EVERGLADES NATIONAL PARK
United States of America (N76)

STATE PARTY REPORT

ON THE STATE OF CONSERVATION OF

EVERGLADES NATIONAL PARK

January 2020

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1. Executive Summary

In 1993, Everglades National Park was placed on the List of World Heritage in Danger, based on four key threats to its Outstanding Universal Value (OUV): alterations of the hydrologic regime; adjacent urban and agricultural growth; increased nutrient pollution; and impacts to the protection and management of Florida Bay. In response, a series of corrective measures were developed in 2006, to assess progress toward restoration of the site's OUV. In 2012, a suite of hydrological and ecological indicators of integrity was added. The focus of these site-specific conservation efforts is the provision of the necessary clean water to the freshwater marshes and to Florida Bay, by re-establishing flows into the Northeast Shark River Slough (SRS) basin of the park, reducing groundwater seepage losses into the adjacent eastern developed areas, and then redirecting these flows through the Northeast SRS and Taylor Slough marshes to the coastal estuaries.

This 2019 State of Conservation report generally covers the period from May 1, 2018 – April 30, 2019, which matches the water year of 2019 (WY19). During this period conditions within Everglades National Park were not optimal, due to several short periods of high rainfall, separated by prolonged drought conditions. Unlike the large surface water inflows to SRS from the prior 2-3 years that produced higher marsh water levels and longer flooding durations, 2019 was drier overall, so we did not experience a buildup of freshwater fish and macroinvertebrates, or the formation of supercolonies of wading birds along the marsh/mangrove interface. Under these drier conditions, the freshwater marshes in the park experienced reduced water depths and shorter flooding durations, and Florida Bay again experienced hypersaline conditions and persistent algal blooms.

In WY19, in spite of the lower rainfall, continuation of the incremental field tests that reflect early implementation phase of the Modified Water Deliveries (MWD), and C-111 South Dade (C-111) projects, helped to maintain Northeast SRS and Taylor Slough inflows above the 20-year average. Water quality entering from the upstream Everglades has generally continued to improve as well. Unfortunately, lower water levels in the upstream Water Conservation Areas during May through August 2019 contributed to a spike in total phosphorus at several park inflow sites, suggesting an upcoming exceedance of the established state and federal water quality standards. All of these fluctuations in hydrologic conditions indicate that the park does not currently receive sufficient flows of clean water during average to dry years to support more natural marsh water depths and flooding durations, stabilize estuarine salinities, and advance the recovery of healthy native plant and animal populations.

Although hydrologic conditions were suboptimal for this reporting period, water management decisions continue to prioritize a restored Everglades. Full implementation of the recently completed MWD, and C-111 projects will occur in August 2020, through the completion of the Combined Operational Plan. These water management improvements should begin to deliver higher volumes of dry season inflows, addressing the requirements of the first two corrective measures. Water quality improvements under the State of Florida's Everglades Construction Project (ECP) were completed by 2016, and the expanded treatment areas included in the ongoing Restoration Strategies project are addressing the requirements of the third corrective measure. Florida Bay has been slowly recovering following the seagrass die-off and algal blooms of 2015–2016, and Hurricane Irma in 2017. Achieving the improved salinity and seagrass conditions envisioned in the fourth corrective measure are dependent on larger volumes of freshwater, which

will begin to be achieved by the Central Everglades and Everglades Agricultural Area Reservoir projects, which will redirect water flows from Lake Okeechobee, back into the Everglades. These two projects were authorized in 2016 and 2018, respectively, and are currently in design.

Additional funding commitments for the next phase of Everglades restoration began in 2019, and represent a significant new milestone in these efforts. The federal and Florida state governments have both committed to substantial funding increases to accelerate many critical Everglades Restoration projects. Approximately $730 million was directed to the rehabilitation of the Herbert Hoover Dike around Lake Okeechobee, which will be completed by the end of 2022. Funding increases for the Central Everglades Planning Project (CEPP), which now includes the Everglades Agricultural Area Reservoir (EAAR), have accelerated the planned completion of this $3.2 billion effort to 2027, and the State's $880 million Restoration Strategies (RS) project will be in place to provide additional water quality treatment for the additional southward flows by 2026. Finally, the Tamiami Trail Next Steps (TTNS) Phase 2 project, that will raise the remaining roadway and add six small bridges, is expected to be complete by early 2023, along with three new CEPP water conveyance features.

Completion of all of these next generation projects over the coming years is critical to restoring a more historic hydrologic regime. As an example, the combination of the CEPP and EAAR projects is expected to send an additional 370,000 acre-feet of clean water to the Everglades by 2027. The majority of these new water deliveries to the park are expected to occur in the dry season, when the freshwater wetlands and estuaries need it the most. These proposed water flow and water quality improvements are expected to fully achieve the site's Desired State of Conservation.

This report, prepared in 2019 for examination by the World Heritage Committee at its 44th session, is the fourth biennial report to be submitted by the NPS that includes the agreed upon physical and ecological indicators of integrity. This report follows the recommended format of the World Heritage Committee and responds to the recent decisions of the Committee. It provides updated information on progress toward implementing the corrective measures and describes recently detected changes in the status of the indicators of integrity. The information presented is intended to assist in decision-making for the state of conservation of this site, which is on the List of World Heritage Sites in Danger. The report will also gauge the overall response of Park ecosystems to factors such as changes in water management, climatic change, invasive exotic species, and implementation of Everglades Restoration projects.

In spite of the long history of alterations to the Everglades watershed, the natural resources protected within Everglades National Park provide key ecosystem services to the regional human population. These services include water storage and treatment, recharge of the surficial aquifer, buffering against the impacts of tropical storms and hurricanes, as well as economic benefits associated with tourism, including recreational and commercial fishing. In 2011, ENP-related tourism generated $146.8 M USD in economic benefit locally, and provided 2,408 jobs. Benefits to the wider, world community include: 1) the protection and preservation of a unique mix of temperate and subtropical habitats and species, 2) the maintenance of a refuge for rare, threatened, and endangered species, and 3) climate modification benefits from carbon sequestration within the freshwater wetlands, mangrove forests, and seagrasses along the Gulf Coast and within Florida Bay.

Construction of the MWD and C-111 foundation projects was complete in 2018. This provided the capacity for additional water flows into the Northeast SRS and Taylor Slough regions of the park. These two locations have not seen these types of high water conditions in decades. Though unplanned and uncontrolled, these unusual wet and dry weather events give us insight into how the ecosystem may respond to future flow restoration conditions and increased water storage. There are some notable outcomes that confirm that Everglades restoration efforts are on track:

- There have been no large-scale, damaging fires within Everglades National Park in over a decade,
- In spite of seagrass die-offs and hurricanes, Florida Bay continues to support healthy sportfish populations and a world-class recreational fishery,
- Hurricane Irma's record rainfall did not cause extreme or prolonged flooding in adjacent agricultural and urban areas, nor did it result in nutrient enriched or contaminated water entering into the park,
- With 3.3-miles of Tamiami Trail bridging, and the MWD and C-111 project infrastructure now complete, we at the cusp of realizing significant improvements in water deliveries to Northeast SRS and Taylor Slough.

World Heritage Committee Decision 43 COM 7A.3
Forty-Third Session (Baku, Republic of Azerbaijan, 2019)

Everglades National Park (United States of America) (N76)
Decision: 43 COM 7A.3

The World Heritage Committee,

1. Having examined Document WHC/19/43.COM/7A.Add,

2. Recalling Decision **41 COM 7A.1**, adopted at its 41st session (Krakow, 2017),

3. Welcomes the progress achieved in implementing the 2006 corrective measures and notes with satisfaction that their full operational benefits are expected to be in place by mid-June 2020, that water quality targets have already been met and that "supercolonies" of wading birds have returned to the property;

4. Commends the State Party for also implementing next generation restoration projects in order to achieve the Desired state of conservation for the removal of the property from the List of World Heritage in Danger (DSOCR) by 2025-2026, and congratulates it for committing as much as USD 2.5 billion over four years to advance the restoration of the Everglades;

5. Notes with concern the ongoing threat from invasive alien species (IAS), and requests the State Party to ensure a continued, long-term allocation of resources to control the existing IAS inside the property, and for the management strategy to emphasize prevention and early detection with rapid response measures;

6. Appreciates that the General Management Plan (GMP) of the property aims to respond to the impacts of climate change, including sea-level rise, and reiterates its requests to the State Party to submit the GMP to the World Heritage Centre and IUCN;

7. Also recalling its established position on the incompatibility of oil and gas exploration and exploitation with World Heritage status, notes with utmost concern the prospect of exploratory drilling within the Water Conservation Areas located upstream of the property, and urges the State Party to ensure a detailed Environmental Impact Assessment (EIA) that assesses the possible impacts on the Outstanding Universal Value (OUV) of the property is undertaken, in line with the IUCN World Heritage Advice Note on Environmental Assessment, and to submit the EIA to the World Heritage Centre for review by IUCN as a matter of priority and before conducting any hydrocarbon drilling activities;

8. Also reiterates its request to the State Party to inform the World Heritage Centre about the potential for hydraulic fracturing projects in proximity of the property and the proposal of a utility transmission line along its eastern border;

9. Also requests the State Party to submit to the World Heritage Centre, by **1 February 2020**, an updated report on the state of conservation of the property and the implementation of the above, for examination by the World Heritage Committee at its 44th session in 2020.

10. Decides to retain Everglades National Park (United States of America) on the List of World Heritage in Danger.

2. Responses to the 2019 Decisions of the World Heritage Committee

Decision 3: Welcomes the progress achieved in implementing the 2006 corrective measures and notes with satisfaction that their full operational benefits are expected to be in place by mid-June 2020, that water quality targets have already been met and that "supercolonies" of wading birds have returned to the property;

Full implementation of the new Combined Operational Plan (COP) is ongoing, but the schedule has stalled slightly, and is now expected in August 2020. This new water management plan includes a revised Tamiami Trail Flow Formula that will improve water deliveries to Everglades National Park by changing the timing, location, and volume of water delivered to Shark River Slough (SRS). The largest COP water flow benefit will be an increase in dry season water deliveries, which will extend the duration of flooding in the wetlands of Northeast SRS and Taylor Slough, and incrementally improve water quality.

There has been a long-term trend of improving inflow and downstream marsh water quality conditions in the park as measured by total phosphorus (the limiting nutrient in the Everglades) and downstream periphyton health. During this reporting period, water quality in the park either improved or remained stable, except at two monitoring stations in Shark River Slough. These two marsh stations, near the L-29 inflow canal, have elevated levels of total phosphorus relative to the 8 mg L-1 long-term target for SRS, and both of these locations exhibit long-term increasing trends. High total phosphorus concentrations were observed in SRS from March through August 2019, consistent with relatively low water levels in the upstream canals. These relatively high total phosphorus concentrations (> 10 mg L-1) for such an extended duration is coincident with a preliminary exceedance of the long-term compliance limit for SRS in 2019 (for water quality compliance purposes, the water year runs from October 2018-September 2019).

This phenomenon of increased total phosphorus in SRS inflows is linked to drying in the upstream Water Conservation Area 3A marsh, and these phosphorus spikes frequently coincide with the opening of the Northeast SRS inflow structures after long periods of zero flow. Federal and state water quality and water management experts are currently working to develop possible remedies for the elevated total phosphorous concentrations periodically observed in Shark River Slough inflows. Our expectation is that the combination of the revised Tamiami Trail Flow Formula, a new Northeast SRS inflow structure, and adaptive water management strategies, will improve the water quality conditions at these sites. All of these activities are integrated into the Combined Operational Plan, which will be implemented in August 2020.

