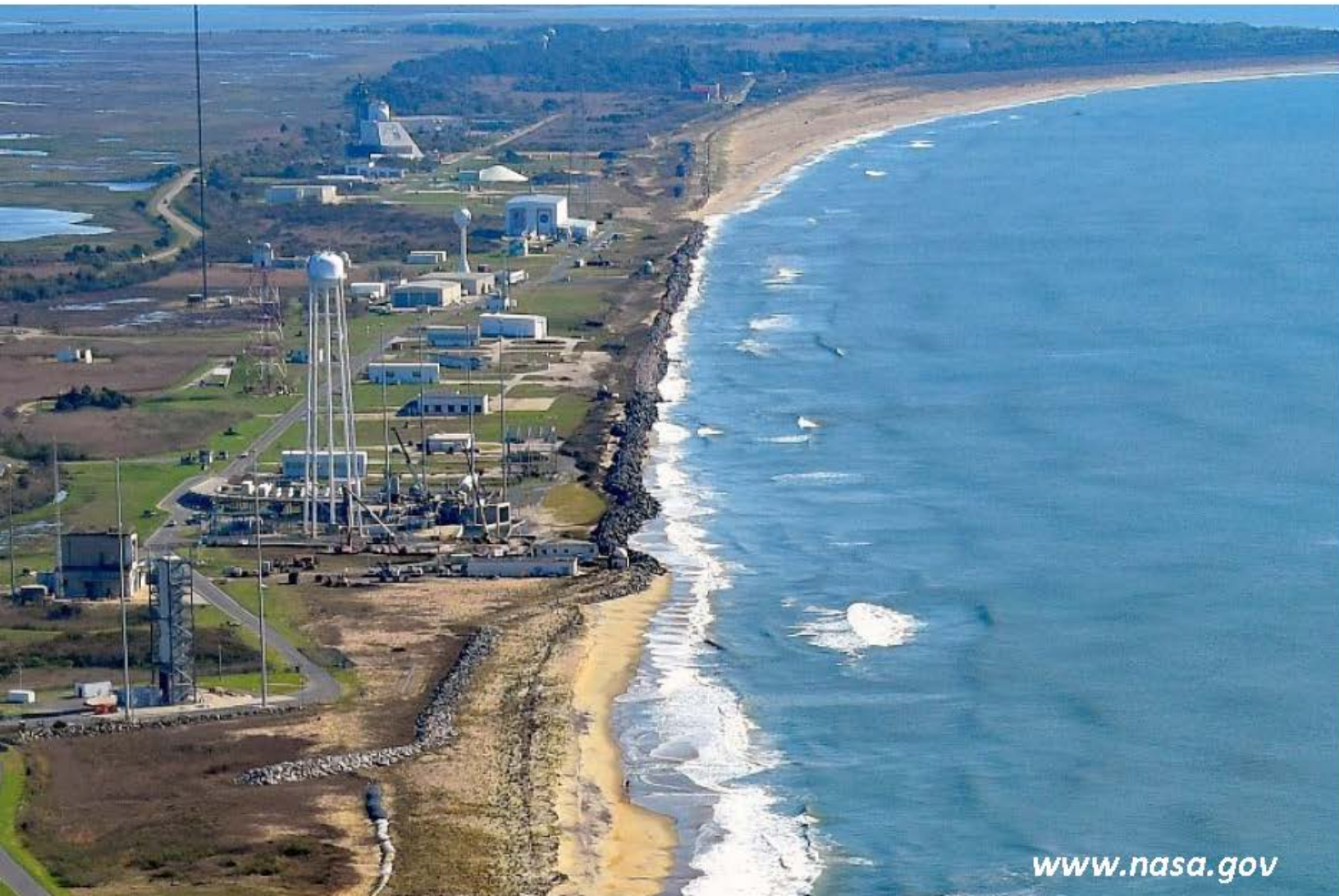
National Aeronautics and
Space Administration

Final Environmental Assessment

NASA Wallops Flight Facility
Shoreline Enhancement and Restoration Project

June 2019

In Cooperation with:
Bureau of Ocean Energy Management
U.S. Army Corps of Engineers



Cover image:
Wallops Island in April 2019 – Photo Credit: Patrick J. Hendrickson / Highcamera.com

FINAL NASA WFF SHORELINE ENHANCEMENT AND RESTORATION PROJECT ENVIRONMENTAL ASSESSMENT

Lead Agency: National Aeronautics and Space Administration (NASA)

Cooperating Agencies: U.S. Bureau of Ocean Energy Management
U.S. Army Corps of Engineers

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Abstract:

In accordance with the National Environmental Policy Act, NASA has prepared this Environmental Assessment to assess the restoration of the Wallops Island shoreline at the Wallops Flight Facility, located in Accomack County, Virginia. Under the Proposed Action, NASA would fund the placement of up to approximately 1.3 million cubic yards of sand sourced from either the north Wallops Island beach or dredged from offshore Unnamed Shoal A. Additionally, NASA could construct a series of offshore parallel breakwaters approximately 200 feet offshore from the renourished beach. Resources evaluated in detail include coastal geology; water quality; the coastal zone; air quality; noise; benthos; wildlife; fish and Essential Fish Habitat; marine mammals; special status species; cultural resources; and recreation.

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Abbreviations and Acronyms

APE	area of potential effect
APHIS	U.S. Department of Agriculture Animal and Plant Health Inspection Service
ASTM	American Society for Testing and Materials
ATV	all-terrain vehicle
BMP	best management practice
BO	Biological Opinion
BOEM	Bureau of Ocean Energy Management
CAA	Clean Air Act
CEA	cumulative effects analysis
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CNWR	Chincoteague National Wildlife Refuge
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dBA	A-weighted decibel
dBpeak	instantaneous peak sound pressure level
dBRMS	root mean square sound pressure level
EA	Environmental Assessment
EPA	Environmental Protection Agency
EFH	Essential Fish Habitat
ESA	Endangered Species Act
°F	degrees Fahrenheit
FCD	Federal Consistency Determination
FONSI	Finding of No Significant Impact
GCM	Global Climate Model
GHG	greenhouse gases
HABS	Historic American Building Survey
HAP	Hazardous Air Pollutants
HAPC	Habitat Areas of Particular Concern
HIF	Horizontal Integration Facility
mm	millimeter
mm/year	millimeters per year
MMPA	Marine Mammal Protection Act
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NPR	NASA Procedural Requirement
NPS	National Park Service
NRHP	National Register of Historic Places
O_3	ozone
OCS	Outer Continental Shelf
Pa	Pascal
Pb	lead
PEIS	Programmatic Environmental Impact Statement
$PM_{2.5}$	Particulate matter less than 2.5 microns in diameter
PM_{10}	Particulate matter less than 10 microns in diameter
ROD	Record of Decision
SERP	Shoreline Enhancement and Restoration Project
SHPO	State Historic Preservation Office
SL	sound level
SO_2	sulfur dioxide
SPL	sound pressure level
SRIPP	Shoreline Restoration and Infrastructure Protection Program
TSS	Traffic Separation Schemes

U.S.	United States
U.S.C.	U.S. Code
VDHR	Virginia Department of Historic Resources
VDEQ	Virginia Department of Environmental Quality
VDOT	Virginia Department of Transportation
VMRC	Virginia Marine Resources Commission
WFF	Wallops Flight Facility

1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1 INTRODUCTION

The National Aeronautics and Space Administration (NASA) has prepared this Environmental Assessment (EA) to evaluate the potential environmental impacts of both enhancing and restoring the shoreline on Wallops Island. This Shoreline Enhancement and Restoration Project (SERP) EA has been prepared by NASA in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended (42 United States [U.S.] Code [U.S.C.] 4321-4347); the Council on Environmental Quality (CEQ) regulations implementing NEPA (Title 40 of the Code of Federal Regulations [CFR] Parts 1500-1508); NASA procedures for implementing NEPA (14 CFR 1216.3); and NASA Procedural Requirement (NPR) *Implementing the National Environmental Policy Act and Executive Order 12114* (NPR 8580.1). The U.S. Department of Interior Bureau of Ocean Energy Management (BOEM) and U.S. Army Corps of Engineers (USACE) Norfolk District are Cooperating Agencies with NASA in preparation of this EA, with NASA serving as the lead agency.

NASA has prepared this EA as a document tiered from the *2010 Final Shoreline Restoration and Infrastructure Protection Program (SRIPP) Final Programmatic Environmental Impact Statement (PEIS)*[1] with information and project components as presented in the *2013 Final Post-Hurricane Sandy EA* [2]. The *2010 Final SRIPP PEIS* and *2013 Final Post-Hurricane Sandy EA* are incorporated by reference with new information and analysis provided as appropriate.

1.2 BACKGROUND

On December 13, 2010, NASA issued a Record of Decision (ROD) for the Wallops Flight Facility (WFF) SRIPP PEIS, hereafter referred to as the *2010 Final SRIPP PEIS*. The U.S. Department of the Interior's BOEM and the USACE, Norfolk District were Cooperating Agencies. The primary goal of the SRIPP is to reduce direct damage to Wallops Island's infrastructure; however, its true benefit is the continued use of the island to support the aerospace programs that are at the core of WFF's mission (NASA 2010). The *2010 Final SRIPP PEIS* analyzed three action alternatives including structural and non-structural options, varying beach berm widths, and multiple sources of fill material. In its ROD, NASA selected *Alternative 1: Full Beach Fill, Seawall Extension* and adopted a suite of mitigation and monitoring protocols to both reduce potential environmental impacts and track project performance. Implementing the initial phase of Alternative 1 entailed: 1) the placement along the Wallops Island shoreline of approximately 3.2 million cubic yards of sand dredged from Unnamed Shoal A, located on the Outer Continental Shelf (OCS) in the Atlantic Ocean under BOEM jurisdiction; and 2) an initial 1,430 foot southerly extension of the Wallops Island rock seawall with future extensions completed as funds are available to a maximum length of 4,600 feet. An estimated nine beach renourishment cycles at approximately five year intervals would be implemented. The ROD stated that fill material for future renourishment cycles could be taken from either Unnamed Shoal A, Unnamed Shoal B, or north Wallops Island beach and left the specifics of how and when the fill material would be obtained to be addressed in future action-specific NEPA documentation.

[1] The *2010 Final SRIPP PEIS* is available online at: https://code200-external.gsfc.nasa.gov/250-wff/programmatic-environmental-impact-statement-shoreline-restoration-and-infrastructure-protection

[2] The *2013 Final Post-Hurricane Sandy EA* is available online at: https://code200-external.gsfc.nasa.gov/250-wff/wallops-island-post-hurricane-sandy-shoreline-repair-final-environmental-assessment-fea-and-finding

In October 2012, Hurricane Sandy made landfall. Monitoring surveys following the storm event identified the need to repair a section of the seawall and the southern two-thirds of the recently nourished beach. Public Law 113-2, *Disaster Relief Appropriations Act, 2013*, was signed into law on January 29, 2013. The bill included a provision for NASA to repair facilities that sustained damage during the hurricane. NASA signed a Finding of No Significant Impact (FONSI) on June 6, 2013, for the *Wallops Island Post-Hurricane Sandy Shoreline Repair Final Environmental Assessment* (NASA 2013), hereafter referred to as the *2013 Final Post-Hurricane Sandy EA*. Repairs to the seawall and beach renourishment were completed in September 2014. Subsequent storms including Hurricane Joaquin in 2015 and Winter Storm Jonas in 2016 reduced the sand volume in the southern portion of the project area by an average of 1,014,337 cubic yards as compared to volumes present after 2014 shoreline repair (USACE 2018a). Additional sand volume reduction occurred most recently in 2018 with Winter Storm Riley.

