UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
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St. Petersburg, Florida 33701-5505
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F/SER46:JS

APR 04 2018

Ann Broadwell
Environmental Administrator
Florida Department of Transportation District 4
3400 West Commercial Boulevard
Fort Lauderdale, Florida 33309

Dear Ms. Broadwell:

The enclosed Biological Opinion ("Opinion") responds to your request for consultation with us, the National Marine Fisheries Service (NMFS), pursuant to Section 7 of the Endangered Species Act (ESA) for the following action. This consultation is being carried out with the Florida Department of Transportation (FDOT) pursuant to the Surface Transportation Project Delivery Program, 23 U.S.C. §327 and a Memorandum of Understanding dated December 14, 2016, and executed by FDOT and the Federal Highway Administration (FHWA). Under these authorities, FHWA has assigned, and FDOT has assumed, the responsibilities of the Secretary under the National Environmental Policy Act (NEPA) with respect to one or more highway projects within the State, and associated consultation responsibilities of the FHWA under the Endangered Species Act.

Applicant	**SER Number**	**Project Type**
Florida Department of Transportation District 4	SER-2017-18664	Bridge Replacement

The Opinion considers the effects of replacing the US1 Bridge over the Loxahatchee River (also known as the Jupiter Bridge) by FDOT on the following listed species and/or critical habitat: sea turtles (loggerhead, leatherback, Kemp's ridley, hawksbill, and green (both North Atlantic (NA) and South Atlantic (SA) distinct population segments (DPS)), smalltooth sawfish, and Johnson's seagrass. There is no critical habitat in the project area. NMFS concludes that the proposed action will have no effect on hawksbill or leatherback sea turtles, is not likely to adversely affect loggerhead, Kemp's ridley, and the NA and SA DPSs of green sea turtles; and is not likely to adversely affect smalltooth sawfish. NMFS also concludes that the proposed action will adversely affect Johnson's seagrass but is not likely to jeopardize the continued existence of the species.

Because the Section 7 requirement to prepare an incidental take statement (ITS) does not apply to listed plants, no ITS is provided for this action. However, we have included conservation recommendations for your consideration.

We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat. If you have any questions on this consultation, please contact Jennifer Schull, Consultation Biologist, by phone at 561-249-1652, or by email at jennifer.schull@noaa.gov.

Sincerely,

Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure (s): Biological Opinion
NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006

cc:
File: 1514-22.L.4

Endangered Species Act - Section 7 Consultation
Biological Opinion

Action Agency:	Florida Department of Transportation District 4
Activity:	Replacement of the US1 Bridge over the Loxahatchee River (Jupiter Bridge), Jupiter, Palm Beach County, Florida
Consulting Agency:	Protected Resources Division Southeast Regional Office National Marine Fisheries Service NMFS Consultation Number SER-2017-18664
Approved by:	Roy E. Crabtree, Ph.D., Regional Administrator NMFS, Southeast Regional Office St. Petersburg, Florida
Date Issued:	April 4, 2018

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Acronyms and Abbreviations

CCFHR	NOAA's Center for Coastal Fisheries and Habitat Research
DPS	Distinct Population Segment
ESA	Endangered Species Act
FDOT	Florida Department of Transportation
FRP	Fiber Reinforced Polymer
FY	Fiscal Year
ITS	Incidental Take Statement
LAA	Likely to Adversely Affect
NA	North Atlantic
NE	No Effect
NLAA	Not Likely to Adversely Affect
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	NOAA's National Ocean Service
OFW	Outstanding Florida Water(s)
PRD	Protected Resources Division
RMS	Root Mean Square
RPM	Reasonable and Prudent Measures
SA	South Atlantic
SFWMD	South Florida Water Management District
SJRWMD	St. John's River Water Management District
SPGP	State (Florida) Programmatic General Permit
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service

Units of Measurement

ac	acre(s)
cm	centimeter(s)
$cm\ s^{-1}$	centimeters per second
cSEL	cumulative sound exposure level
dB	decibel(s)
ft	foot/feet
ft^2	square foot/feet
in	inch(es)
km	kilometer(s)
m	meter(s)
m^2	square meter(s)
mi	mile(s)
psu	practical salinity unit(s)

Background

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 et seq.), requires each federal agency to "insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species." Section 7(a)(2) requires federal agencies to consult with the appropriate Secretary in carrying out these responsibilities. National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share responsibilities for administering the ESA.

Consultation is required when a federal action agency determines that a proposed action "may affect" listed species or designated critical habitat. Consultation is concluded after NMFS determines that the action is not likely to adversely affect listed species or critical habitat or issues a Biological Opinion ("Opinion") that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify critical habitat; if either of these outcomes is likely, NMFS must identify a reasonable and prudent alternative to the action as proposed that will avoid jeopardizing listed species or destroying or adversely modifying critical habitat. The Opinion states the amount or extent of incidental take of the listed species that may occur, develops measures (i.e., reasonable and prudent measures - RPMs) to reduce the effect of take, and recommends conservation measures to further the recovery of the species. However, the ESA does not require that an opinion include an ITS or RPMs for take of threatened plant species.

This document represents NMFS's Opinion based on our review of impacts associated with the proposed action to issue a permit for in-water construction activities. This Opinion analyzes the project's effects on threatened and endangered species and designated critical habitat, in accordance with Section 7 of the ESA. We based it on project information provided by FDOT, the consultant, and other sources of information, including the published literature cited herein.

1 CONSULTATION HISTORY

We received a letter from FDOT dated May 11, 2017, requesting ESA consultation and transmitting a Natural Resource Evaluation Report. We conducted a site visit on June 13, 2017, to confirm the composition and extent of seagrass at the project site. NMFS participated in a conference call with FDOT and their consultants on September 1, 2017, that resulted in NMFS making a request for additional information. This information was received on October 17, 2017.

Project Location

Address	**Latitude/Longitude**	**Water body**
US1 over the Loxahatchee River	26.947250°N, 80.084928°W (North American Datum 1983)	Loxahatchee River/Atlantic Intracoastal Waterway

2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

2.1 Proposed Action

FDOT is proposing to demolish the existing bascule bridge due to structural and functional deficiencies, and replace it with a new bascule bridge, including enhanced pedestrian features. The proposed replacement bridge would be 36 feet (ft) wider than the existing bridge to accommodate pedestrians and cyclists, but maintain the same centerline as the existing bridge. The overall length of the bridge will be approximately 3,000 ft (0.57 miles (mi)). The new bridge will have a 35 ft vertical clearance. FDOT will demolish the existing bridge by cutting it into sections and removing the pieces using cranes and barges. No debris will be allowed to fall into the water. Existing pilings will be extracted by barge-mounted cranes. All debris will be removed from the area by barge and disposed of in an appropriate offsite upland location.

New bulkheads will be constructed at both ends of the new bridge and reinforced with 4,060 ft^2 of rip-rap for scour protection. Concrete seawalls will be constructed at both bridge touch-down locations. Bulkheads and seawalls will be installed using land-based construction equipment as well as water based construction barges and other floating platforms; any water based equipment will operate in deeper waters where seagrasses do not occur. The in-water portion of the project is expected to take 38 months and work will be conducted during daytime only.

As part of the proposed action, FDOT will widen the channel under the bridge to provide better navigation. FDOT will dredge approximately 9,820 cubic yards (18,660 ft^2, 0.43 ac) when widening about 533 ft of the navigation channel from 90 to 125 ft and installing cables. Dredging is expected to be performed by cutter head dredge, clamshell dredge or dragline mounted dredge. If a different method, such as hopper dredging, is selected to accomplish the channel widening, then NMFS must be contacted to determine if reinitiation of this Section 7 consultation is needed. FDOT anticipates placing the dredged material on a barge and disposing the material in uplands. Dredge waters will be filtered before being discharged back into the waterway.

To support the new bridge, two piling configurations are being evaluated to determine which will have the least impact on nearby sensitive cultural resources. Either 30-in square solid concrete piles (Scenario 1) or 60-in open-ended steel pipe piles (Scenario 2) will be used. The steel pipe piles may be used to minimize impacts to nearby sensitive cultural resources (i.e., the Jupiter Lighthouse and Married Officers Quarters). Both scenarios will employ impact hammer installation using cushion hammers and blocks. If concrete piles are used, preformed holes will be augured and steel casing will be installed via jetting and vibratory installation to assist in setting the concrete piles into place. It is anticipated that approximately 66 days would be required to install all piles for scenario 1 and scenario 2 would require about 29 days of pile driving. Additionally, piles will be installed to support bridge fenders. For the fenders, 116 16-in round fiber reinforced polymer (FRP) piles will be used. These piles will be installed using a combination of impact driving and jetting. Details regarding all pile sizes and types, installation methods are included in Table 1.