Periphyton, an algal/diatom community that represents a key component of Everglades' net primary productivity and ecosystem health, responds quickly to changes in environmental conditions. During WY19, periphyton tissue total phosphorous and periphyton biomass at sites in SRS and Taylor Slough met the established criteria for marshes un-impacted by high nutrient influx. Relative to water years 2017 and 2018, there was a slight increase in periphyton biomass in Northeast Shark River Slough during WY19. These periphyton studies are ongoing, and continued monitoring will track responses to changing water management actions.

The Everglades experienced suboptimal hydrological conditions during water year 2019, with 10 months of below normal rainfall and 2 isolated months of extremely high rainfall. These wet

months triggered reversals of the seasonal water level recession patterns, impacting the availability of marsh prey fish, and led to a reduction in region-wide wading bird nesting success. Preliminary 2019 data indicates that the Everglades experienced widespread failures of Wood Stork nesting, the abandonment of Great Egret nests in many colonies, and failure of many bird species to initiate nesting in the routinely monitored colonies in the park. These swings in ecosystem productivity are expected, given typical seasonal and annual variations in Everglades rainfall patterns, and current limitations in dry season water deliveries.

A larger percentage of the total wading bird nesting effort has continued to return to the marsh/mangrove ecotone in the park, but we remain well below the established 70% goal (2018 data, 36%). Wood Storks did nest earlier in the dry season (in January 2019 vs February-March in 2017-2018), getting closer to the target nesting initiation date seen pre-drainage of November-December, which supports higher rates of fledging survival. Finally, the interval between exceptional White Ibis nesting years has been increasing, but we currently meet the metric of every 1-2 years due to the 2018 supercolony event. Our next State of Conservation report will help us determine if recent positive trends in wading birds nesting will continue, following completion of our initial phase of foundation restoration projects (such as the MWD and C-111 projects).

Decision 4: Commends the State Party for also implementing next generation restoration projects in order to achieve the Desired state of conservation for the removal of the property from the List of World Heritage in Danger (DSOCR) by 2025-2026, and congratulates it for committing as much as USD 2.5 billion over four years to advance the restoration of the Everglades;

In September 2019, the Army Corps of Engineers updated their Integrated Delivery Schedule. The Integrated Delivery Schedule provides a forward-looking snapshot of the recommended design and construction schedule and sequencing for the South Florida Ecosystem Restoration (SFER) Program, and lays out the proposed sequencing and funding strategy through 2030. Last year's (2019) funding of just over $400 million marked the highest level of financial commitment to the SFER Program to date. The 2020 federal budget, signed into law on December 20, 2019, includes $200 million for the Army Corps of Engineers SFER projects. The State of Florida's FY20 budget includes $256 million for SFER projects, and more than $300 million in additional funding for related water quality and water resources improvements. Combined, that's a total of $756 million in funding supporting Everglades Restoration in FY20.

This latest project delivery schedule update proposes to accelerate three new water conveyance structures included in the $3.3 billion multi-year Central Everglades Planning Project (CEPP), and these structures will specifically route additional water from the upstream Water Conservation Areas southward toward the park. In a parallel effort, the Florida Department of Transportation and the Federal Highway Administration have jointly committed $103.5 million to accelerate the completion of 6.5-miles of roadway raising and new conveyance features included in the Tamiami Trail Next Steps (TTNS) project. The combination of TTNS roadway improvements and these early CEPP water conveyance features will eliminate a long standing flow constraint to Northeast Shark River Slough, and create an opportunity to redirect substantially high flows southward into Everglades National Park wetlands and Florida Bay, beginning in 2023. It's important to keep in mind that while these initial CEPP and TTNS improvements appear to be funded, the Integrated

Delivery Schedule simply identifies project funding and sequencing priorities, while implementation is dependent upon future state and federal funding commitments.

Decision 5: Notes with concern the ongoing threat from invasive alien species (IAS), and requests the State Party to ensure a continued, long-term allocation of resources to control the existing IAS inside the property, and for the management strategy to emphasize prevention and early detection with rapid response measures;

We appreciate the recognition that invasive species pose a significant threat to the park. Though the individual species involved are often quite different, many other parts of the world are challenged by this same threat, and the impacts of invasive species on these sensitive ecosystems can be profound. Efforts to control invasive species within the park are challenged by the expansive and remote landscape, which makes it more difficult to detect incipient invasions and also expensive to manage them. Additionally, the National Park Service has management jurisdiction only over the park, but new invasive populations originate primarily from adjacent areas. We therefore must work with our Federal, State, and Local partners to effectively address the threat of invasive species in and around the park.

In 2015, the Department of the Interior's Office of Everglades Restoration Initiatives invited all land management agencies and authorities within the greater Everglades ecosystem who work on invasive species to develop a "Strategic Action Framework." This document focused on helping the invasive species management practitioners recognize and focus on priority topics that would be strategically important, and prevention and Early Detection/ Rapid Response (EDRR) were key priority topics. Since that time, risk assessment methods have been developed to aid in determining appropriate responses to new species, and additional invasive species management capacity has been added by our State of Florida partners to focus on invasive animals. All of these improvements are being incorporated into an ongoing update of the Strategic Action Framework, which is expected to be completed in 2020.

The park has been working to increase our efforts to manage invasive species in conjunction with our State partners. These efforts include hiring new staff to focus on invasive animal species and creating a group devoted to invasive-species management. The NPS is also active in supporting and participating in interagency efforts to coordinate management and research activities and successfully identifying and rapidly responding to new populations of invasive plants and animals in the park. In 2019, approximately $600,000 was spent on invasive plant management efforts within Everglades National Park, with 2/3 of this funding provided by State agencies and 1/3 provided by the NPS. Approximately $320,000 was spent on invasive animal managements in Everglades National Park, and approximately 1/3 of this funding was provided by State agencies, and 2/3 by NPS. An additional $4 million was also spent in 2019 on the "Hole-in-the-Donut" wetland restoration project (a wetland mitigation bank managed by the park) which eliminated approximately 350 acres (141 hectares) of invasive plants.

In 2020, the National Park Service has committed $900,000 for invasive species management, with $500,000 allocated to invasive plant management, and $400,000 allocated for invasive animal management. We also expect to spend a similar amount as we did in 2019, on the Hole-in-the-Donut wetland restoration project. This funding commitment is a substantial increase in NPS

funding to manage invasive species, and will be matched by our State partners' investments in invasive species management within Everglades National Park. The funding will focus on increasing staff capacity to manage invasive animals in and around the park, funding partner agency research into invasive species management, and improving early detection and rapid response efforts to keep non-native species from establishing populations in the park. The park is working to ensure a consistent commitment of funding to invasive species management programs in coming years.

Decision 6: Appreciates that the General Management Plan (GMP) of the property aims to respond to the impacts of climate change, including sea-level rise, and reiterates its requests to the State Party to submit the GMP to the World Heritage Centre and IUCN;

The park's General Management Plan was released in 2015 and is included in this update to the Committee. (It is available online here: https://www.nps.gov/ever/learn/management/ever-general-management-plan.htm) The NPS preferred alternative was selected and aims to restore natural ecosystems while also providing improved opportunities for quality visitor experiences. The General Management Plan recommended that approximately 42,000 acres (17,000 ha) should be conserved as wilderness, and 43,100 acres (17,441 ha) should be proposed wilderness within the park's 109,000 acre (44,110 ha) East Everglades Addition (approximately 90% of the park is already designated as wilderness). All of this is good news for a restored Everglades because a conserved ecosystem, protected as wilderness, will respond more favorably to increased water flow into the park.

The plan also identified several issues, including potential impacts from climate change, storm surge, and sea level rise, as well as the cost and economic feasibility of new development at Everglades National Park. The park has taken an active leadership role to address these challenges by reevaluating all of our NPS operations and visitor activities with reference to the anticipated impacts from climate change. We are preparing for and mitigating climate change impacts by activities such as increasing use of alternative transportation, renewable energy, and other sustainable practices. More on this can be found in Volume 1 of the GMP, pages 30-31.

Everglades National Park is also a member of the NPS Climate Friendly Parks Program, and the park developed a Climate Action Plan in 2005. As part of the plan, three key strategies were developed which guide park decisions: 1) reduce fuel use and greenhouse gas emissions from transportation services, 2) reduce greenhouse gases through buildings and facilities management, and 3) increase climate change outreach and education. More can be found here: https://www.nps.gov/subjects/climatechange/upload/EVER_CFP_Action_Plan_508Compliant.pdf

Decision 7: Also recalling its established position on the incompatibility of oil and gas exploration and exploitation with World Heritage status, notes with utmost concern the prospect of exploratory drilling within the Water Conservation Areas located upstream of the property, and urges the State Party to ensure a detailed Environmental Impact Assessment (EIA) that assesses the possible impacts on the Outstanding Universal Value (OUV) of the property is undertaken, in line with the IUCN World Heritage Advice Note on Environmental Assessment, and to submit the

EIA to the World Heritage Centre for review by IUCN as a matter of priority and before conducting any hydrocarbon drilling activities;

This specific concern originates from a Florida Department of Environmental Protection (FDEP) permit request submitted by Kanter Real Estate LLC, for exploratory well drilling on five acres (two hectares) in Broward County, approximately 40-miles (64 km) northeast of the park. FDEP denied the permit request in 2015, and the company filed an appeal. In February 2019, the First District Court of Appeal reversed FDEP's permit denial, stating that FDEP relied upon an un-adopted rule that would prohibit all exploratory oil drilling in the Everglades, which lacks statutory authority.

In June 2019, the U.S. House of Representatives passed a bill banning oil drilling within the Everglades. This action specifically prohibits the Army Corps of Engineers from issuing a Clean Water Act Section 4 permit that involves dredging of filling wetlands within Water Conservation Area 3, upstream of the park. In response, the U.S. Army Corps of Engineers informed Kanter Real Estate LLC that they would require the preparation of a formal Environmental Impact Statement (EIS) for any proposed exploratory drilling on their property. This EIS would be a comprehensive document that would likely take more than a year to produce. The Army Corps EIS review process involves public meetings, and provides opportunities for written public comments and requires extensive consultation with government agencies. The National Park Service is committed to working with the Army Corps of Engineers and the Florida Department of Environmental Protection on the review of any environmental impact assessment that would be completed for proposed exploratory drilling in the Everglades.

On January 15, 2020, Florida Governor DeSantis announced plans to buy approximately 20,000-acres (8,000 ha) of land and associated drilling rights in the Everglades, including the parcels of land in Broward County targeted for potential oil and gas drilling. If this plan goes forward, it would permanently protect these lands from oil and gas production. In response, the Kanter family has formally agreed to sell this land to the State of Florida for $16.5 million.

Decision 8: <u>Also reiterates its request</u> to the State Party to inform the World Heritage Centre about the potential for hydraulic fracturing projects in proximity of the property and the proposal of a utility transmission line along its eastern border;

A bill called SB 200 won approval from the Florida Senate Environment and Natural Resources Committee in a November 5, 2019 vote. The proposed bill would ban hydraulic fracturing operations from taking place anywhere in Florida. SB 200 would also ban matrix acidification, a process that uses large volumes of acid to dissolve rock, which has been proposed as an alternative to fracking. Unfortunately, the full Florida Senate is did not approve the bill in a vote in January 2020. That vote prompted the January 15, 2020 announcement by Governor DeSantis to purchase 20,000 acres (8,000 ha) of land and drilling rights in the Everglades. The state of Florida expects to complete this purchase by the end of March 2020.

In reference to proposed utility transmission lines, Florida Power & Light (FPL) submitted an application in 2009 to the State of Florida and the U.S. Nuclear Regulatory Commission, for a new transmission line corridor as part of a proposed expansion of their energy production at the Turkey Point Nuclear Power Plant. The FPL Site Certification Application proposed to construct two new

nuclear reactors (units 6&7). At this time, their application is on hold, since an acceptable manufacturer of nuclear reactors has not been identified.