1.3 COOPERATING AGENCIES

NASA, as the WFF property owner and project proponent, is the lead agency in preparing this EA. As with the *2010 Final SRIPP PEIS*, BOEM and USACE Norfolk District have served as Cooperating Agencies because they each possess both regulatory authority and specialized expertise regarding the Proposed Action. A Cooperating Agency, as defined in 40 CFR §1508.5, is "any federal agency other than a lead agency which has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major federal action significantly affecting the quality of the human environment."

BOEM has jurisdiction over mineral resources on the federal OCS. A Negotiated Noncompetitive Agreement pursuant to Section 30 CFR Part 583, would be negotiated among BOEM, USACE, and NASA to allow the dredging of sand from the OCS. Under Section 404 of the Clean Water Act (CWA), the USACE Regulatory Program has jurisdiction over the disposal of dredged and fill material in waters of the U.S. Similarly, under Section 10 of the Rivers and Harbors of Act of 1899, the USACE has jurisdiction over the placement of structures and work conducted in navigable waters of the U.S. NASA would require authorizations from both the BOEM and the USACE to undertake the proposed project.

In addition to its regulatory role in the project, the USACE Norfolk District is involved in project design, construction, and monitoring of SRIPP on NASA's behalf. Since issuing its 2010 ROD and 2013 FONSI, NASA and USACE oversaw the initial seawall extension between August 2011 and March 2012 and have nourished the beach twice, once during initial construction in 2012 and again in 2014. Beginning prior to the initial beach fill, both agencies have sponsored biannual (spring and fall) topographic and hydrographic monitoring surveys of the Wallops Island shoreline, which have demonstrated a trend in sediment transport from the southern portion of the project area to the north. Additionally, the USACE Norfolk District has evaluated using breakwaters along the Wallops Island shoreline to reduce the intensity of wave action to valuable assets and slow the rate of sediment transport.

1.4 PURPOSE AND NEED FOR THE PROPOSED ACTION

1.4.1 PURPOSE

The purpose of the Proposed Action is to restore the Wallops Island shoreline in order to reduce the potential for damage to, or loss of, NASA, U.S. Navy, and Virginia Commercial Spaceflight Authority's Mid-Atlantic Regional Spaceport assets on Wallops Island from wave impacts associated with storm events.

1.4.2 NEED

The Proposed Action is needed because the shoreline's beach berm and dune system established to protect NASA's Wallops Island launch range infrastructure has been eroded through storm wind and wave damage; therefore, the existing beach cannot provide the level of storm damage reduction for which it was originally designed.

The constructed beach system has served its intended purpose of reducing damage to the range assets. However, a notable portion of sub-aerial (i.e., on land surface) sand has been relocated by storm winds and waves with a majority of this sand volume transported to the north end of Wallops Island. The effects of storms are most apparent within the southern half of Wallops Island, where the majority of the most critical launch assets are located. Within this area, the seaward half of the beach berm has been lowered by 3 feet or more. As such, the beach berm and dune system can no longer provide the level of storm damage reduction to which it was originally intended, without being restored to regain full functionality.

1.4.3 COOPERATING AGENCIES PURPOSE AND NEED

BOEM and USACE, as cooperating federal agencies, would each undertake a "connected action" (40 CFR 1508.25) that is related to, but unique from, NASA's Proposed Action, the funding of the project. The purpose of BOEM's Proposed Action is to consider NASA's request for the use of OCS sand resources in renourishing the Wallops Island beach. The purpose of USACE's Proposed Action is to consider NASA's request for authorization to: 1) discharge fill material into waters of the U.S. under Section 404 of the CWA; and 2) conduct work in navigable waters of the U.S. under Section 10 of the Rivers and Harbors Act. The BOEM and USACE Proposed Actions are needed to fulfill each agency's jurisdictional responsibilities under the OCS Lands Act, the CWA, and the Rivers and Harbors Act, respectively.

1.5 PUBLIC INVOLVEMENT

The steps taken to involve the public in the preparation of this SERP EA are outlined below.

- **Scoping** – Federal, state, and local agencies and members of the public were invited to provide input during the scoping period that began February 27, 2018, and ended March 29, 2018. Comments were received from the Accomack County Administrator, the Virginia Department of Environmental Quality (VDEQ), the Environmental Protection Agency (EPA), Virginia Marine Resources Commission, and the Pamunkey Indian Tribe. The comment letters received are provided in **Appendix A**. A project website has been established to keep all interested parties informed and to encourage public input: https://sites.wff.nasa.gov/code250/Tiered_Shoreline_Enhancement_and_Restoration_EA.html.
- **Draft EA** – The draft EA analyzed the environmental consequences of the Proposed Action and a range of reasonable alternatives, including no action alternative. It included the purpose and need for the Proposed Action, the description of the alternatives, the existing environmental conditions where the Proposed Action would take place, and the environmental consequences of implementing the alternatives. The Draft EA is supported by detailed technical studies.
- **Draft EA Notice of Availability (NOA) and Notice of Public Meeting** – Advertisements were placed in the following newspapers: *Chincoteague Beacon, Eastern Shore News, Eastern Shore Post,* and *The Daily Times*. The advertisements announced the availability of the Draft

EA for review and comment as well as the details of the public meeting held at the Wallops Flight Facility Visitor Center on December 19, 2018, from 5 to 7 p.m. An electronic version of the Draft EA, along with the advertisement of the public meeting, were available to the public on the NASA project website. Print copies of the Draft EA were available for review at the following locations: Chincoteague Island Library, Chincoteague, VA; Eastern Shore Public Library, Accomac, VA; Northampton Free Library, Nassawadox, VA; and the WFF Visitor Center, Rt. 175, Wallops Island, VA. Print copies were also available upon request.

- **Public Comment Period** – Federal, state, and local agencies and members of the public were invited to provide written comments on the Draft EA over a 30-day period. Electronic versions of all public meeting materials were available to the public on the project website. Written comments were accepted throughout the 30-day public comment period.
- **Final EA** – The Final EA incorporates changes, as appropriate, resulting from substantive comments. Changes include supplementing, improving, or modifying the analyses; and factual corrections.
- **Final EA NOA and FONSI** – Advertisements were placed in the following newspapers: *Chincoteague Beacon*, *Eastern Shore News*, *Eastern Shore Post*, and *The Daily Times*. The advertisements announce the availability of the Final EA and the FONSI. Electronic versions of the Final EA and FONSI are available to the public on the NASA public website and at the following locations: Chincoteague Island Library, Chincoteague, VA; Eastern Shore Public Library, Accomac, VA; Northampton Free Library, Nassawadox, VA; and the WFF Visitor Center, Rt. 175, Wallops Island, VA. .

1.5.1 SCOPING COMMENT SUMMARY

Table 1.5-1 provides a brief summary of the issues raised during the scoping period. Refer to **Appendix A** for the comment letters received during the scoping period.

Table 1.5-1. Summary of Scoping Issues

Comment	Addressed in EA?	If yes, location in PEIS; if no, rationale
EPA requests the list of federal and state permits required to implement the Proposed Action.	Yes	Section 3.1
How has shoal A diminished in volume since the 2013 Shoreline Repair EA; can it sustain additional dredging as a source of material for beach nourishment?	Yes	Section 2.3.3.2
What impacts would dredging Shoal A have on the habitat it provides for birds and invertebrates such as annelids, mollusks and crustaceans?	Yes	Sections 3.7 and 3.8
Please evaluate and discuss any impacts the Proposed Action may have on herpetofauna and any proposed avoidance and minimization measures.	Yes	Sections 3.8 and 3.11

Table 1.5-1. Summary of Scoping Issues		
Comment	**Addressed in EA?**	**If yes, location in PEIS; if no, rationale**
Please include discussion of any anticipated habitat creation for species such as the Piping Plover or Diamondback Terrapin and any monitoring of these species that will be conducted.	Yes	Sections 3.8 and 3.11
It would be helpful if the EA documented if offshore sandbars have formed since the additional sand was incorporated into the nearshore system. Please describe how any offshore sandbars formed since the Shoreline Repair EA may influence the construction of offshore breakwaters proposed in the SERP.	Yes	Section 3.2
Virginia Marine Resources Commission is concerned that a southern end jetty would affect longshore transport of sand to Assawoman Island.	No	No jetty is proposed.
Pamunkey Indian Tribe has requested notification of an inadvertent discovery of a cultural or religious site of significance	Yes	Section 3.12.3

1.5.2 DRAFT COMMENTS SUMMARY

Table 1.5-2 provides a brief summary of the substantive issues raised during the Draft EA review period that required changes to the Final EA. Refer to **Appendix B** for the comment letters received during the scoping period.

Table 1.5-2. Summary of Substantive Public Comments		
Comment	**Addressed in EA?**	**If yes, location in PEIS; if no, rationale**
Concerns that history of dredging Chincoteague Channel was not complete.	Yes	Table 3.2.1 was updated with dredging history for Chincoteague Inlet 1993-present
Questions about required mitigations and monitoring of natural resources during and after proposed activities.	Yes	The following sections were updated based on required permitting and consultations: • 3.4 – Coastal Zone Management Act Consultation • 3.9 – Essential Fish Habitat Consultation • 3.11 – Endangered Species Act Consultation

Based upon consultations with resource agencies, and its own internal review, NASA made the following substantive changes to the document which are reflected in this Final EA:

- A summary of the Coastal Zone Management Act consultation has been added to Section 3.4;
- A summary of the Essential Fish Habitat consultation has been added to Section 3.9;
- A summary of Endangered Species Act consultation has been added to Section 3.11;
- Comments received on the Draft EA have been included as Appendix B;
- The Biological Opinion issued by the U.S. Fish and Wildlife Service has been added to Appendix G
- The USACE Individual Permit for the project has been added as Appendix I

2.0 DESCRIPTION OF PROPOSED ACTION AND NO ACTION ALTERNATIVE

2.1 INTRODUCTION

This section provides a discussion of the alternatives under consideration for the restoration of the Wallops Island shoreline. The *2010 Final SRIPP PEIS* considered in detail a range of potential storm damage reduction alternatives, including structural and non-structural options, varying beach berm widths, and multiple sources of fill material. Based upon a combination of economic, engineering, and environmental factors in its ROD, NASA selected for implementation *Alternative 1: Full Beach Fill, Seawall Extension*. The initial phase of the 50 year SRIPP project was completed in August 2012. However, within two months of completion, the effects of Hurricane Sandy damaged the southern two-thirds of the recently renourished beach including a portion of the rock seawall; post-Hurricane Sandy repairs were completed in 2014. The effects of subsequent storms have greatly reduced the shoreline most notably within the southern half of the Wallops Island beach where many of the most critical launch assets are located. Therefore, the focus of this EA is to regain function of the Wallops Island beach berm and dune system to reduce storm damage as described and analyzed in the *2010 Final SRIPP PEIS*.

2.2 PROPOSED ACTION

Consistent with the renourishment component of Alternative 1 described in detail in the *2010 Final SRIPP PEIS* and reexamined in the *2013 Final Post-Hurricane Sandy EA*, NASA's Proposed Action is to renourish the beach along the Wallops Island shoreline infrastructure protection area. Before the renourishment, NASA may construct a series of parallel nearshore breakwater structures that would reduce the intensity of wave action and slow sediment transport.

