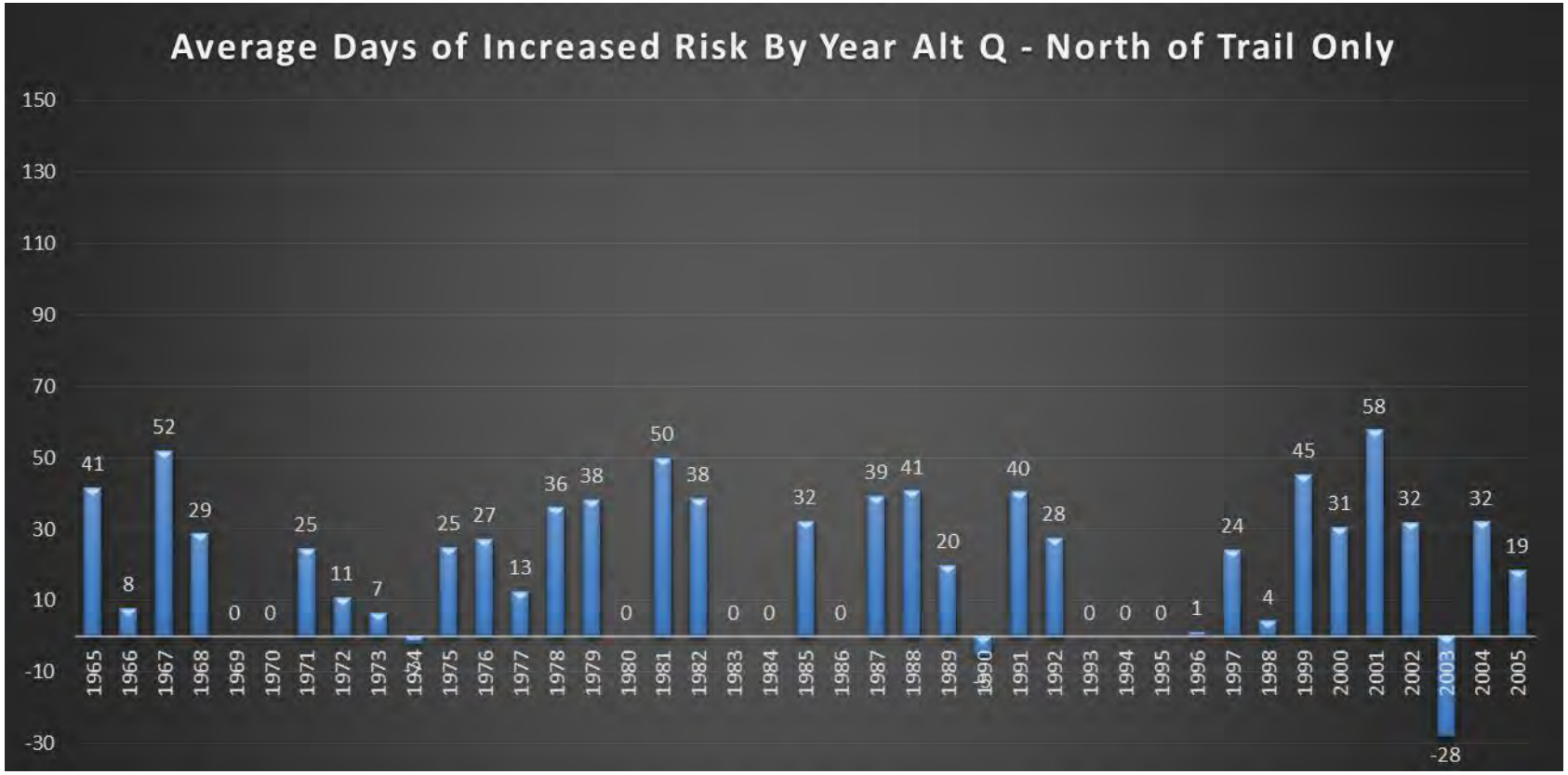

Figure 4-155: Increase in average number of potential impact days by year – ALT Q.

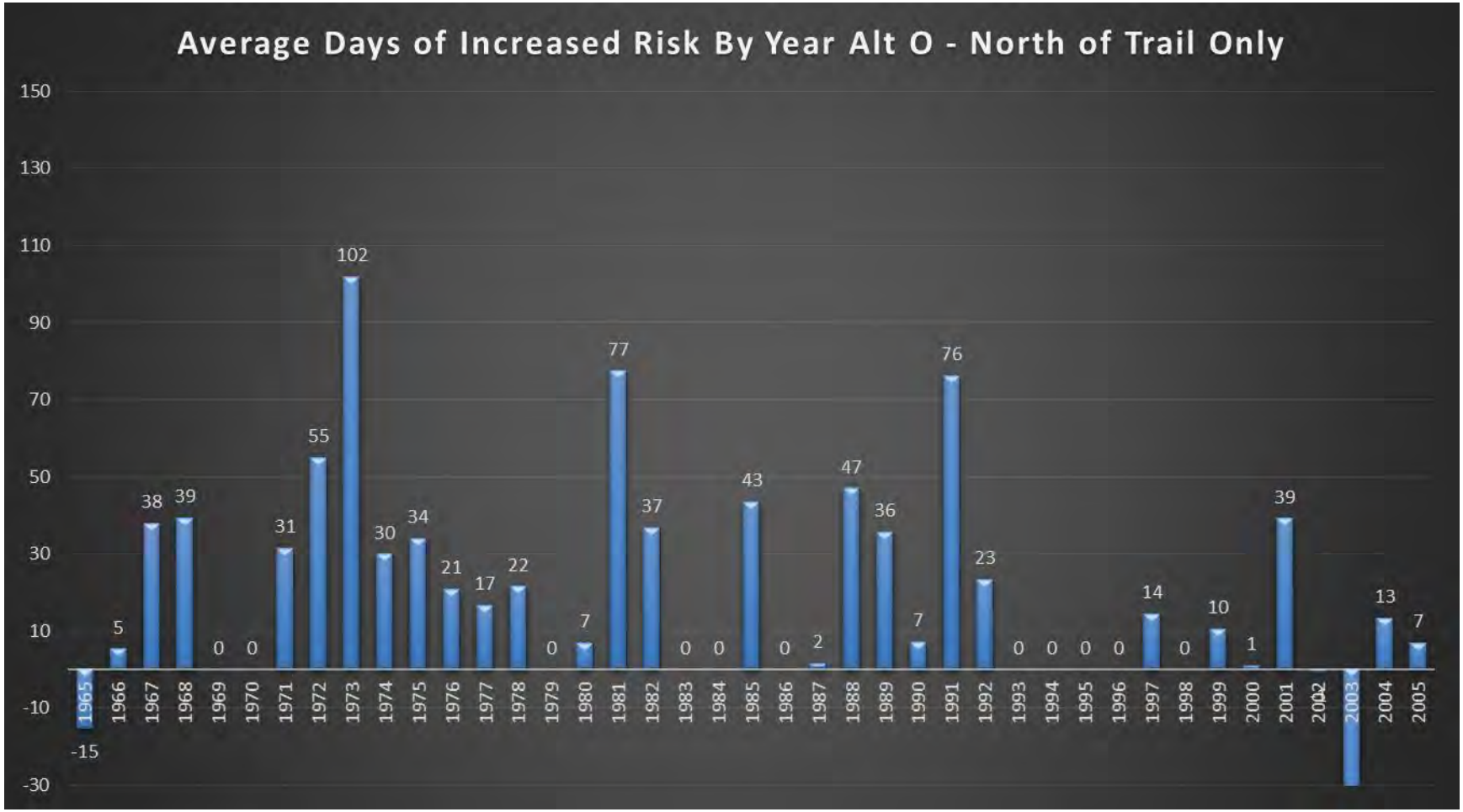

Figure 4-156: Increase in average number of potential impact days by year – ALT O.

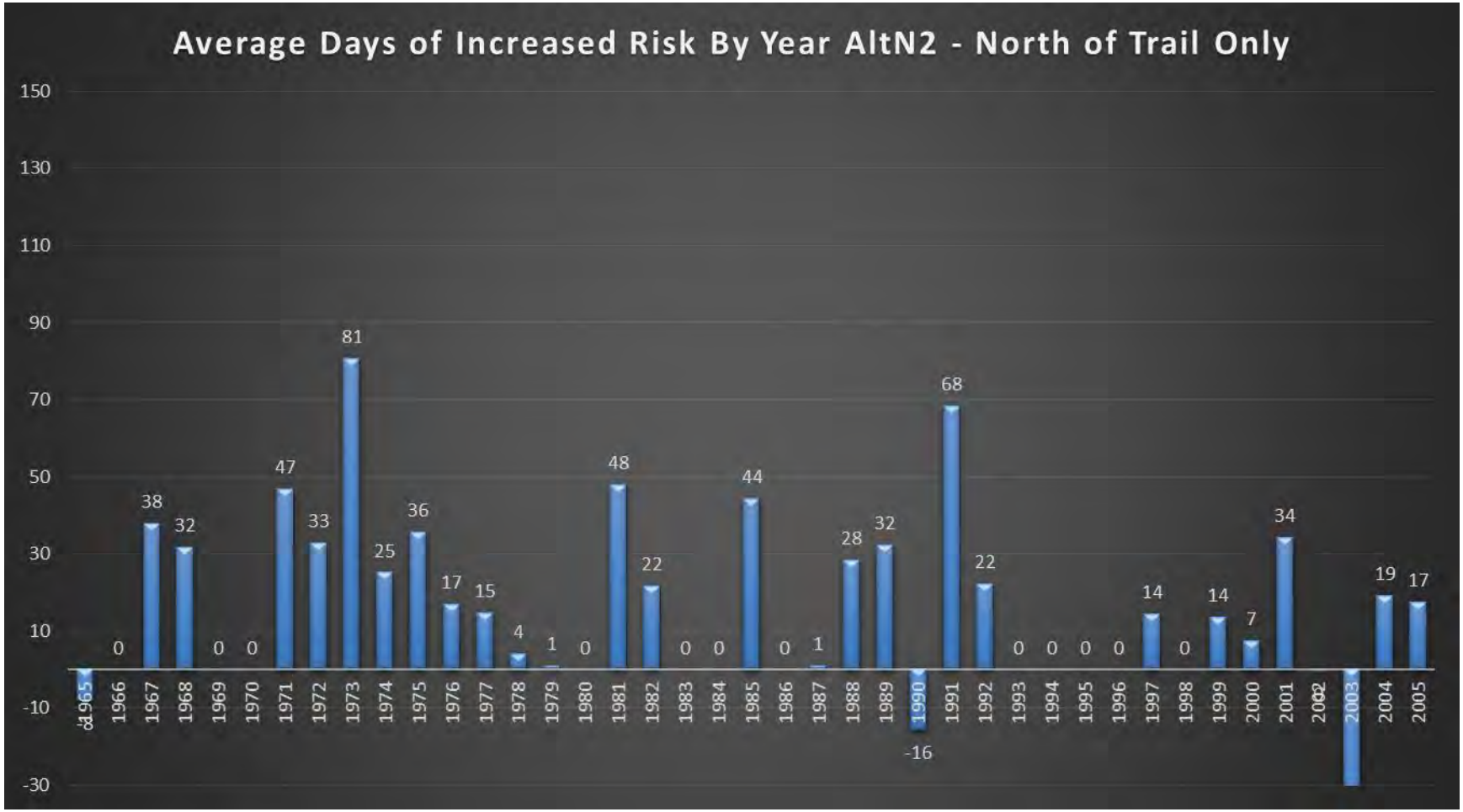

Figure 4-157: Increase in average number of potential impact days by year – ALTN2.

4.16.3 Cumulative Summary of EJ Effects and Determination

Cumulative EJ effects are associated primarily with effects on public health and safety, air quality, noise, water supply, and socioeconomics from implementation of the COP and other past, present and reasonably foreseeable actions. Implementation of the COP is anticipated to increase the availability of water deliveries from WCA 3A to ENP through NESRS and improve hydrologic conditions in Taylor Slough, the Rocky Glades, and the eastern panhandle of ENP relative to ECB19RR. The additional water flowing into ENP will help to restore pre-drainage vegetative communities and habitat for fish and wildlife while providing incremental restoration of natural processes critical for the development of peat soils and tree islands, which are essential features of the Everglades ridge and slough landscape. The COP would provide benefits to quality of life by contributing to hydrological improvements in the historic Everglades. Wetland and estuarine habitat improvements would benefits fish and wildlife species abundance for recreation and subsistence fishing/hunting, as well as aesthetic existence value.

Additionally, when compared to the originally authorized level of flood mitigation[8], there is a beneficial reduction in flood risk across all of the impact areas within South Dade Conveyance System as modeled under the socioeconomic impact analysis performed under the COP. Several EJ communities were identified in the study area as having a potential to be affected. Based on the above analysis, no disproportionately high and adverse impacts nor benefits are imparted upon the Miccosukee Tribe, lower income communities, or minority communities. The COP AMMP (AMMP) has been included in the Draft EIS. The primary objective of the COP AMMP is to identify the monitoring necessary to inform decision-makers, the COP partner agencies, and the public on progress toward achieving restoration success, as well as address uncertainties related to project performance. Reference **Section 4.27** (**Environmental Commitments**)**.** Furthermore, regularly scheduled interagency PSCs allow the USACE to gather input on desired long-term (annual and/or seasonal) conditions within the system. In addition, the PSCs occur on an as needed basis with the frequency of the calls determined based upon ongoing or anticipated conditions within the WCAs, SDCS, and ENP and provides a forum for consideration of increased low-water stages within WCA 3A, including along the western L-29 canal between S-12A and S-333. This forum would provide an opportunity to discuss concerns related to decreases in water levels in WCA 3A during implementation of the COP, and would provide a forum for recommendations, if needed, to address those concerns. Decreases in water levels in WCA 3A may limit airboat access to tree islands by the Miccosukee Tribe during extremely dry periods. The Miccosukee Tribe maintain a traditional life style that is intricately connected to the Everglades. Traditional practices of hunting, fishing, frogging, trapping, and general living are still maintained, along with modern entrepreneurship with tourism related businesses (airboat concessionaires) along Tamiami Trail. These practices continue to tie the Miccosukee tribe to the Everglades in such a way that careful consideration of effects on tribal cultural, well-being, and way of life is warranted. Tree islands were and still are important places to the Native American populations of Florida. It is generally agreed that most of the tree islands of any reasonable size contain archaeological sites and many contain burial components. Potential limitations to accessing tree islands via airboat may affect the ability of the Miccosukee Tribe to participate in cultural and religious practices that take place on these islands. WCA 3A conditions are highly dependent on weather. Access to these islands would be limited to means other than airboats during times of below average rainfall.