FPL did propose a series of alternative transmission corridors. Their original West Secondary Corridor would have potentially run through FPL owned wetlands within Northeast Shark River Slough. Several outside groups (the Miami-Dade Limestone Products Association, Miami-Dade County, and the National Parks Conservation Association) submitted alternative western corridors, as allowed by the Power Plant Siting Act. In 2012, FPL closed out their alternative review process with the State of Florida. FPL defined their West and East Preferred Corridors, following an extensive State administrative hearing process. The West Preferred Corridor runs west then north, from the Turkey Point plant through primarily agricultural and rural lands. The corridor then shifts eastward, following the canal alignment passing well east of the park's border. A legal agreement was signed in 2012, between FPL and the Miami-Dade Limestone Products Association, to use a portion of rock-mining owned lands for this West Preferred Corridor. The West Preferred Corridor would avoid the wetland impacts associated with FPL's original West Secondary Corridor, and keeps the proposed transmission line east of Northeast Shark River Slough. At this time, activities related to any proposed FPL Turkey Point transmission lines is on hold, since the construction of the planned nuclear units has not moved forward. More information on the West Preferred transmission corridor can be found here:
https://parkplanning.nps.gov/document.cfm?parkID=374&projectID=37220&documentID=41519

3. Threats to the Desired State of Conservation

Everglades National Park (ENP) was established in 1947 with a mission unique within the National Park Service (NPS). In contrast to earlier parks in the western United States featuring dramatic landscapes, this park was set aside to protect the abundant and diverse biological resources of its vast subtropical wetlands and coastal/marine ecosystems. Achieving this mission has proven challenging in light of the extensive human modifications to south Florida, resulting primarily from alterations in hydrology and land use. The park is located at the southernmost end of the highly modified greater Everglades ecosystem that originates in the Kissimmee River headwaters near Orlando, Florida. The flow of water in this once continuous watershed was altered by the construction of canals and levees beginning in the 1880's. The initial private and State of Florida drainage efforts were expanded by the U.S. Army Corps of Engineers, creating the Central and Southern Florida (C&SF) Flood Control Project, which was authorized by the U.S. Congress in 1948. The primary result has been unnaturally large discharges from Lake Okeechobee to the Caloosahatchee and St. Lucie estuaries, and limited flows southward into the Everglades and southern estuaries. The C&SF Project created a series of five Water Conservation Areas (WCAs) upstream of the park, which act as shallow reservoirs to retain wet season rainfall and provide dry season water deliveries. These WCAs have further altered the volume, distribution, and timing of water deliveries to the park.

These long-term changes in the upstream watershed have had tremendous implications within ENP: Northeast SRS and Taylor Slough are persistently too dry; Western Shark River Slough (Western SRS) is frequently too wet; and the west coast estuaries and Florida Bay are generally starved for freshwater and suffer from high salinity levels. This has promoted mangrove

encroachment into the adjacent freshwater wetlands. The altered wetland and estuarine functions have profoundly affected both the habitats and the fish and wildlife that depend on them.

In recognition of these threats, and at the request of the U.S. Government, ENP was inscribed on the List of World Heritage in Danger in 1993. Four major threats have negatively affected the park for many decades, and were highlighted at the time of the World Heritage listing.

Threat 1. Alterations of the hydrologic regime have resulted in changes in the volume, distribution, and timing of water flows to the park.

> **Response:** All of the required East Everglades land acquisition was completed in 2016, and the flood mitigation components needed to protect the 8.5 Square Mile Area were completed by 2018. In 2019, construction was completed on all of the Modified Water Deliveries (MWD) and Canal-111 South Dade (C-111) foundation project components. We are currently receiving increased water volumes and improved flow distribution benefits within Northeast SRS and Taylor Slough as a result of these projects. Upcoming next generation restoration projects, such as Phase 2 of the Tamiami Trail Next Steps (TTNS) roadway improvement project, the Western Everglades Restoration Project (WERP), the Central Everglades (CEPP), and the Everglades Agricultural Area Reservoir (EAAR), all show great promise for additional improvements to water flows into the park.

Threat 2. Adjacent urban and agricultural growth has resulted in flood protection actions (lowering canal stages along the eastern ENP boundary), which can drain the park's eastern wetlands. These developed areas are also locations where invasive exotic species enter the park from man-made environments.

> **Response:** A 5-mile (8 km) long partially penetrating seepage barrier was constructed in 2012 along the park's northeastern boundary by a local rock-mining company. This seepage barrier has reduced seepage out of the immediately adjacent Park wetlands by approximately 25%. By 2019, all of the planned MWD and C-111 flood mitigation and water detention areas, and their associated pumping stations, were completed. This has created a 20-mile (32 km) long seepage management system that extends from the 8.5 Square Mile Area down to the Frog Pond area.
>
> The C-111 north and south detention areas and their associated pumps, which extend over the lower 15-miles (24 km), have created a nearly continuous hydraulic ridge between the higher water levels in the Everglades and the lower water levels in the eastern developed areas. During 2018-2019 additional water was brought in from the upstream water management system (when excess water was available). The combination of local seepage return flow and these supplemental flows produced the highest inflows into Taylor Slough since the 1960's. This system has reduced some of the impacts of the lowered canal stages along the eastern urban/agricultural areas, thereby retaining more surface water in the wetlands of the park. While these features are quite helpful, the costs of operating the pump stations is high, and a significant portion of the pumped flows return to the east, due to the steep water level gradients.

Threat 3. Increased nutrient pollution has resulted from the transport of agricultural and urban runoff into the park, causing alterations in native flora and fauna.

Response: The State of Florida's Everglades Construction Project (ECP) constructed 45,000 acres (18,210 ha) of man-made Stormwater Treatment Areas (STAs), which were fully operational in 2012. Since then, the State's Restoration Strategies (RS) Project expanded the STAs by an additional 12,000 acres (4,856 ha), and more than 20,000 acres (8,093 ha) of Flow Equalization Basis (FEBs) have been added to regulate the rate of flows and reduce nutrients before the water enters several of the STAs. While the Restoration Strategies project is not expected to be fully operational until 2029, we have seen substantially improved water quality throughout much of the Everglades marsh. Upcoming projects, such as the Broward County Water Preserve Areas, the Western Everglades Restoration Project, the Central Everglades Project, and the Everglades Agricultural Area Reservoir, include additional planned water detention and water quality treatment features, and show promise for further improving water quality in the park.

Threat 4. Impacts to the protection and management of Florida Bay have resulted from reduced or re-directed freshwater flows, and increased nutrient loadings.

Response: Implementation of the MWD and C-111 projects has resulted in higher water levels and longer flooding durations in the wetlands in Northeast Shark River Slough and Taylor Slough. This creates a slightly higher flow gradient to direct water flows into Florida Bay. By 2019, the expanded C-111 detention areas and two new C-111 Spreader Canal Western pump stations were in place, adjacent to the Taylor Slough headwaters. These features reduce seepage losses from Taylor Slough and have slightly increased water flows into Florida Bay. As the next phase of upstream flow restoration projects come online (particularly the Tamiami Trail Next Steps and Central Everglades Projects), larger volumes of freshwater will be delivered through Northeast Shark River Slough and Taylor Slough and ultimately into Florida Bay.

3a. Progress in Implementing the 2006 Corrective Measures that Address Threats to the park

Substantial progress has been made since the last State of Conservation (SOC) report, in implementing the majority of the corrective measures developed in 2006. In 1994, three water management foundation projects were proposed to address the threats to Everglades National Park, identified at the time the site was added to the List of World Heritage in Danger. Today, all three of these initial water flow and water quality restoration projects have been constructed, and their full operational benefits should be in place by approximately June 2020.

The results in this 2019 report indicate that flows into Northeast SRS and Taylor Slough are trending upward, while constraints associated with Tamiami Trail and eastern flood protection still need to be resolved. Water quality has improved substantially throughout much of the Everglades marsh, but we still need to resolve SRS water quality exceedances, particularly as we transition quickly, following marsh dry downs. These findings support that completion of these initial foundation projects was not sufficient to deliver the required volumes of clean water needed to achieve our Desired State of Conservation. Fortunately, a series of four next generation restoration projects have been authorized, and are moving forward, to address these performance deficits. The status of each of the 2006 corrective measures is described below, relative to the originally identified threats.

Threat 1 - Alterations of the Natural Hydrologic Regime

Corrective Measure (CM) 1 focuses on re-establishing water flows into the Northeast Shark River Slough (SRS) watershed of Everglades National Park. This action requires bringing all of the privately owned lands in the East Everglades Expansion Area into public ownership (CM 1A), and providing flood protection to any remaining developed areas (CMs 1A/B).

Reestablishing more natural water flows into Northeast SRS also requires the removal of barriers to natural sheetflow (both within the upstream Water Conservation Areas and along Tamiami Trail) to reestablish more natural marsh connectivity (CM 1C). All of these actions will support our efforts to increase water flows back into the historic sloughs and marl prairies, and to restore more natural water depths and flooding durations within the eastern watersheds of the park.

Corrective Measure 1A addresses the U.S. Congressional requirement to complete acquisition of approximately 44,000 hectares (109,000 acres) of privately owned land in the East Everglades, and flood protecting the remaining developed sites, as a prerequisite to restoring water flows into Northeast SRS.

> **Status – East Everglades Land Acquisition - Completed:** As of July 2016, all 44,000 hectares of the East Everglades were acquired and placed into public ownership. A required land exchange with the Florida Power and Light Company (relocating a planned utility corridor) was completed, including transfer of title. The three commercial airboat operations and two radio tower sites along Tamiami Trail were also brought into federal ownership. The airboat operations now serve as concessionaires, operating under multi-year agreements with the National Park Service.
>
> **Status – Flood Protection for Commercial Sites - Underway:** Protecting the remaining five developed sites along Tamiami Trail from flooding is required before we can significantly increase water flows into Northeast Shark River Slough. Flood protection plans for these sites are currently being implemented (through a combination of government and private actions). These flood protection cures will enable continued business services at the commercial airboat and radio tower sites, as restoration moves forward. The initial flood protection features are expected to be in place to allow the Modified Water Deliveries and C-111 South Dade projects to be fully operational by August 2020. Additional longer-term cures will be needed to make these sites compatible with future CERP restoration goals.

Corrective Measure 1B recognized the need to complete flood mitigation features in the 8.5 Square Mile Area and to develop a new water control plan, prior to implementing the MWD project full flow benefits.

> **Status – Flood Mitigation in the 8.5 Square Mile Area - Completed:** Construction of the originally planned flood mitigation features that protect the 8.5 Square Mile Area (SMA) were initially completed in 2012, and an additional seepage collection canal, water control structure, and additional internal levees in the 8.5 SMA detention cell were completed in 2018-2019. The features within the 8.5 Square Mile Area not only provide flood mitigation to the agricultural and residential lands, but also are part of the seepage management system along the eastern border of the park. Additionally, the 8.5 SMA detention cell is also linked to Corrective Measure 4A, since the C-111 North Detention Area receives stormwater runoff from the upstream 8.5 SMA features (via the S-357 pump station and detention cell). Monitoring of these

features to determine their year-round benefits is underway. Full operation of this system is linked to the completion of the Combined Operational Plan, expected in August 2020.