2.2.1 ELEMENTS COMMON TO ALL ALTERNATIVES

2.2.1.1 Beach Renourishment

Approximately 1.3 million cubic yards of sand material would be placed on the shoreline areas that have sustained berm and dune system reductions (**Figure 2.2-1)**. Material for renourishment could come from the north Wallops Island beach, an area that has been accreting due to transport of material from the south, or from Unnamed Shoal A, which was used as a sand source for previous renourishment projects. Detailed descriptions of these two alternatives are provided in **Section 2.3, Alternatives Carried Forward for Detailed Analysis**.

If work were conducted between April and September, NASA would ensure that the work site and adjacent areas would be surveyed for nesting birds and sea turtles by a biological monitor on a daily basis. Survey protocols would be the same as those developed for the initial beach fill and seawall extension (NASA 2011a). The biological monitor would coordinate directly with onsite project employees to ensure that all parties are made aware of nesting status and any need to suspend or relocate work activities until chicks have fledged and/or sea turtles have hatched.

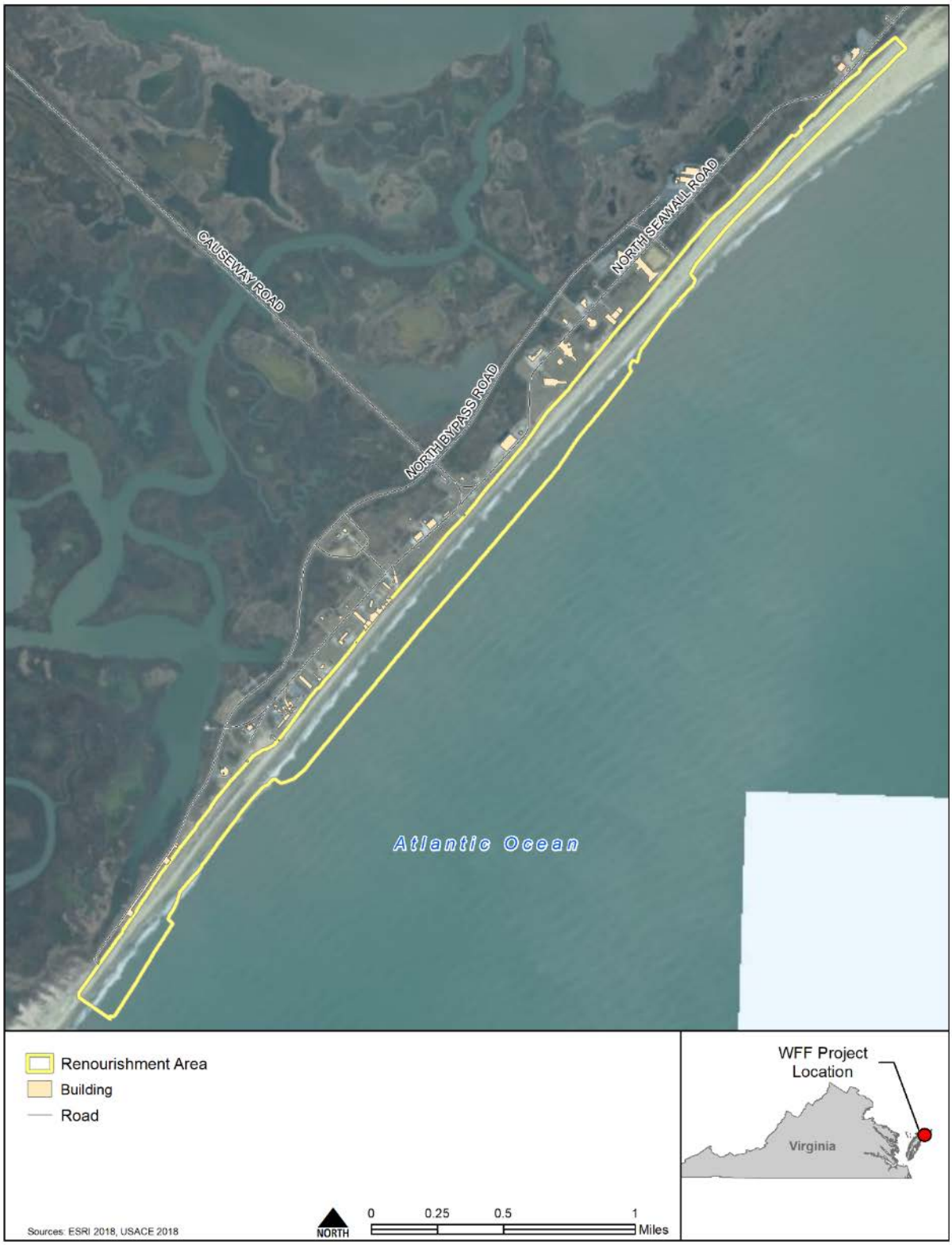

Figure 2.2-1. Approximate Beach Renourishment Area

2.2.1.2 Post-Renourishment Activities

Once renourishment and grading are complete, dune grasses would be planted along the renourished dune (**Figure 2.2-2**). As described in detail in the *2010 Final SRIPP PEIS*, NASA and USACE would also resume the regular beach profile monitoring of the project site once beach renourishment activities have been completed.

Figure 2.2-2. Beach Post-Renourishment Activity, Planting Dune Grasses

2.3 ALTERNATIVES CARRIED FORWARD FOR DETAILED ANALYSIS

2.3.1 NO ACTION ALTERNATIVE

CEQ regulations require that an agency "include the alternative of no action" as one of the alternatives it considers (40 CFR 1502.14[d]). The No Action Alternative serves as a baseline against which the impacts of the Proposed Action are compared. Under the No Action Alternative for this SERP EA, NASA would not restore the Wallops Island shoreline infrastructure protection area beach and dune system to their full functionality or construct nearshore breakwater structures.

2.3.2 ALTERNATIVE 1: RENOURISHMENT ONLY WITH SAND FROM NORTH WALLOPS ISLAND BEACH

Alternative 1 would use sand from an existing beach at the northern end of Wallops Island to renourish the beach along the shoreline infrastructure protection area. USACE modeling showed that prior to the initial shoreline restoration, on average, approximately 40,000 cubic yards of sediment per year was accumulating at the northern end of Wallops Island by longshore transport from the south (NASA 2010). A requirement of the *2010 Final SRIPP PEIS* was the establishment of semiannual (fall and spring) beach monitoring. The Fall 2017 Monitoring Report (USACE 2018a), which described high erosion rates and substantial losses of sediment in the southern portion of the project area and significant accretion resulting from longshore transport in the northern portion of the project area.

USACE calculated that 1.7 million cubic yards of sand is available at the north Wallops Island borrow area, more than enough to provide the 1.3 million cubic yards required for the proposed renourishment. Based on vegetation and wildlife habitat constraints (such as avoiding areas of most dense vegetation and bird and sea turtle nesting season), the total potential area for sand removal is approximately 200 acres. Excavation depth would be to an average of -2.35 feet above mean sea level (**Figure 2.3-1**).

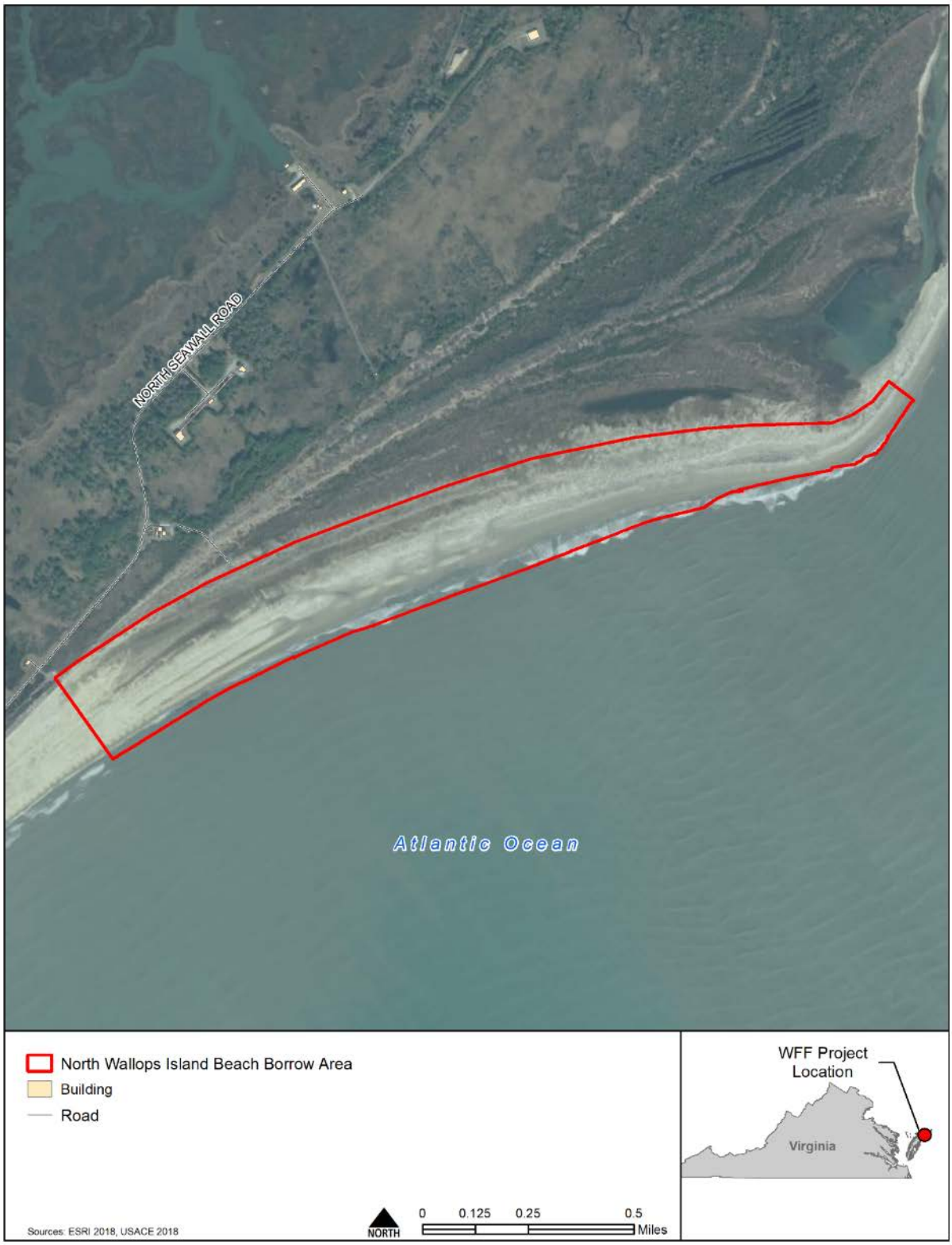

Figure 2.3-1. Approximate Backpassing Borrow Area

Using sand from the northern end of Wallops Island would offer a material without the mobilization and operational costs associated with offshore dredging. Sediment transported alongshore to the north from a previous fill cycle would be of the proper grain size and could be effectively recycled, or "backpassed" by excavating it and placing it in eroding areas in the southern project area.

A pan excavator would likely be used to remove sand from north Wallops Island beach. Because it runs on several rubber tires with a low tire pressure, it can work in areas of the beach where typical equipment may be bogged down in unstable sand. The sand would be stockpiled and then loaded onto dump trucks for transport down the beach. Based on an average 12 cubic yard capacity of a 10 wheel dump truck, is estimated that 108,000 loads would be required to move the sand. Bulldozers would be used to spread the fill material once it is placed on the beach. Other onshore equipment may include all-terrain vehicles (ATVs), an office trailer, mobile generators, construction site lighting, and mobile fuel tanks. All heavy equipment would access the beach from existing roads and established access points. No new temporary or permanent roads would be constructed to access the beach or to transport the fill material to renourishment areas.