Table 1. Pile installation types, numbers and installation methods

	Number piles	Installation method
<u>Bridge piles</u>		
Scenario 1		
~43" steel casing (temporary installation)	196	Jetting and vibratory
30" Square Solid Concrete Piles (with cushion blocks)	196	Augering and impact
Scenario 2		
60" Open-Ended Steel Pipe Piles (with cushion blocks)	87	Impact
Fender piles 16" FRP	116	Jetting and impact

Conservation Measures
A seagrass protection plan will ensure that impacts to seagrass beds beyond those described below are avoided. The seagrass protection plan will require the following: a pre-construction benthic survey; a barge accessibility plan depicting the locations of barge work channels and barge exclusion zones; delineation of seagrass beds, including a 50 ft buffer, with anchored buoys to identify the extent of the seagrass beds; an erosion control plan requiring floating turbidity barriers for pile driving, dredging, and riprap placement; and silt fencing on upland areas of roadway construction.

The applicant has agreed to adhere to the *NMFS's Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 26, 2006. Floating turbidity barriers will be used around all active work areas and will be weighted or staked to the substrate to prevent marine life entanglement.

The applicant has also agreed that all impact hammer installation of piles will use high density cushion blocks to reduce source noise levels.

Work vessels will operate at idle speeds at all times in the project area.

All in water work, including pile driving, will occur only during daylight hours.

The project is expected to permanently impact approximately 0.03 ac of mangrove wetland habitat (0.01 ac direct, 0.02 ac indirect impacts) and 0.03 ac of seagrass beds (0.01 ac direct, 0.02 ac indirect impacts) containing Johnson's seagrass, paddle grass and shoal grass. Direct impacts will result in the removal of mangroves and seagrasses from dredge and fill, construction of piers and embankments, and construction of new seawalls. Indirect impacts to mangroves and seagrasses will result from shading associated with the enlarged bridge. As an additional precautionary measure, indirect impacts were calculated as those anticipated to occur within a 25 ft buffer zone around the footprint of the proposed action. There is no critical habitat within the project area. Johnson's seagrass critical habitat is located approximately 0.2 mi southeast of the project area, and there are no potential effects to this critical habitat.

2.2 Action Area

The project site is located at 26.947250°N, -80.084928°W (North American Datum 1983) in the Loxahatchee River, Jupiter, Palm Beach County, Florida (Figure 1). 50 CFR 402.02 defines action area as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The action area for this project includes the waters, submerged lands, and associated wetlands within the immediate vicinity of the project site where work will be conducted as well as the behavioral response zone in which animals may be affected by pile-driving activities (see Section 3.1.3). The action area is within the Loxahatchee River-Lake Worth Creek Aquatic Preserve, which is an outstanding Florida Water (OFW). The project area is an estuarine waterbody approximately 0.88 mi from the Jupiter Inlet that is part of the Intracoastal Waterway. Mangroves, seagrass, sand, and sand/shell hash are present. Mangroves are in urbanized, impacted areas, generally above the mean high water line, and mixed with other estuarine and invasive vegetation. Water depths at the action area are between 0 – 25 ft.

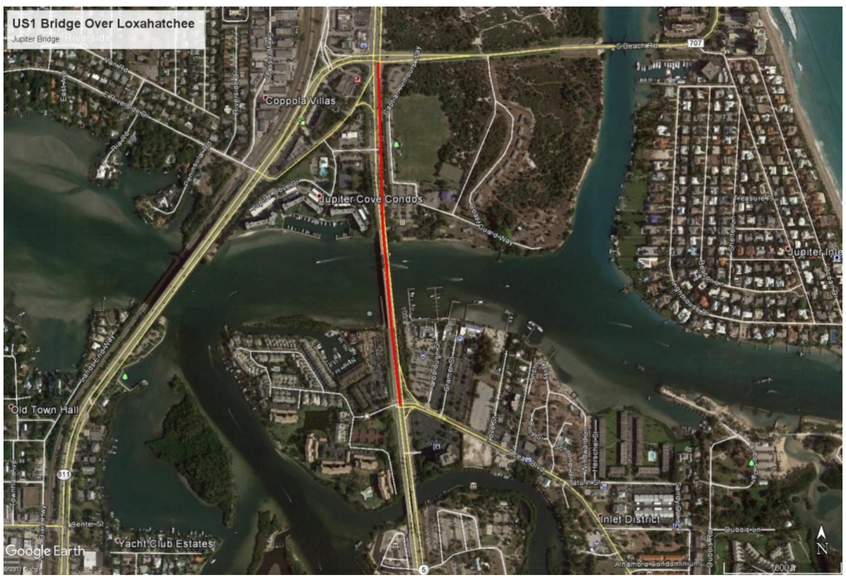

Figure 1. Image of the project location and surrounding area (©2017 Google)

3 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

Table 1 below provides a list of the ESA-listed species that may be affected by the proposed action. The project is not located in designated critical habitat, and there are no potential routes of effect to any designated critical habitat. The following species under the jurisdiction of NMFS may occur in or near the action area.

Table 1. Effects Determination(s) for Species the Action Agency or NMFS Believes May Be Affected by the Proposed Action

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green, North Atlantic DPS	T	NLAA	NLAA

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Green, South Atlantic DPS	T	NLAA	NLAA
Kemp's ridley	E	NLAA	NLAA
Leatherback	E	NLAA	NE
Loggerhead (Northwest Atlantic Ocean DPSs)	T	NLAA	NLAA
Hawksbill	E	NLAA	NE
Fish			
Smalltooth sawfish (U.S. DPS)	E	NLAA	NLAA
Invertebrates and Marine Plants			
Johnson's seagrass	T	LAA	LAA
E = endangered; T = threatened; NLAA = may affect, not likely to adversely affect; NE = no effect; NP = not present			

The FDOT determined that hawksbill and leatherback sea turtles may be affected by the proposed action; however, we believe the project will have no effect on hawksbill and leatherback sea turtles, due to the species' very specific life history strategies, which are not supported at the project site. Leatherback sea turtles have pelagic, deep-water life history, where they forage primarily on jellyfish. Hawksbill sea turtles typically inhabit inshore reef and hard bottom areas where they forage primarily on encrusting sponges.

3.1 Species Not Likely to be Adversely Affected

Four sea turtle species (Kemp's ridley, loggerhead, and North and South Atlantic DPSs of green) and the smalltooth sawfish may be present in the action area and may be affected by the project. We have concluded that these species are not likely to be adversely affected by the proposed action for the reasons described below.

3.1.1 Direct Physical Effects

Direct physical injury to sea turtles and smalltooth sawfish is not expected from interactions with construction machinery (e.g., cranes and pile-driving equipment), barges, work vessels, or interactions with materials (e.g., demolition debris, riprap or piles) because sea turtles and smalltooth sawfish will be able to detect and move away from the types of construction activities that are proposed for this project. Thus, direct physical impacts are considered extremely unlikely to occur and effects will be discountable. Additionally, floating, anchored turbidity barriers may act as a physical barrier to species presence during construction. The project will adhere to NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006 (enclosed), which will provide additional protection by requiring work vessels to operate at idle speeds at all times in the project area and in-water work to stop work if a listed species is observed within 50 ft of operating machinery.

Potential effects to ESA-listed species include the risk of interaction with dredging equipment or material during dredging; however, NMFS has previously determined in dredging biological opinions that, while oceangoing hopper-type dredges may lethally entrain protected species, non-hopper type dredging methods (i.e., clamshell dredge or a dragline mounted on a barge) are slower and extremely unlikely to affect these species. Because this action will use either clamshell or other form of mechanical dredging, we believe it is extremely unlikely that an ESA-listed species could be injured or entrained in the dredge equipment and therefore, this effect will be discountable.

3.1.2 Foraging and Refuge

Sea turtles and smalltooth sawfish may be unable to use the project site for forage and shelter habitat due to avoidance of construction activities, related noise, and physical exclusion from areas blocked by floating turbidity barriers. The habitat available at the project site is low quality, highly trafficked, and sparse. Because these species are mobile, we expect that they will move away from the construction activities and forage in adjacent areas which contain similar (if not higher quality),available habitat. Therefore, the effects to sea turtles and smalltooth sawfish from the loss of foraging and refuge habitat during construction will be insignificant.

Both DPSs of green sea turtles may be affected by the permanent loss of seagrass habitat which may be used for foraging. The project will result in 0.03 ac of loss of seagrass habitat. Impacts will be from dredge and fill operations, shading, and construction of piers, embankments and seawalls. However, there is similar habitat available immediately adjacent to the project site. Given that sea turtles are mobile, we expect them to forage in these adjacent areas. Therefore, effects to green sea turtles due to permanent loss of seagrass foraging habitat will be insignificant.