As summarized in **Section 4.6.2** (**Tree Islands**), the COP has the potential for beneficial effects to tree islands in the chronically inundated portions of southern WCA 3. The reduction of water levels within WCA 3A is likely to aid in reducing future tree island degradation due to prolonged inundation and high water depths, and thereby, aid in the preservation of cultural resources by allowing stabilizing growth to occur

on the tree islands. Inundation of tree islands in ENP is not affected by the COP; however, increases of water into NESRS and Taylor Slough may enable the promotion of peat accretion by potentially reducing soil oxidation; thereby stabilizing the existing soil matrix and prevent future erosion, oxidation, or subsidence of cultural resources. Reference **Section 0** (

Cultural Resources) and **Section 4.19** (**Native Americans**) for further information on potential effects of the COP. The COP is anticipated to be in place until construction of new CERP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and Florida Bay. If new information becomes available through implementation of the COP Water Control Plan and/or the COP AMMP that would necessitate a need to modify water management operations, this information will be incorporated as appropriate in accordance with laws and regulations including the NEPA. Increased flow deliveries into the study area may help to alleviate low water conditions in southern WCA 3A, including along the western L-29 canal between S-12A and S-333.

4.17 Recreation

ALTN2, ALTO, ALTQ, and ALTQ+ would create minor to moderate long-term beneficial effects for nature based recreation in portions of ENP where hydrologic conditions would improve compared to ECB19RR, including Florida Bay. Increases in observed overall flow compared to ECB19RR would potentially improve existing fishing opportunities. Improved hydrologic conditions would result in improved habitat suitability for fish and wildlife resources, resulting in a beneficial effect for outdoor recreation opportunities. Due to lowering of water levels in WCA 3A and WCA 3B, ALTN2, ALTO, ALTQ, and ALTQ+ may potentially reduce airboat access and recreational fishing within the marsh during extremely dry periods, having a negligible to minor long-term adverse effect; however access to canals for recreation would not change under the COP relative to ECB19RR. Reference **Section 4.16** (**Environmental Justice**) for further information on potential The potential risk posed by the COP alternatives would be the reduction in surface water depths to the point in which airboats would not be able to launch from docks along Tamiami Trail.

Table 4-48 provides information on when the FWC considers closures in the EWMA due to high and low water stages. High stage closures occur when the two-gauge average is over 11.6 feet, NGVD. Low stage closures occur when the two-gauge average is below 9.3 feet, NGVD. For recreational purposes, closure of WCA 3A is considered an impact as public access is diminished due to specific restrictions on hunting or the use of motorized devices. A closure before or during a hunting season may cause the hunter to modify from their current plan and/or pursue hunting in another location. Closures were based on calendar years and were calculated based on stage data at WCA 3A_3A-2 and WCA 3A_3A-3 gages. A closure was counted as soon as the closure criteria were exceeded. If there were up to two consecutive weeks that did not violate the criteria in between closures, that was counted as one closure (i.e. the area did not open and close). The total number of days does not include the days that did not violate the closure criteria in between closures (i.e., the day count does not include the days referred to in the prior sentence). Results presented in **Table 4-48** are strictly based on WCA 3A stages and were used for the purpose of comparing alternative plans. These results do not directly correlate to the discretionary decisions made by the FWC to close the EWMA, which may also include weather forecasts and consideration of the ability to inform the public in a timely manner.

Compared to ECB19RR, ALTN2 resulted in a 0.49% period of record decrease in the number of days the Everglades WMA was closed due to high water and a 1.23% period of record increase in the number of days the Everglades WMA was closed due to low water. ALTQ further moderated the potential decreases or increases in high and low water closures demonstrated in ALTN2. ALTQ resulted in a 0.17% period of

record decrease for high water and a 0.82% period of record increase for low water. Compared to ECB19RR, ALTO did not differ in the number of days the Everglades WMA was closed due to high water (0.01%); however, a 0.17% period of record decrease was observed for low water. ALTN2 decreased stages in portions of WCA 3A to a greater extent than ALTQ and ALTO.

Significant adverse effects to recreation as a result of closures in the EWMA would not occur under ALTN2, ALTO, ALTQ, or ALTQ+. Differences in the number of days the FWC criteria were exceeded between each alternative and ECB19RR was less than a 2% period of record increase or decrease for both the high water and low water criteria. The number of high water or low water closures expected with each alternative did not significantly deviate from ECB19RR. Performance varied based on the alternative considered. Each alternative performed equivalent to ECB19RR or either increased or decreased the number of high water or low water closures by no more than one event. ALTQ+ would result in similar effects as discussed under ALTQ. Reference **Section 4.2.5** (**Alternative Q+**). The hydrologic effect of ALTQ+ on WCA 3 and ENP is expected to be very similar to that of ALTQ with no significant change. Hydroperiods and similar depths are expected for the entire range of expected stages.

Table 4-48. High stage and fire (low water) closures over the period of record for the COP alternatives and baseline condition.

Alternative	Days High Water Criteria Exceeded (Percent Period of Record Change from ECB19RR)	Days Low Water Criteria Exceeded (Percent Period of Record Change from ECB19RR)	Number of High Water Closures	Damaging High Water Closures (> 60 Days)	Number of Low Water Closures
ECB19RR	506	750	10	3	16
ALTN2	434 (-0.49%)	930 (1.23%)	9	3	16
ALTO	507 (0.01%)	880 (0.89%)	10	3	15
ALTQ	481 (-0.17%)	870 (0.82%)	9	2	16

4.18 Cultural Resources

The proposed action consists of an operational change to current water management operations and would not include construction of structures or modifications to existing water management features. Additionally, the proposed action does not add to the existing water budget within the area of potential effects (APE); therefore, potential impacts to cultural resources would result from decreases or increases to hydroperiods within the APE. Based on these conditions, research conducted under the Everglades Restoration Transition Plan (ERTP) represents the most current analysis of the effects of water levels on cultural resources and consists of the same APE and water budget as the proposed action.

ERTP was implemented in October 2012, and at that time, a Programmatic Agreement (PA) was executed among the USACE, the Florida State Historic Preservation Officer (SHPO), the Advisory Council on Historic Preservation (ACHP), ENP, and the Seminole Tribe of Florida (STOF) in order to complete the necessary cultural resources surveys and research to determine if the operational change between the Interim Operational Plan (IOP) and ERTP posed an effect to historic properties. The overarching goal of the PA was

to determine if natural and operational fluctuations in water levels and changes to historic hydrologic conditions within the APE has had/will have an effect on historic properties. The results of these studies were intended to inform future operational strategies while taking into consideration additional scientific research and consultation with interested parties as part of the process outlined in Section 106 of the National Historic Preservation Act (NHPA).

As detailed in **Section 3.19** (**Cultural Resources**), cultural resources within the APE are generally found on tree islands as they represent the only historical habitable locations in the ridge and slough environment. As a result of the research conducted as part of the ERTP PA, the USACE determined that tree islands and their corresponding archaeological deposits have been subject to fluctuating water levels throughout history; however, these fluctuations have been interrupted by the drainage or impoundment of water. Everglades restoration attempts to restore historic hydropatterns and mimic natural annual fluctuations in water levels. While it is reasonable to assume that deep muck fires and sediment loss as a result of historic over drainage and impoundment of water had an effect on cultural resources throughout time, the archaeological evidence suggests that the ERTP did not directly or indirectly alter or diminish the integrity or ability of historic properties to generate important information about history or prehistory. Those characteristics of historic properties that qualify them for inclusion in the National Register of Historic Places (NRHP) under the IOP were not compromised under the ERTP, indicating the ERTP did not have an adverse effect to historic properties. While not restorative of historic water levels, it was found that the ERTP helped to alleviate conditions that have the potential to adversely affect historic properties. By reducing water levels from impounded areas in southern WCA 3A and slowly reintroducing more historic hydroperiods into over-drained portions of ENP, natural hydrologic conditions that promoted the formation of tree islands will help to stabilize the existing soil matrix and prevent future erosion, oxidation, or subsidence of corresponding archaeological deposits. By attempting to restore or mimic natural hydroperiods that existed prior to historic drainage, cultural resources are subject to similar geochemical processes that helped form the deposits and provide the context from which the archaeological research is derived. The processes of drying out and rehydrating soil horizons and the corresponding archaeological deposits has occurred on a geologic scale (changing environmental conditions throughout the last 5,000 years), over periods of several decades as a result of climate variability, annually (wet and dry seasons), and during the modern period as a result of early twentieth century uncontrolled drainage followed by impoundment. Archaeological deposits from all soil horizons that have been subject to these processes have proven to retain their integrity and research potential; therefore, it is reasonable to assume that long-term and cumulative effects of water operations implemented with respect to restoration objectives and ecological targets are unlikely to adversely affect historic properties.

Because the No Action Alternative (ECB19RR), ALTN2, ALTO, ALTQ, and ALTQ+ do not increase the existing volume of water within the same APE as ERTP, results of the ERTP analysis is relied on heavily in consideration of the effects of the proposed action on historic properties. Likewise, the results of cultural resources monitoring and analyses conducted during the MWD Incremental Field Tests were also utilized in the consideration of potential effects of each of the alternatives. As part of this consideration of effects, the USACE has been actively consulting with interested parties in conjunction with its obligation under Section 106 of the NHPA. Within these consultation events, information has been sought to determine what, if any, effects the project could have on cultural resources and historic properties located within the APE. Consultation has been initiated and is ongoing between the USACE, the SHPO, appropriate Federally recognized tribes and Tribal Historic Preservation Officers (THPO), and ENP. Presentations and face-to-face meetings were conducted, as well as email and phone correspondence with state, federal, and tribal government staff members to brief them on the project development and to discuss issues of concern. Formal letters requesting consultation on potential effects to cultural resources were sent to the

SHPO, Seminole THPO, Miccosukee Tribal Representative, the Seminole Nation of Oklahoma THPO, the Thlopthlocco Tribal Town THPO, and the ENP Superintendent on July 31, 2019 (**Appendix D.3** (**National Historic Preservation Act Compliance**).

To supplement the investigation conducted as part of the ERTP and MWD Incremental Field Tests, multiple lines of research were conducted as part of the analysis of the proposed alternatives. To better understand potential effects associated with ALTN2, ALTO, ALTQ, and ALTQ+, an examination of tree islands and associated cultural resources that are currently monitored within the Everglades Depth Estimation Network (EDEN) was performed, in addition to the analysis of the tree island performance indicator detailed in **Section 4.6.2** (**Tree Islands**). The use of this data is warranted as it is a common factor that most, if not all of the known archaeological sites are located on such tree islands thus creating relationship within effects to tree islands and the cultural resources contained within them. This research builds on previously existing information gathered as part of the ERTP PA, the Increment 1 EA and FONSI (dated May 27, 2015), the Increment 1.1 and 1.2 EA and FONSI (dated February 16, 2017), and the Increment 2 EA and FONSI (dated February 21, 2018).

The USACE previously determined the No Action Alternative (ECB19RR) to have no adverse effects on historic properties. This determination was made through consultation with the SHPO, ENP, and the appropriated federally recognized tribes/THPOs. Based on the constraints of ALTN2, ALTO, ALTQ, and ALTQ+, potential effects to cultural resources would generally be a result of raising the L-29 canal stage maximum operation limit from 7.8 feet, NGVD to 8.5 feet, NGVD. ALTN2, ALTO, ALTQ, and ALTQ+ demonstrate an average annual reduction of water stages in southern WCA 3A, where water is artificially impounded due to the Tamiami Trail, of approximately +/- 1.2 inches up to 6 inches, and an average annual increase in water levels by +/- 1.2 inches up to 6 inches in Shark River Slough, which has been subject to peat loss and dry-outs as a result of over-drainage. These conditions are within the range of water levels experienced throughout the period of record and considerably less than those experienced historically. Due to the minimal variation is performance between ALTN2, ALTO, ALTQ, and ALTQ+ with regards to average annual stage difference, the greatest difference between ECB19RR and the effects of ALTN2, ALTO, ALTQ, and ALTQ+ would be the potential overtopping of tree islands that do not seasonally inundate historically; therefore, an analysis of those tree islands that are not subject to periodic inundation was warranted. This analysis is consistent with previous lines of investigation for the MWD Incremental Field Tests and those concerns expressed from consulting agencies with respect to cultural and burial resources.

The cultural resources analysis was performed using mapped elevations of 394 tree islands in WCA 3 and ENP. Using the EDEN, the daily water surface of WCA 3 and ENP during the 41-year period of record (January 1, 1965 through December 31, 2005) was compared with the tree island elevations. If the water surface was above the tree island elevation, then that tree island was scored as inundated. Of the 394 tree islands mapped within the APE, a total of 38 tree islands and a corresponding 32 known cultural resources were not inundated during the period of record and analyzed using data collected from the EDEN network and the RSM-GL hydrologic modeling briefly discussed in **Section 4.2**(**Hydrology**) of this EIS.

The hydrologic model run was utilized to predict anticipated water levels in the APE as a result of ECB19RR, ALTN2, ALTO, and ALTQ (with ALTQ+ not modeled and expected to result in similar conditions to those experienced with ALTQ). Due to the similarity in all the modeled alternatives in effects to cultural resources, and errors in the modeling output of ALTO, only ECB19RR and ALTQ were analyzed for inundation to tree islands and cultural resources; however, the results may be extrapolated in a review of ALTN2, ALTO, and ALTQ+.

Each of the 38 tree islands that have not been inundated during the period of record were correlated to the closest modeled gage to determine predicted effects of water levels. The ECB19RR and ALTQ modeled period of record results were averaged by month and compared to observed water elevations at each gage and corresponding tree islands; comparisons were also made to modeled water level averages for ERTP, Increment 1, and Increment 2. Results of this analysis determined that ALTN2, ALTO, ALTQ, and ALTQ+ will cause slight decreases in water levels in central and southern WCA 3A and slight increases in northern ENP (Shark River Slough) and eastern ENP (Taylor Slough). Tree islands in WCA 3B will not be affected by the COP as that part of the system is subject to constraints outlined in the operational plan for the Decomp Physical Model (USACE 2017f). In northern WCA 3A, no difference in water stages were observed through the modeling comparison. Moving southward to central WCA 3A, a reduction in water levels from 0 to 2.2 inches may be observed over an annual average. Modeled yearly averages in southern WCA 3A show a potential decrease in water stages of up to 3.5 inches over an annual average. Corresponding to the decrease of water stages in WCA 3A is an increase in water stages in northern ENP (Shark River Slough) of up to 3.5 inches over an annual average. Eastern ENP (Taylor slough) saw slightly less increases in water stages from 0 to 3 inches over the annual averages. Modeling results did not show increases in water stages in southern ENP. Modeled data showed that tree islands that were not inundated during the period of record were not subject to inundation as a result of ALTN2, ALTO, ALTQ, and ALTQ+.