Status – Development of MWD Water Control Plan - Underway: Corrective Measure 1B recognized the need to develop a new water control plan that will improve water deliveries and promote increased sheetflow into ENP, while maintaining flood control and water supply requirements. This water control plan has been addressed through a combination of incremental field testing of the evolving water management infrastructure, toward the development of a final Combined Operational Plan (COP) that will control the operations of the combined Modified Water Deliveries and C-111 project infrastructure. During the last reporting period (2017–2018), we completed the first incremental field test (increments 1.1-1.2), and in September 2018, we initiated increment 2 operations. Under this 2nd increment, we further relaxed the operational constraints and raised the L-29 canal stage by up to one foot, allowing for increased water flows into Northeast Shark River Slough.

The final COP is building on the lessons learned during the more than four years of the incremental field tests. During 2019, we completed three rounds of hydrological, ecological, and water quality modeling, as well as developed a new recommended operational plan (referred to as Alternative Q+ in the Army Corps of Engineers, Draft Environmental Impact Statement (EIS). The draft EIS has undergone interagency reviews by our federal, state, and tribal partners. In February 2020, the Draft EIS should be out for full public review. The Final EIS will be prepared by June 2020, and the Army Corps is expected to release their Record of Decision in August 2020. These documents describe in detail the environmental impacts and level of restoration benefits and that can be achieved, following completion of the full suite of MWD and C-111 project components.

Corrective Measure 1C recognizes the benefits of removing barriers and artificial short circuiting to enhance sheetflow and marsh connectivity between ENP and the upstream Everglades. These barriers included the levees and canals within Water Conservation Area 3 (WCA 3), which either block sheetflow or rapidly redirect flows across the landscape upstream of the park. The final barrier to sheetflow entering the park is the Tamiami Trail roadway. When the corrective measures were developed in 2006, both the Modified Water Deliveries project and the regional-scale Comprehensive Everglades Restoration Plan (CERP) contemplated improving water conveyance, sheetflow, and marsh connectivity between WCA-3A, WCA-3B, and Northeast Shark River Slough. The MWD project would accomplish this by constructing water conveyance structures in the levees between WCA-3A/3B and Northeast Shark River Slough, and adding structures/plugs in the L-67A and L-67C canals to promote sheetflow and reduce short circuiting. CERP contemplated going further, degrading large portions of these levees and backfilling long segments of their associated canals.

Status – MWD/TTNS/CERP Project Sheetflow and Marsh Connectivity - Underway: While the Modified Water Deliveries project was formally closed out without constructing the planned water conveyance and sheetflow improvements in the upstream WCAs, these features were carried over into the Central Everglades Planning project design. In addition, a pilot CERP project referred to as the Decompartmentalization Physical Model (DPM) constructed the first water control structure to move water across the L-67A levee between WCA-3A and

WCA-3B, and has tested three options for degrading the downstream L-67C levee, and backfilling its associated canal.

The $97 million Tamiami Trail Next Steps (TTNS) Phase 1 project began construction in 2016 and was completed in Feb. 2019, adding 2.3-miles of additional bridging and adjacent roadway raising to further promote sheetflow and marsh connectivity. The Phase 2 project envisioned raising and reconstructing the remaining 6.5-miles of un-bridged roadway and constructing six smaller bridges to replace existing culverts. In July 2018, the state and federal agencies completed an NPS sponsored Value Analysis workshop, which developed the initial Phase 2 design. In October 2018, the State of Florida committed $43.5 million for the TTNS phase 2 project design and construction. The NPS received a $60 million grant from the Federal Highway Administration in May 2019 to cover the federal match, bringing the project funding to $103.5 million. The NPS is on track to complete the preliminary design by March 2020, the construction contract award is expected in October 2020, and construction is expected to be substantially complete by the end of 2022. This action will fully remove the eastern Tamiami Trail flow constraint and meet the future CERP water conveyance requirements.

The planned southern components in the Central Everglades Planning project (CEPP) included three additional water conveyance structures in the L-67A levee between WCA-3A and WCA-3B, and expanded levee removal and canal backfilling at L-67C. The design and construction of these three planned Central Everglades water conveyance structures were recently accelerated, and are now expected to be completed by the end of 2022. This means that the combination of the TTNS roadway project and these early CEPP conveyance features will allow us to further improve water deliveries to the park beginning in 2023, approximately three years earlier than planned in the 2018 Integrated Delivery Schedule (IDS). Full implementation of the Central Everglades (CEPP) features, and the Everglades Agricultural Area Reservoir (EAAR) have also been proposed to be accelerated with their completion moved to 2027, three to four years earlier than the previous IDS. While the delivery of these full project benefits is dependent on future federal and state appropriations, the planned acceleration reflects an increased commitment to these longer-term flow restoration projects, which will greatly increase water flows to the park and reduce many of the adverse impacts of upstream water management.

Threat 2 – Adjacent Urban and Agricultural Growth

Past actions to improve flood protection in adjacent urban and agricultural areas have reduced water levels within ENP wetlands and redirected freshwater flows away from Florida Bay, due to increased eastward groundwater seepage. This problem could be compounded without improved seepage management because Everglades restoration progressively increases water flows into the park. Corrective measure 2 addresses these ENP groundwater losses, through the development of improved seepage management systems. First, federal lands within ENP needed to be exchanged with lands owned by the State of Florida (CM 2A) to support construction of the C-111 project water detention areas and pump stations (CM 2C). Then, the Combined Operational Plan (COP) will address water management operations and optimize the return of groundwater seepage back to the park (CM 2B). Reducing seepage losses also helps to reestablish flows into the historic sloughs, thereby restoring water depths and flooding durations within the park.

Corrective Measure 2A recognizes that completion of a land exchange between the South Florida Water Management District (SFWMD) and NPS is required to construct the C-111 North and South Detention Areas (NDA and SDAs).

> **Status – C-111 Land Exchange – Completed**: The land exchange between the NPS and the SFWMD was approved by Congress in 2011, and no additional real estate within ENP was required for completion of the C-111 NDA and SDAs.

Corrective Measure 2B recognized the need to develop a new water control plan that will improve water deliveries and promote increased sheetflow to ENP, while maintaining flood control and water supply requirements (see also CM 1B).

> **Status – Development of C-111 Water Control Plan - Underway:** This water control plan has been addressed through a combination of incremental field testing of the evolving water management infrastructure, and the development of the COP that will control the operations of the combined Modified Water Deliveries and C-111 project infrastructure. The modeling of alternatives and their environmental assessments were completed in November 2019 with a recommended alternative (referred to as Alternative Q+). The Army Corps of Engineers Draft Environmental Impact Statement (EIS) has been prepared and reviewed by the federal, state, and tribal agencies, and will be sent out for public review in February 2020. The Final EIS is expected to be complete in June 2020, and the Army Corps Record of Decision is expected in August 2020. The operational plan included in the EIS builds on the lessons learned during the four plus years of incremental field tests. Our next State of Conservation report will document the environmental impacts and level of restoration that can be achieved following completion of the full suite of MWD and C-111 project components.

Corrective Measure 2C requires completion of construction of the C-111 detention-area features from the 8.5 Square Mile Area south to the area known as the Frog Pond. These features include northern and southern components. The detention areas reduce seepage losses along the portions of the eastern ENP boundary.

> **Status – Construction of the C-111 Detention Areas – Completed:** The S-332B/C/D pump stations and the C-111 South Detention Areas were operational by 2009. Construction of the C-111 Northern Detention Area was completed in early 2017. The northern detention area now receives runoff from the 8.5 SMA detention cell via the S-357 pump station. These detention areas have been shown to maintain higher water levels in upper Taylor Slough, but they are not very efficient (with 70-80% of the pumped water returning back to the eastern canals via groundwater seepage). During 2018-2019, the Army Corps constructed a series of new internal levees that can hold the S-332B/C/D pump station water farther west, closer to western edge of the detention areas (further from the lowered eastern canals). The State of Florida backfilled and plugged the L-31W canal. We will better understand how well these new features work to reduce seepage to the east, over the next 1-2 years.

Threat 3 - Increased Nutrient Pollution from Upstream Agricultural Areas

Water entering the park must be low in nutrients, with concentrations of phosphorus in surface water <10 parts per billion (ppb), as established by State of Florida and Federal water quality standards. Total phosphorus (TP) concentrations above this level have led to imbalances in native flora and fauna. Corrective Measure 3 focuses on improving water quality upstream of the Water

Conservation Areas and ENP by implementing agricultural best management practices (BMPs) and constructing man-made Stormwater Treatment Areas (CM 3A). Reducing ENP inflow nutrient concentrations and redistributing phosphorus loadings will contribute to healthier freshwater Everglades wetlands and a healthier estuary in Florida Bay.

Corrective Measure 3A focuses on implementing upstream water quality source controls, such as Best Management Practices (BMPs) and construction of engineered wetlands or Stormwater Treatment Areas (STAs), to achieve the long-term TP limits for water flowing into Shark River Slough and the Taylor Slough/Coastal Basins.

Status – Implementation of Agricultural BMPs and STAs – Completed: The State of Florida passed the Everglades Forever Act in 1994, mandating the implementation of Everglades Agricultural Area BMPs and requiring the construction of 45,000 acres (18,210 ha) of STAs as part of the Everglades Construction Project (ECP). The ECP was completed by 2006, and the DOI and the State worked together to expand the STAs by an additional 12,000 acres (4,856 ha) in 2012. In addition, the agricultural BMPs were designed to achieve a 25% reduction to total phosphorus (TP) loads entering the Everglades. But they have performed better than expected, achieving a 57% TP load reduction, on average. In response to these treatment actions, total phosphorus levels have been reduced at the majority of the park inflow structures.

Status – Implementation of Longer-Term Water Quality Projects – Significant Progress: In 2010 the U.S. Environmental Protection Agency (EPA) determined that additional actions were needed to achieve the States' Everglades water quality standards, beyond the Everglades Construction Project. The EPA's amended determination required establishment of a new water quality based effluent limit (WQBEL) for STA outflows. The State developed the Restoration Strategies project, which further expanded the STAs within the Everglades Agricultural Area (EAA), and included construction of new Flow Equalization Basins (FEBs) to regulate the rate of water inflows to the STAs. The full Restoration Strategies project is scheduled to be complete in 2025, and is expected to achieve the WQBEL requirements by approximately 2029. Fortunately, the first new Flow Equalization Basin (referred to as A-1) was constructed in the central EAA flow path in 2016. This is the flow path that treats the EAA runoff that most directly affects the water quality entering the park. The performance of the STA and FEBs tends to vary in response to hydrologic conditions, and the sources of water. In 2018, a very wet year, the combination of the A-1 FEB and its associated STA produced an annual average outflow TP concentration of approximately 11 ppb, achieving the WQBEL.

As we move forward with planned Everglades restoration actions, additional water from Lake Okeechobee will be directed into the central EAA flow path. In order for the Central Everglades project to redirect this new water Lake Okeechobee southward into the Everglades, an additional 14,000-acre FEB (A-2) was originally planned to provide the required water quality treatment. In 2017, the State of Florida recommended that this shallow FEB be replaced with the 10,000-acre deep water reservoir (the Everglades Agricultural Area Reservoir) and a 6,500-acre STA. The new EAA reservoir will help retain wet season flows currently being discharged into the northern estuaries and pass these flows southward when water quality treatment capacity is available. The additional flows from Lake Okeechobee (essentially a new water source) and the existing EAA runoff will need to meet the State's water quality standard (WQBEL) before these flows are

discharged into the Everglades, including the park. The 2019 update to the Army Corps Integrated Delivery Schedule (IDS), proposes to complete construction on all of these features by 2030, which is subject to federal and state appropriations.

Finally, a new Western Everglades Restoration Project (WERP) was initiated in 2015, which focuses on addressing water flow and water quality improvements in predominately agricultural lands to the west of the Everglades Agricultural Area. This project is still in the planning phase, but would improve water deliveries to two downstream Seminole and Miccosukee Indian Reservations and WCA-3A, prior to the water entering into western Shark River Slough. The 2019 IDS proposes that this project would be submitted for Congressional authorization in 2022.