Smalltooth sawfish may be affected by the permanent loss of access to mangroves which juvenile smalltooth sawfish may use for forage and refuge to avoid predation. The project will directly and indirectly impact 0.03 ac of mixed mangrove habitat from dredge and fill operations and construction of embankments and seawalls. The project area does contain red mangroves typically used by juvenile smalltooth sawfish. However, these mangroves are sparse and located at urbanized, hardened shorelines intermixed with other estuarine vegetation and invasive species. Most of the red mangroves at the project site are inaccessible to smalltooth sawfish most of the time because they are either located shoreward of the mean high water line or are behind hardened shorelines, and better quality, accessible mangrove habitat is available nearby. Therefore, effects to smalltooth sawfish due to the permanent loss of mangrove habitat will be insignificant.

3.1.3 Noise Impacts

Noise created by pile installation can be physically injurious to, or result in behavioral changes by animals in the affected areas. Physically injurious effects can occur in 2 ways. First, effects can result from a single noise event’s exceeding the threshold for direct physical injury to animals, and these constitute immediate adverse effects on affected animals. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative sound exposure threshold for the animals, and these can constitute adverse effects if animals are exposed to the noise levels for sufficient periods. Behavioral effects can be adverse depending on the circumstances in which they occur (i.e., if such effects interfere with animals feeding, resting, or reproducing). All in-water noise levels discussed below are referenced to 1 micropascal. The NMFS-accepted noise thresholds for impact pile driving are 206 decibels (dB) for peak-pressure injury and 187 dB for cumulative sound exposure level (cSEL) injury for both sea turtles and fishes, 150 dB root mean square (RMS) for behavioral disturbance of fishes, and 160 dB RMS for behavioral disturbance of sea turtles[1]. The NMFS-accepted noise thresholds for vibratory driving are the same as for impact driving with the exception of the cSEL injury threshold, which is 234 dB for vibratory driving for both fishes and sea turtles.

Jetting may be used to install temporary steel casings that will assist with installation of concrete piles under scenario 1. Additionally under scenario 1, augering may be used to create a pilot hole to assist in installation of concrete piles and jetting may be used to assist with installation of the FRP piles that will be installed to support fender construction. Based on our calculations, the use of augering or jetting will not result in any form of injurious or behavioral noise effects.

If 30-inch square concrete piles are used, steel casings will be installed to maintain the augered holes into which concrete pilings will be placed and subsequently impact driven. The steel casings will be jetted and vibrated into place. To determine noise thresholds, we used CALTRANS (2015) [2] acoustic measurements for 36-in steel pipes (as a proxy for steel casings) which are the closest size reference available. Based on our noise calculations, the installation of 36-in steel pipes will not cause injury due to either peak-pressure injury or cumulative sound exposure to smalltooth sawfish and sea turtles.

The vibratory installation of steel casings could cause behavioral disturbance effects at radii of 152.3 ft from the source for sea turtles and 706.8 ft from the source for smalltooth sawfish. If an individual chooses to remain within the behavioral disturbance zone, it could be exposed to behavioral noise effects during casing installation and alter its behavioral pattern. Due to the mobility of sea turtles and smalltooth sawfish, we expect them to move away from noise disturbances to similar habitat outside of the behavioral disturbance zones and resume normal behaviors, which in this area would likely consist of opportunistic foraging. In addition, smalltooth sawfish and turtles that remain within the disturbance radii will be able to resume normal activities during quiet periods between casing installations, and at night. Therefore, we anticipate any behavioral effects will be insignificant.

If the project uses 30-in square solid concrete piles, 196 piles will be installed by impact hammer, using cushion hammers and cushion blocks. These piles would be installed over about 66 days during daylight hours only. To analyze this scenario, we use acoustic metrics derived from the Test Pile Program Hydroacoustic Monitoring Report for Construction of State Road 83 (US 331), Choctawhatchee Bay Bridge, Walton County, FL which used similar pilings.[3] Based

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[1] NMFS. USACE Jacksonville District's Programmatic Biological Opinion (JAXBO) (SAJ-2015-17616), November 20, 2017.

[2] California Department of Transportation. 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. California Department of Transportation, Division of Environmental Analysis, Environmental Engineering, Hazardous Waste, Air, Noise Paleontology Office, Sacramento, CA.

[3] Illingworth and Rodkin. 2014. State Road 83 (United States 331 Highway) Choctawhatchee Bay Bridge Hydroacoustic Monitoring Report. Draft Report. Submitted to Florida Department of Transportation, Chipley,

on our noise calculations, the installation of 30-in square solid concrete piles by impact hammer using cushion hammers and blocks could cause peak-pressure injury if a smalltooth sawfish or sea turtle was within 5 ft of the pile driving operations. Because it is extremely unlikely that a sea turtle or sawfish would remain in such close proximity to construction activities, and we anticipate that smalltooth sawfish and turtles will move away from the project area during set up for pile driving, we believe that an animal's suffering physical injury from peak-pressure noise exposure is extremely unlikely to occur. The applicant's compliance with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006, will provide an additional measure of protection by causing the installation activities to stop if sea turtles or smalltooth sawfish are spotted within 50 ft of operations. There are adequate avenues for a smalltooth sawfish or sea turtle to leave or avoid the project area during pile-driving activities. Thus, we believe that the potential for peak-pressure injury effects is extremely unlikely and thus, this effect will be discountable.

Based on our calculations, the cumulative sound exposure level of multiple pile strikes to 30-in square solid concrete piles (5,400 strikes per day) over the course of a day may cause injury to smalltooth sawfish and sea turtles at a radius of up to 92 ft from pile driving if a smalltooth sawfish or turtle remained within this zone for a full day's pile driving. Due to the mobility of smalltooth sawfish and turtles, we expect them to move away from noise disturbances. Because we anticipate that smalltooth sawfish and turtles will move away from the project area, we believe that an animal's suffering physical injury from cSEL noise exposure is extremely unlikely to occur. The project has adequate avenues for a smalltooth sawfish or sea turtle to leave or avoid the project area during pile-driving activities, and there is similar habitat outside of the cSEL injury zone. Thus, we believe the risk of injury is extremely unlikely and is discountable. The use of pre-formed holes is likely to further reduce the exposure of fish and turtles to injury by reducing the number of strikes required to install each pile, though we cannot quantitatively account for this reduction with the information provided by the applicant at this time. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

The impact hammer installation of 30-in square solid concrete piles could cause behavioral disturbance effects at maximum radii of 92 ft from the source for sea turtles and 292 ft from the source for smalltooth sawfish. If an individual chooses to remain within the behavioral disturbance zone, it could be exposed to behavioral noise effects during pile installation and alter its behavioral pattern. Noise abatement through drilling of pre-formed holes is likely to further reduce behavioral disturbance effects. Due to the mobility of sea turtles and smalltooth sawfish, we expect them to move away from noise disturbances to similar habitat outside of the behavioral disturbance zones and resume normal behaviors. In addition, smalltooth sawfish and turtles will be able to resume normal activities during quiet periods between pile installations, and at night. Therefore, we anticipate any behavioral effects will be insignificant.

If the project uses 60-in open-ended steel pipe piles, 87 piles will be installed by impact hammer, using cushion hammers and cushion blocks. These piles would be installed over a period of

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Florida, under Contract No. C-9B22 — Amendment No. 3, issued to HDR Inc., Tampa, Florida. Petaluma, California.

approximately 29 days during daylight hours only. Based on our noise calculations derived from CALTRANS 2015[2], the installation of 60-in open-ended steel pipe piles by impact hammer using cushion hammers and blocks could cause peak-pressure injury if a smalltooth sawfish or sea turtle was within 11 ft of the pile driving operations. Because it is extremely unlikely that a sea turtle or sawfish would remain in such close proximity to construction activities and we anticipate that smalltooth sawfish and turtles will move away from the project area during setup, we believe that an animal's suffering physical injury from peak-pressure noise exposure is extremely unlikely to occur. The applicant's compliance with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions,* dated March 23, 2006, will provide an additional measure of protection by causing the installation activities to stop if sea turtles or smalltooth sawfish are spotted within 50 ft of operations. There are adequate avenues for a smalltooth sawfish or sea turtle to leave or avoid the project area during pile-driving activities, and there is similar habitat nearby. Thus, we believe that the potential for peak-pressure injury effects is extremely unlikely and is discountable.

On the days which pile driving would occur, installation of 60-in open ended steel pipe piles (5,400 strikes per day) could cause cumulative sound exposure injury to sea turtles and smalltooth sawfish at a radius of up to 1,306 ft from pile driving. However, this injury would only occur if a smalltooth sawfish or turtle remained within this zone for a full day's pile driving. Due to the mobility of smalltooth sawfish and turtles, we expect them to move away from noise disturbances. Because we anticipate that smalltooth sawfish and turtles will move away from the project area, we believe that an animal's suffering physical injury from cSEL noise exposure is extremely unlikely to occur. The project has adequate avenues for a smalltooth sawfish or sea turtle to leave or avoid the project area during pile-driving activities, and there is similar habitat outside of the cSEL injury zone. Additionally, the total duration of pile driving for this scenario is 29 days, which will result in a short duration of potential effects due to cumulative noise levels. Thus, we believe the risk of injury is extremely unlikely and is discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

On the days during which pile installation would occur, the impact hammer installation of 60-in open-ended steel pipe piles could cause a maximum behavioral disturbance effects at radii of 1,306 ft from the source for sea turtles and 6,062 ft from the source for smalltooth sawfish. If an individual chooses to remain within the behavioral disturbance zone, it could be exposed to behavioral noise effects during pile installation and alter its behavioral pattern. Due to the mobility of sea turtles and smalltooth sawfish, we expect them to move away from noise disturbances to similar habitat outside of the behavioral disturbance zones and resume normal behaviors, which in this area would likely consist of opportunistic foraging. In addition, smalltooth sawfish and turtles will be able to resume normal activities during quiet periods between pile installations, and at night. Therefore, we anticipate any behavioral effects will be insignificant.