In addition to modeled data, the L-29 canal stage and observed water elevations and all 394 mapped tree islands were reviewed using the available EDEN data (January 1, 1999 to August 21, 2019). This data was utilized to understand water elevations at all tree islands when the L-29 canal stage is at or above 8.3 feet NGVD and to compare previous operational strategies (IOP, ERTP, and the MWD Incremental Field Tests) to those observed during Increment 2 which is the closest approximation to ALTN2, ALTO, ALTQ, and ALTQ+ based on the stage of the L-29 canal. While variations in the weather may be the largest impetus between variations in yearly average water elevations, this line of investigation demonstrated that tree islands in WCA 3 and ENP have been subject to conditions within the recent past that may be experienced under ALTN2, ALTO, ALTQ, or ALTQ+. Additionally, the fluctuations in water levels experienced from 2018 to 2019 under Increment 2 are more representative of the natural 2.5 foot average fluctuations that are vital to tree island survival.

As summarized in **Section 4.6.2** (**Tree Islands**), ECB19RR, ALTN2, ALTO, and ALTQ/Q+ have the potential for negligible to minor long-term beneficial effects for tree island in the chronically inundated portions of southern WCA 3. Inundation in ENP was not affected by any alternative. The reduction of water levels within WCA 3A is likely to aid in reducing future tree island degradation due to prolonged inundation and high water depths, and thereby, aid in the preservation of cultural resources by allowing stabilizing growth to occur on the tree islands. Increases of water into Shark River Slough and Taylor Slough, may enable the promotion of peat accretion by potentially reducing soil oxidation; thereby stabilizing the existing soil matrix and prevent future erosion, oxidation, or subsidence of cultural resources.

ALTN2, ALTO, ALTQ, and ALTQ+ do not add additional volumes of water into WCA 3 or ENP, thereby allowing the USACE to use the previous research conducted as part of ERTP and the current line of study to make a determination of effects to cultural resources. ALTN2, ALTO, ALTQ, and ALTQ+ show minimal difference in variations to water levels (0-3.5 inches on an annual average), the alternatives are not expected to cause inundation of tree islands that have not experienced inundation on a seasonal basis, and the alternatives show projected water elevations at tree islands that are less than those experienced at the tree islands historically; therefore, the USACE has determined that none of the alternatives would have an adverse effect to historic properties within the APE. Consultation with the SHPO, ENP, STOF,

Miccosukee Tribe, Seminole Nation of Oklahoma, and the Thlopthlocco Tribal Town on this determination was sent on November 21, 2019. SHPO concurred with the USACE's determination of no adverse effect by letter dated December 20, 2019. On December 26, 2019, the STOF requested a 30-day extension to provide a response to the USACE's determination of effects. The USACE agreed to this request by email on January 02, 2020. No responses were provided by ENP, the Miccosukee Tribe, the Seminole Nation of Oklahoma, or the Thlopthlocco Tribal Town. Consultation will be complete prior to finalization of this EIS.

4.19 Native Americans

The Miccosukee Tribe and its members rely upon the Everglades in its natural state to support their religious, subsistence, and commercial activities. The Tribes' main property and Federal Reservation are partially situated within WCA 3A. In addition, the Miccosukee Tribe holds a perpetual lease from the State of Florida over a large portion of the WCA 3A (**refer to Figure 3-6**). The Miccosukee Tribe's religious activities traditionally include the planting and harvesting of corn on tree islands in the Everglades. Subsistence activities include gathering of materials, hunting, and fishing; while commercial activities include frogging, airboat and other guided tours, and providing recreational and tourism facilities within the Everglades. The Miccosukee Tribe stated that "for far too many years, as a direct result of discriminatory water management actions, hundreds of thousands of Tribal Everglades in Water Conservation Area 3A have been flooded and degraded… It has threatened the health and safety the Miccosukee community." (Miccosukee Tribe ERTP Draft EIS Comment 2011). More recently, the Miccosukee Tribe has expressed concern on the potential increased risk to airboat accessibility of the tree islands within southern WCA 3A as a result of the COP. Decreases in water levels in WCA 3A may prohibit access to tree islands by the Miccosukee Tribe, who currently use airboats for access to tree islands and as part of tourism related businesses (airboat concessionaires) along Tamiami Trail. Potential limitations to accessing tree islands via airboat may affect the ability of the Miccosukee Tribe to participate in cultural and religious practices that take place on these islands.

The STOF's focus has been on the health and well-being of tree islands within the Everglades as well. Tree islands were and still are important places to the Native American populations of Florida. It is generally agreed that most of the tree islands of any reasonable size contain archaeological sites and many contain burial components. The STOF are concerned about protecting these cultural resources from inundation that is anthropogenic in origin beyond historic levels and not the result of naturally occurring weather events.

As part of the development of this project consultation has occurred and is ongoing between the USACE and the two federally recognized tribes within the immediate area of potential effects and other tribes that have expressed an interest in the region. Letters requesting government-to-government consultation were sent to the Miccosukee Tribe, STOF, and Seminole Nation Chairmen on September 22, 2017 (**Appendix D.3** (**National Historic Preservation Act Compliance**)). In addition, presentations and face-to-face meetings were conducted as well as email and phone correspondence with tribal government staff to brief them on the project development, discuss issues of concern, and solicit input from the tribal governments regarding their assessment of effects on Indian trust resources, tribal rights to use those resources, and cultural values related to those resources and rights within the area resulting from the implementation of the COP. Reference **Section 6** (**Public Involvement**).

The following evaluations are designed to assess potential impacts to Native American lands discussed in **Section 3.18** (**Native Americans**). The reader should note that Native American concerns extend beyond

physical impacts to their lands and, as such, considerations have taken into account discussions and consultations that have occurred with Federally recognized tribes.

Continued implementation of Increment 1.1 and 1.2 (ECB19RR) would have no effect on Tribal properties. Affiliated, non-federally recognized tribes located along Tamiami Trail are of sufficient elevation that increased water flows will have no effect as described in the Increment 1 EA and FONSI (dated May 27, 2015) (USACE 2015). The ability for increased flows out of WCA 3A has the potential to alleviate concerns associated with excessive high water elevations and offers flexibility to provide additional outlets for water removal. However, any changes to the system are a priority concern for both Federally recognized tribes as their cultures remain interconnected to the Everglades.

The implementation of ALTN2, ALTO, ALTQ, and ALTQ+ is not anticipated to impact Tribal lands. As summarized in **Section 4.6.2** (**Tree Islands**), the Alternatives have the potential for beneficial effects to tree islands or religious and cultural importance of southern WCA 3. Cultural resources are not expected to be adversely affected by implementation of the Alternatives as described in section **0** (

Cultural Resources). Decreases in water levels in WCA 3A as a result of the Alternatives may prohibit airboat access to tree islands on lands leased by the Miccosukee Tribe during extremely dry periods. WCA 3A conditions are highly dependent on weather and access to these islands would be limited to other means during times of below average rainfall. A detailed analysis of the Miccosukee Tribe's concerns related to access of tree islands did not find a disproportionate impact. Reference **Section 4.16** (**Environmental Justice**).

4.20 Climate Change

The USACE established an overarching Climate Change Adaptation Policy Statement to support climate preparedness and resilience in 2011. In 2014, the policy was updated and the Climate Preparedness and Resilience (CPR) Community of Practice (CoP) was established. CPR policy states that climate change assessments should be considered for all phases of the project life cycle, for both existing and proposed projects where decision documents are required. As a result, in order to determine the risk and resiliency of the project to climate change, the COP project was evaluated in accordance with the USACE climate guidance. The implementation of the COP is anticipated to start in 2020.

The purpose of the COP is to define the water management operations for the Water Conservation Area (WCA) 3A, WCA 3B, structures in the L-31N and the C-111 basins constructed as part of the C&SF project and the constructed components of the MWD and C-111 South Dade projects. The proposed operations will also be consistent with the original purposes of the C&SF project to provide flood control, water supply for agricultural irrigation, municipalities and industry, and ENP; regional groundwater control and prevention of saltwater intrusion; enhancement of fish and wildlife; and recreation. Refer to **Section 1.3** of the EIS for additional background on the MWD and C-111 South Dade projects.

In addition to potential impacts from inland hydrology (precipitation, air temperature, stream flow), the COP project may also be impacted by sea level change from the east and the south. For this reason, the project was evaluated for both inland hydrology and sea level change.

4.20.1 Sea Level Change

The climate assessment for sea level change (SLC) follows the USACE guidance of Engineer Regulation (ER) 1100-2-8162, *Incorporating SLC in Civil Works Programs and Engineer Technical Letter (ETL) 1100-2-1, Procedures to Evaluate SLC: Impacts, Responses, and Adaptation*. ER 1100-2-8162 and ETL 1100-2-1 provide guidance for incorporating the direct and indirect physical effects of projected future sea level change across the project life cycle in managing, planning, engineering, designing, constructing, operating, and maintaining the USACE projects and systems of projects.

The water management operation criteria relating to the 2012 WCAs, ENP, and ENP to the South Dade Conveyance System (SDCS) Water Control Plan affects an area within the C&SF project located in south Florida and includes portions of several counties, as well as WCA 3, ENP, Big Cypress National Preserve, and adjacent areas. The MWD project is a modification of the C&SF project. Features of the MWD project are located in Miami-Dade County, including portions of ENP and adjacent areas. The 1992 MWD GDM and Final EIS defines the project boundary as Shark River Slough (SRS) and that portion of the C&SF project north of S-331 to include WCA 3. The C-111 South Dade project is adjacent to ENP to the west and discharges to the eastern panhandle of ENP, Florida Bay, Manatee Bay, and Barnes Sound. The project components of the MWD and C-111 South Dade projects are shown in **Figure 1-1** of the EIS.

The COP project is vulnerable to increases in sea levels in Florida Bay to the south and the Atlantic Ocean to the east. A sub-set of the water control structures included in the COP Water Control Plan are located in close proximity to Florida Bay and/or the Atlantic Ocean, within Biscayne Bay. The S-197 gated culvert is located at the southernmost tidal boundary of C&SF Project, at the terminus of the C&SF C-111 Canal. In addition to S-197, the following additional COP WCP structures are located within 15 miles of the tidal boundary, with each located upstream of intermediate water control structures between these structures and the C&SF tidal boundary: S-18C gated spillway (6.5 miles upstream of the S-197 gated culvert, along the C&SF C-111 Canal); S-177 gated spillway (12.5 miles upstream of the terminus S-197 gated culvert, along the C&SF C-111 Canal; intermediate C-111 structure S-18C); S-196 gated culvert (12 miles upstream of the terminus S-20F gated spillway, along the C&SF C-103 Canal; intermediate C-103 structures S-167 and S-179); S-194 gated culvert (11 miles upstream of the terminus S-21A gated spillway, along the C&SF C-102 Canal; intermediate C-102 structure S-165); S-338 gated culvert (15 miles upstream of the terminus S-21 gated spillway, along the C&SF C-1W Canal; intermediate C-1W structure S-148); and S-356 pump station (15 and 18 miles, respectively, upstream of the terminus G-93 gated spillway (C-3 Canal) and S-22 gated spillway (C-2 Canal), including intermediate C-4 structures G-119 and S-380. Based on the location of these structures, existing or future sea levels to the east and south may impact the hydrologic boundaries, including coastal surge and groundwater impacts, governing the performance and operation of the COP Project.

To assess the vulnerability of the COP project to future SLC, the web-based USACE Sea Level Change Curve Calculator was used at National Oceanographic and Atmospheric Administration (NOAA) tidal gauge 8724580 in Key West for the following three SLC scenarios:

- Baseline (or “low”) estimate, which is based on historic sea level rise (SLR) and represents the minimum expected SLC.
- Intermediate estimate.
- High estimate, representing the maximum expected SLC.

Analysis of the COP project area in relationship with the Key West NOAA gauge can be found in **Figure 4-158**. The COP is anticipated to be in place until construction of new CERP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and Florida Bay; based on the October 2019 USACE Integrated Delivery Schedule (IDS) for the South Florida Ecosystem Restoration (SFER) Program, the CERP CEPP South infrastructure that is located within the spatial footprint of the COP WCP will be constructed and operational by 2027. If new information becomes available through implementation of the COP WCP and/or the COP AMMP that would necessitate a need to modify water management operations, this information will be incorporated as appropriate in accordance with laws and regulations including the NEPA. The figure shows that the following future SLC elevations are projected for the low, intermediate and high SLC projected curves in 2030 (COP water management operations are anticipated to start in 2020, and 2030 corresponds to an assumed maximum 10-yr operational life cycle of COP project features applied for this evaluation):

- Low curve: -0.59 feet NAVD88 (after the assumed 10-year maximum project life cycle, assuming the project life cycle starts when the project is operational in 2020)
- Intermediate Curve: -0.46 feet NAVD88
- High Curve: -0.06 feet NAVD88