Prior to excavation, a pre-project topographic and hydrographic survey would be conducted. Multiple survey crews would employ ATVs and light trucks to conduct pre-project surveys of the project site.

2.3.3 ALTERNATIVE 2: RENOURISHMENT ONLY WITH SAND FROM UNNAMED SHOAL A

Alternative 2 would renourish the beach along the Wallops Island shoreline infrastructure protection area using material from OCS Unnamed Shoal A, an offshore sand ridge located at the southern end of the Assateague ridge field. In 2010, the surface area was measured at approximately 1,800 acres. Up to 515 acres of the shoal (sub-area A-1) were dredged to produce approximately 3.2 million cubic yards of material for the initial beach fill cycle. An additional 800,000 cubic yards were dredged from the same area (sub-area A-1) for the post-Hurricane Sandy repairs.

2.3.3.1 Beach Fill Mobilization

The first phase of the beach fill portion of the project would involve the dredge contractor transporting equipment and materials to the project site. Offshore equipment would include at least several miles of discharge pipe, pumpout buoys, multiple barges, tugboats, derricks, and smaller crew transportation vessels (**Figure 2.3-2**).

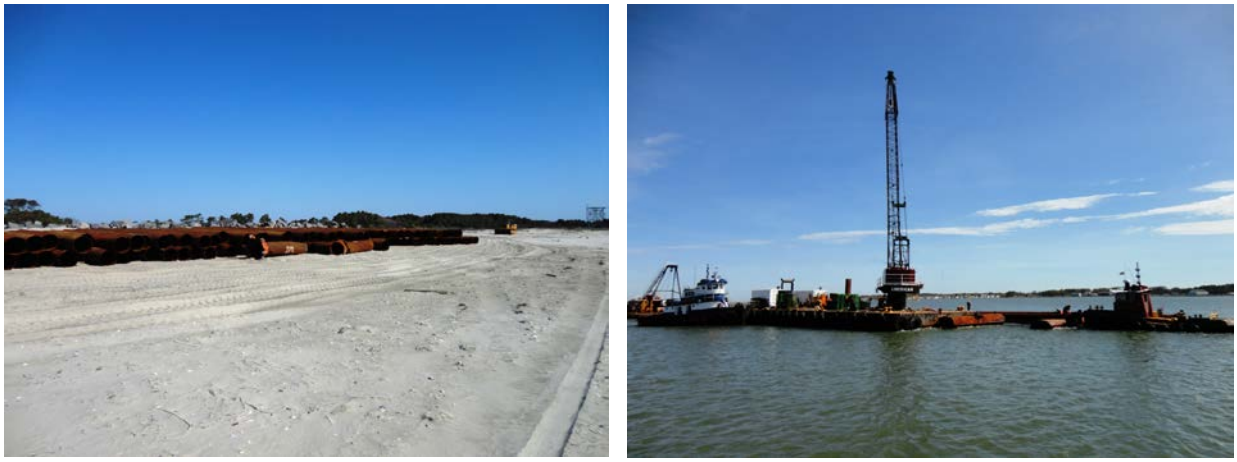

Figure 2.3-2. Beach Fill Mobilization, Onshore Staging (left) and Offshore Equipment (right)

Based on experience gained during the initial beach fill cycle in 2012 and implemented during the post-Hurricane Sandy restoration in 2014, it is expected that the discharge lines would be assembled inside the protected waters of Chincoteague Inlet, then "rafted" together, and floated to their ultimate placement site as weather conditions allow. Onshore, it is expected that sections of the discharge lines would be trucked in, staged, and placed using a front-end loader or crane. Other onshore support equipment would likely be trucked in and include multiple bulldozers, several ATVs, an office trailer, mobile generators, construction site lighting, and mobile fuel tanks. The mobilization is expected to take 30 to 45 days.

2.3.3.2 Dredging and Sand Placement Process

Upon receipt of all necessary authorizations, the USACE (on NASA's behalf) would contract the placement of approximately 1.3 million cubic yards of sand. The dredging process would employ one or more munitions and explosives of concern (MEC) screened trailing suction hopper dredges to obtain material. The dredging process would be cyclic in nature, with the vessel transiting to the borrow area, lowering its dragarms, filling its hopper, and returning to a discharge site. Approximately 2 miles east of Wallops Island in 25 to 30 feet of water, the dredge would connect to the floating end of the submerged pipeline temporarily placed on the seafloor. The sand/water slurry would be pumped through this pipeline to the beach. All dredging and equipment placement would take place in areas previously surveyed as part of the analyses associated with the *2010 Final SRIPP PEIS* and the *2013 Post-Hurricane Sandy EA.*

Once the hopper has discharged its entire load, the dredge would return to the borrow area to remove more material.

Because of overflow from the hopper dredge at the borrow area during dredging and losses during discharge and placement, a larger volume of material would need to be dredged to meet the targeted fill volume. As with the *2013 Post-Hurricane Sandy EA*, sediment losses during dredging and placement operations are assumed to be up to 25 percent. Using this estimate, the dredged volume for the proposed renourishment would be approximately 1.625 million cubic yards.

Dredging would be conducted in a manner generally consistent with the recommendations of two publications examining the effects of dredging of offshore shoals in the mid-Atlantic as presented in the *2010 Final SRIPP PEIS*. More specifically, NASA would:

- Dredge offshore sand from Unnamed Shoal A sub-area A-1 (an accretional area);
- Dredge over a large area and not create deep pits;
- Require that cut depth not be excessive (approximately 7 to 10 feet);
- Require that dredging not occur over the entire length of the shoal;
- Require MEC screening at the drag head; and
- Ensure that if dredging occurs during migration season, certified whale and/or sea turtle watchers would be required on the dredging vessel.

The ROD for the *2010 Final SRIPP PEIS* states that dredged depth be limited to not more than 9.8 feet. To date, an average cut of 4 feet occurred in 2012 and 1.1 foot in 2014 (Bonsteel 2015).

Nearshore, it is expected that the contractor would employ one or more anchored pumpout stations approximately 2 miles east of Wallops Island in 25 to 30 feet of water. Up to several miles of submerged steel pipeline would be temporarily placed on the seafloor in areas previously cleared for cultural resources and/or on hard bottom. The sand/water slurry would be pumped from the dredge through the pipeline to the beach.

As the sand slurry is discharged onto the shoreline, bulldozers would grade the material (**Figure 2.3-3**) to the desired design template, which is proposed to include an additional foot of berm elevation (raised from +6 feet to +7 feet referencing North American Vertical Datum of 1988) as compared to the initial beach fill. The purpose of this design change would be to provide an additional buffer during storm conditions.

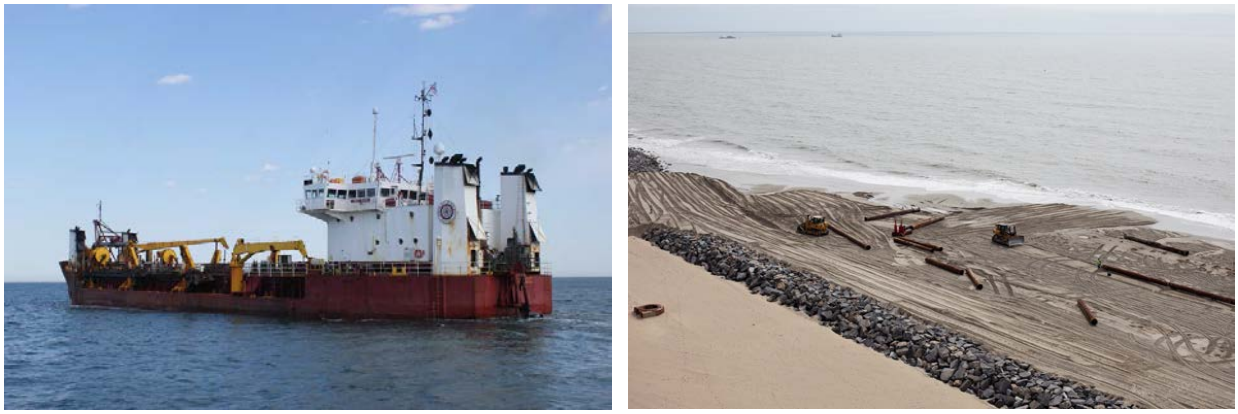

Figure 2.3-3. Dredging and Sand Placement Process, Trailing Suction Hopper (left) and Bulldozers Grading Discharge Sand (right)

The time in the tidal cycle would factor into the location on the beach within which the equipment would work for a given dredge load. During low tide, the equipment would likely concentrate on the intertidal and subtidal zones, whereas during high tide, work would be focused on the upper beach berm and dune. After each section of beach is confirmed to meet design criteria, the process would continue in the longshore direction, with sections of discharge pipe added as it progresses.

The dredging and beach fill portion of the project is expected to take 3 months. At the conclusion of dredging and beach fill, the construction contractor would begin the demobilization phase of the project, the largest task of which would be the disassembly, staging, and loading of discharge piping for transport offsite.

2.3.3.3 Pre- and Post-Dredging Surveys

Another important component of the mobilization phase is the performance of pre-project topographic and hydrographic surveys. Offshore, the dredge contractor would employ vessels to conduct pre- and post-dredging surveys at the borrow site to assess morphological changes of the shoals. Surveys would also be conducted of the nearshore zone within which dredge pumpout equipment would be placed, and the shallower areas of proposed transit routes. Onshore, multiple survey crews would employ ATVs and light trucks to conduct pre- and post-renourishment surveys of the project site.

2.3.4 Alternative 3: Renourishment and Construction of Nearshore Detached Parallel Breakwaters

Nearshore breakwaters reduce the amount of storm related wave energy reaching protected upland areas as well as slow the rate of longshore sediment transport thereby increasing the longevity of a beach fill project. Because previous renourishments provided only temporary protection, NASA requested the USACE Norfolk District Hydraulics and Hydrology Section to evaluate the effectiveness of constructing a breakwater or series of breakwaters along the Wallops Island shoreline to reduce the rate of sediment

transport. Their analysis employed numerical modeling to determine the size and placement of breakwater(s) that would address the erosion issues. The model evaluated seven alternative configurations with varying placement, size, and number of breakwaters and calculated how each alternative affected shoreline stabilization and sediment transport (USACE 2018b). Based on this analysis, a series of rubble mound breakwaters would be constructed under Alternative 3, prior to the renourishment actions described in either Alternative 1 or Alternative 2. The breakwaters would be placed in areas offshore from critical launch assets, approximately 200 feet offshore from the mean high water line of the Wallops Island shoreline infrastructure protection renourishment area. Each breakwater would be constructed of Virginia Department of Transportation (VDOT) Type I armor stone for the outer layer, which ranges from 0.75 to 2 tons, and VDOT Class II Stone for the core layer, which ranges from 150 to 499 pounds. All stone would be placed parallel to the shore on top of approximately 130 feet long of prefabricated geotextile marine mattresses. The breakwaters would measure approximately 10 feet wide at top crest elevation and would be placed approximately 100 feet apart from each other. Water depths in these areas is approximately 4 to 8 feet. The breakwaters would be positioned offshore of Launch Pad 0-B and continue north to the Horizontal Integration Facility (HIF; Building X-079). Depending upon economic, engineering, and environmental factors, the initial series may be broken into smaller series of three breakwaters offshore of Launch Pad 0-B and another three offshore of the HIF. The USACE modeling showed that this configuration could reduce wave energy, resulting in slower shoreline erosion, while still allowing shoreline growth to the north (**Figure 2.4-1**) (USACE 2018b).