Threat 4 - Impacts to the Protection and Management of Florida Bay

Decades of drainage and upstream water diversions have decreased the volume and altered the timing and distribution of freshwater flows into Florida Bay. Salinities in the nearshore areas of Florida Bay have also risen in response to sea level rise. Increased freshwater flows would help to maintain longer hydroperiods in the coastal freshwater wetlands, reducing soil oxidation and slowing down the impacts of saltwater intrusion. Corrective measure 4 therefore focuses on increasing water deliveries through Northeast Shark River Slough, Taylor Slough and the ENP Eastern Panhandle, and reducing groundwater seepage losses from the coastal wetlands (CMs 4A/B). These actions will reduce salinity fluctuations in the nearshore and open water areas of Florida Bay, which will promote healthier and more diverse seagrass communities, as well as increase fish and invertebrates that support coastal wading bird communities. Our longer-term Everglades restoration efforts, such as the Central Everglades and EAA Reservoir projects focus on recreating the original/pre-drainage water flow connection between Lake Okeechobee and the Everglades. This new water from Lake Okeechobee would have the largest impact on buffering salinity variations in Florida Bay.

Corrective Measure 4A calls for completion of construction of the C-111 Detention Areas from the 8.5 Square Mile Area to the Frog Pond. Implementing a new rainfall-based water delivery formula, as part of the MWD and C-111 Combined Operational Plan will also reduce the likelihood of nutrient enrichment via pumping water from the C-111 canal system back into the ENP marshes and Florida Bay.

Status – C-111 Project Construction – Completed: The S-332B/C/D pump stations and the C-111 South Detention Area (SDA) were operational by 2009. Construction of the C-111 Northern Detention Area was completed in early 2017. The northern detention area now receives runoff from the 8.5 SMA detention cell via the S-357 pump station. These detention areas have been shown to maintain higher water levels in upper Taylor Slough, but they are not very efficient (with approx. 80% of the pumped water returning back to the eastern canals via groundwater seepage). In response, the U.S. Army Corps of Engineers recently completed new internal levee systems to hold the pumped water closer to the western edge of the detention areas. The benefits of this fully completed water management system will be described in the next SOC report.

Status - New Operational Plan – Underway: Development of a new Tamiami Trail Flow Formula is being addressed through the development of a final Combined Operational Plan (COP). COP will control the operations of the combined Modified Water Deliveries and C-111

project infrastructure. The COP is expected to be complete in August 2020, and will build on the lessons learned during the incremental field tests. The next SOC report will document the environmental impacts and level of restoration benefits that can be achieved, following completion of the full suite of MWD and C-111 project components.

Corrective Measure 4B calls for completion of the C-111 Spreader Canal project, and development of a revised water control plan to include rainfall-driven operations. These new features would reduce seepage losses from ENP and direct flows toward Florida Bay.

Status – C-111 Western Spreader Canal Construction – Completed: The SFWMD completed construction of the C-111 Western Spreader Canal project in 2012, and efforts to evaluate the operational benefits and impacts of this project are ongoing. The Eastern phase of the C-111 Spreader Canal project has not yet moved forward, but project planning is scheduled to begin in 2023.

Status - New Operational Plan – Underway: The final operations for these features have been incorporated into the Combined Operational Plan for the MWD and C-111 projects. In the last year, two additional pumps stations were added (S-199 and S-200), and the overall pumping scheme has been increased as part of the most recent incremental field tests. Preliminary information suggests that the more aggressive pumping does help to retain water in upper Taylor Slough, but it is unclear if these benefits extend southward into the coastal wetlands or Florida Bay. The eastern areas of Florida Bay appear to be responding positively to the increased C-111 westward pumping, while flow benefits in the critical areas in central Florida Bay have not yet been observed.

3b. Is the Timeframe for Implementing the Corrective Measures Suitable?

The 2015 SOC report acknowledged that we face a significant challenge in implementing the corrective measures, while assuring that the objectives for restoration are not lost during the extended planning, authorization, and funding process. The original 2006 corrective measures were linked to three water management projects: the Modified Water Deliveries, Canal-111 South Dade, and Everglades Construction Project, which were all authorized by 1994. This date corresponds with the timeframe when the site was placed on the list of World Heritage Sites in Danger. As of 2019, all three of these initial restoration projects have been constructed and are now operational, while the final Combined Operational Plan for the MWD and C-111 projects has been delayed until August 2020.

Over this long period of implementation, we determined that completion of these foundation projects was not sufficient to deliver the volumes of clean water needed to achieve our Desired State of Conservation. This is due to a combination of: (1) lost benefits resulting from design, cost, and/or operational changes required to balance ecosystem restoration, water supply, and flood control goals, (2) the continued deterioration of the overall Everglades ecosystem, and (3) our evolving understanding of the specific water flow and water quality targets needed to achieve our long-term restoration goals. In response to these restoration performance shortfalls, the 2015 SOC report added additional larger-scale water management projects to our descriptions of the corrective measures needed to achieve the Desired State of Conservation. These include the State of Florida's Restoration Strategies project to further improve water quality, and the Central Everglades/EAA Reservoir project will redirect Lake Okeechobee discharges southward, back

into the Everglades. While both of these projects are progressing, their full benefits are not expected to be realized before approximately 2027 - 2030. The most recent project that will further improve water quality entering WCA-3A and ultimately the park is the Western Everglades Restoration Project that is still in the planning phase.

The National Park Service will continue to track our progress in achieving the corrective measures and indicators of integrity that define the Desired State of Conservation for Everglades National Park. At the same time, the status and trends for a larger set of system-wide ecological indicators are also being evaluated for the entire South Florida ecosystem in the Department of Interior's Strategy and Biennial Reports to Congress, which focus on broader Everglades restoration progress. This report is produced by the South Florida Ecosystem Restoration Working Group and Science Coordination Group, for dissemination by the South Florida Ecosystem Restoration Task Force, (http://evergladesrestoration.gov/content/Strategic_Plan_Biennial_Report.html). The National Park Service's World Heritage State of Conservation report therefore serves as a subset of these system-wide indicators, (https://www.nps.gov/ever/learn/nature/worldheritage.htm).

The NPS and the Department of the Interior have actively participated in local and regional restoration planning and environmental evaluation efforts for decades. We specifically use our ongoing State of Conservation assessments to shape our restoration recommendations and to more directly address these park-specific threats. The shorter-term and more localized MWD and C-111 projects, as well as the regional-scale and longer-term CEPP/EAA Reservoir and Restoration Strategies projects, form a continuum of important corrective measures that will move the park resources toward the Desired State of Conservation.

4. Progress Achieved Toward the Desired State of Conservation for the Removal of the Property from the List of World Heritage Sites in Danger

The prior sections of this report have described the progress and challenges in implementing the correctives measures over the last two decades (e.g., implementation of the Modified Water Deliveries, C-111, and Everglades Construction Projects). Completion of these water management and water quality treatment projects alone is not sufficient to deliver the volumes of clean water into Northeast Shark River Slough and reduce groundwater seepage losses to achieve our Desired State of Conservation. The sections below describe the status and trends of the hydrological, water quality, and ecological indicators of integrity, for the current reporting period. We are not able to report on the full suite of indicators in 2019, because the timeframe to collect, analyze, and interpret the information is not sufficient.

Hydrological and Water Quality Indicators of Integrity

The current reporting period May 1, 2018 to April 30, 2019 displayed a rather unusual rainfall pattern. Overall, water year 2019 was slightly wetter than average, but this was largely due to two high rainfall periods in May 2018 and again in January 2019. By contrast, the remainder of the 2018 wet season through the early dry season (June through December 2018) was drier than normal. This pattern resulted in 2019 being an average flow year for Shark River Slough.

Hydrologic Indicators - Northeast SRS Inflows and Water Levels: Water flows into the Shark River Slough and Taylor Slough watersheds are a major driver of downstream marsh water depths and flooding durations, and they also influence freshwater flows and salinity in the gulf Coast and Florida Bay estuaries. Water flow and marsh water level characteristics are therefore key indicators of the ecosystem health of the park, and can closely track our progress on the corrective measures needed to restore the Desired State of Conservation.

Water flows from the upstream Water Conservation Areas into Shark River Slough during water year 2019 reached just over 800 thousand acre-feet. This is close to the average annual inflow, but less than half the inflow volume observed in WY18. In response to the completion of the Modified Water Deliveries infrastructure, the WY19 annual total inflow into Northeast SRS reached approximately 368 thousand acre-feet. This was above the 2018 water year flows into Northeast Shark River Slough of 300,000 acre-feet, which were constrained during the wet season to reduce the risk of flooding in the 8.5 Square mile area, and adjacent agricultural areas. Even with the improved MWD infrastructure, Northeast SRS inflows were below the established average annual inflow target of 550 thousand acre-ft, but the percentage of the total SRS inflows passed into Northeast SRS increased to 46%, still below the established target of 55%. Peak wet season water levels in Northeast SRS reached just over 8.0 feet NGVD (essentially, over sea level - as measured at station NE2) in September 2018 due to raising of the L-29 canal stage constraint in the 2nd incremental testing period. The reduced wet season rainfall caused marsh water levels to recede quickly. As a result, the average annual water level in WY19 at the NE2 gage was just over 7 feet, which is below the dry year target of 7.5 feet.

Water Quality Indicators – Total Phosphorus in Surface Waters and Periphyton:

Phosphorus is the limiting nutrient in the Everglades, and total phosphorus (TP) concentrations in surface water and plant tissue are good indicators of overall marsh water quality conditions. The established water quality metric for the site include TP at the ENP inflow structures and TP in the downstream marsh surface water. In addition, TP concentrations in periphyton tissue and periphyton biomass are both measured in the downstream marsh. For the ENP inflow structures, the goal is to be in compliance with all State of Florida and Federal standards for total phosphorus over the water year defined as October through September. Surface water TP has an inverse relationship with Everglades marsh water levels, as nutrients become more concentrated in shallower water. The low water levels observed in the upstream Everglades marsh and in the L-29 canal west of structure S333 during 2019, translate into higher TP concentrations delivered to Shark River Slough.

High TP inflow concentrations occurred from March through August 2019, which is consistent with the period of low water levels in the upstream L-29 canal. Relatively high TP concentrations (> 10 mg L-1) occurred over an extended duration and were coincident with a preliminary exceedance of the long-term compliance limit for Shark River Slough in WY19. Phosphorus concentrations across all marsh stations in our water quality monitoring network indicated the TP levels were generally below the established limits, and many of these stations exhibit improving trend in TP, which continued during WY19. However, two marsh stations near the L-29 canal have elevated TP levels relative to the 8 mg L-1 long-term target for Shark River Slough, and both of these locations exhibit long-term increasing trends. Efforts to address the causes and possible remedies for the elevated TP concentrations delivered to ENP have been underway. Federal and

state water quality and hydrologic experts believe that these conditions will improve as we fully implement the Combined Operational Plan, beginning in August 2020.

Periphyton is an algal/diatom community that represents a large portion of Everglades' net primary productivity, which responds quickly to changes in environmental conditions at both small and large spatial scales. Small increases in phosphorus concentrations can decrease periphyton biomass, shift periphyton community structure, and adversely impact higher trophic levels. The WY19 measurements of periphyton tissue TP and periphyton biomass at the measurement sites in SRS and Taylor Slough met the established criteria for un-impacted marshes. Relative to WY17 and WY18, there was a slight recovery in periphyton biomass in Northeast SRS during WY19, but these levels remain modestly lower than most years since WY06. Biomass and tissue TP remained relatively stable since WY06. Future monitoring will determine if there is any cause for concern.