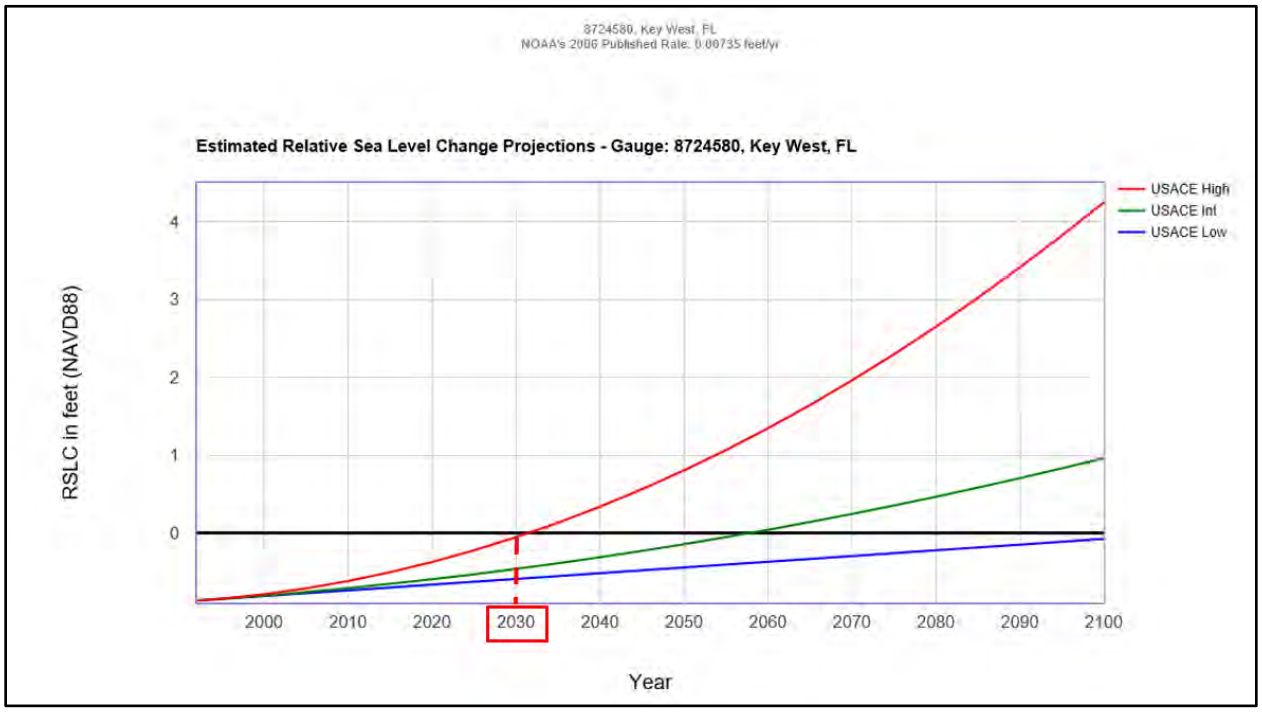

Figure 4-158. SLC Curves at Key West, FL (http://corpsmapu.usace.army.mil/rccinfo/slc/slcc_calc.html)

Note that, for COP's limited operational timeframe, it is assumed that climate-related projections are likely more influenced by natural variability in global climate systems (El Niño/La Niña-Southern Oscillation and the Atlantic Multidecadal Oscillation (AMO)) and uncertainty in global climate model projections. At this time, there is no consensus on whether climate change has any influence on the AMO or occurrence, strength, or duration of El Niño/La Niña-Southern Oscillation.

In lieu of identifying a critical elevation at which SLC impacts the performance or operation (including backwater effects from SLC at hydrologic boundaries or groundwater impacts) of the COP project, the

future SLC elevations were mapped on a regional terrain dataset of south Florida to determine if the inundation footprint due to SLC would encroach on the COP project footprint during the assumed maximum 10-yr life cycle applied for this evaluation. Based on the inundation of the high curve shown, the SLC from the Florida Bay is likely to directly impact the S-197 water control structure (southeastern most structure) for the USACE high SLC projections (**Figure 4-159**). The USACE low and intermediate SLC projections, however, will not likely impact the S-197 structure because the low and intermediate sea levels are approximately 0.5 feet less than the high curve sea levels at the end of COP's limited operational timeframe. The risk of high tide Mean Higher High Water (MHHW) impacts were also evaluated by assessing the SLC high curve inundation footprint with a MHHW of 0.04 ft. The MHHW elevation was obtained from the tidal datums reported at the NOAA Key West gauge as shown in **Figure 4-160.** Because the difference between NAVD88 and MHHW vertical datums is very small, the resulting differences in SLC high curve inundation footprints between NAVD88 and MHHW were also negligible.

While the near-term SLC does not appear to impact the COP project aside from the southernmost reach of the C-111 Canal near S-197, future resiliency and adaptive management measures for the COP project may be considered as part of the COP AMMP and/or through future CERP studies. Operational considerations for the COP may preliminarily be considered with high SLC projections potentially impacting water control structures to the east, notably S-197, and potential impacts will be monitored and assessed in accordance with the COP AMMP. Since the COP is expected to govern operations within the SDCS primary canal network for a limited operational timeframe, when SLC increases are fairly small, subsequent operational studies with CERP (including CEPP and the C-111 Spreader Canal projects) will require more expansive evaluations for potential SLC impacts.

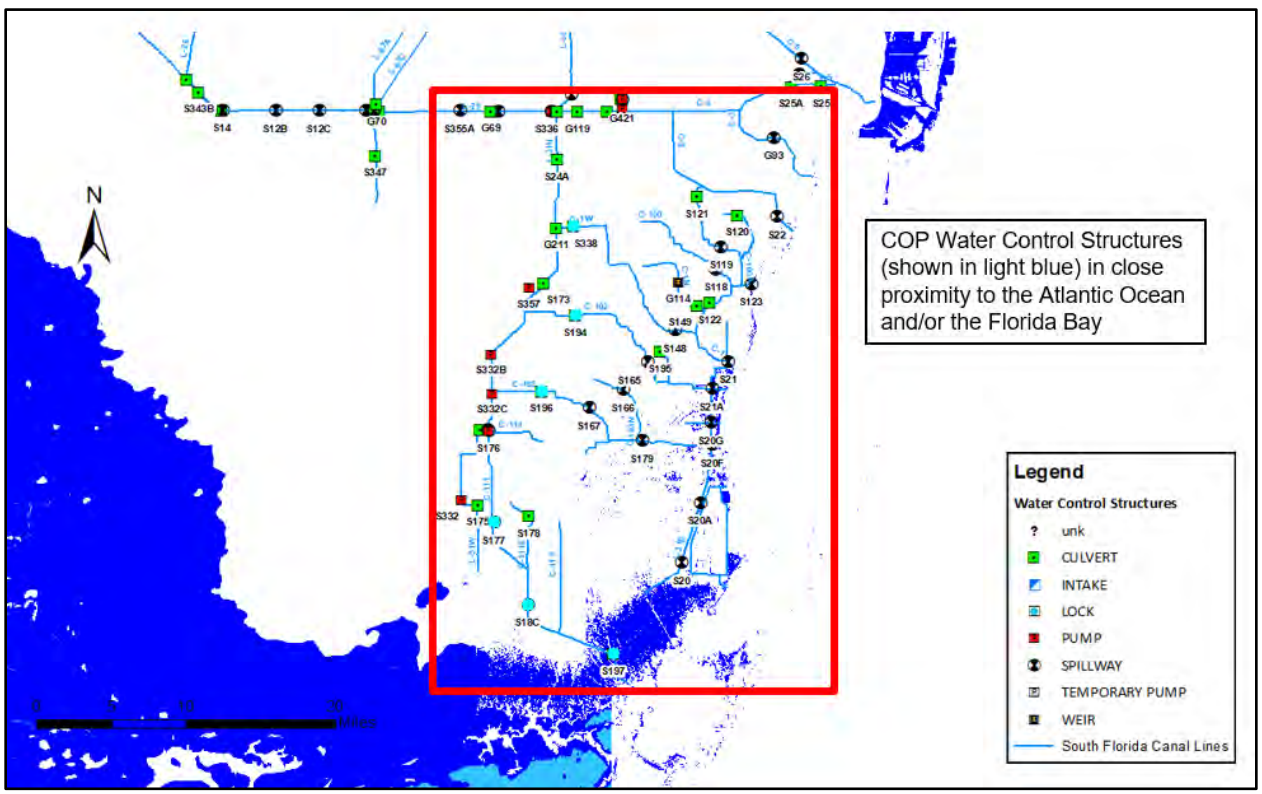

Figure 4-159. SLC Inundation in 2030 – USACE High Curve

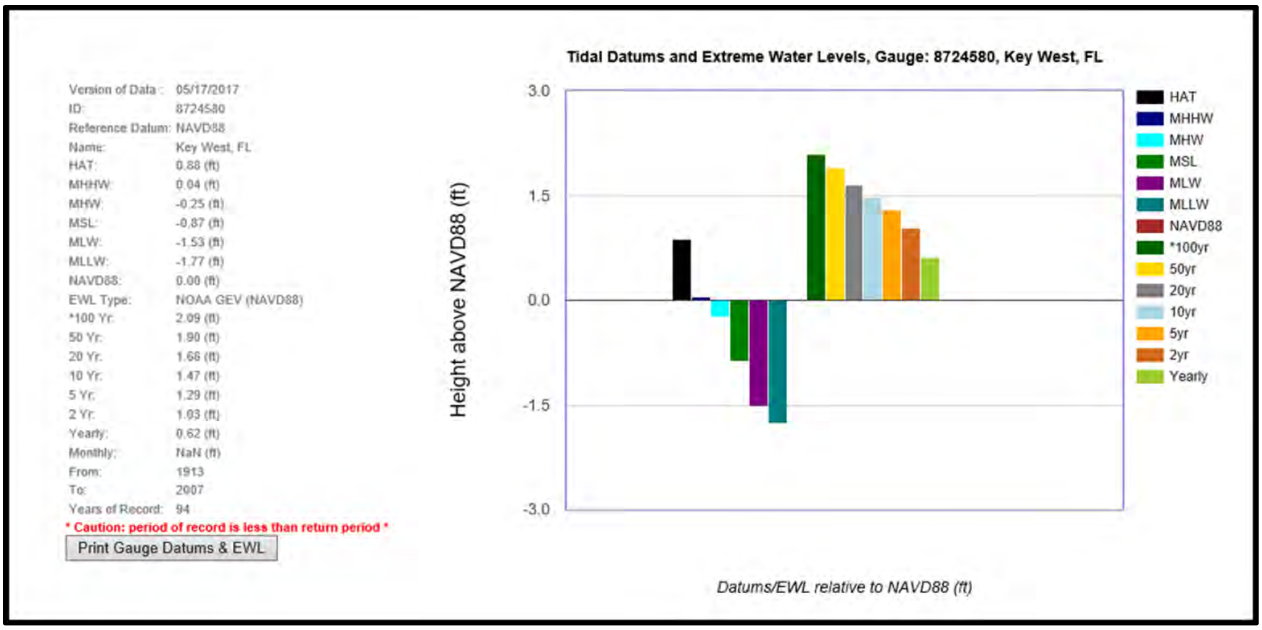

Figure 4-160. Key West Tidal Datum (http://corpsmapu.usace.army.mil/rccinfo/slc/slcc_calc.html)

4.20.2 Inland Hydrology

The climate assessment for inland hydrology follows the USACE guidance of Engineering and Construction Bulletin (ECB) 2018-14, Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects. ECB 2018-14 provides guidance for incorporating climate change information in the hydrologic analyses in accordance with the USACE climate preparedness and resilience policy and ER 1105-2-101, *Risk Assessment for Flood Risk Management Studies*.

The vulnerability and risk to C-111 South Dade project associated with inland hydrology climate change was assessed qualitatively as outlined in ECB 2018-14. In general, projects addressing climate change as part of an operational study are less comprehensive than projects evaluated at the Feasibility phase.

The vulnerability assessment includes a literature review and an application of climate tools to evaluate observed and projected climate trends.

The literature review includes the following sources specific to Florida and the surrounding region:

1) *Recent US Climate Change and Hydrology Literature Applicable to US Army Corps of Engineers Missions – South Atlantic-Gulf Region 03* (USACE, 2015a)
2) *Climate Change Indicators in the United States* (EPA, 2016)
3) *Climate Science Special Report: Fourth National Climate Assessment, Volume I* (USGCRP, 2017) *and II* (USGCRP, 2018)
4) *NOAA State Climate Summaries* (Runkle et al., 2017)
5) *The USACE Jacksonville District Report on Climate Change*, *Comprehensive Everglades Restoration Plan Central Everglades Planning Project Final Integrated Project Implementation Report and Environmental Impact Statement* (USACE, 2014)

The vulnerability assessment includes a literature review and an application of climate tools to evaluate observed and projected climate trends. These USACE CPR web-based tools were used in the analysis:

1. Climate Hydrology Assessment Tool (CHAT) – evaluate historic and projected climate trends.
2. Nonstationarity Detection Tool (NSD) – evaluate historic climate trends.
3. Vulnerability Assessment Tool (VA) – provide qualitative information on projected climate conditions.

The CHAT and NSD analyses was performed using data from U.S. Geological Survey (USGS) gauge 2256500 Fisheating Creek at Palmdale, Florida. The Fisheating Creek gauge was selected to identify trends and potential nonstationarities because it has the longest unregulated period of record of any streamflow gauge within the C&SF region. There are other long-term gauges in the COP project area, but these gauges were not selected because they are influenced by known man-made changes to basin hydrology that could affect the frequency and magnitude of flood flows and mask the impacts of climate change on the basin.

4.20.3 Risk Assessment

The increases in extreme storm frequency and intensity and increases in temperatures indicated by the literature review present risks to the COP project area. The literature and statistical analysis show little evidence that indicates change in streamflow. Despite there being no consensus in the literature regarding trends in either observed or projected streamflow, it can reasonably be expected that increased extreme precipitation may lead to increased flows and larger flood volumes and potential impact to the project's performance and operation. In addition, increased temperatures may lead to decreased flows and increases in drought severity and frequency.

The Phase II Vulnerability Assessment results indicate that the project is located in a relatively vulnerable watershed for the USACE flood risk management business line. The watershed is most vulnerable to increases in extreme storm frequency and intensity, and increases in air temperature. Per guidance in ECB 2018-14, **Table 4-49** identifies risk resulting from changed climate conditions in the future. The table shows the major project feature, the trigger event (climate variable that causes the risk), the hazard (resulting dangerous environmental condition), the harms (potential damage to the project or changed project output), and a qualitative assessment of the likelihood and uncertainty of this harm. Note that not all impacts of climate change will result in increased risk, as there may be project benefits.

Because there is not substantial evidence within the observed streamflow record and the literature that inflows to the study area are presently increasing, climate change and resilience should be accounted for by incorporation into the project's risk register. Based on the vulnerability assessment (literature review results indicate a high potential for increases in temperature and extreme precipitation and increases in the projections of annual maximum monthly streamflow), it would be beneficial for the project to account for risk due to climate change by developing a strategy for adaptive management of the project. Adaptive management could be used as a means of ensuring that the project is resilient to the impact of climate change for the duration of the project life cycle. This includes ensuring that the design of the project and prescribed operations can easily be adapted to handle extreme wet and dry conditions, including floods and droughts. This will ensure that the plan selected is robust enough to accommodate changing climatic conditions.