The rocks for constructing each breakwater would be transported to the breakwater construction area by barge or to the WFF area by rail, offloaded, and then barged to the handling or placement site offshore of Wallops Island. Construction, estimated to last approximately 6 to 9 months, would take place in the water using a barge and heavy lifting equipment. These breakwaters would be permanent structures as removal would be impractical and cost prohibitive (NASA 2010).

Once offshore breakwaters are constructed, beach renourishment would occur using material sourced from either the north Wallops Island beach or Unnamed Shoal A, as described above in Alternatives 1 and 2, respectively.

2.4 ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD

2.4.1 EXCAVATION FROM NORTH WALLOPS ISLAND BEACH AND DREDGING FROM UNNAMED SHOAL A

One alternative considered was to source sand from both the north Wallops Island beach and from Unnamed Shoal A; however, it was determined that utilizing sand from both sources would be inefficient and too costly. Vessel mobilization and demobilization costs associated with dredging Unnamed Shoal A would be the same whether sourcing sand for either a partial or a full beach renourishment from the borrow site.

2.4.2 EXCAVATION FROM NORTH WALLOPS ISLAND BEACH VIA SAND SLURRY PIPELINE

Using a system of pipes to move sand from the north Wallops Island beach in slurry form was also considered. This alternative was also eliminated from detailed consideration because water would have to be added to dry sand and a number of pumping stations would be required to transfer the resulting slurry over the distance of more than four miles. Additionally, if launches were scheduled during the renourishment, piping would have to be removed prior to launch and remobilized afterward, thereby, requiring additional cost and delays in the project schedule.

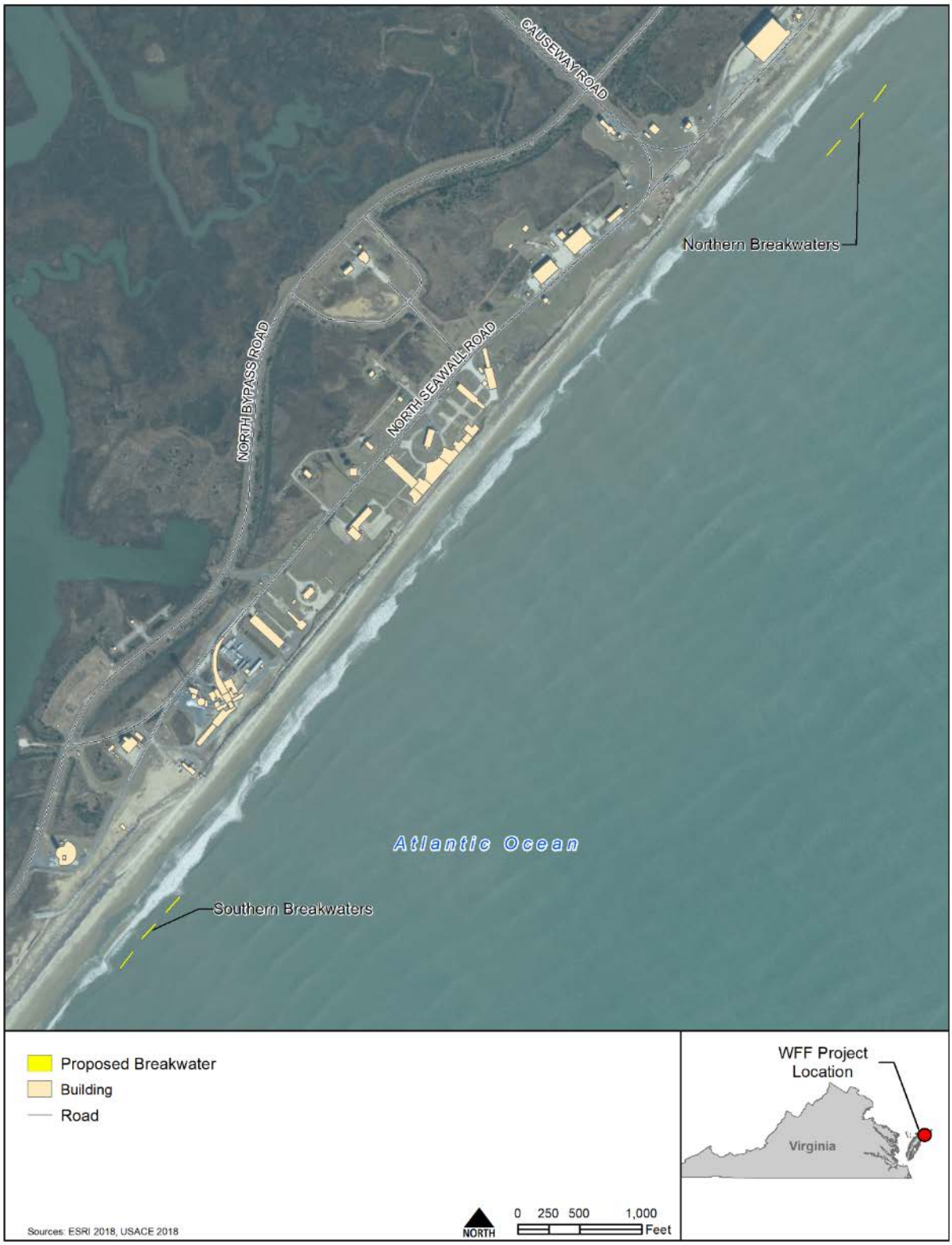

Figure 2.4-1. Proposed Locations of Offshore Parallel Breakwaters

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3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 ANALYSIS APPROACH

NEPA requires focused analysis of the areas and resources potentially affected by an action or alternative. It also provides that an EA should consider, but not analyze in detail, those areas or resources not potentially affected by the proposal. NEPA also requires a comparative analysis that allows decision makers and the public to differentiate among the alternatives. CEQ regulations (40 CFR §§ 1500-1508) for NEPA require an EA to discuss impacts in proportion to their significance and present only enough discussion of other than significant issues to show why more study is not warranted.

The analysis in this EA considers the existing conditions of the affected environment and compares those to conditions that might occur should WFF implement the alternatives under the Proposed Action or the No Action alternative.

The *2010 Final SRIPP PEIS* presented a complete description of all project related resource areas with relevant, updated descriptions and information presented in the *2013 Post-Hurricane Sandy EA.* As such, only those resources that have measurably changed or would be notably affected are discussed in this SERP EA; all other resources are incorporated by reference.

3.1.1 AFFECTED RESOURCES

Resources that have the potential to be affected by implementing the Proposed Action are carried forward for detailed analysis in this SERP EA. **Table 3.1-1** provides the list of resources carried forward for detailed analysis, the section the analysis is located, and regulatory permits that would be required prior to implementing the Proposed Action.

Table 3.1-1. Resources Carried Forward for Detailed Analysis in this SERP EA

Resource	Analysis Section	Regulatory Consultation or Permit
Coastal Geology and Processes	Section 3.2	none
Water Quality	Section 3.3	Individual Permit from USACE Dune and Subaqueous Permits from VMRC
Coastal Zone Management	Section 3.4	Federal Consistency Determination with DEQ
Air Quality	Section 3.5	none
Noise	Section 3.6	none
Benthos	Section 3.7	none
Wildlife	Section 3.8	none
Fisheries and Essential Fish Habitat	Section 3.9	Essential Fish Habitat Assessment with NMFS
Marine Mammals	Section 3.10	none
Special Status Species	Section 3.11	ESA Consultation with NMFS and USFWS
Cultural Resources	Section 3.12	NHPA Consultation with SHPO
Recreation Resources	Section 3.13	none

Legend: USACE – US Army Corps of Engineers; VMRC – Virginia Marine Resources Commission; DEQ – Virginia Department of Environmental Quality; NMFS – National Marine Fisheries Service; ESA – Endangered Species Act; USFWS – U.S. Fish and Wildlife Service;
NHPA – National Historic Preservation Act; SHPO – State Historic Preservation Office.

Numerous other resources were considered; however, the potential impacts would be negligible as documented in the *2010 Final SRIPP PEIS*. As such, the list of resources not carried forward for detailed

analysis warrant no further evaluation. **Table 3.1-2** provides the list of resources not carried forward for detailed analysis.

Table 3.1-2. Resources Considered But Not Carried Forward for Detailed Analysis in this SERP EA	
Floodplains	*2010 Final SRIPP PEIS* concluded there would be a negligible impact to each of these resources.
Hazardous Materials and Waste	
Vegetation	
Plankton	
Invertebrate Nekton	
Land Use	
Infrastructure and Utilities	
Socioeconomics	
Health and Safety	
Environmental Justice	
Recreation – Offshore	

3.2 COASTAL GEOLOGY AND PROCESSES

The interaction of wave, wind, and tidal energies determine how erosional and depositional processes shape coastlines. Sections 3.1.4 and 3.1.5 of the *2010 Final SRIPP PEIS* describe in detail the coastal processes influencing the project area and updated information is presented in Section 3.1.1 of the *2013 Post-Hurricane Sandy EA*. This section provides a summary of information presented in these documents and describes impacts expected to result from the Proposed Action.

3.2.1 AFFECTED ENVIRONMENT

Wallops Island is one of the twelve Virginia barrier islands that front the Atlantic Ocean. Though it is morphologically similar to neighboring islands and is shaped by the interplay of waves and tide, localized processes occurring over both the short and long term have led to Wallops Island being distinct from other barrier islands in Virginia. Generally, net sediment transport along the Virginia barrier islands is from north to south. However, along much of Wallops Island, the direction of net longshore sediment transport is toward the north, due primarily to the growth and resulting wave sheltering effects of Fishing Point at the south end of Assateague Island (King *et al*. 2010). In addition to the northerly sediment transport, the westward drift of Chincoteague Inlet ebb shoals in the cross shore direction contributes to the rapid growth of north Wallops Island beach. This sediment accumulation is changing the existing north-south shoreline orientation to one that is oriented more east-west.

Of the Virginia barrier islands, Wallops Island is the only one that has been developed or nourished. With the exception of federally sponsored recreational beach parking area repairs on south Assateague Island, the other islands are managed for conservation and are driven by natural forces. Sediment samples collected on Wallops Island in 2007 and 2009 indicated native median grain sizes ranging from approximately 0.18 to 0.27 millimeter (mm), corresponding to fine sand per the American Society for Testing and Materials (ASTM) unified classification system. Samples collected during the initial beach fill indicate that the sediment within the nourished portion of the beach is coarser, with median grain sizes between approximately 0.28 and 0.54 mm, corresponding to fine to medium sand per ASTM (NASA 2013).

The *2010 Final SRIPP PEIS* included implementation of semiannual topographic and hydrographic beach profile monitoring to evaluate the performance of beach fill projects and to identify the need for future

renourishment. Each spring and fall, data are collected from the southern tip of Assateague Island / Toms Cove through Wallops / Assawoman Islands south to Gargathy Inlet. The data collected to date illustrate a general trend of substantial loss of material in the southern portion of Wallops Island and significant volume gain to the north. The data show no evidence of formation of offshore sandbars or impacts to Chincoteague Inlet to the north (USACE 2018a). This monitoring program will continue.

Unnamed Shoal A is an unvegetated offshore sand ridge located approximately 7 miles east of Assateague Island and approximately 11 miles northeast of Wallops Island.