The project expects to install 116 16-in FRP fender piles by jetting or impact driving. In this analysis we assume all piles will be installed by impact hammer. We use 14-in wood timber piles as a proxy for the 16-in FRP piles[4]. Based on our noise calculations, the installation of 16-in FRP fender pilings by impact hammer could cause peak-pressure injury to smalltooth sawfish and sea turtles up to one ft from the source. We believe it is extremely unlikely that a sea turtle or sawfish would remain in such close proximity to construction activities. Therefore this effect will be discountable. The applicant's compliance with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006, will provide an additional measure of protection by causing the installation activities to stop if sea turtles or smalltooth sawfish are spotted within 50 ft of operations.

The cumulative sound exposure level resulting from multiple pile strikes to 16-in FRP fender piles (5,400 strikes per day) over the course of a day may cause injury to smalltooth sawfish and sea turtles at a radius of up to 152 ft from pile driving, if a smalltooth sawfish or turtle remained within this zone for a full day's pile driving. Due to the mobility of smalltooth sawfish and turtles, we expect them to move away from noise disturbances. Because we anticipate that smalltooth sawfish and turtles will move away from the project area, we believe that an animal's suffering physical injury from cSEL noise exposure is extremely unlikely to occur. The project has adequate avenues for a smalltooth sawfish or sea turtle to leave or avoid the project area during pile-driving activities. Thus, we believe the risk of injury is extremely unlikely and is discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

The impact hammer installation of 16-in FRP fender pilings could cause behavioral disturbance effects at radii of 152 ft from the source for sea turtles and 707 ft from the source for smalltooth sawfish. If an individual remains within this zone, it could be exposed to behavioral noise effects during pile installation and alter its behavioral pattern. Due to the mobility of sea turtles and smalltooth sawfish, we expect them to move away from noise disturbances to similar habitat outside of the behavioral disturbance zones and resume normal behaviors. In addition, smalltooth sawfish and turtles will be able to resume normal activities during quiet periods between pile installations, and at night. Therefore, we anticipate any behavioral effects will be insignificant.

3.2 Species Likely to be Adversely Affected

Johnson's Seagrass

Johnson's seagrass is likely to be adversely affected by the proposed project. Impacts to Johnson's seagrass are expected from construction activities and shading. Benthic surveys conducted by the applicant's consultant in April 2016 determined that 0.03 ac of seagrass would be impacted by the project. The seagrass at the project site is a mix of paddle grass, shoal grass and Johnson's seagrass. Johnson's seagrass coverage was between 10% - 35%.

NMFS listed Johnson's seagrass as threatened under the ESA on September 14, 1998. Kenworthy (1993; 1997; 2000) and NMFS (2002; 2007) discuss the results of numerous field studies and summarize an extensive literature review regarding the status of Johnson's seagrass. In addition to the published literature, the Johnson's Seagrass Recovery Implementation Team (Recovery Team) is in the process of updating the 2002 Recovery Plan for Johnson's Seagrass.

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[4] NMFS. Biological Opinion on Regional General Permit SAJ-82 (SAJ-2007-01590), Florida Keys, Monroe County, Florida. June 10, 2014.

The updated Recovery Plan will contain the latest information concerning the status of this species and potential threats to its persistence and recovery. The following discussion summarizes those findings relevant to our evaluation of the proposed action.

Life History and Population Biology

Based on the current knowledge of the species, Johnson's seagrass reproduction is believed to be entirely asexual, and dispersal is by vegetative fragmentation. Sexual reproduction in Johnson's seagrass has not been documented. Female flowers have been found; however, dedicated surveys in the Indian River Lagoon have not discovered male flowers, fertilized ovaries, fruits, or seeds, either in the field or under laboratory conditions (Hammerstrom and Kenworthy 2002; Jewett-Smith et al. 1997; NMFS 2007). Searches throughout the range of Johnson's seagrass have produced the same results, suggesting either that the species does not reproduce sexually or that the male flowers are difficult to observe or describe, as noted for other *Halophila* species (Kenworthy 1997). Surveys to date indicate that the incidence of female flowers appears to be much higher near the inlets leading to the Atlantic Ocean.

Throughout its range, Johnson's seagrass occurs in dynamic and disjunctive patches. It spreads rapidly, growing horizontally from dense apical meristems with leaf pairs having short life spans (Kenworthy 1997). Kenworthy suggested that the observed horizontal spreading, rapid growth patterns, and high biomass turnover could explain the dynamic patches observed in distribution studies of this species. While patches may colonize quickly, they may also disappear rapidly. Sometimes they will disappear for several years and then re-establish, a process referred to as "pulsating patches" (Heidelbaugh et al. 2000; Virnstein and Hall 2009; Virnstein and Morris 2007). Mortality, or the disappearance of patches, can be caused by a number of processes, including burial from bioturbation and sediment deposition (Heidelbaugh et al. 2000), erosion, herbivory, desiccation, and turbidity. In the absence of sexual reproduction, one possible explanation for the pulsating patches is dispersal and re-establishment of vegetative fragments, a process that commonly occurs in aquatic plants and has been demonstrated in other seagrasses (Di Carlo et al. 2005; Philbrick and Les 1996), and was also confirmed by experimental mesocosm[5] studies with Johnson's seagrass (Hall et al. 2006).

Johnson's seagrass is a shallow-rooted species and vulnerable to uprooting by wind, waves, storm events, tidal currents, bioturbation, and motor vessels. It is also vulnerable to burial by sand movement and siltation (Heidelbaugh et al. 2000). Having a canopy of only 2 cm - 5 cm, it may be easily covered by sediments transported during storms or redistributed by macrofaunal bioturbation during the feeding activities of benthic organisms. Mesocosm experiments indicate that clonal fragments can only survive burial for up to a period of 12 days (W.J. Kenworthy, CCFHR, NOAA, Beaufort, North Carolina, 1997 unpublished). Mechanisms capable of disturbing patches may create clonal fragments that become dispersed. Hall et al. (2006) showed that drifting fragments of Johnson's seagrass can remain viable for 4 to 8 days, during which time they can settle, root, and grow. The process of asexual fragmentation can occur year-round. Fragments could drift several kilometers under the influence of wind and tidally-driven circulation, providing potential recruits for dispersal and new patch formation. In the absence of

[5] A mesocosm is an experimental tool that brings a small part of the natural environment under controlled conditions.

sexual reproduction, these are likely to be the most common forms of dispersal and patch maintenance.

Population Status and Distribution

Johnson's seagrass occurs in a variety of habitat types, including on intertidal wave-washed sandy shoals, on flood deltas near inlets, in deep water, in soft mud, and near the mouths of canals and rivers, where presumably water quality is sometimes poor and where salinity fluctuates widely. It is an opportunistic plant that occurs in a patchy, disjunctive distribution from the intertidal zone to depths of approximately 2 to 3 m in a wide range of sediment types, salinities, and in variable water quality conditions (NMFS 2007).

Johnson's seagrass exhibits a narrow geographical range of distribution and has only been found growing along approximately 200 km of coastline in southeastern Florida north of Sebastian Inlet, Indian River County, south to Virginia Key in northern Biscayne Bay, Miami-Dade County. This apparent endemism suggests that Johnson's seagrass has the most limited geographic distribution of any seagrass in the world. Kenworthy (Kenworthy 1999; Kenworthy 1997) confirmed its limited geographic distribution in patchy and vertically disjunctive areas throughout its range. Two survey programs have monitored the presence and abundance of Johnson's seagrass within this range. One program, conducted by the St. Johns River Water Management District since 1994, continues to survey the northern section of the species' geographic range between Sebastian Inlet and Jupiter Inlet (Virnstein and Hall 2009; Virnstein and Morris 2007). The second survey, initiated in 2006, monitored the southern range of the species between Jupiter Inlet and Virginia Key in Biscayne Bay (Kunzelman 2007). This survey is no longer conducted. Since the last status review (NMFS 2007), there have not been any reported reductions in the geographic range of the species. In fact, the St. Johns River Water Management District observed Johnson's seagrass approximately 21 km north of the Sebastian Inlet mouth on the western shore of the Indian River Lagoon-a discovery that slightly extends the species' known northern range (Virnstein and Hall 2009).