Ecological Indicators in Freshwater Environments

The status of the ecological indicators of integrity in the freshwater marshes are a good reflection of both the overall health of the park ecosystems, and the progress in achieving the corrective measures. The monitoring data on freshwater fish and aquatic invertebrates for the full water year 2019 has not been processed, so we will focus on wading birds and the American alligator, which are good indicators of our progress in restoring water flows and marsh water depths.

Freshwater Fauna Indicator – Wading Bird Nesting Success, Location, and Timing:

The great abundance and diversity of wading birds (particularly herons, egrets, ibises, and storks) is a defining characteristic of the Everglades, and a significant reason for the creation of ENP. Since wading birds are easy to monitor across the landscape and their habitat requirements and historical nesting patterns are well known, they are excellent indicators of environmental conditions.

In the pre-drainage Everglades, nesting colonies regularly formed at the coastal marsh/mangrove ecotone within ENP. Large "supercolonies" were observed during peaks in prey-base availability. Increased wading bird nesting effort has been correlated with high wet season water depths that boosts prey production, along with gradual water level recession rates during the dry season, when most nesting occurs. Under these optimum conditions aquatic prey increases before the wading birds begin nesting, and the prey gradually concentrates as water levels recede, with the highest prey density matching the timing when chicks require the highest level of energy for growth and fledging.

By contrast, in the post-drainage Everglades, wading bird numbers have been reduced by 70–90%, and the major nesting areas have shifted northward out of the park and into the Water Conservation Areas. This shift northward is thought to be due to the altered hydrological conditions in the park (shallower wet season water depths and shortened durations of flooding), which resulted in degraded habitat in the historical nesting areas of the southern coastal regions. Wood Storks are especially sensitive to changes in hydrological conditions and have responded by delaying nest initiation later into the dry season. If stork chicks are not fledged by the arrival of the rainy season, adults will often abandon their nests when water levels rise and prey concentrations are dispersed.

Wading bird nesting success has been slowly increasing in south Florida since the 1990's. In 2018, following back-to-back high rainfall years, the water depth and prey conditions along the

marsh/mangrove ecotone of ENP appeared optimal. In response, supercolonies returned to ENP, with nesting numbers and fledgling success that has not been observed in 50 years. Unfortunately the 2019 nesting season's hydrological conditions were suboptimal for region-wide nesting. Wet season water depths were modest, and several dry season rainfall events reversed water recessions in the marshes, limiting prey availability. This led to failure of Wood Stork nesting, the abandonment of Great Egrets in many colonies and failure of any birds to initiate nesting in many monitored colonies. The ratio of Wood Stork and White Ibis nests to Great Egret nests remains below the desired proportion of 32:1 (2018 data, 6:1.) While the 2019 region-wide summary was not available at the time of reporting, we do know that storks mostly failed region-wide, thus the wood stork metric will not be met. A larger percentage of the total wading bird nesting effort continues to return to the ENP marsh/mangrove ecotone, however we remain below the 70% goal (2018 data, 36%).

Although the 2019 season summary was not available for this update, the trend should continue to increase as several large ibis colonies successfully nested in ENP. Wood Storks continue to nest earlier in the dry season (2019 data, January initiation vs February-March.) but this is still later than the pre-drainage observations of November-December that assure higher rates of fledging survival. And lastly, the interval between exceptional White Ibis nesting years has been increasing, and currently meets the metric of every 1-2 years as of 2018. ENP had 11,100 of the target of 13,000 ibis nests during the 2019 nesting season. Our next SOC report will help us determine if the recent positive trends in wading birds nesting will continue, following completion of our initial phase of restoration projects.

Freshwater Fauna Indicator – American Alligator Abundance, Nesting Success, Location, and Size Class:

The American alligator is a keystone species and an important indicator of Everglades ecosystem health because they are highly responsive to hydrologic changes. Alligators were abundant throughout the pre-drainage Everglades, and the highest densities were in the marl prairies and along the marsh/mangrove ecotone within ENP. Alligators are much less common in these areas today because of reduced water depths and shortened hydroperiods in the marl prairies, and reduced freshwater flows and elevated salinities in the southern coastal marshes. The American alligator metrics focus on nesting effort and success, nest density and distribution, and population demographics (size class and sex). Since the American alligator responds quickly to changing hydrologic conditions, annual assessments of nesting effort/success fluctuate substantially from year to year, and are best evaluated over longer periods.

American alligator nesting effort in the park has increased significantly since 1985, but remains below restoration targets. Recent trends have shown more stability during poor to moderate conditions, and record high numbers during favorable conditions. Two of the five highest nesting effort years (2014, 2015) were followed by moderate (2016) and extremely low (2017) effort years. Nesting rebounded in the 2018 season which exhibited the second highest effort on record (comparable to that of 2015) and 55% of monitored nests successfully produced hatchlings. Nesting success continues to be highly erratic due to both extreme natural rainfall variability and managed hydrologic fluctuations. While alligator numbers remain low, nest density has increased and nests have been better distributed in recent years (2014–18). While nesting effort and nest

densities have increased, we are below all of the established metrics for the American alligator within ENP.

Ecological Indicators in Coastal/Estuarine Environments

The status of the coastal and estuarine integrity indicators are linked to the corrective measures via their influence on the volume, distribution, and timing of freshwater flows, which impact downstream salinities. Both mean salinities and the range of variations are drivers of seagrass abundance and diversity. Periods of high salinity, coupled with warm and calm weather, can lower dissolved oxygen levels. This has triggered widespread seagrass die-offs in Florida Bay, releasing nutrients that can cause algal blooms and further reducing light penetration. These water column and benthic community changes, in turn, control the growth, survival, and abundance of estuarine fish and invertebrates, coastal bird populations, and keystone species such as the American crocodile.

Salinity Indicator – Desired Range and Frequency of Extremes:

Salinity is the primary parameter controlling the major ecological processes in coastal and estuarine ecosystems, influencing the distribution of aquatic plants and animals, overall biological productivity, and nutrient cycling. In the pre-drainage Everglades, freshwater inflows were more persistent, both from a seasonal and annual perspective. This created lower salinity conditions throughout much of the year, over large areas along the park's coastline (from the Gulf of Mexico and throughout much of Florida Bay). In the post-drainage Everglades, most of the historic freshwater flows have been diverted to the northern estuaries, or to meet urban and agricultural water supply needs. Consequently, the southern coastal ecosystems receive far less freshwater, and salinities routinely reach and exceed oceanic conditions (35 parts per thousand (ppt). Three metrics are used to track the influence of hydrologic restoration activities on salinities in Florida Bay: the amount of time each year that salinities are in the desired range, the difference between observed salinities and the desired low-salinity targets, and the frequency of extreme high-salinity events. All of these targets are based on predicted pre-drainage conditions, derived from a combination of paleo-ecological studies and model simulations.

During the 2018–2019 reporting period, Florida Bay and the Gulf Coast region of the Everglades exhibited more uniform salinities than experienced in the previous 2 years. Hypersalinity events, while still common, were not as extreme as observed in 2015-16 when values at some stations exceeded 70 ppt. During the current reporting period, salinity in the most isolated basins of Florida Bay reached 46 ppt. While more moderate, salinity in general tracked along the upper 25th percentile of salinity values, continuously reading above the average of the most recent 5 years of data. These moderately hypersaline zones included all of the central Florida Bay region. Northeastern Florida Bay, including Joe Bay, is more isolated from the neighboring basins to the south and directly connected to Taylor Slough. This area experienced extended periods of mesohaline (5 – 18 ppt) conditions throughout the wet season due to a combination of rainfall and runoff. While Tropical Storm Alberto hit the region in May 2018 followed by Tropical Storm Gordon in September 2018, neither of these storms provided the intense rainfall or wind driven storm surge that would cause large changes in salinity or water levels within the park. Ultimately, conditions were variable across the bay but conformed to the historic average conditions of having hypersalinity dominating the central basins with more moderate conditions in the northeastern basins of the bay.

While Florida Bay experienced more stable salinity during the 2018–2019 reporting period, and salinities were within the interquartile range relative to the previous 5-year period, salinities were routinely above the predicted pre-drainage target range for desired conditions. Given that evaporation slightly exceeds precipitation, hypersalinity will be common unless additional managed freshwater flow can be provided. Currently, managed flow is delivered primarily through Taylor Slough and to a lesser extent through numerous other small creeks and rivers as a result of deliveries and seepage management along the eastern boundary of the park. Insufficient flow from the upstream basins allows seasonal events where salt water reaches station TR upstream in the usually freshwater reaches of the Taylor River. Until the full suite of flow restoration projects are implemented, hypersaline conditions will continue to dominate the Florida Bay landscape and saltwater will continue to flow into the neighboring freshwater sloughs.

Seagrass Indicators – Spatial Extent, Abundance, and Species Dominance:

The seagrass community of Florida Bay plays an essential role in sustaining the entire bay ecosystem. Seagrass beds provide habitat and food for fauna, supporting productivity and biodiversity. They also provide important ecosystem services such as stabilizing sediments and sequestering carbon and nutrients, which helps to sustain high water clarity and improve water quality in the bay. Consequently, the state of bay seagrasses strongly influences the overall state of the bay. Everglades National Park and our restoration partners conduct extensive monitoring of the abundance and diversity of this critical ecosystem throughout Florida Bay.

Seagrass monitoring in May 2019 found that seagrass recovery varied spatially across the basins most strongly affected by the 2015 seagrass die-off event. Recovery continued in Rankin Lake, in the central bay zone, despite the setback caused by Hurricane Irma in 2017. Both turtle grass (*Thalassia testudinum*) and shoal grass (*Halodule wrightii*) continued to increase their abundance, yielding improved habitat quantity and quality in this basin. In contrast, seagrass die-off continued in Johnson Key Basin in the western bay zone, with further decreases in turtle grass abundance both before and after Hurricane Irma. Shoal grass, which is a "pioneer" species that can readily grow in impacted bay areas, did increase its abundance after Irma in Johnson Key Basin. These patterns may be influenced by algal blooms that occurred in both zones. Poor conditions resulting from the blooms and destabilized sediments may be causing continued turtle grass die-off in that region. Blooms in the central zone, while continuing, decreased considerably in water year 2019 compared to 2018, enabling improved seagrass abundance and diversity.

Algal Blooms in Florida Bay – Chlorophyll-a Concentrations and Spatial Extent:

Florida Bay has a history of highly variable water quality conditions, with algal bloom episodes in the bay water column that can last from weeks to even years. Blooms sustained for more than several months can be damaging to seagrass habitat and fauna, especially sponges. Chlorophyll-*a* (chl-*a*) is often used as metric to estimate the biomass of microalgal cells and here is used as an indicator of Florida Bay water quality, corresponding to bloom intensity and also reflecting nutrient and light availability in the bay. The indicator showed water quality degradation in Florida Bay occurred following the seagrass die-off event in 2015, and then again following Hurricane Irma in 2017. This combination of events released nutrients that were stored in sediments, seagrass, and mangrove tissues and spurred the occurrence of record-high chl-*a* concentrations in much of the Bay.

During WY19, chl-*a* concentrations indicated that Florida Bay water quality in most of the bay was slowly recovering from the impacts of the seagrass die-off and hurricane events of 2015-2018, but blooms continued to occur in some regions. In the previous year (2017-2018), chl- *a* concentrations were at or near record high values bay-wide. Indicator scores warned of cautionary water quality conditions in southern (SFB) and western (WFB) bay regions and poor conditions in north-central (NCFB) and northeastern (NEFB) bay regions. These conditions moderated in 2018-2019 in much of the bay, with NEFB and SFB having good chl- *a* indicator scores and NCFB improving to a cautionary score level. However, indicator scores in WFB degraded further, with a poor score and the highest regional median chl-a concentration found in the 26 year monitoring record. Differences between WFB and the other Florida Bay regions may be related to the spatial distribution of nutrient sources that drive algal blooms, local accumulation of dead seagrass and mangrove organic matter (detritus) or newly sustained nutrient inputs from upstream along the western Florida coast. Consequently, algal blooms in the western zone in WY19 were the worst observed in 26 years of monitoring.