3.2.1.1 Consideration of Sea Level Rise

Coastal environments are highly dynamic and particularly vulnerable to climate change. The impacts of climate change at WFF includes rising sea levels, more frequent flooding, and increasingly intense, unevenly distributed rain events resulting in detrimental impacts to WFF infrastructure. Most of Wallops Island is less than 10 feet above mean sea level (MSL), with the sandy area approximately 6.9 feet above MSL and the highest elevation approximately 15 feet above MSL. Sea level rise, storm surges from hurricanes and nor'easters are increasingly make natural and built systems vulnerable to disruption or damage.

For the purposes of projecting changes affecting Wallops Island, MSL data collected by the National Oceanic and Atmospheric Administration (NOAA) from two stations nearest to WFF (Wachapreague, Virginia (VA) and Ocean City, Maryland) were examined. Data collected from long term tidal gauges in Wachapreague indicate that between 1978 and 2017, the relative sea level trend is 5.35 millimeters per year (mm/year) (+/-0.76 mm/year), the equivalent to a change of 1.76 feet in 100 years (NOAA 2018a). At Ocean City, data indicate the relative sea level trend is 5.59 mm/year (+/- 0.87 mm/year) based on monthly MSL data from 1975 to 2017 which is equivalent to a change of 1.83 feet in 100 years (NOAA 2018b).

3.2.2 ENVIRONMENTAL CONSEQUENCES

Sections 4.2.1 through 4.2.3 of the *2010 Final SRIPP PEIS* as well as Section 3.1.1.2 of the *2013 Post-Hurricane Sandy EA* describe in detail the expected effects of dredging and beach renourishment on coastal processes. This section provides a summary applicable to the No Action Alternative and the alternatives to the Proposed Action.

3.2.2.1 No Action Alternative

Under the No Action Alternative, renourishment of the Wallops Island shoreline infrastructure protection area would not occur. It is expected that the north Wallops Island beach would continue to grow, and the remaining areas to the south including the shoreline infrastructure protection area would continue to erode at historical rates exacerbated by the frequency and intensity of future storm events. Over time, the shoreline infrastructure protection area would continue to narrow until the rock seawall is undermined and eventually fails, jeopardizing the existing infrastructure.

3.2.2.2 Alternative 1

The removal of sand from the north end of Wallops Island would lower topography within the footprint of the excavated areas. This accretion area on the north end of Wallops Island is expected to continue to grow as a result of the littoral transport of sand from the renourished beach as well as from Assateague Island. Thus, the impacts from sediment removal from the north Wallops Island beach would be mitigated

by the redeposition of sediment from ongoing littoral processes. While the use of the north Wallops Island beach as a sand source would result in direct, short term adverse impacts on the shoreline in that area for a few months, with full recovery projected 4 to 6 years after excavation activities, in the long term using the sand in this area is not anticipated to result in significant changes to the shoreline.

Renourishment of the beach at the Wallops Island shoreline infrastructure protection area (see **Figure 2.2-1**) would result in a new shoreline extending several hundred feet offshore from the current shoreline. The new beach profile would provide increased wave dissipation and added protection from storm events for the onshore infrastructure. After the initial placement, there would be an equilibration period during which there would be a rapid loss of sand offshore to fill in deeper portions of the beach profile. Analysis of sediment samples from the borrow area indicate only trace amounts of silt and other fine sediments (NASA 2010), which would result in limited increase of water turbidity during longshore sediment transport and equilibration of the borrow sand. The new beach profile would continue to adjust to the minor changes in borrow material sediment size, local wind and wave, climate and tidal action. Adjustments may be episodic as spring tides and/or storms result in transport of the borrow material.

Over time, the new beach would be reshaped until it is in equilibrium with the natural forces and assume a normal profile (Wilson *et al*. 2017). However, this profile would shift with seasonal differences in wave action. Higher wave energy during the winter would likely steepen the beach profile with some of the sand moved offshore into a bar system. During the lower energy summer months, the beach profile would tend to flatten out as sand from the offshore bar system is moved back onto the beach face. The onshore-offshore beach dynamics would also be influenced by the littoral transport of the sand both to the north and to the south depending upon the direction of incident wave action. Transport to the north should be recaptured at the north end as wave action is diminished in the lee of Assateague Island. Transport to the south would eventually provide additional sand resources to the barrier islands south of Wallops Island. The construction of the new dune would provide additional infrastructure protection during major storm events.

This alternative could have short term minor impacts to onshore and nearshore sediments resulting from the accidental release of petroleum products, or other contaminants from construction vehicles and heavy equipment used to remove, transport and deposit the sand. The potential for such construction-related impacts to occur would be minimal as contractors would implement best management practices (BMPs) for vehicle and equipment fueling and maintenance as well as site specific spill prevention and control measures (NASA 2010).

The primary offshore impacts of the beach renourishment would likely be the formation of an offshore bar system and changes in local bathymetry that reduce the slope of the offshore portion of the beach profile. Any offshore bar system that may form would be both dynamic and seasonal. Wave action would constantly form and reform these bars moving them onshore, offshore and along the shore. They may also appear and disappear depending on wind and wave action and storm events. There would also be a seasonal component to their location and configuration with bars being more prominent during the winter and less pronounced during the summer as described above.

The adjacent Chincoteague Channel would not likely be affected by use of the north Wallops Island beach as a sand source. Excavation within the proposed borrow area to -2.35 feet above MSL (**Figure 2.3-1**) would not likely alter the cross-sectional area of the channel or influence current velocities in any

meaningful way. The Chincoteague Inlet is dynamic and periodically dredged for depth maintenance (see **Table 3.2-1**). The only likely consequence would be reestablishment of sand accumulation on the north end of Wallops Island.

Table 3.2-1. Historic Dredging of Chincoteague Inlet

Beginning Date	Volume Dredged (cubic yards)
March 1993	112,169
March 1994	123,333
March 1995	120,835
June 1996	120,079
November 1997	122,898
July 1998	72,592
September 2002	91,292
November 2003	12,261
March 2006	71,009
March 2008	63,841
August 2014	11,015
January 2015	13,300
December 2015	3,600
Various dates 2017	26,285
February 2018	8,745
September 2018	4,245
October 2018	8,315

Sources: Wood personal communication, 2019

3.2.2.3 Alternative 2

The onshore and nearshore impacts of Alternative 2 would be very similar to those for the beach renourishment component of Alternative 1. The only difference would be that the sand would be delivered as slurry from the dredge instead of being truck hauled.

As with previous renourishment projects, removal of material from Unnamed Shoal A would be done in a uniform manner across the areal extent of sub-area A-1 in accordance with the mitigation requirements described above in **Section 2.3.3.2, Dredging and Sand Placement Process**. Survey Area Cross-Section Profiles collected before and after the 2012 and 2014 dredge events show the effectiveness of these measures (Bonsteel 2015). For this renourishment, approximately two-thirds of the southern half of the shoal's elevation would be lowered by an additional 1.5 to 3 feet, with some areas approaching an additional 10 feet below the current profile. While cut depths on the order of 5 to 10 feet would not be necessary over the entire borrow area to obtain the targeted fill volume, they could occur in some places due to the inherent limitations in precision associated with operating a dredge in the open ocean. As proposed, the elevation of the northern portion of the shoal (sub-area A-2) would remain the same.

The conservative model-based analysis performed for the *2010 Final SRIPP PEIS* indicated that even if a 2 square mile area of the shoal was "planed" to an elevation necessary to obtain up to 10 million cubic yards of material, the induced effects on the Assateague Island shoreline could not be distinguished from those changes occurring as a result of natural variation in sediment transport. Therefore, it is not expected

that the additional lowering of the shoal would cause any measurable reduction in wave sheltering effects on properties to the west of the borrow area. Dredging the borrow area would again create steeply sloped areas of micro-topography, which would be smoothed by tidal and wave energy in the years following the dredge event. The lowering of the shoal's topography would be a longer-term effect, with the shoal maintaining the same general morphology but at a lower elevation and different profile. Changes of this type and order would be expected based on past analyses of Unnamed Shoal A bathymetric surveys conducted before and after each prior dredging effort (Bonsteel 2015). Overall consequences to the offshore shoal would be further reduced because of NASA's commitment to implement the minimization measures detailed above in **Section 2.3.3.2, Dredging and Sand Placement Process**.

3.2.2.4 Alternative 3

Impacts resulting from the beach renourishment portion of Alternative 3 would be the same as those described for Alternatives 1 or 2, depending on the source of sand utilized. Additionally, construction of nearshore breakwater structures would result in a build-up of sediment along the shoreline perpendicular to the breakwaters. Temporary and minor adverse effects on sediments are anticipated in the immediate vicinity of the breakwater during the construction period. Use of offshore parallel breakwaters in conjunction with beach renourishment would allow an accumulation of the sand landward of the breakwaters without substantially interrupting the normal littoral transport. This would help provide an increased level of shoreline protection behind the breakwaters with the minimum possible impact on littoral processes. The greatest amount of erosion and accretion would occur immediately adjacent to each breakwater and would exponentially decrease with distance from the breakwater series. The fact that the breakwaters are designed to "leak" sand would help prevent the structures from impeding the normal transport of the sand south to Assawoman Island or to the north end of Wallops Island.

The offshore impacts of the breakwaters would be temporary alterations to littoral transport that diminish as the system approaches equilibration after beach renourishment. Relatively minor permanent changes in bathymetry adjacent to the breakwaters would be measurable as slight depressions immediately seaward of the breakwaters as the nearest sand bars would tend to be displaced toward the up-coast and down-coast ends of the structures.

Potential impacts to Chincoteague Inlet were discounted from the breakwater analysis, design, and modeling based upon biannual monitoring conducted by USACE, Norfolk District (USACE 2018b).

3.3 WATER QUALITY

This section briefly describes the surface and marine waters in and around Wallops Island. Refer to Section 3.1.6 of the *2010 Final SRIPP PEIS* for the detailed description of the water resources within and adjacent to the project area.

3.3.1 REGULATORY CONTEXT AND PERMITTING

The CWA of 1972 is the primary federal law that protects the nation's waters, including coastal areas. The primary objective of the CWA is to restore and maintain the integrity of the nation's waters. Section 404 of the CWA established a permit program to regulate the discharge of fill material into waters of the U.S. Managed jointly by the USACE and the EPA, the primary intent of the program is to minimize adverse effects to the aquatic environment. USACE is responsible for day-to-day administration and permit review while EPA provides program oversight.

On February 22, 2016, USACE extended the permit NAO-1992-1455 issued on March 10, 2011 for post-Hurricane Sandy renourishment. The permit expires on February 22, 2021. This permit authorizes the seawall extension and beach renourishment. A Joint Permit Application was submitted to USACE, VDEQ, VMRC, and Accomack County on October 1, 2018 (**Appendix C**). After receiving the JPA,USACE indicated that a new Individual Permit for the Proposed Action, including breakwater construction and dredging of sand at the north end of the island or Shoal A, whichever is selected as the preferred alternative would be required. VMRC has previously a issued an extension to Permit #10-2003, which was reissued on February 2, 2016, for rehabilitation of the seawall and beach renourishment. The permit expires in 2021 (VMRC 2016). Following receipt of the JPA, VMRC conducted a public hearing in Accomack County on January 2, 2019, then presented the project to the full Commission in a hearing on January 22, 2019, where it was approved with a unanimous vote. On April 29, 2017, VMRC issued a final permit that includes the current design for beach renourishment and dredging at the north end of the island and a dune/beach permit for required dune impacts (**Appendix C**). VDEQ has waived the requirement for a permit for the proposed action in lieu of USACE and VMRC permits (VDEQ 2018). The USACE issued an Individual Permit for the project on July 2, 2019 (**Appendix I**).