If SLR trends increase significantly, or if an increase in the frequency of extreme storm events increases the design events used for the MWD and C-111 South Dade infrastructure design efforts completed prior to the COP development, or if drought conditions increase, then future resiliency and adaptation measures to the area served by the project could include:

a) Operations of project structures, especially during the wet/dry season.

b) Additional water control structures/pump stations may be added to provide increased pump capacity

Table 4-49. Risk Assessment

Feature or Measure	Trigger	Hazard	Harm	Qualitative Likelihood
NDA/SDA Storage Reservoir, C-111 South Dade	Increased extreme precipitation – may occur from increased tropical storm activity.	Future flood volumes may be larger than present.	Floodwaters may remain on the levee for longer durations, and more frequently, potentially damaging the NDA or SDA perimeter levees. Larger flood volumes may not be adequately captured and have to bypass to the downstream C-111 Spreader Canal detention areas and/or the Estuary.	Somewhat Likely
NDA/SDA Storage Reservoir, C-111 South Dade	Increased temperatures	Increased evapotranspiration or drought	Decrease in flows may result in lower reservoir stages, resulting in reduced effectiveness for seepage management, resulting in loss of habitat and vegetation and reducing project benefits.	Likely
Water Control Structures and Pump Stations	Increased extreme precipitation – may occur from increased tropical storm activity.	Future flood volumes may be larger than events simulated within the RSM-GL (1965-2005) and MD-RSM (Water Year 2006, 2007 and 2012) periods of simulation.	Increase in flows resulting in 8.5 SMA and SDCS structures under-performing during high-flow events. Tamiami Trail Flow Formula is forward compatible with future increases in flows, including additional WCA 3A inflows and rainfall.	Somewhat Likely
Water Control Structures and Pump Stations	Increased Sea Level	Future sea-level elevation may be larger than present.	Increased SLR may limit discharge capacities of water control structures near the coast with current headwater conditions, increasing the frequency of COP pump operations (S-356, S-332B/C/D).	Likely

4.21 Cumulative Effects

Cumulative effects include the effects of future Federal, State, Tribal, local, or private actions reasonably certain to occur in the action area considered in this EIS. Cumulative effects are defined in 40 CFR 1508.7 as those effects that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.

A sensitivity model run based on ALTQ looked into the feasibility of refining the WCA 1 and WCA 2A regulation schedules. The goal was to confirm the robustness of ALTQ if some of the upstream sources of water flows changed and to provide insight into the potential to refine the regulation schedule in the future. Current regulation schedules for WCA 1 and WCA 2A have hydrologic induced challenges resulting in documented impacts to the observed system and that have also been identified in planning studies over the last several years (Sklar et al. 2002). Changes to the WCA 1 and WCA 2A regulation schedules, as modeled in sensitivity run based on ALTQ are outside the scope of this EIS and therefore were not incorporated into the proposed action. In the future, a more thorough planning study will need to be conducted to refine one or both WCA 1 and WCA 2A regulation schedules. This includes coordination with Federal and state agencies as well as Tribal partners, stakeholders and interested parties of the public. Additional NEPA will need to be conducted to implement a future change to the Water Control Plan to incorporate proposed regulation schedule changes for WCA 1 and WCA 2. A plan to conduct such a study (how, when, who, etc.) has not been identified. Reference **Section 2** (**Alternatives**) and **Appendix H**, **Annex 4** (**Sensitivity Runs**) for a description of the WCA 1 and WCA 2 sensitivity runs.

The following summarizes past, present, and projected efforts that cumulatively affect the regional environment of south Florida **Table 4-50**. In addition, there are efforts underway by other Federal, State, and local agencies, as well as non-governmental organizations that are all working toward similar restoration goals.

Table 4-50. Past, present, and reasonable foreseeable actions and plans affecting the action area.

-	Past Actions and Authorized Plans	Current Actions and Operating Plans	Reasonably Foreseeable Future Actions and Plans
Status of Non-CERP Projects	- C&SF Project (1948) - ENP Protection and Expansion Act (1989) - MWD GDM and Final EIS (1992) - C-111 South Dade GRR (1994)	- SFWMD Restoration Strategies Project - MWD 8.5 SMA GRR (2000) - MWD Tamiami Trail Modifications Limited Reevaluation Report (2008) - C&SF C-51 West End Flood Control Project - Kissimmee River Restoration - Seepage Barrier near the L-31 N Levee (Miami-Dade Limestone Products Association)	- SFWMD Complete Restoration Strategies Project - MWD Closeout - Tamiami Trail Modifications Next Steps (TTMNS) Project, Phase 2

		- Tamiami Trail Modifications Next Steps (TTMNS) Project, Phase 1 - SFWMD Florida Bay Initiatives - C-111 South Dade Project (Contracts 8, 8A, and 9)	
Operations Plan for Lake Okeechobee, WCA 3A, ENP and the SDCS	- Water Supply and Environment (WSE) Lake Okeechobee Regulation Schedule (2000) - IOP 2002 to 2012 ERTP	- Lake Okeechobee Regulation Schedule (LORS 2008) - SFWMD LEC Regional Water Supply Plan - ERTP October 2012 until replaced by the COP; temporary planned deviations included Increment 1 and Increment 1.1 and 1.2 and 2 Operational Strategies - Herbert Hoover Dike Dam Safety Modification Study (HHD DSMS) risk reduction measures (2011 through 2022)	- LORS 2008 to be replaced by revised Lake Okeechobee System Operating Manual by 2022 - SFWMD periodically revises the LEC Regional Water Supply Plan
CERP Projects		Congressional Authorization Received: - Broward County Water Preserve Areas Project - Caloosahatchee River (C-43) West Basin Storage Reservoir - Central Everglades Planning Project (CEPP) - CEPP Post-Authorization Change Report for EAA Southern Reservoir Project (conditional authorization pending completion and ASA review of the 1308b report specified in the WRRDA 2018) Congressional Authorization Received and Construction in Progress: - Central Everglades Planning Projects (DOI removal of portions of Old Tamiami Trail roadway and SFWMD increased capacity of S-333N	Future CERP Projects: - Lake Okeechobee Watershed Restoration Project - Western Everglades Restoration Project - Biscayne Bay Coastal Wetlands Phase 2 - C-111 Spreader Canal Project Phase 2

		- Indian River Lagoon-South Project - Picayune Strand Restoration Project - Site 1 Impoundment Project - Biscayne Bay Coastal Wetlands Project Phase 1 - C-111 Spreader Canal Western Project (operated by SFWMD)	

Beneficial effects to ENP have occurred through implementation of the MWD Incremental Field Tests conducted under the authority of the MWD Project. The USACE signed a FONSI on February 21, 2018 for the MWD Increment 2 Field Test to raise the L-29 canal maximum operating limit up to 8.5 feet NGVD subject to downstream constraints. Raising of the L-29 canal constraint above 7.8 feet NGVD (the maximum operating limit under Increment 1.2) was dependent upon completion of critical features necessary to operate the C-111 South Dade Project NDA. Following completion of the C-111 South Dade Project construction (both the NDA and SDA components) in August 2018 and following recovery of the 8.5 SMA flood mitigation system from an early September 2018 rainfall event, the L-29 canal maximum operating limit was incrementally increased from 8.3 feet NGVD to 8.5 feet NGVD on September 19, 2018. In 2018, 343,400 acre-feet of water (inflow volume of S-333 plus S-356 minus S-334 outflows) was delivered to NESRS (**Figure 4-161**). Increased flows have continued through 2019 and as of October 31, 2019 (at the time of this Draft EIS), 442,100 acre-feet has been delivered. This is an increase of more than 336,975 acre-feet of water into NESRS as compared to an average of 105,125 acre-feet delivered per year from 2012 through 2015 prior to implementation of the MWD Incremental Field Tests.

WCA-3A WATER DELIVERIES (AC-FT) TO NORTHEAST SHARK RIVER SLOUGH (S-333 + S-356 - S-334)*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2012	16,400	7,700	1,400	300	15,000	14,000	700	3,400	-200	-300	400	8,200	67,000
2013	18,900	8,200	2,200	500	26,400	18,200	3,500	1,000	-1,500	-700	0	0	76,700
2014	800	29,300	30,700	400	100	9,800	44,000	15,800	16,300	0	31,800	12,400	191,400
2015	1,700	0	5,700	0	0	0	0	0	6,400	36,700	26,300	8,600	85,400
2016	8,100	28,700	74,400	65,700	25,900	11,100	30,600	10,800	500	100	0	7,700	263,600
2017	2,700	5,200	1,300	300	100	33,300	10,500	0	20,300	700	4,100	45,500	124,000
2018	9,700	21,600	3,100	900	14,600	31,600	60,400	72,000	52,400	74,800	1,400	900	343,400
2019	1,000	21,100	21,700	16,300	24,700	49,400	80,000	74,400	86,400	67,100	0	0	442,100
2020													

Note: All data is provisional.

LEGEND
- Minimum Water Delivery
- IOP
- ERTP
- Increment 1
- 2016 Emergency Deviation
- Increment 1.1/1.2
- 2017 Temporary Deviations
- Increment 2
- COP

Figure 4-161. WCA 3A water deliveries (AC-FT) to NESRS (S-333+S-356-S-334)

The COP is expected to contribute to a net beneficial cumulative impact on the regional ecosystem, providing benefits to ENP by increasing flows to NESRS and Taylor Slough. The COP modifies the Rainfall Plan that conveys water from WCA 3A to ENP as per ERTP 2012. This is the first time the Rainfall Plan will be updated since the 1980s. The COP takes advantage of all that has been learned through operating the system under the MWD Incremental Field Tests and integrating modeling tools with real time operations. The COP PDT identified "the signal" which will guide the conveyance of water across Tamiami Trail to meet

ecological, flood protection, and water supply needs simultaneously in WCA 3A and ENP. Although the L-29 canal has been operated up to 8.5 feet NGVD recently, it has been under a short-term deviation approved by the USACE. The COP, if approved, would make this operation permanent, until such time that the 2020 Water Control Plan is revised under future CERP efforts. Based on ALTQ model results, just these two changes will enable water flows across Tamiami Trail to increase from 571,000 to 733,000 acre-feet average annual flows. This is a 28% increase in flows to ENP just from changing operations with the infrastructure that is currently on the ground today.

Furthermore, the COP addresses high water conditions during extreme wet events by moving water from WCA 3A to ENP as part of regular operations to avoid high water emergency operations. The last 3 years have required the USACE to seek planned temporary deviations from the current 2012 Water Control Plan and has required the State of Florida to issue emergency orders, both of which require a tremendous amount of analysis and coordination. The inclusion of the EHWL in the COP would streamline the process (and the need for additional NEPA) required to implement changes due to extreme high water levels to apply more attention to alleviating future high water condition.

The COP would also enable the S-356 pump station to operate as part of the 2020 Water Control Plan for the first time since construction. Not only will it be operated, it would have priority over S-333 to manage L-31N canal stages for flood protection as flows to NESRS increase.

Regular operation of S-328, which delivers water to Taylor Slough, would be included in the 2020 Water Control Plan for the first time. This is consistent with the SFWMD's Florida Bay Initiative which had the goal to improve flood control in southern Miami-Dade County while directing much-needed water to natural areas. The COP would move more water toward Taylor Slough with seasonal and lower canal operations consistent with the SFWMD's South Dade Study. The COP will send 92,000 acre-feet average annually toward Florida Bay. Furthermore, the COP would reduce damaging flows from S-197 to Manatee Bay/Barnes Sound by modifying operation of the C&SF structures while maintaining flood protection. This would be the first time operations at the southern end of the canal system have been revisited since construction of the S-197 structure. The COP would reduce the frequency and volume of damaging flows. S-197 Flows > 800 cfs at S-197 would decline from 4 times to 2 times per year, which corresponds to a reduction of average annual flows from 60,000 to 19,000 acre-feet.

Table 4-51 shows the net cumulative effects of the various resources which are directly or indirectly impacted. The COP will serve to further refine and optimize operations within WCA 3A, ENP and SDCS and make adjustments to the WCA 3 Rainfall Plan through implementation of the TTFF.

Table 4-51. Summary of Cumulative Effects

Resource	Cumulative Effects
Hydrology	-
Past Actions	Flood and water control projects have greatly altered the natural hydrology.
Present Actions	Federal and state agencies are coordinating on and implementing projects to improve hydrology.
Proposed Action	The combined flows to ENP are anticipated to be greater than discharges to ENP relative to the 2012 Water Control Plan. Hydroperiods within NESRS and Taylor Slough are expected to increase with the Proposed Action.
Future	Additional CERP projects propose to restore hydrology to more natural conditions.

Resource	Cumulative Effects
Actions	
Cumulative Effect	Although it is unlikely that natural hydrologic conditions would be fully restored to pre-drainage conditions, improved hydrology would occur with implementation of the Proposed Action. CERP is expected to improve the quantity, quality, timing and distribution of freshwater flow.
Endangered Species	-
Past Actions	Water management practices and urbanization have resulted in the degradation of existing habitat function and direct habitat loss leading to negative population trends of threatened and endangered species.
Present Actions	ERTP implementation represents a paradigm shift from single species to multi-species management. ERTP includes performance measures specifically directed at managing water levels and releases for the protection of multiple species and their habitats within the project area.
Proposed Action	Effects determinations for Federally threatened and endangered species within the project area are listed in **Table 4-13**. The USACE acknowledges the potential usage and occurrence of the previously discussed threatened and endangered species and/or critical habitat within the COP action area. The Proposed Action is being implemented in accordance with the mandated RPAs of the 2016 ERTP BO and RPA for the benefit of the CSSS.
Future Actions	Ongoing projects would be implemented to maintain threatened and endangered species within the study area. It is anticipated that suitable CSSS habitat will be maintained under future restoration initiatives, but it may not occur with the current or historic footprints in some areas.
Cumulative Effect	Habitat improvement, monitoring, and management of threatened and endangered species are anticipated to allow populations to be maintained. Improvement of degraded populations is expected to be facilitated by the restoration and enhancement of suitable habitat through efforts to restore more natural hydrologic conditions within the project area.
Fish and Wildlife Resources	-
Past Actions	Water management practices have resulted in aquatic vegetation community changes and a resultant disruption of aquatic productivity and function that has had repercussions through the food web, including effects on wading birds, large predatory fishes, reptiles and mammals.
Present Actions	Ongoing efforts have been made by Federal and state agencies to implement projects to improve hydrology within the project area to restore habitat conditions for fish and wildlife resources.
Proposed Action	Increases in forage prey availability (i.e. crayfish and other invertebrates, fish) resulting from improved hydroperiods would in turn provide beneficial effects for amphibian, reptile, small mammal, and wading bird species in ENP. Significant adverse impacts are not anticipated in WCA 3.
Future Actions	Some level of improvement to fish and wildlife resources is expected to occur as a result of implementation of projects with the capability of improving the timing, quantity, quality and distribution of freshwater flow to the study area. Hydrologic restoration planned as part of CERP would further improve fish and wildlife habitat.
Cumulative Effect	Habitat improvement efforts are anticipated to benefit fish and wildlife resources.
Vegetation and Wetlands	-
Past Actions	Drainage of Florida's interior wetlands, conversion of wetlands to agriculture, and urban development has reduced the spatial extent and quality of wetland resources.