Estuarine Fauna – Sport Fish Abundance:

The Gulf Coast and Florida Bay estuaries are world renowned for these abundance and diversity of sports fish, and they are an important indicator of the health of south Florida's coastal ecosystems. The abundance and availability of the four native sport fish species (snook, red drum, spotted seatrout, and gray snapper) were chosen as indicators of the condition of the coastal and estuarine faunal communities because each of these species relies on this region throughout its life cycle. Sport fish abundance is known to fluctuate in response to salinity and other environmental conditions, but these relationships have yet to be fully quantified. Sport fish abundance is monitored by the NPS using a fishing-dependent metric called "catch per unit effort" (CPUE), which tracks the catch success of anglers who are targeting particular species. Unlike our other ecological indicators that have targets that are linked to a pre-drainage or historic range of conditions, the Desired State of Conservation for the sport fish species is to achieve a stable to increasing trend in CPUE, which generally translates to sustainable recreational use. Over time, we may refine this target with respect to the linkages with restoration of freshwater flows, stabilization of salinity, or other environmental parameters, as more information becomes available. In the past, pink shrimp density was also included, which is known to closely track salinity variations and upstream water management. This indicator has not been routinely sampled since 2012, and is therefore not included in this assessment.

Three of the four sport fish indicator species (snook, red drum and spotted seatrout) showed sustainable trends in CPUE in 2018. Gray snapper showed a precipitous drop in CPUE in 2018, and should be watched to ensure local population viability.

Snook and Red Drum CPUE have shown an increase over the current reporting period. Snook CPUE reached a decadal low in 2010 after the winter freeze in January of that year, which killed many of this temperature-sensitive species in South Florida waters. The state of Florida imposed a moratorium on Snook take for two years thereafter to allow for recovery of the population. Snook CPUE remained stable but low each year between 2010 and 2016. Recently, Snook CPUE has seen large increases in 2017 and again in 2018, reaching the highest level since 2007. The first months of 2019 showed continued increase in Snook CPUE reaching a 60-year high. Similarly, Red Drum showed a 70% increase in CPUE in 2018, and continued to increase in the first quarter of 2019.

This is a reversal of a 5-year decline from the peak CPUE in 2011. Observationally, much of the increased catch of both Snook and Red Drum in the last year were undersized fish indicating a recent, large reproductive success.

Spotted seatrout CPUE has remained steady since 2017, and has been relatively stable over the last 40 years. Gray snapper CPUE was stable from 2003 to 2015, then increased to a 38-year high in 2017. In 2018, Gray snapper CPUE experienced a significant drop, which has continued in 2019, reaching the lowest level in 60 years.

Estuarine Fauna - American Crocodile Abundance, Nesting Effort, and Juvenile Survival:

The American crocodile species' lifecycle is responsive to changing patterns of freshwater flow, salinity, and estuarine productivity. Responsiveness to short and long term change makes them a useful ecosystem indicator. American crocodiles were federally listed as "endangered" in 1975, due to extensive habitat degradation (including nesting sites) and over-hunting. Crocodiles have been slowly recovering in the park and the wider Everglades. There are now more crocodiles, nesting in more places, than in the prior 45 years, leading to their reclassification as "threatened" in 2007.

The most important metrics related to hydrologic restoration include the total crocodile population and distribution, nest distribution, nesting effort, and growth/survival from hatching to late juvenile stages. Crocodiles nest in the late dry season primarily in elevated, sandy areas along ENP mangrove shorelines and manmade berms. Upstream water management practices have reduced freshwater inflows to the coastal areas along Florida Bay; increasing salinity and decreasing productivity. Hatchlings tend to migrate inland from their nesting sites to better suited nursery areas to avoid prolonged exposure to high salinities and reduce predation risks. Possible effects of unnatural freshwater flows include: longer hatchling migration to nursery habitat, reduced use of nest sites further from mainland freshwater sources, and impacts to growth, survival, and dispersal of juvenile crocodiles.

The American crocodile has been studied within the park since 1978, and the above set of metrics is used to infer trends in crocodile abundance. American crocodile abundance has been increasing within the park, and this trend continued during 2017–2018. Nesting effort has increased throughout ENP, particularly in the Flamingo/Cape Sable region, where the NPS has been plugging historic drainage canals, which allowed brackish water to penetrate into the interior wetlands. Nesting continues to increase in Northeast Florida Bay but at a much slower rate. Nesting success is typically high in ENP with few total failures. Crocodiles are starting to use new or previously unknown nesting areas in recent years. Crocodile hatchling growth rates (which increase the odds of juvenile survival) were variable but high in most regions. Recent improved estimates of survival using enhanced modeling techniques demonstrate first and second year survival within ENP is more than five times higher than previously thought, and are demonstrably higher than adjacent nursery areas. Increased population growth, nesting success, and juvenile survival is expected, once upstream hydrologic restoration projects are completed and more natural freshwater flows and associated estuarine productivity are restored.

Estuarine Fauna – Roseate Spoonbill Abundance, Nesting Effort, and Juvenile Survival:

Roseate spoonbills are a good indicator species, since they nest in and around Florida Bay and forage in adjacent coastal wetlands, and their prey is controlled by freshwater flows and marsh flooding durations. Spoonbills have been studied in the park since the 1930's, and were almost extirpated in Florida due to plume hunting and habitat degradation. By 1935, the only known nesting colony in the state consisted of about 15 pairs on Bottle Key in Florida Bay. The establishment of the park led to increased protection, and spoonbill abundance steadily increased until the 1980s, when changes in water management began to impact spoonbill nesting by diminishing, redirecting, and disrupting the timing of freshwater inflows, which reduced the availability of prey. In 2010, the state of Florida reclassified the Roseate Spoonbill from a "Species of Special Concern" to "Threatened" because of the bird's small population and restricted range. While spoonbill numbers and nesting locations are on the rise statewide, spoonbill nesting in the park has not recovered since the 1980's.

The most important spoonbill recovery metrics include the total number of nesting pairs in Florida Bay, the return of spoonbill nesting to historically important areas in Florida Bay, and an increase in spoonbill chick production to fledging age. These behavioral responses can result in substantial annual variations in these indicator values, and trends are best evaluated over long periods. Breeding populations (reported as nesting pairs) sharply declined after the mid 1980's, and the total number of nesting pairs for the 2015-2019 reporting period remains well below the pre-1984 target of 1250 (2019, N<400). However nesting pairs in northwestern Florida Bay met and slightly exceeded the target of 200 nests (N=203) during the 2019 breeding season. Northeastern Florida Bay nest numbers continued to remain well below the target of 625 nests (N<60). Estimated spoonbill chick production in northeastern Florida Bay varied, but remained below the target of 1.5/chicks per nest (N=0.2). In northwest Florida Bay, estimated chick production has also varied over the years and exceeded the target from 2015 to 2018. During the 2019 season it dipped below the target of the desired 1.24/chicks per nest (N=0.79). However this appears to have been a result of suboptimal foraging conditions observed throughout south Florida during the 2019 nesting season.

5. Other Current Conservation Issues Identified by the State Parties which may Impact on the Property's Outstanding Universal Value

Exotic and Invasive Species

In 2015, the South Florida Ecosystem Restoration Task Force developed an Invasive Exotic Species Action Framework (http://evergladesrestoration.gov/content/ies/). This framework is helping to align and prioritize the work of the various government entities (Federal, State and Local) in the fight against invasive species in the south Florida ecosystem, including the park. In addition, the Task Force effort has brought the situation of invasive species in the south Florida ecosystem to a higher level of awareness at the national level. The U.S. National Invasive Species Council (NISC) Secretariat has produced a documentary on invasive species entitled, *Protecting What Matters*, that includes information on south Florida invasive species. All of these efforts are positive progress toward addressing the issue of invasive species within the World Heritage property.

The park has been working to increase our efforts to manage invasive species in conjunction with our State partners. In 2020, the National Park Service increased its committed to $900,000 for

invasive species management, with $500,000 allocated to invasive plant management, and $400,000 allocated for invasive animal management. We also expect to spend a similar amount ($4 million) as we did in 2019, on the Hole-in-the-Donut wetland restoration project. This funding commitment is a substantial increase in NPS funding to manage invasive species, and will be matched by our State partner's investments in invasive species management within Everglades National Park. The park is working to ensure a consistent commitment of funding to invasive species management programs in coming years.

Current data indicate that many additional exotic species are present in the urban and agricultural areas outside the boundaries of the site, though not yet found inside the boundaries. Thus we expect to be working on this threat to the Outstanding Universal Values for many years to come. The NPS places the highest management priority on exotic species that cause the greatest ecological harm to native plant and animal communities. The park is working to maintain and expand existing successful exotics control and maintenance programs, but the scale of the problem, and limited resources have prevented establishment of control programs exotic fish and some wildlife species. The park is focused on tracking existing and new invasions, investing in research, applying early detection and rapid response, and working with our partners and the public on education, outreach, and controlling exotic species introductions. We are still in the early stage of establishing formal corrective measures and quantitative targets, with respect to exotic species. This section of the report builds on the 2013 World Heritage report, in the assessment of indicator metrics and preliminary statements of desired conditions.

Exotic Invasive Plants – Relative Abundance or Percentage of Native to Exotic Species:

Approximately 1,000 known plant species occur in the park, and approximately 250 are considered exotic (i.e., non-native). The highest management priority is given to the four exotic plant species that are the most invasive, and cause the greatest ecological harm: melaleuca, Australian pine, Old World climbing fern, and Brazilian pepper. The percent cover of these key invasive plant species over the entire park was digitally mapped during low elevation overflights in 2013. Supplemental mapping of melaleuca and Australian pine has been done in key treatment locations, while the status of Brazilian pepper and Old World climbing fern has not been systematically updated since 2013, due to limited resources. The percent cover of other invasive plant species are not estimated by aerial surveys, because these species inhabit the understory or have localized distributions, making it difficult to confidently estimate changes in percent cover for these taxa.

The desired state for these four key exotic plants and their management approaches are species-dependent. Their current status reflects available funding for control, current treatment technologies, and the biology, distribution, and accessibility of the particular exotic plant species. For melaleuca and Australian pine, the target is less than 1% cover per km^2 in the current or historical areas containing these species and preventing expansion into new areas. The target for Old World climbing fern and Brazilian pepper is less than 5% cover per km^2 in areas currently containing these species and preventing expansion into new areas. The target for all other exotic plant species is less than 1% cover per species per km^2 in areas currently containing these species, and preventing expansion into new areas. Our Desired State of Conservation also includes expanded monitoring and control of newly detected species.

Melaleuca receives the most management attention of any exotic plant in the park via direct application of chemical and biological control agents. While we have not achieved the < 1% cover target, the total km^2 of melaleuca infestation has decreased over the last 10 years. Australian pine is second in terms of management attention, and chemical control is effective, but no effective bio-control exists. While we have not achieved the < 1% cover target, the total km^2 of Australian pine infestation has decreased in recent years. Management of Old World climbing fern is frequently limited by its remoteness. Chemical, biocontrol, and prescribed fire have been effectively applied in areas of dense infestations. We have not achieved the < 5% cover target, and the total km^2 of Old World Climbing Fern infestations has increased in recent years, due to expansion into previously undetected areas. Management of Brazilian pepper is generally limited to areas near man-made disturbances (roadsides, former farmlands, etc.), because no effective chemical or bio-control options exist, and mechanical control is expensive. We have not achieved the < 5% cover target, and the total km^2 of Brazilian pepper infestation has increased in recent years, due to expansion, particularly in coastal marshes near the mangrove ecotone. Management of other invasive exotic plants is limited to areas of high concern (visitor use areas, T&E species habitats). The effectiveness of chemical and biocontrol approaches differs by species. We have not achieved the < 1% cover target, and the total km^2 of these other exotic plant species infestations has increased in recent years (see Table 2 for the status and trend details on the exotic plant metrics).