3.3.2 AFFECTED ENVIRONMENT

Inshore surface waters in the vicinity of Wallops Island are saline to brackish and are influenced by the tides. Marine waters in the affected environment, away from inlets, maintain a fairly uniform salinity range (32 to 36 parts per thousand) throughout the year (NASA 2003). Winter surface water temperatures average 57° Fahrenheit (°F) and average summer temperature is 77° F (Paquette *et al*. 1995).As reported in the *2013 Post-Hurricane Sandy EA,* Unnamed Shoal A shows bedforms (i.e., ripples) on its surface, indicating that wave energy reaches the seafloor and mixing occurs throughout the water column.

3.3.3 ENVIRONMENTAL CONSEQUENCES

3.3.3.1 No Action Alternative

Under the No Action Alternative, the proposed breakwater construction and beach renourishment would not occur. Therefore, there would be no project related impacts to water quality.

3.3.3.2 Alternative 1

The *2010 Final SRIPP PEIS* provides a detailed analysis of potential water quality impacts associated with moving sand from the north Wallops Island beach and placement in the shoreline infrastructure protection area. This alternative could have short term minor impacts on nearshore water quality resulting from the accidental release of petroleum products, or other contaminants from construction vehicles and heavy equipment used to remove, transport and deposit the sand. The potential for such construction-related impacts to occur would be minimal as contractors would implement BMPs for vehicle and equipment fueling and maintenance as well as site specific spill prevention and control measures (NASA 2010).

The beach fill material from the north Wallops Island beach has a grain size appropriate for use for renourishment. It is expected that the turbidity plume generated at the placement site would be comparable to those reported in similar projects: concentrated within the swash zone (the part of the beach extending from the edge of the surfzone landward to the limit of maximum inundation), dissipating between 1,000 to 2,000 feet alongshore; and short term, only lasting several hours.

Under this alternative there would be no dredging of sand from the offshore environment and no offshore impact to water quality.

3.3.3.3 Alternative 2

The impact to water quality nearshore would be the same as described for Alternative 1.The *2010 Final SRIPP PEIS* and the *2013 Final Post-Hurricane Sandy EA* provided an analysis of the potential offshore water quality impacts that could result from proposed dredging and pumpout buoy operations, which would cause sediment to be suspended in the water column. Studies of past similar projects specify that the extent of the sediment plume is normally limited to between 1,640 to 4,000 feet from the dredge operation and that elevated turbidity levels are usually short term, approximately an hour or less (NASA 2013).

The length and shape of the plume depends on the hydrodynamics of the water column and the sediment grain size. Given that the dominant substrate material at the borrow site is fine to medium sand, it is expected to settle steadily and cause less turbidity and oxygen demand than finer-grained sediments would cause. No appreciable effects on dissolved oxygen, pH, or temperature are anticipated because the dredged material has low levels of organics and low biological oxygen demand. Additionally, dredging activities would occur within the open ocean where the water column is subject to constant mixing and exchange with oxygen rich surface waters. Turbidity resulting from the dredging would be short term (i.e., present for approximately an hour) and would not be expected to extend more than several thousand feet from the dredging operation. Accordingly, it is anticipated that the project would have only temporary minor impacts on offshore water quality.

3.3.3.4 Alternative 3

The impacts to water quality from the renourishment portion of Alternative 3 would be the same as described above for Alternatives 1 and 2, depending on the sand source. Offshore impacts to water quality associated with the movement of sediment from either the north Wallops Island beach or Unnamed Shoal A to the renourishment area would be the same as described above for Alternatives 1 and 2, depending on the sand source. Additionally, offshore impacts to water quality could result from breakwater construction. Construction of the breakwaters would have the potential to result in sediment suspension during placement of the materials (e.g., marine mattresses, armor stone) and the movement of construction barges and vessels. Increases in suspended sediment would be temporary, localized, and would dissipate upon cessation of sediment disturbing activities. To construct the breakwater segments, each prefabricated geotextile marine mattresses would be floated out to its final location, and then lowered to the bottom by the weight of large rocks to minimize sediment resuspension. Rocks would be placed inside the geotextile mattress in a manner that limits sediment resuspension. Rocks used for armoring and to construct the breakwaters would be made of “clean” material, further minimizing the potential for release of suspended material into the water column. Crane barges would be continually moved during construction, and vessels carrying construction materials. Construction vessels would maintain at least 2 feet of clearance from the bottom of the ocean, or work only at tide levels sufficient to keep the barges off the ocean bottom to further minimize sediment disturbance. Expected increases to suspended sediment concentrations related to vessel activity during construction would likely be minimal relative to background levels. Breakwater construction activities may result in the accidental release of petroleum products, or other contaminants to offshore waters from the barge or tenders. Construction-related impacts would be considered temporary in nature, and would not likely be adverse; NASA would

require its contractors to implement BMPs as well as site specific spill prevention and control measures for the water based activities.

3.4 COASTAL ZONE MANAGEMENT

The following discussion specifically refers to compliance with the Coastal Zone Management Act (CZMA) of 1972 (16 U.S.C. § 1451, et seq., as amended). In accordance with Section 307 of the CZMA and 15 CFR 930 subpart C, federal agency activities affecting a land or water use or natural resources of a state's coastal zone must be consistent to the maximum extent practicable with the enforceable policies of the state's coastal management program.

NASA prepared a Federal Consistency Determination (FCD) in conjunction with the *2010 Final SRIPP PEIS*. VDEQ concurred with NASA's determination of consistency; however, subsequent discussions with VDEQ indicate that a new FCD would be required for each beach renourishment cycle, including this Proposed Action.

3.4.1 REGULATORY CONTEXT AND PERMITTING

The VDEQ is the lead agency for the Virginia Coastal Zone Management (CZM) Program. Although federal lands are excluded from Virginia's CZM Program, any activity on federal land that has reasonably foreseeable coastal effects must be consistent with the enforceable policies of the CZM Program (VDEQ 2018). Enforceable policies of the CZM Program that must be considered when making an FCD include the following:

- **Fisheries Management.** Administered by VMRC, this program stresses the conservation and enhancement of shellfish and finfish resources and the promotion of commercial and recreational fisheries.
- **Subaqueous Lands Management**. Administered by VMRC, this program establishes conditions for granting permits to use state-owned bottomlands.
- **Wetlands Management**. Administered by VMRC and VDEQ, the wetlands management program preserves and protects tidal wetlands.
- **Dunes Management**. Administered by VMRC, the purpose of this program is to prevent the destruction or alteration of primary dunes.
- **Non-Point Source Pollution Control**. Administered by the Virginia Department of Conservation and Recreation, the Virginia Erosion and Sediment Control Law is intended to minimize non-point source pollution entering Virginia's waterways.
- **Point Source Pollution Control**. Administered by VDEQ, the Virginia Pollutant Discharge Elimination System permit program regulates point source discharges to Virginia's waterways.
- **Shoreline Sanitation**. Administered by the Virginia Department of Health, this program regulates the installation of septic tanks to protect public health and the environment.
- **Air Pollution Control**. Administered by VDEQ, this program implements the Clean Air Act through a legally enforceable State Implementation Plan.

- **Coastal Lands Management**. Administered by the Chesapeake Bay Local Assistance Department, the Chesapeake Bay Preservation Act guides land development in coastal areas to protect the Chesapeake Bay and its tributaries.

On February 22, 2016, USACE extended the permit NAO-1992-1455 issued on March 10, 2011 for post-Hurricane Sandy renourishment. The permit expires on February 22, 2021. This permit authorizes the seawall extension and beach renourishment. The USACE has issued an Individual Permit for the Proposed Action for breakwater construction and renourishment (**Appendix I**). VDEQ has completed their review, waiving the requirement for a permit for the proposed action in lieu of USACE and VMRC permits (VDEQ 2018). VMRC has previously a issued an extension to Permit #10-2003, which was originally issued on February 2, 2016 for rehabilitation of the seawall and some beach renourishment. The permit expires in 2021 (VMRC 2016). VMRC conducted a public hearing in Accomack County on January 2, 2019, then presented the project to the full Commission in a hearing on January 22, 2019, where it was approved with a unanimous vote. On April 29, 2017, VMRC issued a final permit that includes the current design for beach renourishment and dredging at the north end of the island and a dune/beach permit for required dune impacts (**Appendix C**).

3.4.2 AFFECTED ENVIRONMENT

Barrier islands such as Metompkin, Assawoman, Wallops, and Assateague Islands are elongated, narrow landforms that consist largely of unconsolidated and shifting sand and lie parallel to the shoreline between the open ocean and the mainland. These islands provide protection to the mainland, recreation resources, important natural habitats, and valuable economic opportunities to the county. The northern end of Wallops Island also contains coastal primary sand dunes that serve as protective barriers from the effects of flooding and erosion caused by coastal storms. The Coastal Barrier Resources Act (Public Law 97-348, 16 U.S.C. 3501-3510), enacted in 1982, designated various undeveloped coastal barrier islands as units in the Coastal Barrier Resources System. Designated units are ineligible for direct or indirect federal financial assistance programs that could support development on coastal barrier islands; exceptions are made for certain emergency and research activities.

3.4.3 ENVIRONMENTAL CONSEQUENCES

3.4.3.1 No Action Alternative

Under the No Action Alternative, the proposed breakwater construction, dredging, and beach renourishment would not occur. Therefore, there would be no project related impacts to Virginia's CZM.

3.4.3.2 Impacts Common to all Alternatives

The activities proposed would affect resources within Virginia's Coastal Zone. Therefore, NASA prepared an FCD that found its Proposed Action to be consistent with the enforceable policies of Virginia's CZM Program. On December 6, 2018, NASA submitted its FCD to VDEQ for concurrence. In a letter dated January 17, 2019, VDEQ concurred with NASA's determination, provided that all applicable permits and approvals are obtained. Refer to **Appendix D** for the FCD and the VDEQ response.

3.4.3.3 Applicable Permits

NASA consulted with VMRC to determine the applicability of its existing permit to the Proposed Action. On April 29, 2017, VMRC issued a final permit that includes the current design for beach renourishment and dredging at the north end of the island and a dune/beach permit for required dune impacts (**Appendix**

D). VDEQ has waived the requirement for a permit for the proposed action in lieu of USACE and VMRC permits (VDEQ 2018).

3.5 AIR QUALITY

The discussion of air quality is focused on the atmospheric layer at or below 3,000 feet above ground level, which the EPA accepts as the nominal height of the atmosphere mixing layer in assessing contributions of emissions to ground level ambient air quality under the Clean Air Act (CAA) (EPA 1992) for criteria and hazardous air pollutants (HAPs).

Section 3.1.9 of the *2010 Final SRIPP PEIS* describes in detail the regulatory context and types and quantities of air pollutants emitted from NASA's activities on Wallops Island. This section provides both a summary and updated information obtained since that time.

3.5.1 AFFECTED ENVIRONMENT

The affected region for the air quality analysis is limited to the Northeastern Virginia Intrastate Air Quality Control Region, as defined in 40 CFR Part 81.144, which includes Accomack County.