Resource	Cumulative Effects
Present Actions	Efforts are being taken by state and Federal regulatory agencies to reduce wetland losses.
Proposed Action	Increased hydroperiods within the eastern marl prairies may act to alleviate some of the problems associated with drier conditions. The Proposed Action may have beneficial effects on vegetative communities within NESRS and Taylor Slough. Additional operational flexibility has been included within the Proposed Action to further allow for a rapid response to extreme high water levels in WCA 3A, directly benefitting tree islands within WCA 3A.
Future Actions	Some level of improvement to vegetative communities is expected to occur as a result of implementation of projects with the capability of improving the timing, quantity, quality, and distribution of freshwater flow to the study area. More natural hydrology as part of the CERP would assist in restoring natural plant communities.
Cumulative Effect	While the spatial extent of natural plant communities would not be restored to historic proportions, the quality of vegetative communities would be improved.
Water Quality	-
Past Actions	Water quality has been degraded from urban, suburban, commercial, industrial, recreational and agricultural development.
Present Actions	Efforts to improve water quality from agricultural areas are ongoing. Construction of Federal and state projects can temporarily elevate localized levels of suspended solids and turbidity.
Proposed Action	Water quality conditions in the vicinity of the L-29 canal and L-31N canal may be affected by implementation of the Proposed Action.
Future Actions	Actions by the State of Florida's Restoration Strategies is expected to decrease nutrient concentrations and loadings to the project area. In general there is a slowly improving trend in water quality entering and exiting the WCAs.
Cumulative Effect	While anthropogenic effects on water quality are unlikely to be eliminated, water quality is expected to slowly improve. This is based on trends indicated by data analysis and the fact that Best Management Practices (BMP's) are continuing to reduce nutrient loading to the system.

4.22 Irreversible and Irretrievable Commitment of Resources

An irreversible commitment of resources is one in which the ability to use and/or enjoy the resource is lost forever. An irretrievable commitment of resources is one in which, due to decisions to manage the resource for another purpose, opportunities to use or enjoy the resource as they presently exist are lost for a period of time. The Proposed Action consists of an operational change to current water management operations and does not include construction of permanent structures or modifications to existing water management features. The Proposed Action would not cause the permanent removal or consumption of any natural resources.

4.23 Incomplete or Unavailable Information

The analysis provided in this section of this document are based upon current knowledge of the physical and biological conditions in the action area and on projections of the most probable future conditions, as indicated by regional simulation hydrologic and ecological models. It is recognized that there is uncertainty in the predictions derived from these models. The likelihood of capturing all the processes occurring in a system as complex as the Everglades within regional simulation models is low. There will always be some uncertainty present in predicting environmental benefits associated with any project

because of the size and complexity of the Everglades ecosystem as well as the difficulty in fully understanding its physical and biological processes. However, the outputs of the regional simulation models used to assess projected hydrologic changes and to quantify ecosystem benefits were the best data available to predict the most likely hydrologic changes as a result of the project. Even though uncertainty is recognized, ecological benefits derived from performance measures are useful in making planning level decisions. These values provide a quantitative means for comparing alternatives to identify the best performing alternative.

It is recognized that new technical information or additional regional simulation models may be developed as the Proposed Action is implemented and that the observed results may differ from predicted results. Considering this, it may be necessary to adjust operations to address the new information or observed results to achieve better performance for environmental restoration and protection to ensure the health, safety, and well-being of the general public and affected individuals. Using an adaptive management approach during implementation of the COP, as documented in **Appendix C.2** (**COP Adaptive Management**), would provide new information to address uncertainties and risks over time and ultimately support fulfillment of the COP restoration goals and objectives. The COP AMMP is also likely to provide information to support future operational changes for the planned CERP/CEPP features.

4.24 Unavoidable Adverse Effects

Environmental effects for each resource are discussed above. The COP is an operational plan that changes the amount and timing of releases from WCA 3A to ENP. Potential unavoidable adverse effects that may potentially occur as a result of the proposed action and summarized below and include: (1) tribal concerns in WCA 3A; (2) increased risk to soils in WCA 3 due to reduced water levels; (3) increased risk to recreational access in WCA 3A during extremely dry periods; (4) increased risk to accessibility of tree islands for cultural and religious practices by the Miccosukee Tribe; (5) increased risk for phosphorous loading in ENP and exceedance of the Settlement Agreement Consent Decree; (6) potential for high volume discharges to Barnes Sound/Manatee Bay associated with the EHWL. Construction of CERP infrastructure is anticipated to improve the quantity, quality, timing, and distribution of flows to the study area. Increased flow deliveries to the study area under CERP may offset potential decreases in water levels in WCA 3 as a result of the COP.

<u>Tribal Concerns:</u> Decreases in water levels in WCA 3A may prohibit access to tree islands by the Miccosukee Tribe during extremely dry periods, who currently use airboats for access. The Miccosukee Tribe maintains a traditional life style that is intricately connected to the Everglades. Traditional practices of hunting, fishing, frogging, trapping, and general living are still maintained, along with modern entrepreneurship with tourism related businesses (airboat concessionaires) along Tamiami Trail. These practices continue to tie the Miccosukee Tribe to the Everglades in such a way that careful consideration of effects on tribal cultural, well-being, and way of life is warranted. Tree islands were and still are important places to the Native American populations of Florida. It is generally agreed that most of the tree islands of any reasonable size contain archaeological sites and many contain burial components. Potential limitations to accessing tree islands via airboat may affect the ability of the Miccosukee Tribe to participate in cultural and religious practices that take place on these islands. Independent of implementation of the COP, tribal airboat access is currently limited during the dry season; however these durations would be expected to be extended with the COP. Access during these times may be limited to walking and/or use of swamp buggies.

The COP has the potential for beneficial effects to tree islands in the chronically inundated portions of southern WCA 3. The reduction of water levels within WCA 3A is likely to aid in reducing future tree island degradation due to prolonged inundation and high water depths, and thereby, aid in the preservation of cultural resources by allowing stabilizing growth to occur on the tree islands. Inundation of tree islands in ENP is not affected by the COP; however increases of water into NESRS and Taylor Slough, may enable the promotion of peat accretion by potentially reducing soil oxidation; thereby stabilizing the existing soil matrix and prevent future erosion, oxidation, or subsidence of cultural resources. As stated above, the COP is anticipated to be in place until construction of new CERP infrastructure, including features which would enable increased flow deliveries into the WCAs, ENP, and Florida Bay. If new information becomes available through implementation of the COP Water Control Plan and/or the COP AMMP that would necessitate a need to modify water management operations, this information will be incorporated as appropriate in accordance with laws and regulations including the NEPA.

WCA 3 Water Levels: A potential decrease in dry event severity relative to ECB9RR was observed in portions of WCA 3 which presents an increased risk to soils from oxidation; however the observed results for the majority of WCA 3 were still above the threshold of a marsh that is consistent with peat accumulation. Reference **Section 0** (

Geology and Soils).

Recreational Access: Due to lowering of water levels in WCA 3, the COP may potentially reduce airboat access and recreational fishing within the marsh during extremely dry periods; however access to canals for recreation would not change relative to ECB19RR. Differences in the number of days the FWC considers closure in the EWMA due to low water stages were observed to be less than a 2% period of record change relative to ECB19RR. The number of low water closures did not significantly deviate from ECB19RR. ALTQ+ performed equivalent to ECB19RR in the number of low water closures events anticipated. Specific access points along Tamiami Trail west of the L-67 Extension canal face an increased risk of being inaccessible for recreational finishing, air boating, and paddling to an estimated average of 5% period of record change relative to ECB19RR. Reference **Section 4.17** (**Recreation**).

Water Quality: Until water quality is improved and there is more storage capacity upstream of the WCA's, there are few opportunities to move water within the greater Everglades system to achieve restoration goals. The PDT investigated various adaptive management options that, based on modeling, could help reduce nutrient pulses and higher FWM TP concentrations for NESRS. Unavoidable potentially adverse impacts on water quality over the next several years could occur with implementation of the proposed action however the adaptive management options evaluated by the PDT have determined it is possible to reduce those potential impacts. Additionally, regardless of any other upstream projects expected to improve water quality, there is a clear decreasing trend for long-term phosphorus concentrations delivered to NESRS.

The USACE conducted a detailed water quality analysis to determine the potential impacts of operational changes to NESRS on FWM TP concentrations and loads to NESRS. Phosphorus is the primary nutrient of concern for the Everglades, which historically has been a phosphorus-limited system. The analysis evaluated potential changes to phosphorus loading, loadings into NESRS above 8 ppb (considered undesirable) and the flow weighted annual mean. Data used included output from the modeling on WCA 3A gauge stages and flows through WCA 3A outflow structures (S-12A, S-12B, S-12C, S-12D, S-333, S-334, and S-356). The PDT used five metrics to evaluate the changes in average annual FWM TP concentrations impacts for 2018 and 2023 compared against the Long-term FWM. All metrics assumed that changes to

the distribution, source, and timing of flows in WCA 3A were minimal for the considered alternatives, relative to ECB19RR, and that such changes would not materially alter water quality conditions. Based upon the PDT water quality analysis, ALTQ + resulted in a long-term (by 2023) FWM similar to ECB19RR and improvements in loadings above 8 ppb by 2023.

The metrics used to evaluate water quality for ALTQ + predicted an increase in excess TP Load (delivered above 8 ppb) to NESRS. The change in the average FWM concentration delivered to NESRS was 1.2 ppb above ECB19RR for 2018 conditions and 0.5 ppb above ECB19RR under 2023 conditions. When the adaptive management options are employed, the LT FWM is predicted to improve to 0.7 or 0.8 ppb above baseline (SRQ2 and SRQ3 respectively) under 2018 conditions and improve to 0.2ppb or 0.1ppb lower than the LT FWM ECB19RR under 2023 conditions. Reference **Section 4.9** (**Water Quality**).

<u>EHWL and S-197 Discharges to Manatee Bay and Barnes Sound:</u> The proposed action does include additional operational flexibility by inclusion of an EHWL for water management operations when extreme high water levels in WCA 3A exist. Under this condition discharges at S-197 may be increased up to a maximum of 2400 cfs as summarized as detailed in **Appendix A**. This operational flexibility is not expected to be triggered frequently and is intended to be available if needed to help reduce risks to the WCA 3A perimeter levee system, a population at risk of 70,600 people, hurricane evacuation routes, and wildlife and tree islands from extreme high water conditions. Reference **Figure 4-26** in **Section 4.2** (**Hydrology**).

4.25 Energy Requirements and Conservation Potential

Energy use and conservation potential of the Proposed Action would be minimal.

4.26 Conflicts and Controversy

Over the lifetime of the MWD and C-111 South Dade Projects, considerable interest has been generated among local and regional stakeholders. The USACE continually strives to include all interested parties in its decision making process and will continue to consider all issues that arise. While the Proposed Action (ALTQ+) is based on this wealth of knowledge, concerns and controversies were documented during the planning process. The COP AMMP in **Appendix C.2** provides a forum to address the concerns and controversies exacerbated by information gaps. Reference **Appendix D.1** (**National Environmental Policy Act Correspondence**) for pertinent correspondence related to the COP which includes responses to NEPA scoping comments and comments received as each round of alternatives was developed (**Table D.1-1** through **Table D.1-4**). Major concerns expressed by stakeholders included effects of the Proposed Action on increased risk to accessibility of tree islands for cultural and religious practices by the Miccosukee Tribe, effects of the Proposed Action on flood risk in agricultural areas of Miami-Dade County, and the performance of the TTFF during regional droughts. These concerns were addressed through plan formulation processes and supported by adaptive management strategies where possible. The COP was never expected to solve all controversies associated with the regional water management system, but it does significantly improve the performance of the regional system and initiates a constructive ongoing dialogue to help recognize and develop effective management options for the challenges that remain.

4.27 Environmental Commitments

The USACE commits to avoiding, minimizing, or mitigating for adverse effects. All practicable means to avoid or minimize environmental effects were incorporated into the Proposed Action. A monitoring plan has been developed for the COP.

The COP AMMP includes seven sections organized by major topic category: (1) C.1 Introduction; (2) C.2 COP Adaptive Management; (3) C.3 Ecological Monitoring Plan; (4) C.4 Water Quality and Hydrology Monitoring Plan; (5) C.5 Water Quality and Hydrology Monitoring Plan South of S-331; (6) C.6 Water Quality and Hydrology Monitoring Plan for 8.5 SMA Flood Mitigation; and (7) Cultural Resources Monitoring Plan. The COP AMMP identifies the monitoring information needed to inform implementation and to document progress toward meeting the projects goals and objectives, as well as address uncertainties related to project performance. The overall objective of the COP AMMP is to focus resources on refinement of the COP to fine tune performance due to inevitable uncertainties, based on existing knowledge and knowledge that will be gained through monitoring and assessment. A fundamental principle of adaptive management is that an adaptive management action can be taken when it is demonstrated through data or modeling that a project can be adjusted to achieve higher performance toward the project's goals and objectives and to remain within its constraints. In adaptive management, the adjustments are based on a scientifically efficient and sound process of learning from data. Given this fundamental principle of adaptive management, the COP AMMP provides suggestions for potential improvements and refinements of aspects of the COP if necessary, called adaptive management options. For each of the COP objectives, the monitoring parameters, their value to the COP, timeframe needed to see changes, measurement frequencies, decision criteria for triggering adaptive management options, and suggested adaptive management options are documented. The COP AMMP will be closely coordinated with the CERP **RE**storation, **CO**ordination, and **VE**rification (RECOVER) Monitoring and Assessment Plan (MAP) where monitoring overlaps with the COP study area to leverage existing monitoring to avoid duplication of efforts.