Exotic Invasive Fish and Wildlife – Relative Abundance or Percentage of Native to Exotic Species:

Invasive fish and wildlife continue to present significant challenges in the park, and preventing the arrival and establishment of new species remains the preferred course of action. Most of these species arrive in the park from the upstream canal system, or from adjacent developed areas, and new regulatory actions to limit introductions are not expected in the near future. The park's control efforts focus on addressing new threats as they emerge, and long-term management of well-established species.

The management metrics for invasive fish are linked to reducing the rate of new introductions and maintaining a low relative abundance (less than 2%) vs native species. No new introductions of exotic freshwater fishes have been observed in the park since 2010, but surveys in the adjacent canal systems detected three exotic fishes. These could have gotten into the canals either from the aquarium trade or stocked by the SFWMD for aquatic vegetation control. In addition, several other recently observed exotic fishes in the broader south Florida canal system have establish populations, and could pose a risk of spreading into the park. The relative abundance of exotic freshwater fishes during this reporting period increased above the 2% threshold at all monitoring sites. In Shark River and Taylor Sloughs, relative abundance of exotic fishes was 3.8% and 2.4%, respectively. In the ENP-wide monitoring sites, relative abundance of exotic fishes was 48% during the reporting period. The drought tolerant African jewelfish continues to be the most abundant exotic fish observed in park-wide monitoring at 43% of all catches and 89% of all exotic fishes, with patterns of increasing abundance in both shorter hydroperiod marshes and slough habitats.

The management metrics for herpetofauna include minimizing or eliminating new introductions, and containing and decreasing known exotic species within the park. Recent studies suggest that all previously documented exotic reptile and amphibian species continue to persist across their formerly known range in and around the park. Limited monitoring surveys during 2014–2018

suggest range expansion is occurring for the Burmese python and the Argentine tegu within South Florida. Burmese pythons have been established in the park for multiple decades. Burmese pythons were captured in substantial numbers during the reporting period due in part to increased python removal efforts resulting from State python removal contractor programs, but there is little optimism to expect widespread control in the near future. The Argentine tegu established a large population relatively recently just east of the park. We have an aggressive containment program and continue to capture increasing numbers, but they still present a significant threat for incursion. The North African python has been observed outside the park in recent years. Increased monitoring has produced limited actionable information to determine if containment or eradication is possible. Additional exotic herpetofauna species have expanded their range in recent years (such as the African redhead agama and veiled chameleon). These species also present potential threats of incursion into the park.

The Indo-Pacific lionfish was first reported inside the park in 2010. This is the only notable invasive marine species in and around the park. Our management metric is to minimize the number and reduce the spatial distribution of lionfish. The density of lionfish in the park is low, with a total of 40 lionfish sightings reported in the park between 2010 and 2016. Our partner agencies have documented a rapid increase in lionfish numbers on reef habitats in adjacent coastal waters. The only Park habitats where lionfish have been captured thus far include hard bottom environments or man-made structures. Lionfish are known to occupy a wide range of other habitats including coral reefs, seagrass beds, mangroves, and estuaries, so they could potentially invade any habitat within Florida Bay. Because seagrass beds and mangrove areas are important nursery areas for juvenile fish and invertebrates, the potential impact of lionfish in the park is a serious concern. We initiated our first lionfish survey in 2013, and the rate of lionfish observations has not increased greatly. Recent surveys in 2017 and 2018 removed 32 and 10 lionfish, respectively, during summer sampling of hard bottom and submerged man-made features each year. Sampling in 2018 revisited sites from 2017 and added 33 new sites for a total of 47 sampling dives, indicating little recruitment into areas previously occupied. Limited data suggest occupancy rates and densities of lionfish in Florida Bay are low and there is currently little impact to native fish and invertebrate species compared to adjacent shallow-reef and deeper-water habitats in the Atlantic and Gulf of Mexico. The potential for invasion by this species is still high due to high densities and expanding populations in adjacent waters (see Table 2 for the status and trend details on the exotic herpetofauna and fish metrics).

Climate Change

Everglades National Park is considered to be highly vulnerable to the impacts of climate change, particularly sea-level rise. An NPS general discussion of the impacts to Everglades National Park is available at (https://www.nps.gov/subjects/climatechange/sciencevideos.htm). The NPS has been documenting the impacts of sea-level rise across the Service for a number of years, and sea-level rise and 2050/2100 projections under various emissions scenarios are available on the NPS interactive viewer (https://maps.nps.gov/slr/). The NPS developed research, adaptation, and mitigation guidance, (https://www.nps.gov/subjects/climatechange/sealevelchange.htm). For Everglades National Park, our 2015 General Management Plan (GMP) outlines a series of recommended responses including: (1) expanded research to identify specific natural and cultural resources at risk from climate change, (2) new or ongoing partnerships with management entities to

maintain regional habitat connectivity, (3) restoration of key ecosystem features to increase ecosystem resilience, and (4) minimization of the impacts of other stressors on park resources. These are all important aspects of the overall ENP strategy to address climate change and sea-level rise impacts to park natural and cultural resources.

The park has several cooperative research and monitoring studies on climate change, to assess the potential impact of sea-level rise on the ecotone between the marine and freshwater landscapes. A good example is studies of the loss of organic peat soils as a result of saltwater intrusion, which impacts freshwater marsh plants via increased pore water salinities. This information is critical to defining water management actions to increase ENP freshwater inflows to mitigate against sea-level rise. ENP also continues to work on internal projects to reduce the impact of man-made features near the coast, such as drainage canals. The park recently completed an Environmental Assessment to examine the potential for a second phase of canal plug and repairs to multiple historic canals on Cape Sable, in the southwestern corner of the park. The park is also undertaking comprehensive climate-change planning now that the GMP is approved. Wayside exhibits are being developed to illustrate the risk sea-level rise poses to park resources and to open a conversation with visitors regarding climate change.

Oil and Gas Exploration/Extraction

The World Heritage Committee previously asked about potential impacts of proposed expansion of oil and gas extraction within the Everglades. These activities have previously been limited to the Big Cypress Watershed including within the Big Cypress National Preserve (BCNP), or to the west of ENP's major drainage basins. This specific concern originates from a Florida Department of Environmental Protection (FDEP) permit request submitted by Kanter Real Estate LLC, for exploratory well drilling on five acres in Broward County, approximately 40-miles northeast of the park. FDEP denied the permit request in 2015, and the company filed an appeal. In February 2019, the First District Court of Appeal reversed FDEP's permit denial, stating that FDEP lacked statutory authority.

In June 2019, the U.S. House of Representatives passed a bill banning oil drilling within the Everglades. In response, the U.S. Army Corps of Engineers informed Kanter Real Estate LLC that they would require the preparation of a formal Environmental Impact Statement (EIS) for any proposed exploratory drilling on their property. On January 15, 2020, the State of Florida announced plans to buy approximately 20,000-acres of land and associated drilling rights in the Everglades, including the parcels of land in Broward County targeted for potential oil and gas drilling. If the plan goes forward, this would permanently protect these lands from oil and gas production. The Kanter family agreed to sell their land to the State.

6. Summary of New Developments that may affect the OUV

As explained previously, completion of several new or ongoing restoration projects: (1) rehabilitation of the Herbert Hoover Dike (HHD) around Lake Okeechobee, (2) the Central Everglades Planning Project (CEPP), which now includes the Everglades Agricultural Area Reservoir (EAAR) south of Lake Okeechobee, (3) the expanded water quality treatment features included in the State's Restoration Strategies (RS) project, and (4) the Tamiami Trail Next Steps

(TTNS) Phase 2 roadway improvements will be needed to achieve the water flow and water quality enhancements that would substantially improve the ecological health of the park, and achieve the indicators of integrity. All four of these projects will collectively contribute to increased upstream water storage, improved water conveyance, and expanded water quality treatment, resulting in greater flows of clean water to the park. Fortunately, all four of these projects have recently been accelerated, and are expected to provide restoration benefits much earlier than originally planned.

Region-wide water availability was substantially decreased in 2008, when safety concerns with the Herbert Hoover Dike (HHD) around Lake Okeechobee prompted the Army Corps of Engineers to lower the Lake regulation schedule. This change increased wet season regulatory discharges to the northern estuaries, and made less water available for dry season water deliveries to the Everglades and other water users. In 2008, the Army Corps began work on a $1.7 billion HHD rehabilitation project. By 2018, numerous improvements had been made to the 80-year old Herbert Hoover dike and associated water control structures, at a cost of approximately $1 billion, but the remaining planned improvements were not expected to be completed until after 2025, because of funding limitations. The damages caused by regulatory releases during the wet seasons of 2017–2018, and the harmful algal blooms in the Lake and northern estuaries, prompted calls for immediate action. In late 2018, the federal and state governments collectively committed approximately $730 million of disaster supplemental and dam safety funding, to increase the pace of the HHD repairs, and development of a new Lake regulation. With the increased funding, the remaining improvements to the HHD were accelerated, and are now expected to be complete in late 2022. A revised Lake Okeechobee regulation schedule, referred to as the Lake Okeechobee System Operating Manual (LOSOM), is also expected to be complete by late 2022. This acceleration in Lake Okeechobee projects make it possible to send additional water southward to the Everglades, putting pressure to accelerate the Central Everglades/EAA Reservoir projects, and other foundation and CERP projects.

In May 2019, the Tamiami Trail Next Steps Phase 2 project received $103.5 million of combined State and Federal transportation funding, including a $60 million grant to the NPS from the Federal Highway Administration. This has accelerated the design and construction of remaining roadway and water conveyance features years earlier than previously expected. The Phase 2 project will raise the remaining 6.5-miles of the roadway, and replace six small culverts with larger bridges. This funding advanced this critical water conveyance project, which will remove a roadway flow constraint that has limited water deliveries into Northeast Shark River Slough for over 50 years.

In September 2019, the Army Corps of Engineers revised their Integrated Delivery Schedule (IDS), which defines the priorities and sequencing of Everglades restoration projects. This new IDS also recognized that the key to reaching our most critical restoration goals is through the completion of the Central Everglades and Everglades Agricultural Area Reservoir projects. The new IDS proposed an aggressive schedule and funding projections to complete all of the CEPP/EAAR features (with a combined cost of approximately $3.3 billion) by 2027. The new schedule also accelerated three important CEPP water conveyance features, which can work with the Tamiami Trail roadway improvements, to deliver the next increment of additional water to Northeast Shark River Slough by 2023.

The State of Florida's Restoration Strategies (RS) project, a large-scale effort that will add thousands of acres of new water quality treatment features, has been moving forward ahead of schedule. All of the $880 million construction components that make up the RS project are now expected to complete by 2026. The accelerated RS project funding means that required water quality treatment features should be in place to clean the new Lake Okeechobee water that is expected to begin flowing southward into the Everglades by 2027. The combination of these four major flow restoration projects are expected to send enough clean water to the park, to fully achieve our desired state of conservation.

Public Access to the State of Conservation Report

We approve public access to the entirety of this report on the World Heritage Centre's State of Conservation Information System.

(Signature of the Authority)

Pedro M. Ramos
Superintendent
Everglades and Dry Tortugas National Parks