Johnson's seagrass is a perennial species (meaning it lasts for greater than 2 growing seasons), showing no consistent seasonal or year-to-year pattern based on the northern transect surveys, but has exhibited some winter decline (NMFS 2007). However, during exceptionally mild winters, Johnson's seagrass can maintain or even increase in abundance from summer to winter. In the surveys conducted between 1994 and 2007, it occurred in 7.1% of the l m^2 quadrats in the northern range. Depth of occurrence within these surveys ranged from 0.03 to 2.5 m. Where it does occur, its distribution is patchy, both spatially and temporally. It frequently disappeared from transects only to reappear several months or several years later (NMFS 2007).

Based on the results of the southern transect sampling, it appears there is a relatively continuous, although patchy, distribution of the species from Jupiter Inlet to Virginia Key (NMFS 2007). The largest reported contiguous patch of Johnson's seagrass in the southern range was observed in Lake Worth Lagoon and was estimated to be 30 ac (Kenworthy 1997). Eiseman and McMillan (1980) documented Johnson's seagrass in the vicinity of Virginia Key (latitude 25.75°N); this location is considered the southern limit of the species' range. There have been no reports of this species further south of the currently known southern distribution. The presence of Johnson's seagrass in northern Biscayne Bay (north of Virginia Key) is well documented. In addition to localized surveys, the presence of Johnson's seagrass has been documented by various field experiences and observations of the area by federal, state, and county entities. Johnson's seagrass has been documented in various U.S. Army Corps of Engineers (USACE) and U.S. Coast Guard (USCG) permit applications reviewed by NMFS. Findings from the southern transect sampling (summer 2006 and winter 2007) show little difference in the species' frequency or abundance between the summer and winter sampling period. The lower frequencies of Johnson's seagrass occurred at those sites where larger-bodied seagrasses (e.g., turtle grass, *Thalassia testudinum,* and manatee grass, *Syringodium filiforme*) were more abundant (NMFS 2007). The southern range transect data support some of the conclusions drawn from previous studies and other surveys. This is a rare species; however, it can be found in relatively high abundance where it does occur. Based on the results of the southern transect sampling, it appears that, although it is disjunctively distributed and patchy, there is some continuity in the southern distribution, at least during periods of relatively good environmental conditions and no significant large-scale disturbances (NMFS 2007).

Information on the species' distribution and results of limited experimental work suggest that Johnson's seagrass has a wider tolerance range for salinity, temperature, and optical water quality conditions than other species such as paddle grass, *Halophila decipiens* (Dawes et al. 1989) (Kenworthy and Haunert 1991); (Gallegos and Kenworthy 1996); (Durako et al. 2003; Kenworthy and Fonseca 1996; Torquemada et al. 2005). Johnson's seagrass has been observed near the mouths of freshwater discharge canals (Gallegos and Kenworthy 1996), in deeper turbid waters of the interior portion of the Indian River Lagoon (Kenworthy 2000; Virnstein and Morris 2007), and in clear water associated with the high energy environments and flood deltas inside ocean inlets (Heidelbaugh et al. 2000; Kenworthy 1993; Kenworthy 1997; Virnstein and Morris 2007; Virnstein et al. 1997). It can colonize and persist in high-tidal energy environments and has been observed where tidal velocities approach the threshold of motion for unconsolidated sediments (35-40 cm s^{-1}). The persistent presence of high-density, elevated patches of Johnson's seagrass on flood tidal deltas near inlets suggests that it is capable of sediment stabilization. Intertidal populations of Johnson's seagrass may be completely exposed at low tides, suggesting high tolerance to desiccation and wide temperature tolerance.

In Virnstein's study areas within the Indian River Lagoon, Johnson's seagrass was found associated with other seagrass species or growing alone in the intertidal, and, more commonly, at the deep edge of some transects in water depths down to 180 cm. In areas in which long-term poor water and sediment quality have existed until recently, Johnson's seagrass appears to occur in relatively higher abundance, perhaps due to the inability of the larger species to thrive. Johnson's seagrass appears to be out-competed in seagrass habitats where environmental conditions permit the larger seagrass species to thrive (Kenworthy 1997; Virnstein et al. 1997). When the larger, canopy-forming species are absent, Johnson's seagrass can grow throughout the full seagrass depth range of the Indian River Lagoon (NMFS 2007; Virnstein et al. 2009).

Observations by researchers have suggested that Johnson's seagrass exploits unstable environments or newly-created unvegetated patches by exhibiting fast growth and support for all local ramets in order to exploit areas in which it could not otherwise compete. It may quickly recruit to locally uninhabited patches through prolific lateral branching and fast horizontal growth. While these attributes may allow it to compete effectively in periodically disturbed areas, if the distribution of this species becomes limited to stable areas it may eventually be outcompeted by more stable-selected plants represented by the larger-bodied seagrasses (Durako et al. 2003). In addition, the physiological attributes of Johnson's seagrass may limit growth (i.e., spreading) over large areas of substrate if the substrate is somehow altered (e.g., dredged to a depth that would preclude future recruitment of Johnson's seagrass); therefore, its ability to recover from widespread habitat loss may be limited. The clonal and reproductive growth characteristics of Johnson's sea grass result in its distribution being patchy, non-contiguous, and temporally fluctuating. These attributes suggest that colonization between broadly disjunctive areas is likely difficult and that the species is vulnerable to becoming endangered if it is removed from large areas within its range by natural or anthropogenic means.

Threats

The emerging consensus among seagrass experts on the Recovery Team is that the possibility of mortality due to reduced salinity over long periods of time is the most clearly identified threat to the species' long-term persistence. Some studies have shown that Johnson's seagrass has a wide tolerance for salinity. Conversely, short-term experiments have shown reduced photosynthesis and increased mortality at low salinities (<10 psu [practical salinity units, equivalent to parts per thousand]). Longer duration mesocosm experiments have resulted in 100% mortality of Johnson's seagrass after 10 days at salinities <10 psu (Kahn and Durako 2008). The Recovery Team has determined that the most significant threat to the species is the present or threatened destruction, modification, or curtailment of its habitat or range through water management practices and stochastic environmental factors that can alter the salinity of its habitat. Given that it is not uncommon for salinities to decline below 15 to 20 psu in its range (Steward et al. 2006), and that a number of natural and human-related factors can affect salinity throughout its range, the Recovery Team identified reduced salinity as a potential significant threat to the species because the potential for long-term mortality over a large scale could counteract the life history strategy the species uses to persist in the face of numerous, ongoing, environmental impacts. In previous reviews, including the critical habitat listing rule and the 2002 Recovery Plan, several additional factors were considered threats: (1) dredging and filling, (2) construction and shading from in-and over-water structures, (3) propeller scarring and anchor mooring, (4) trampling, (5) storms, and (6) siltation. In reviewing all information available since the original listing, the Recovery Team conducted assessments of each of these factors and has been unable to confirm that any of these pose a significant threat to the persistence and recovery of the species. A brief discussion of these factors follows.

Routine maintenance dredging associated with the constant movement of sediments in and around inlets may affect seagrasses by direct removal, light limitation due to turbidity, and burial from sedimentation. The disturbance of sediments can also destabilize the benthic community. Altering benthic topography or burying the plants may remove them from the photic zone. Permitted dredging of channels, basins, and other in- and on-water construction projects cause loss of Johnson's seagrass and its habitat through direct removal of the plants, fragmentation of habitat, shading, turbidity, and sedimentation. Although dredge-and-fill activities can and do adversely affect Johnson's seagrass and its designated critical habitat, these activities and the construction of in- and over-water structures are closely scrutinized through federal, state, and local permitting programs. The USACE, under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, has federal authority over the issuance of dredge-and-fill permits. This permitting process includes language to protect and conserve seagrasses through field evaluations, consultations, and recommendations to avoid, minimize, and mitigate for impacts to seagrasses.

Shafer et al. (2008) emphasized avoidance of seagrasses as a first priority in their study evaluating the regulatory construction guidelines to minimize impacts to seagrasses from single-family residential dock structures in Florida and Puerto Rico. While most dock construction is subject to the construction guidelines (i.e., the USACE's and NMFS's jointly-developed October 2002 *Key for Construction Conditions for Docks or Other Minor Structures Constructed in or over Johnson's Seagrass* and the 2001 guidelines), some docks meeting certain provisions are exempt from state permitting[6] and contribute to loss of Johnson's seagrass through construction impacts and shading. In Florida, the USACE's SPGP authorizes permits for the construction of docks, boat ramps, piers, maintenance dredging, and the construction of other minor over-water structures. The USACE is required to consult with NMFS in order to implement the SPGP; therefore, anticipated effects to Johnson's seagrass from implementation of the SPGP would be considered during ESA consultation between the USACE and NMFS. NMFS provides conservation recommendations in this Biological Opinion that if implemented, would benefit Johnson's seagrass.