The suggested adaptive management options are based on current experience and knowledge and are not required actions, nor are they meant to limit agencies from considering other options. All of the adaptive management options are considered part of the Proposed Action (ALTQ+), although some would require more information in order to perform a full NEPA analysis, including permitting, and agency coordination before they could be initiated. The adaptive management options are not always automatically implementable; they are informed suggestions provided as part of the Proposed Action (ALTQ+) that capture current knowledge of what may be needed in the future to adjust and maximize performance as the COP progresses. In fact there are three types of adaptive management options identified in the COP AMMP: (1) Adaptive Management Options Defined in Water Control Plan and supported by the EIS; 2) Adaptive Management Options Not Defined in Water Control Plan which would require an additional EIS or EA to implement; and (3) Adaptive Management Options Not in the Authority of the COP (additional NEPA is required to implement, but options are outside of the COP process). Reference **Appendix C.2** (**COP Adaptive Management**).

The USACE, the SFWMD, and ENP will establish an interagency collaborative forum (referenced from this point forward within the EIS and AMMP as the "PDT+") that succeeds the COP interagency PDT, consisting of the COP implementing agencies, oversight agencies, and stakeholder groups during the COP implementation. The COP AMMP identifies annual or biannual (twice per year) interagency workshops to describe the performance of operations of the completed MWD and C-111 South Dade features relative to the achievement of goals and objectives of the COP. These workshops are planned to be conducted

under the process defined in the COP AMMP. Reference **Appendix C.2** (**COP Adaptive Management** for a complete description of the institutional structure of the adaptive management process. Additional technical sub-teams will also be established to oversee hydrologic monitoring, coordinate data evaluations, and prepare data reports, consistent with the commitments identified in the COP AMMP. Established meetings (e.g., WCA-3 Periodic Scientists Calls) may also support evaluation of the COP AMMP and/or provide additional forums for periodic updates on the monitoring and assessment results. The USACE, the SFWMD, and ENP water managers will meet on an as-needed basis to discuss system conditions and recommended goals for operations, and water managers will continue active participation in the COP AMMP technical sub-teams. Additional technical staff from these agencies who are involved in the collection and assessment of monitoring data will also participate in either the monthly coordination meetings, or monthly/bimonthly wildlife assessment calls as needed. Discussions resulting from these coordination meetings, including preliminary recommendations from water managers will be further discussed with the PDT+ during regularly scheduled interagency meetings to occur one to two times per year. PDT+ meetings will also include updates from the Water Quality and Eco sub-teams. When complex issues are identified as needing additional analysis or effort, and adaptive management task team can be recommended by the PDT+. These task teams may coordinate additional meetings and/or workshops may be conducted in support of the COP on an as-needed basis based upon ongoing or anticipated conditions within WCAs, ENP, and/or the SDCS.

The COP AMMP will also contain the monitoring and associated costs required under the USFWS Biological Opinion (BO) and other agency permits that are needed to protect and conserve natural resources. The BO and associated monitoring information for the COP will be found in **Appendix C.3** (**Ecological Monitoring Plan**) upon receipt of the BO in the Final EIS. **Appendix C.3** (**Ecological Monitoring Plan**) currently identifies monitoring required under the July 2016 ERTP BO as a placeholder. A BO will be received after submittal of a BA by the USACE to the USFWS concurrent with release of the Draft EIS for public review.

4.28 Compliance with Environmental Requirements

This subsection documents compliance of the Preliminary Preferred Alternative with environmental requirements.

4.28.1 National Environmental Policy Act of 1969

Environmental information on the project has been compiled and this Draft EIS has been prepared and coordinated for public, state, and Federal agency review. The Proposed Action is in compliance with NEPA.

4.28.2 Endangered Species Act of 1973

Upon completion of an assessment for species under NMFS purview it was determined that the Proposed Action would have no effect on these species; therefore, consultation with NMFS was not necessary. The USACE requested written confirmation of federally listed threatened and endangered species that are either known to occur or are likely to occur within the study area from the USFWS by correspondence dated September 26, 2017. In correspondence dated October 31, 2017, the USFWS provided a revised list for the COP. The USACE provided subsequent email correspondence seeking clarification on the revised list due to the recent listing of several species. The USFWS provided concurrence on the revised list on November 27, 2017 via e-mail. A BA was submitted to the USFWS on December 11, 2019. Reference

Appendix D.2 (**Endangered Species Act Compliance**) for pertinent correspondence. The Proposed Action has been fully coordinated under the Endangered Species Act and will be in full compliance with the Act.

4.28.3 Fish and Wildlife Coordination Act of 1958, as amended

The Fish and Wildlife Coordination Act (FWCA; 16 U.S.C. 661 et seq., March 10, 1934, as amended 1946, 1958, 1978, and 1995) requires Federal agencies to consult with the USFWS regarding the impacts to fish and wildlife resources and the proposed measures to mitigate these impacts. Additional coordination authorities exist through the review process of the NEPA (NEPA; 42 U.S.C. 4321-4347, January 1, 1970, as amended 1975 and 1982) and the consultations required under the ESA of 1973 (ESA; 7 U.S.C. 136, 16 U.S.C. 1532 ET SEQ. December 28, 1973). A Memorandum for Record (MFR) was signed by representatives from the USACE and the USFWS on October 3, 2017 and October 10, 2017 respectively, to document an informal understanding to utilize the COP NEPA review and ESA consultation process to complete coordination responsibilities under the FWCA. The MFR indicated that the USFWS will continue to coordinate and consult with the USACE through NEPA and the ESA to ensure impacts to fish and wildlife resources are adequately ad-dressed via these two authorities. The USFWS will include comments relevant to the FWCA in its response to the Corp's ESA coordination letter, where applicable. Formal comments have also been submitted through Planning Aid Letters (PALs) in accordance with the FWCA. The Proposed Action is in full compliance with the Act.

4.28.4 National Historic Preservation Act of 1966

The Proposed Action is in compliance with Section 106 of the National Historic Preservation Act, as amended (Public Law 89-665). As part of the requirements and consultation process contained within the National Historic Preservation Act implementing regulations of 36 CFR 800, this project is also in compliance through ongoing consultation with the Archaeological and Historic Preservation Act, as amended (Public Law 93-291), Archaeological Resources Protection Act (Public Law 96-95), American Indian Religious Freedom Act (Public Law 95-341), Native American Graves Protection and Repatriation Act (NAGPRA) (Public Law 101-601), Executive Order 11593, 13007, and 13175, the Presidential Memo of 1994 on Memorandum on Government-to-Government Relations With Native American Tribal Governments and appropriate Florida Statutes. Presentations and face-to-face meetings were conducted, as well as email and phone correspondence with state, federal, and tribal government staff members to brief them on the project development and to discuss issues of concern. Formal letters requesting consultation on potential effects to cultural resources were sent to the SHPO, Seminole THPO, Miccosukee Tribal Representative, the Seminole Nation of Oklahoma THPO, Thlopthlocco Tribal Town THPO, and the ENP Superintendent on July 31, 2019. The USACE has determined that the Proposed Action will have no adverse effect on historic properties eligible or potentially eligible for listing in the National Register of Historic Places. Consultation with the SHPO, ENP, STOF, Miccosukee Indians of Florida, Seminole Nation of Oklahoma, and the Thlopthlocco Tribal Town on this determination was sent on November 21, 2019 and is ongoing. Consultation will be complete prior to finalization of this EIS.

4.28.5 Clean Water Act of 1972

The Proposed Action is in compliance with this Act.

4.28.6 Clean Air Act of 1963

The Proposed Action is being coordinated with the State of Florida. The Proposed Action is in compliance with Section 176 of the Clean Air Act, known as the General Conformity Rule. The Proposed Action will not cause or contribute to violations of the National Ambient Air Quality Standards.

4.28.7 Coastal Zone Management Act of 1972

A Federal consistency determination in accordance with 15 CFR 930 Subpart C is included in this report as **Appendix B** (**Coastal Zone Consistency Determination**). The USACE has determined that the Proposed Action is consistent to the maximum extent practicable with the enforceable policies of Florida's approved CZMP. The USACE has coordinated a consistency determination pursuant to the CZMA through circulation of this Draft EIS. Final concurrence of consistency with the CZMP will be determined during environmental permitting processes, as applicable.

4.28.8 Farmland Protection Policy Act of 1981

The USDA-NRCS had previously determined that there are delineations of Important Farmland Soils (Farmland of Unique Importance) within the study area. Approximately 975 acres of Prime and Unique Farmland are located mainly within the boundaries of ENP. In addition, correspondence received from the USDA-NRCS dated August 15, 2017, noted that protected lands (i.e. ENP) would be exempt as the property is set aside by the National Park Service. Conversion of Prime and Unique Farmland is not anticipated as a result of the Proposed Action.

4.28.9 Wild and Scenic River Act of 1968

No designated Wild and Scenic river reaches would be affected by project related activities. The Proposed Action is in full compliance.

4.28.10 Marine Mammal Protection Act of 1972

No marine mammals would be harmed, harassed, injured, or killed as a result of the Proposed Action. The Proposed Action is in full compliance.

4.28.11 Estuary Protection Act of 1968

No designated estuary would be affected by the Proposed Action. The Proposed Action is in full compliance.

4.28.12 Federal Water Project Recreation Act of 1965, as amended

Recreation and fish and wildlife enhancement have been given full consideration in the Proposed Action.

4.28.13 Fishery Conservation and Management Act of 1976

No fisheries or other areas under the purview of NMFS would be affected by the Proposed Action. The Proposed Action is in full compliance.

4.28.14 Submerged Lands Act of 1953

The Proposed Action is an operational change to existing infrastructure; therefore, no construction is proposed on submerged lands. The Proposed Action is in full compliance.

4.28.15 Coastal Barrier Resources Act and Coastal Barrier Improvement Act of 1990

There are no designated coastal barrier resources in the study area that would be affected by the Proposed Action. The Proposed Action is in full compliance.

4.28.16 Resource Conservation and Recovery Act (RCRA), As Amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984, Comprehensive Environmental Response Compensation and Liability Act (CERCLA), Toxic Substances Control Act (TSCA) of 1976

Implementation of the Proposed Action is not expected to result in the discovery of HTRW since there is no excavation or other construction activities associated with this project. The Proposed Action has a very low risk for increased mobilization of existing HTRW where it might exist within the study area. The Proposed Action is in compliance with these Acts.

4.28.17 Rivers and Harbors Act of 1899

The Proposed Action would not obstruct navigable waters of the United States. The Proposed Action is in full compliance.

4.28.18 Safe Drinking Water Act of 1974, As Amended

The Proposed Action would not impact safe drinking water standards. The Proposed Action is in full compliance.

4.28.19 Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646)

Acquisition of real estate is not required for the Proposed Action. The Proposed Action is in full compliance.

4.28.20 Anadromous Fish Conservation Act

Anadromous fish species would not be affected. The Proposed Action is in full compliance.

4.28.21 Migratory Bird Treaty Act and Migratory Bird Conservation Act

Migratory and resident bird species have been observed within the study area and are likely to use available habitat for foraging, nesting, and breeding. The Proposed Action is not expected to destroy migratory birds, their active nests, their eggs, or their hatchlings. The Proposed Action will not pursue, hunt, take, capture, kill or sell migratory birds. The Proposed Action is in full compliance with these Acts.

4.28.22 Marine Protection, Research and Sanctuaries Act

Ocean disposal of dredge material is not proposed as part of the Proposed Action. The Proposed Action is in full compliance.

4.28.23 Magnuson-Stevens Fishery Conservation and Management Act

No Essential Fish Habitat would be impacted by this action. The Proposed Action is in full compliance.

4.28.24 E.O. 11990, Protection of Wetlands

The Proposed Action is expected to have beneficial effects on wetlands. The Proposed Action is in full compliance with the goals of this Executive Order (E.O.).

4.28.25 E.O. 11988, Floodplain Management

This E.O. instructs Federal agencies to avoid development in floodplains to the maximum extent possible. The Proposed Action is an operational change to existing infrastructure; therefore, no construction is proposed. This action is consistent with the intent of this E.O. and is in compliance.

4.28.26 E.O. 12898, Environmental Justice

E.O. 12989 provides that each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low income populations. The Proposed Action would not result in disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. The Proposed Action is in compliance with this E.O. Reference **Section 4.16** (**Environmental Justice**).

4.28.27 E.O. 13089, Coral Reef Protection

No coral reefs would be impacted by the Proposed Action. The Proposed Action is in full compliance with the goals of this Executive Order (E.O.).

4.28.28 E.O. 13112, Invasive Species

The Proposed Action is expected to have no significant impact on the introduction of invasive species over the existing conditions. The Proposed Action complies with the goals of E.O. 13112 by restoring habitat conditions in ecosystems that have been invaded and monitors for invasive species as outlined in the COP AMMP. The Proposed Action is in compliance with the goals of this E.O.

4.28.29 E.O. 13045, Protection of Children

E.O. 13045, requires each Federal agency to “identify and assess environmental risk and safety risks [that] may disproportionately affect children” and ensure that its “policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.” This action has no environmental safety risks that may disproportionately affect children. The Proposed Action is in full compliance.

4.28.30 E.O. 13186, Responsibilities of Federal Agencies to Protect Migratory Birds

Migratory and resident bird species have been observed within the study area and are likely to use available habitat for foraging, nesting, and breeding. The Proposed Action is not expected to destroy migratory birds, their active nests, their eggs, or their hatchlings. The Proposed Action is in full compliance with the goals of this E.O.

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5 LIST OF REPORT PREPARERS

This section provides a list of the persons involved in the preparation and review of this document. Federal and state agencies, including Native American Tribes, were asked at the beginning of the planning process to become cooperating agencies under the National Environmental Policy Act (NEPA) in correspondence dated September 22, 2017. Reference **Section 6.2** (**Agency Coordination and Public Involvement**). Everglades National Park (ENP) and the South Florida Water Management District (SFWMD) formally accepted cooperating agency status on October 20, 2017, and November 1, 2017, respectively in response to the request by the U.S. Army Corps of Engineers (USACE).

Table 5-1. List of report preparers and reviewers.