The Recovery Team has identified weaknesses in the oversight practices of state and federal agencies in the permitting process for some or all of the activities discussed above, due to budget, staffing, and technological limitations. The need for post-construction permit compliance and enforcement for dock structures in Florida and Puerto Rico has been discussed in Shafer et al. (2008). The Recovery Team also identified difficulties in monitoring Johnson's seagrass—a rare and patchily-distributed species—in single-event surveys associated with permit applications, and continues to work with collaborators to improve monitoring methods. While it is recognized that dredging and filling projects and construction and shading from in- and over-water structures can adversely affect Johnson's seagrass and its habitat, the Recovery Team determined that these activities are typically local and small-scale. The deficiencies in the permitting process were not presently a significant threat to the survival of Johnson's seagrass because they will not individually or cumulatively result in long-term, large-scale mortality of Johnson's seagrass, nor preclude the species from its strategy of recolonizing areas.

Propeller scarring and improper anchoring are known to adversely affect seagrasses (Kenworthy et al. 2002; Sargent et al. 1995). These activities can severely disrupt the benthic habitat by uprooting plants, severing rhizomes, destabilizing sediments, and significantly reducing the viability of the seagrass community. Propeller dredging and improper anchoring in shallow areas are major disturbances to even the most robust seagrasses. This destruction is expected to worsen with the predicted increase in boating activity within Florida. The Florida Department of Highway Safety and Motor Vehicles (http://www.flhsmv.gov/html/safety.html) reported 963,057 registered commercial and recreational vessels (including canoes) statewide in fiscal year (FY) 2007. Registrations declined to 787,780 in FY 2012, likely due to the economic downturn. However, this number is likely to increase based on Florida's projected population growth from 18 million in 2006 to 25 million in 2025 (www.propertytaxreform.state.f1/docs/eo06141.pdf). An increase in the number of registered vessels will likely lead to an increase in adverse effects to seagrasses caused by propeller dredging/scarring.

[6] http://www.dep.state.fl.us/central/Home/SLERP/Docks/sfdock.pdf

Other indirect effects associated with motor vessels include turbidity from operating in shallow water, dock construction and maintenance, marina expansion, and inlet maintenance dredging. These activities and impacts are also likely to increase (NMFS 2007). Damage to seagrasses from propeller scarring and improper anchoring by motor vessels is recognized as a significant resource management problem in Florida (Sargent et al. 1995). A number of local, state, and federal statutes protect seagrasses from damage due to vessel impacts, and a number of conservation measures, including the designation of vessel control zones, signage, mooring fields, and public awareness campaigns, are directed at minimizing vessel damage to seagrasses. Despite these efforts, vessel damage can have significant local and small-scale (1 m^2 to 100 m^2) impacts on seagrasses (Kirsch et al. 2005), but there is no direct evidence that these small-scale local effects are so widespread that they are a threat to the persistence and recovery of Johnson's seagrass.

Trampling of seagrass beds, a secondary effect of recreational boating, also disturbs seagrass habitat, but is a lesser concern. Trampling damages seagrasses by pushing leaves into the sediment and crushing or breaking the leaves and rhizomes. Since the designation of critical habitat, however, there have been no documented observations or reports of damage by trampling, and if there were, they would be small-scale and local. Therefore, the Recovery Team determined that trampling does not constitute a significant threat to the survival or recovery of Johnson's seagrass.

Large-scale weather events such as tropical storms and hurricanes, while often generating runoff conditions that decrease water quality, also produce conditions (wind setup and abrupt water elevation changes) that can increase flushing rates. The effects of storms can be complex. There are several specifically documented storm effects on seagrasses: (1) scouring and erosion of sediments; (2) erosion of seeds and plants by waves, currents, and surge; (3) burial by shifting sand; (4) turbidity; and (5) discharge of freshwater, including inorganic and organic constituents in the effluents (Steward et al. 2006). Storm effects may be chronic, e.g., due to seasonal weather cycles, or acute, such as the effects of strong thunderstorms or tropical cyclones. Studies have demonstrated that healthy, intact seagrass meadows are generally resistant to physical degradation from severe storms, whereas damaged seagrass beds may not be as resilient (Fonseca et al. 2000; Whitfield et al. 2002). In the late summer and early fall of 2004, four hurricanes passed directly over the northern range (with wind strengths at landfall from <39 to 120 miles per hour) of Johnson's seagrass in the Indian River Lagoon. A post-hurricane random survey in the area of the Indian River Lagoon affected by the four hurricanes indicated the presence of Johnson's seagrass was similar to that reported by the St. Johns River Water Management District (SJRWMD) transect surveys prior to the storms. This indicates that while the species may temporarily decline, under the right conditions it can return quickly (Virnstein and Morris 2007). Furthermore, despite evidence of longer-term reductions in salinity, increased water turbidity, and increased water color associated with higher than average precipitation in the spring of 2005, there was no evidence of long-term chronic impacts to seagrasses and no direct evidence of damage to Johnson's seagrass that could be considered a threat to the survival of the species (Steward et al. 2006).

Silt derived from adjacent land and shoreline erosion, river and canal discharges, inlets, and internally re-suspended materials can lead to the accumulation of material on plant leaves causing light deprivation. Deposition of silt can also lead to the burial of plants, accumulation of organic matter, and anoxic sediments. Johnson's seagrass grows in a wide range of environments, including those that are exposed to siltation from all the potential sources. Documentation of the direct effects of siltation on seagrasses is generally unavailable. The absence of seagrass has been associated with the formation of muck deposits, however, and localized areas of flocculent, anoxic sediments in isolated basins and segments of the Indian River Lagoon have been observed. Furthermore, sustained siltation experimentally simulated by complete burial for at least 12 days may cause mortality of Johnson's seagrass (W.J. Kenworthy, CCFHR, NOS, Beaufort, North Carolina, unpublished data). In general, the effects of siltation are localized and not widespread and are not likely to threaten the survival of the species.

In addition to the six factors discussed above, we also consider the effects of altered water quality on Johnson's seagrass. Availability of light is one of the most significant environmental factors affecting the survival, growth, and distribution of seagrasses (Abal et al. 1994; Bulthuis 1983; Dennison 1987; Kenworthy and Fonseca 1996). Water quality and the penetration of light are affected by turbidity (suspended solids), color, nutrients, and chlorophyll, and are major factors controlling the distribution and abundance of sea grasses (Dennison 1987; Kenworthy and Fonseca 1996) (Kenworthy and Haunert 1991). Increases in color and turbidity values throughout the range of Johnson's seagrass generally are caused by high flows of freshwater discharged from water management canals, which can also reduce salinity. Wastewater and storm water discharges, as well as from land runoff and subterranean sources, are also causes of increased turbidity. Degradation of water quality due to increased land use and poor water management practices continues to threaten the welfare of seagrass communities. Declines in water quality are likely to worsen, unless water management and land use practices can curb or eliminate freshwater discharges and minimize inputs of sediments and nutrients. A nutrient-rich environment caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural runoff stimulates increased algal growth that may smother or shade Johnson's seagrass, or shade rooted vegetation, and diminish the oxygen content of the water. Low oxygen conditions have a demonstrated negative impact on seagrasses and associated communities.

A long-term monitoring program implemented by the SJRWMD assessed overall estuarine water quality in the northern and central region of Johnson's seagrass geographic range as mostly good (67%) (Winkler and Ceric 2006). Only 28% of the stations sampled had fair water quality, while 6% had poor quality. Fifty percent of the sampled estuarine sites were improving, while 6% were degrading, so many more sites were improving than were degrading. Forty-two percent of the lagoon sites had an insignificant trend while 3% had insufficient data to determine a trend. As water management experts have now become confident in the association between water quality and seagrass depth distribution, they have begun establishing water quality targets for the Indian River Lagoon based on seagrass as an indicator (Steward et al. 2005). There is a strong positive correlation between seagrass depth distribution and water quality, which enables managers to predict where seagrasses will grow based on water quality and the availability of light. Given that at least half of the sampling stations were indicating long-term improvements in water quality, it can be assumed that seagrass abundance should not be negatively impacted if water and land use management programs continue to be effective. For example, carefully controlling or reducing water flows from discharge canals will moderate salinity fluctuations and reduce turbidity, color, and light attenuation values.

There has not been a comprehensive assessment of water quality published or reported for the southern geographic range of Johnson's seagrass similar to the SJRWMD study performed in the northern and central range. However, water quality experts at the South Florida Water Management District (SFWMD) confirm that efforts are underway to synthesize water quality information and to gain a more comprehensive understanding of the long-term status and trends of water quality in the southern range of Johnson's seagrass (Dan Crean, SFWMD, pers. comm. to Sarah Heberling, NMFS PRD, March 2011). Of particular concern is an assessment of the impacts of fluctuations in water quality corresponding with variation in climatology, especially "wet years" versus "dry years" variation. Future recovery efforts should include close coordination with the SFWMD and county environmental management agencies in Palm Beach and Dade Counties to evaluate the status and trends of water quality in these regions of the species' distribution.

Climate Change Effects on Seagrasses

Here, we consider the possible effects of climate change (i.e., rising temperatures and sea levels) on seagrasses in general and on Johnson's seagrass in particular. Earth's climate is projected to warm between 2° and 4°C by 2100, and similar projections have been made for marine systems (Sheppard and Rioja-Nieto 2005). At the margins of temperate and tropical bio-regions and within tidally-restricted areas where sea grasses are growing at their physiological limits, increased temperatures may result in losses of seagrasses and/or shifts in species composition (Short et al. 2007). The response of seagrasses to increased water temperatures will depend on the thermal tolerance of the different species and their optimum temperature for photosynthesis, respiration, and growth (Short and Neckles 1999). With future climate change and potentially warmer temperatures, there may be a 1 m-5 m rise in the seawater levels by 2100 when taking into account the thermal expansion of ocean water and melting of ocean glaciers. Rising sea levels may adversely impact seagrass communities due to increases in water depths above present meadows, reducing available light. Climate change may also reduce light by shifting weather patterns to cause increased cloudiness. Changing currents may cause erosion, increased turbidity and seawater intrusions higher up on land or into estuaries and rivers, which could increase landward seagrass colonization (Short and Neckles 1999). A landward migration of seagrasses with rising sea levels is a potential benefit, so long as suitable substrate is available for colonization.

It is uncertain how Johnson's seagrass will adapt to rising sea levels and temperatures. Much depends on how much and how quickly temperatures increase. For example, Johnson's seagrass that grows intertidally (e.g., in some parts of the Lake Worth Lagoon) may be affected by a slight change in temperature (since it may already be surviving under less than optimal conditions). However, this may be ameliorated with rising sea levels, assuming Johnson's seagrass would migrate landward with rising sea levels and assuming that suitable substrate would be available for a landward migration. However, rising sea levels could also adversely impact seagrass communities due to increases in water depths above existing meadows reducing available light.

Reduction in light availability may benefit some seagrass species (e.g., *Halophila* species) that require less light compared to the larger, canopy-forming species; therefore, much depends on the thermal tolerance of the different seagrass species and their optimum temperature for photosynthesis, respiration, and growth (Short and Neckles 1999). While sea level has changed many times during the evolutionary history of Johnson's seagrass, it is uncertain how this species will fare when considering the combined effects of rising temperatures and sea levels in conjunction with other stressors such as reduced salinity from freshwater runoff. It has been shown that evolutionary change in a species can occur within a few generations (Rice and Emery 2003), thus making it possible for seagrasses to cope if the changes occur at a rate slow enough to allow for adaptation.

- **Status Summary**

The results of 14 years of monitoring in the species' northern range (1994-2007) and three years of monitoring in the species' southern range (2006-2009) indicated there were no significant changes in the northern or southern range limits of Johnson's seagrass (NMFS 2007). Populations in the northern range appeared to be stable and capable of sustaining themselves despite stochastic events related to severe storms (Steward et al. 2006) and fluctuating climatology. Longer-term monitoring data are needed to verify the continued stability of the northern distribution and to confirm the stability of the southern distribution of the species (NMFS 2007). However, the results of the southern transect sampling documented a relatively continuous, although patchy, distribution of Johnson's seagrass from Jupiter Inlet to Virginia Key, at least during periods of relatively good environmental conditions and no significant large-scale disturbances. Larger seagrasses, predominantly turtle grass *(Thalassia testudinum)*, begin to out-compete Johnson's seagrass in the southern range. While monitoring indicated a slight extension in the known northern range (Virnstein and Hall 2009), the limit of the southern range in the vicinity of Virginia Key (latitude 25.75°N) appeared to be stable. There have been no reports of this species further south of the currently known southern distribution.

As discussed in the *Threats* section, the Recovery Team has determined that the possibility of mortality due to reduced salinity over long periods of time is a potential significant threat to the species. The other potential threats discussed above (i.e., dredging/filling, construction and shading from in and over-water structures, propeller scarring and anchor mooring, trampling, storms, and siltation) were determined to be local and small-scale and are not considered threats to the persistence and recovery of the species. It is uncertain how Johnson's seagrass will be affected by the synergistic effects of rising temperatures and sea levels associated with climate change (in conjunction with other stressors such as reduced salinity from freshwater runoff). However, evolutionary change in a species can occur within a few generations (Rice and Emery 2003), thus making it possible for seagrasses to cope if the changes occur at a rate slow enough to allow for adaptation.

4 ENVIRONMENTAL BASELINE

This section is a description of the past and ongoing human and natural factors leading to the current status of Johnson's seagrass within the action area. The environmental baseline includes state, tribal, local, and private actions already affecting the species and its habitat that will occur contemporaneously with the consultation in progress. Unrelated federal actions affecting Johnson's seagrass that have completed formal or informal consultation are also part of the environmental baseline, as are federal and other actions within the action area that may benefit the species. This Opinion describes these activities' effects in the sections below.

Federal Actions Affecting Johnson's Seagrass in the Action Area

A wide range of activities funded, authorized, or carried out by federal agencies may affect Johnson's seagrass. These include dredging, dock/marina construction, boat shows, bridge/highway construction, residential construction, shoreline stabilization, breakwaters, and the installation of subaqueous lines or pipelines. Other federal actions (or actions with a federal nexus) that may affect Johnson's seagrass include actions by the Environmental Protection Agency and the USACE to manage freshwater discharges into waterways; regulation of vessel traffic by the USCG; management of National Parks; actions regarding protected species by the USFWS; management of vessel traffic (and other activities) by the U.S. Navy; and authorization of state coastal zone management plans by NOAA's National Ocean Service.

According to a search of the last 5 years of records in NMFS's Public Consultation Tracking System database, there has been one recent ESA Section 7 consultation completed with the potential to affect Johnson's seagrass within the action area. This was a formal consultation resulting in a Biological Opinion (SER-2014-13071, SAJ-2001-01920). This action was for the installation of a 9-slip docking facility and observation pier with an expected impact to 92 ft^2 of Johnson's seagrass. NMFS's Biological Opinion was that the action, as proposed, would adversely affect Johnson's seagrass, but was not likely to jeopardize its continued existence. The project was not located in Johnson's seagrass critical habitat.

State, Private or Natural Actions Affecting Johnson's Seagrass in the Action Area

Recreational Vessel Traffic
Recreational vessel traffic in the range of Johnson's seagrass can result from marina and dock construction, and can impact Johnson's seagrass through improper anchoring, and propeller scarring. As discussed above, propeller scarring and improper anchoring are known to adversely affect seagrasses (Kenworthy et al. 2002b; Sargent et al. 1995). These activities can severely disrupt the benthic habitat by uprooting plants, severing rhizomes, destabilizing sediments, and significantly reducing the viability of the seagrass community. Propeller dredging and improper anchoring in shallow areas are a major disturbance to even the most robust seagrasses. Damage to seagrasses from propeller scarring and improper anchoring by motor vessels is recognized as a significant resource management problem in Florida (Sargent et al. 1995). A number of local, state, and federal statutes prohibit damaging seagrasses through vessel impacts, and a number of conservation measures, including the designation of vessel control zones, signage, mooring fields, and public awareness campaigns, are directed at minimizing vessel damage to seagrasses.

Natural Disturbances
While large-scale weather events, such as tropical storms and hurricanes, often generate runoff conditions that decrease water quality, they also produce conditions (wind setup and abrupt water elevation changes) that can increase flushing rates. The effects of storms can be complex. Specifically documented storm effects on healthy seagrass meadows have been relatively minor:

(1) scouring and erosion of sediments; (2) erosion of seeds and plants by waves, currents, and surge; (3) burial by shifting sand; (4) turbidity; and (5) discharge of freshwater, including inorganic and organic constituents in the effluents (Oppenheimer 1963; Steward et al. 2006; van Tussenbroek 1994; Whitfield et al. 2002). Storm effects may be chronic (e.g., due to seasonal weather cycles) or acute, such as the effects of strong thunderstorms or tropical cyclones.

State and Federal Activities That May Benefit Johnson's Seagrass in the Action Area

State and federal conservation measures exist to protect Johnson's seagrass and its habitat under an umbrella of management and conservation programs that address seagrasses in general (Kenworthy et al. 2006). These conservation measures must be continually monitored and assessed to determine if they will ensure the long-term protection of the species and the maintenance of environmental conditions suitable for its continued existence throughout its geographic distribution.

5 EFFECTS OF THE ACTION ON JOHNSON'S SEAGRASS

We believe that up to 0.03 ac of Johnson's seagrass is likely to be adversely affected (i.e., permanently removed) by construction, shading and piling placement. Because the action will result in adverse effects to Johnson's seagrass, we must evaluate whether the action is likely to jeopardize the continued existence of the species, in section 7 below.