Name	Organization	Discipline/Expertise	Role in Document Preparation
Erik Adamiec	USACE	Economist	Socioeconomic Analyses
Andrea Atkinson	ENP	Ecologist	Adaptive Management and Monitoring Plan
Luis Alejandro	USACE	Water Manager	Reviewer
Kiren Bahm	ENP	Hydrologist	Hydrologic Analyses/Operations
Laureen Borochaner	USACE	Engineer	Reviewer
Dan Crawford	USACE	Hydrologist	Hydrologic Analyses/Operations
Jeff Couch	USACE	Project Management	Reviewer
Lan Do	USACE	Water Manager	Hydrologic Analyses/Operations
Angela Dunn	USACE	Biologist	Reviewer
Jason Engle	USACE	Hydrologist	Reviewer
Donna George	USACE	Project Management	Project Management/Reviewer
Brooke Hall	USACE	Plan Formulation	Plan Formulation
Mike Hensch	USACE	Water Manager	Hydrologic Analyses/Operations
Jeff Ludicello	SFWMD	Modeler	Modeling/Reviewer
Martha Jackson	USACE	Plan Formulation	Reviewer
Robert Johnson	ENP	Hydrologist	Reviewer
Fahmida Khatun	SFWMD	Modeler	Modeling/Reviewer
Andrew LoSchiavo	USACE	Biologist	Reviewer
Brenda Mills	SFWMD	Project Management	Project Management/Review

Name	Organization	Discipline/Expertise	Role in Document Preparation
Agnes McLean	ENP	Ecologist	Environmental Effects Analyses/Plan Formulation/Adaptive Management and Monitoring Plan
Meredith Moreno	USACE	Archeologist	Cultural Resource Analyses and Monitoring Plan
Melissa Nasuti	USACE	Biologist	Environmental Effects Analyses/Plan Formulation/Adaptive Management and Monitoring Plan
Ceyda Polatel	USACE	Hydrologist	Hydrologic Analyses/Operations
Jed Redwine	ENP	Ecologist	Environmental Effects Analyses/Plan Formulation/Adaptive Management and Monitoring Plan/Hydrologic Analyses/Operations
James Riley	USACE	Water Quality	Water Quality Analyses
David Rudnick	ENP	Ecologist	Environmental Effects Analyses /Plan Formulation/Adaptive Management and Monitoring Plan
Eric Summa	USACE	Biologist	Reviewer
Donatto Surratt	ENP	Water Quality	Water Quality Analyses
Erik Stabenau	ENP	Oceanographer	Reviewer
Bill Walker	ENP-consultant	Water Quality	Water Quality Analyses
Russ Weeks	USACE	Hydrologist	Reviewer
Olice Williams	USACE	Water Manager	Hydrologic Analyses/Operations
Kevin Wittman	USACE	Socioeconomics	Reviewer
Suelynn Kirkland	SFWMD	Water Manager	Hydrologic Analyses/Operations
Rodrigo Musalem Jara	SFWMD	Water Manager	Hydrologic Analyses/Operations
Asif Mohamed	SFWMD	Water Manager	Hydrologic Analyses/Operations
Tibebe Dessalegne	SFWMD	Hydrologist	Hydrologic Analyses/Operations
Matahel Ansar	SFWMD	Hydrologist	Hydrologic Analyses/Operations
Luis Cadavid	SFWMD	Hydrologist	Hydrologic Analyses/Operations
Stuart Van Horn	SFWMD	Water Quality	Reviewer
Jonathon Madden	SFWMD	Water Quality	Water Quality Analyses/Reviewer

Name	Organization	Discipline/Expertise	Role in Document Preparation
Fred Sklar	SFWMD	Ecologist	Environmental Effects Analyses/Plan Formulation/Adaptive Management and Monitoring Plan
Christa Zweig	SFWMD	Ecologist	Environmental Effects Analyses/Adaptive Management and Monitoring Plan
Sue Newman	SFWMD	Ecologist	Environmental Effects Analyses/Adaptive Management and Monitoring Plan
Eric Cline	SFWMD	Ecologist	Environmental Effects Analyses/Adaptive Management and Monitoring Plan
Amanda McDonald	SFWMD	Ecologist	Environmental Effects Analyses/ Adaptive Management and Monitoring Plan
Nancy Demonstranti	SFWMD	Water Supply	Water Supply Analysis/Reviewer
Tom Colios	SFWMD	Water Supply	Water Supply Analysis/Reviewer
Chris Madden	SFWMD	Ecologist	Environmental Effects Analyses Adaptive Management and Monitoring Plan
Walter Wilcox	SFWMD	Modeler	Modeling/Reviewer
Raul Novoa	SFWMD	Modeler	Modeling/Reviewer
Ruben Arteaga	SFWMD	Modeler	Modeling/Reviewer
Cal Neidrauer	SFWMD	Modeler	Modeling
Dave Welter	SFWMD	Modeler	Modeling
Jason Godin	SFWMD	Modeler	Modeling
Dillan Mohottige	SFWMD	Modeler	Modeling
Hal Hennessey-Correa	SFWMD	Modeler	Modeling
Sashi Nair	SFWMD	Modeler	Modeling
Clay Brown	SFWMD	Modeler	Modeling
Alaa Ali	SFWMD	Modeler	Modeling
Matthew Morrison	SFWMD	Project Management	Reviewer
John Mitnik	SFWMD	Project Management/Water Manager	Project Reviewer
Jose Otero	SFWMD	Hydrologist	Hydrologic Analyses/Operations
Sean Sculley	SFWMD	Project Management	Project Management

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6 PUBLIC INVOLVEMENT

The following details public involvement during plan formulation.

6.1 Scoping

A Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) for the Combined Operational Plan (COP) was published in the Federal Register (FR) (Volume 82, Number 173) September 8, 2017. A National Environmental Policy Act (NEPA) scoping letter dated September 22, 2017 was used to invite comments from Federal, State, and local agencies, affected Native American Tribes, and other interested private organizations and individuals. Scoping comments were accepted through October 21, 2017. A copy of the scoping letter, NOI, scoping letters received and a comment response matrix (**Table D.1-1**) are located in **Appendix D.1** (**National Environmental Policy Act Correspondence**).

Agencies including ENP, the South Florida Water Management District (SFWMD), and the U.S. Fish and Wildlife Service (USFWS) were asked at the beginning of the planning process to become cooperating agencies under NEPA in correspondence dated September 22, 2017. The SFWMD and ENP formally accepted cooperating agency status on October 20, 2017 and November 1, 2017 respectively. Reference **Appendix D.1** (**National Environmental Policy Act Correspondence**). Correspondence requesting cooperating agency status was also provided to the Miccosukee Tribe, the Seminole Tribe of Florida (STOF) and the Seminole Nation of Oklahoma on October 13, 2017. No correspondence was received in response to these letters.

6.2 Agency Coordination and Public Involvement

The U.S. Army Corps of Engineers (USACE) is in continuous coordination with other Federal and state agencies, Tribal representatives, and members of the general public. This extensive coordination is a result of the magnitude of efforts underway to implement water management strategies in south Florida. Public outreach efforts for the COP began early in the planning process. Project delivery team (PDT) membership consisted of those individuals designated by the USACE, the implementing agency, and representatives designated by other governmental agencies or Native American Tribes. Interagency participation was encouraged to take advantage of technical skills and knowledge of other agencies. Several Federal, Tribal and state agencies were active members of the PDT. Participants included the USFWS, the National Park Service (NPS), the Florida Fish and Wildlife Conservation Commission (FWC), the Florida Department of Agriculture and Consumer Services (FDACS), and the Florida Department of Environmental Protection (FDEP). Representatives from Broward and Miami-Dade counties also participated. **Table 6-1** provides a list of PDT meetings conducted during plan formulation efforts for the COP. Designated public comment periods provided opportunities for public participation during PDT meetings. Additional briefings of the COP by the USACE and the SFWMD also occurred throughout the planning process including presentations to the SFWMD's Governing Board, the Water Resources Advisory Committee (WRAC) and the Everglades Technical Oversight Committee.

The USACE recognizes the obligations that they have to the Miccosukee Tribe, the STOF, and the Seminole Nation of Oklahoma including consultation under the NEPA and Section 106 of the National Historic Preservation Act. Pursuant to Executive Order 13175, and in consideration of USACE's Trust Responsibilities, USACE invited each Tribe to participate in government-to-government consultation via correspondence dated July 6, 2016, as part of the USACE obligation for conditioned coordination.

Reference **Appendix D.1** (**National Environmental Policy Act Correspondence**) for coordination letters sent to the Tribes during plan formulation efforts. Meetings were also held individually with representatives of the Miccosukee Tribe, the STOF, and the Seminole Nation of Oklahoma. **Table 6-2** provides a list of government-to-government consultation meetings conducted.

In addition to NEPA, coordination with agencies as required by other Federal laws, statues, and Executive Orders has been conducted.

Table 6-1. Public involvement summary.

Action	Location	Date
PDT Meeting	West Palm Beach, Florida	August 21, 2017
PDT Meeting	West Palm Beach, Florida	November 13, 2017
PDT Meeting	Teleconference/Webinar	April 11, 2018
PDT Meeting	Boynton Beach, Florida	May 15, 2018
PDT Meeting	Teleconference/Webinar	June 13, 2018
PDT Meeting	Teleconference/Webinar	July 11, 2018
PDT Meeting	Teleconference/Webinar	August 8, 2018
SFWMD Governing Board	West Palm Beach, Florida	August 9, 2018
PDT Meeting	Homestead, Florida	August 14, 2018
WRAC	West Palm Beach, Florida	August 21, 2018
PDT Meeting	West Palm Beach, Florida	August 29, 2018
PDT Meeting	Teleconference/Webinar	November 9, 2018
PDT Meeting	Islamorada, Florida	December 12, 2018
SFWMD Governing Board	West Palm Beach, Florida	January 10, 2019
PDT Meeting	Teleconference/Webinar	February 20, 2019
PDT Meeting	Davie, Florida	March 18, 2019
PDT Meeting	Teleconference/Webinar	April 2, 2019
PDT Meeting	Teleconference/Webinar	May 21, 2019
PDT Meeting	Teleconference/Webinar	June 6, 2019
SFWMD Governing Board	West Palm Beach, Florida	June 13, 2019
PDT Meeting	Teleconference/Webinar	June 21 , 2019
PDT Meeting	Teleconference/Webinar	July 9, 2019
PDT Meeting	Fort Lauderdale, Florida	August 21, 2019
PDT Meeting	Teleconference/Webinar	September 23, 2019
PDT Meeting	Teleconference/Webinar	October 15, 2019

Table 6-2. Government-to-government consultation summary.

Action	Location	Date
Seminole Nation of Oklahoma	-	-
Meeting	Teleconference/Webinar	April 2, 2018

Action	Location	Date
Meeting	Teleconference/Webinar	January 4, 2019
Seminole Tribe of Florida	-	-
Meeting	Teleconference/Webinar	February 23, 2018
Meeting	Hollywood, Florida	August 16, 2018
Meeting	Teleconference/Webinar	February 12, 2019
Meeting	Hollywood, Florida	May 17, 2018
Meeting	Teleconference/Webinar	June 18, 2019
Miccosukee Tribe	-	-
Meeting	Teleconference/Webinar	June 13, 2018
Meeting	Teleconference/Webinar	January 19, 2018
Meeting	Teleconference/Webinar	August 17 2018
Meeting	Miccosukee Reserve Area	August 24, 2018
Meeting	Teleconference/Webinar	December 18, 2018
Meeting	Teleconference/Webinar	July 15, 2019
Meeting	Teleconference/Webinar	September 23, 2019
Meeting	Teleconference/Webinar	October 25, 2019

6.3 List of Statement Recipients

A Notice of Availability (NOA) of the COP Draft EIS was published in the Federal Register and mailed to interested stakeholders to begin the 45 day review period. Recipients include Federal, State, and local agencies, affected Native American Tribes, and other interested private organizations and individuals as listed below. A complete mailing list is available upon request. A list of statement recipients is provided below.

List of Statement Recipients

Federal

- Federal Emergency Management Administration
- Federal Maritime Commission
- National Center for Environmental Health
- U.S. Department of Agriculture (Natural Resources Conservation Service and U.S. Forest Service)
- U. S. Department of Commerce (National Oceanic and Atmospheric Administration, Florida Keys National Marine Sanctuary, and National Marine Fisheries Service)
- U.S. Department of Homeland Security
- U.S. Coast Guard 7th District
- U.S. Department of Housing and Urban Development
- U.S. Department of the Interior (Bureau of Indian Affairs, National Park Service, Big Cypress National Preserve, Biscayne National Park, Everglades National Park, U.S. Fish and Wildlife Service, U.S. Geological Survey, Office of Environmental Policy and Compliance)
- U.S. Department of Justice
- U.S. Environmental Protection Agency

- U.S. Department of Transportation (Federal Highway Administration)
- U.S. Congressman – Florida Districts 22, 23, 24, 25, 26, 27
- U.S. Senators – Florida

State

- Florida Department of Agriculture and Consumer Services (Office of Agricultural Water Policy)
- Florida Department of Environmental Protection
- Florida Department of Transportation
- Florida Fish and Wildlife Conservation Commission
- Florida Governor's Office
- Florida House Representatives – Districts 32, 33, 34, 35, 36, 37, 38, 39, 100, 101, 102, 103, 104, 105, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120
- Florida State Clearinghouse
- Florida State Senators - Districts 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40
- Florida Division of Historical Resources
- South Florida Regional Planning Council
- South Florida Water Management District

Native American Tribe

- Miccosukee Tribe
- STOF
- Seminole Nation of Oklahoma

County Government

- Broward County Commissioners
- Miami-Dade County Commissioners
- Monroe County Commissioners

Groups and Organizations

- Everglades Law Center
- Florida Wildlife Federation
- Audubon of Florida
- Everglades Coordinating council
- Trust for Public Land
- Sierra Club
- Tropical Audubon Society
- 1000 Friends of Florida
- Defenders of Wildlife
- Fish and Wildlife Foundation of Florida
- National Parks Conservation Association
- Everglades Foundation

The Draft EIS was filed in accordance with ER-FRL-8994-7, Amended EIS Filing System Guidance for Implementing 40 Code of Federal Regulations (CFR) 1506.9 and 1506.10 of the Council on Environmental Quality's Regulations Implementing the NEPA. Copies of the Draft EIS were also posted on the internet at the following address:

http://www.saj.usace.army.mil/About/DivisionsOffices/Planning/EnvironmentalBranch/EnvironmentalDocuments.aspx#

http://www.saj.usace.army.mil/Missions/Environmental/EcosystemRestoration/G3273andS356PumpStationFieldTest.aspx#

6.3.1 Scoping Comments Received and Response

A comment response matrix detailing comments received during the NEPA scoping period is included within **Appendix D.1** (**National Environmental Policy Act Correspondence**). Reference **Table D.1-1**.

6.3.2 Comments Received and Response Draft EIS

Comments received in response to public review of the Draft EIS will be included in the Final EIS.

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