6 CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, or local private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

No categories of effects beyond those already described are expected in the action area, and we are not aware of any other future state, tribal, or local private actions that are reasonably certain to occur within the action area.

Dock and marina construction will likely continue at current rates, with concomitant loss and degradation of seagrass habitat, including Johnson's seagrass. However, these activities are subject to USACE permitting and thus the ESA Section 7 consultation requirement.

Upland development and associated runoff will continue to degrade water quality and decrease water clarity necessary for growth of seagrasses. Flood control and imprudent water management practices will continue to result in freshwater inputs into estuarine systems, thereby degrading water quality and altering salinity. Long-term, large-scale reduction in salinity has been identified as a potentially significant threat to the persistence and recovery of Johnson's seagrass.

Increased recreational vessel traffic will continue to result in damage to Johnson's seagrass and its designated critical habitat by improper anchoring, propeller scarring, and accidental groundings. However, we expect that ongoing boater education programs and posted signage about the dangers to seagrass beds from propeller scarring and improper anchoring may reduce impacts to Johnson's seagrass.

7 JEOPARDY ANALYSIS

The analyses conducted in the previous sections of this Opinion serve to provide a basis to determine whether the proposed action would be likely to jeopardize the continued existence of Johnson's Seagrass. In Section 5, we outlined how the proposed action can affect Johnson's seagrass. Now we turn to an assessment of the species response to these impacts, in terms of overall population effects, and whether those effects of the proposed actions, when considered in the context of the status of the species (Section 3), the environmental baseline (Section 4), and the cumulative effects (Section 6), will jeopardize the continued existence of Johnson's seagrass.

"To jeopardize the continued existence of" is defined as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Thus in making this determination, we must first determine whether there will be a reduction in the reproduction, numbers, or distribution. Then, if there is a reduction in one or more of these elements, we evaluate whether it will cause an appreciable reduction in the likelihood of both the survival and the recovery of the species.

As noted in Section 5, we believe that up to 0.03 ac of Johnson's seagrass is likely to be adversely affected by construction activities and shading. We must now determine if the proposed action would reasonably be expected to appreciably reduce, either directly or indirectly, the likelihood of Johnson's seagrass survival and recovery in the wild. In 2 steps, the following sections provide our rationale for why we believe this action is not likely to appreciably reduce the likelihood of Johnson's seagrass survival and recovery in the wild. First we evaluate whether the anticipated loss of 0.03 ac of Johnson's seagrass will result in any reduction in reproduction, distribution or areal coverage (numbers). If so, we will then assess whether any reductions in reproduction, distribution or numbers may appreciably reduce the species' likelihood of survival in the wild. Second, we will consider how the anticipated loss of the species is likely to affect the species' recovery in the wild.

Based on our current knowledge of the species, Johnson's seagrass reproduction is entirely asexual, is presumed to occur by fragmentation, and its growth appears to be rapid. Johnson's seagrass occurs in dynamic and disjunctive patches throughout its range. Reproduction will be reduced by the anticipated loss of up to 0.03 ac of the species, but NMFS believes this reproductive loss does not appreciably reduce the likelihood of survival of Johnson's seagrass in the wild because adjacent areas where Johnson's seagrass is present will continue to reproduce and spread. The proposed action will not disturb Johnson's seagrass outside the action area; therefore, the reproductive potential of the species adjacent to the action area, and in this portion of its range, will persist. The proposed action will not result in a reduction of Johnson's seagrass distribution. Johnson's seagrass will continue to exist in areas in and surrounding the action area and throughout its 200-km range. The loss of up to 0.03 ac of Johnson's seagrass will not reduce or change the distribution within the species range because it will not impact any of the other

Johnson's seagrass outside of the direct footprint of the project. Likewise, this potential loss of Johnson's seagrass will not cause a fragmentation of the range because some Johnson's seagrass patches will likely still remain in the action area and would be capable of spreading via asexual fragmentation.

Because the action will not reduce or change the distribution of the species, and will result in only minor reductions in the numbers and reproduction of the species, NMFS concludes that the proposed action will not appreciably reduce the likelihood of survival of Johnson's seagrass in the wild.

In assessing the possible effects on species recovery, we consider recovery objectives as identified the recovery plan: (1) the species' present geographic range remains stable for at least 10 years, or increases; (2) self-sustaining populations are present throughout the range at distances less than or equal to the maximum dispersal distance to allow for stable vegetative recruitment and genetic diversity; and (3) populations and supporting habitat in its geographic range have long-term protection (through regulatory action or purchase acquisition).

NMFS believes that the proposed action will not appreciably reduce the likelihood of recovery for Johnson's seagrass in the wild. The first recovery criterion for Johnson's seagrass is for its present range to remain stable for 10 years or to increase during that time. NMFS's 5-year review (2007) of the status of the species concluded that the first recovery objective had been achieved. In fact, the range had increased slightly northward. Given the nature of the proposed project and the fact Johnson's seagrass is likely to persist in the surrounding areas, we believe the proposed action will not impact the status of this objective.

The second recovery criterion for Johnson's seagrass requires that self-sustaining populations be present throughout the range at distances less than or equal to the maximum dispersal distance for the species. Self-sustaining populations are present throughout the range of the species and there does not appear to be any overall declining trend. This demonstrates that the overall Johnson's seagrass population is stable. The species' overall reproductive capacity will be only minimally reduced by the potential loss of up to 0.03 ac of Johnson's seagrass. The proposed action is relatively small in nature and will not lead to separation of self-sustaining Johnson's seagrass patches beyond the maximum dispersal distance for the species. Similarly, the proposed action will not adversely affect the availability of suitable habitat in which the species can spread/flow in the surrounding areas in the future. Drifting fragments of Johnson's seagrass can remain viable in the water column for 4-8 days (Hall et al. 2006), and can travel several kilometers under the influence of wind, tides, and waves. Because of this, we believe that the removal of up to 0.03 ac for this project will not impact self-sustaining populations and that seagrass fragments will be able to drift to and over these impacted project sites. Since the proposed action will not disturb all of the Johnson's seagrass estimated to occur inside the action area, or any occurring outside the action area, the potential for a self-sustaining population is not removed from this portion of the range.

The final recovery criterion dictates that populations and supporting habitat in the geographic range of Johnson's seagrass have long-term protection (through regulatory action or purchase acquisition). Though the affected project site will not be available for protection, thousands of acres of habitat are still available for long-term protection, which would include areas surrounding the action area. We do not believe this project will result in the appreciable reduction in the likelihood of recovery of Johnson's seagrass distribution in the area.

We conclude that the proposed action's adverse effects on Johnson's seagrass will not impede achieving the recovery objectives listed above and will therefore not appreciably reduce the species' likelihood of recovery in the wild.

8 CONCLUSION

We have analyzed the best available data, the current status of the species, environmental baseline, effects of the proposed action, and cumulative effects to determine whether the proposed action is likely to jeopardize the continued existence of Johnson's seagrass. Because the proposed action is not likely to appreciably reduce the likelihood of Johnson's seagrass's survival and recovery in the wild, it is our Opinion that the proposed action is not likely to jeopardize the continued existence of Johnson's seagrass.

No incidental take statement or reasonable and prudent measures will be issued because the ESA does not require biological opinions to contain incidental take statements for threatened plants.

9 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

NMFS believes the following conservation recommendations are reasonable, necessary and appropriate to conserve and recover Johnson's seagrass. NMFS strongly recommends that these measures be considered and adopted:

1. NMFS recommends that the FDOT conduct and support research to assess trends in the distribution and abundance of Johnson's seagrass. Data collected should be contributed to the Florida Fish and Wildlife Conservation Commission's Florida Wildlife Research Institute to support ongoing GIS mapping of Johnson's and other seagrass distribution.

2. NMFS recommends that the FDOT, in coordination with seagrass researchers and industry, support ongoing research on light requirements and transplanting techniques to preserve and restore Johnson's seagrass, and on collection of plants for genetics research, tissue culture, and tissue banking.

3. NMFS recommends that the FDOT prepare an assessment of the effects of other actions under its purview on Johnson's seagrass for consideration in future consultations.

Specifically, cumulative effects from bridge replacements, roadway expansion, and other works performed by FDOT that could affect the species.

4. NMFS recommends that the FDOT promote the use of the October 2002 *Key for Construction Conditions for Docks or other Minor Structures Constructed in or over Johnson's Seagrass* as the construction methodology for proposed docks located in the range of Johnson's seagrass.

5. NMFS recommends that the FDOT explore bridge and road designs that avoid and minimize impacts to Johnson's seagrass. Research regarding bridge orientation, light penetration, pile driving and spacing, and minimized cross-sectional profiles should be considered.

10 REINITIATION OF CONSULTATION

As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal action agency involvement or control over the action has been retained, or is authorized by law, and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action on listed species or designated critical habitat in a manner or to an extent not considered in this Opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat not considered in this Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

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