3.5.1.1 Criteria Pollutants

Air quality in a given location is described by the concentration of various pollutants in the atmosphere. The significance of the pollutant concentration is determined by comparing it to the federal and state ambient air quality standards. The CAA, and its subsequent amendments, established the National Ambient Air Quality Standards (NAAQS) for seven "criteria" pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 (PM_{10}) and 2.5 ($PM_{2.5}$) microns in diameter, and lead (Pb). These standards represent the maximum allowable atmospheric concentrations that may occur while ensuring protection of public health and welfare, with a reasonable margin of safety. Areas that exceed a federal air quality standard are designated as non-attainment areas. Wallops Island is located in Accomack County, an attainment area for all criteria pollutants; therefore, a General Conformity Review under Section 176(c) of the CAA does not apply to this project.

Hazardous Air Pollutants (HAPs)

In addition to the criteria pollutants, the EPA currently designates 187 substances as HAPs under the federal CAA. HAPs are air pollutants known or suspected to cause cancer or other serious health effects, or adverse environmental and ecological effects (EPA 2015). NAAQS are not established for these pollutants; however, the EPA developed rules that limit emissions of HAPs from specific industrial sources.

HAP emissions are typically one or more orders of magnitude smaller than concurrent emissions of criteria air pollutants, and only become a concern when large amounts of fuel are consumed during a single activity or in one location. Mobile sources operating as a result of the Proposed Action would be functioning intermittently over a large area and would produce negligible ambient HAPs in a localized area not located near any publicly accessible areas. For these reasons, HAPs are not further evaluated in the analysis.

3.5.1.2 Climate Change

Climate change refers to long term shifts in temperature, precipitation, and weather patterns which are the result of numerous natural and anthropogenic (human-induced) factors. Greenhouse gases (GHGs) are

compounds that contribute to the greenhouse effect—a natural phenomenon in which gases trap heat within the lowest portion of the earth's atmosphere, causing heating at the surface of the earth. The EPA has specifically identified carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride as GHGs (EPA 2009). Carbon dioxide (CO_2), methane, and nitrous oxide occur naturally in the atmosphere. These gases influence the global climate by trapping heat in the atmosphere that would otherwise escape to space. The heating effect from these gases, primarily as a result of anthropogenic activities, is considered the primary cause of the global warming observed over the last 50 years (EPA 2009).

Each GHG is assigned a global warming potential (GWP), which is the ability to trap heat, and is standardized to CO_2, which has a GWP value of one. Six other primary greenhouse gases have GWPs: 25 for methane, 298 for nitrous oxide, 124 to 14,800 for hydrofluorocarbons, 7,390 to greater than 17,340 for perfluorocarbons, 17,200 for nitrogen trifluoride, and up to 22,800 for sulfur hexafluoride. Emissions of a GHG is multiplied by its GWP to calculate the total equivalent emissions of carbon dioxide (CO_2e). The dominant GHG emitted is CO_2, mostly from fossil fuel combustion (81.6 percent) (EPA 2018a).

Executive Oder 13834, *Efficient Federal Operations*, issued on May 17, 2018, establishes policy for federal agencies to reduce waste, cut costs, and enhance resilience of federal infrastructure and operations. On August 1, 2016, the CEQ issued final guidance on the consideration of GHG emissions and climate change in NEPA review (CEQ 2016). The guidance clarified that NEPA review requires federal agencies to consider the effects of GHG emissions and climate change when evaluating Proposed Actions:

> *"Analyzing a proposed action's GHG emissions and the effects of climate change relevant to a proposed action—particularly how climate change may change an action's environmental effects—can provide useful information to decision makers and the public."*

The guidance also emphasized that agency analyses should be commensurate with projected GHG emissions and climate impacts, and should employ appropriate quantitative or qualitative analytical methods to ensure useful information is available to inform the public and the decision-making process in distinguishing between alternatives and mitigations (CEQ 2016). Additionally, the guidance recommended that an agency should take into account the ways in which a changing climate may impact the proposed action and any alternative actions (CEQ 2016). However, pursuant to Executive Order 13783, *Promoting Energy Independence and Economic Growth*, CEQ's guidance was withdrawn for further consideration in March of 2017. Regardless, it is NASA's policy to continue to follow the CEQ guidance on GHG emissions and climate change in NEPA review until directed otherwise by amendments to the guidance or regulation.

3.5.2 ENVIRONMENTAL CONSEQUENCES

The primary emissions from the Proposed Action would result from the burning of fossil fuels in mobile sources (e.g., dredges, earth moving equipment, etc.). For the purposes of evaluating air quality impacts in this EA, emissions are considered to be minor if the Proposed Action would result in an increase of 250 tons per year or less for any criteria pollutant. The 250 tons per year value is used by the EPA in its New Source Review Prevention of Significant Deterioration standards for major stationary sources in areas that meet the NAAQS as an indicator for impact analysis. No similar regulatory thresholds are available for mobile source emissions. Lacking any mobile source emission regulatory thresholds, this threshold is used to equitably assess and compare mobile source emissions. Emission-assumptions and calculations

are provided in **Appendix E**. A discussion of potential climate change impacts to Wallops Island is included in **Section 4.0, Cumulative Impacts.**

3.5.2.1 No Action Alternative

Under the No Action Alternative, the proposed breakwater construction, dredging, and beach renourishment would not occur. Therefore, there would be no project related impacts to air quality.

3.5.2.2 Alternative 1

Implementation of Alternative 1 would involve use of dump trucks, bulldozers, mobile generators, tractor scrapers, and loaders. Sand excavated from the surface of north Wallops Island beach by the scraper would be transported to the renourishment area, where it would be spread and graded by bulldozers. The operation would be a 24-hour, 7-day operation, over a 3-month period. The average distance traveled by dump truck would be 3.25 miles, with a maximum overall length from the northern area of north Wallops Island beach to the southern portion of the renourishment area extending 9 miles overall. Based on an average 12 cubic yard capacity of a 10 wheel dump truck, is estimated that 108,000 loads would be required to move the sand.

As shown in **Table 3.5-1**, Emissions would not exceed the comparative threshold for any of the criteria pollutants. As a result, no significant impacts on air quality would be anticipated from implementing this activity.

Table 3.5-1. Estimated Annual Emissions in Tons per Year from Implementation of Alternative 1

	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Alternative 1 Emissions Only	11.15	33.74	174.72	0.20	5.73	5.56	20,175
Comparative Threshold	250	250	250	250	250	250	NA
Exceeded (Yes/No)	No	No	No	No	No	No	NA

The proposed activities would contribute directly to GHG emissions from fossil fuel combustion. A total of 20,175 tons of CO_2e would be generated. To put these emissions in perspective, 20,175 tons of GHGs is the equivalent of 3,942 cars driving the national average of 11,500 miles for one year (EPA 2018b). These GHG emissions would only be generated during the activity period. While the GHG emissions alone would not be enough to cause global warming, in combination with past and future emissions from all other sources, they would contribute incrementally to the global warming that produces the adverse effects of climate change.

3.5.2.3 Alternative 2

Alternative 2 would remove sand from Unnamed Shoal A using a trailing suction dredge system. The material collected from the subsurface floor would be pumped into the self-contained hopper in the dredge vessel. When full, the vessel would move to the area where a submerged pipeline would be installed, approximately 17 miles from the dredge area. The contents of the hopper would be pumped into the pipeline, which itself would have pumps to move the materials to the renourishment area ashore. The pipeline is estimated to be up to 2 miles long. The vessel pumps are estimated to run 70 percent of the time and for 30 percent of the time the vessel is transporting materials to the pipeline and returning to the dredge area. It is assumed that two dredge vessels would be in operation for the time period. The pipeline is estimated to be located in 10 different locations during the course of the project (approximately every 0.2 miles along the renourishment stretch) and bulldozers would spread and grade the sand at each

location. Because of losses associated with the hopper collection and transport, the total amount of sand estimated as required has been increased by 25 percent to 1.625 million cubic yards. Additionally, the hopper capacity has been reduced to 3,000 cubic yards. The process of dredging and placing the sand is expected to last approximately 3 months, with 10 percent of the schedule allocated for bad weather and/or equipment downtime.

As shown in **Table 3.5-2**, emissions would not exceed the comparative threshold for any of the criteria pollutants. As a result, no significant impacts on air quality would be anticipated from implementing this activity.

Table 3.5-2. Estimated Annual Emissions in Tons per Year from Implementation of Alternative 2

	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Alternative 2 Emissions Only	4.40	54.40	227.90	0.20	8.70	8.5	18,059
Comparative Threshold	250	250	250	250	250	250	NA
Exceeded (Yes/No)	No	No	No	No	No	No	NA

The proposed activities would contribute directly to GHG emissions from fossil fuel combustion. A total of 18,059 tons of CO_2e would be generated. To put these emissions in perspective, 18,059 tons of GHGs is the equivalent of 3,529 cars driving the national average of 11,500 miles for one year (EPA 2018b). These GHG emissions would only be generated during the activity period. While the GHG emissions generated alone would not be enough to cause global warming, in combination with past and future emissions from all other sources they would contribute incrementally to the global warming that produces the adverse effects of climate change.

3.5.2.4 Alternative 3

Under Alternative 3, in addition to renourishment of the shoreline infrastructure protection area, six breakwater structures would be constructed in the water approximately 200 feet offshore and parallel to the beach. Because the breakwaters are located offshore, it is assumed for the purpose of this analysis that the stone would be transported via barge from the Norfolk area. A barge-mounted excavator would be used to place the stone in the specified breakwater areas, and each breakwater structure would extend 130 feet with an exposed top width of 10 feet. The construction time for the breakwaters has been estimated at 6 to 9 months. Construction would occur daily for 16 hours/day. Approximately 5 barge loads of material would arrive daily for placement in the breakwater areas. Emissions have been estimated using 2 barges with excavators. **Table 3.5-3** provides the total emissions that would result from combining the breakwater construction with each renourishment alternative. Emissions from breakwater construction would not exceed the comparative threshold for any of the criteria pollutants. As a result, no significant impacts on air quality would be anticipated from implementing this activity.

Table 3.5-3. Estimated Annual Emissions in Tons per Year from Implementation of Alternative 3

	VOC	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Comparative Threshold	250	250	250	250	250	250	NA
Alternative 3 + Alternative 1	13.52	49.18	190.48	0.27	21.63	5.90	31,011
Exceeded (Yes/No)	No	No	No	No	No	No	NA
Alternative 3 + Alternative 2	7.38	71.91	249.89	0.25	25.93	8.99	29,679
Exceeded (Yes/No)	No	No	No	No	No	No	NA

The proposed breakwater construction would contribute directly to GHG emissions from fossil fuel combustion. Depending on the source of sand utilized, Alternative 1 or 2, a total of 31,011 or 29,679 tons of CO_2e, respectively, would, be generated as a result of implementing Alternative 3. To put these emissions in perspective, they represent the equivalent of 6,059 and 5,799 cars driving the national average of 11,500 miles for one year (EPA 2018b).

Combining the emissions from breakwater construction with beach renourishment activities would increase annual emissions, but would not exceed the comparative threshold for any of the criteria pollutants. Breakwater construction with beach renourishment using material from the north island (Alternative 3 + Alternative 1) would generate the largest increase in annual emissions, and would equal the comparative threshold for NO_x. For this reason, as well as to reduce GHG emissions, the following mitigation actions are recommended to ensure that no significant impacts to air quality from NOx emissions would be anticipated from Alternative 3:

- Implement and enforce idling restrictions,
- Mandate use of newer equipment meeting late-model (Tier IV) engine emission requirements,
- Require that equipment engines are maintained and tuned to meet EPA certification requirements, and control fugitive dust as practical.

3.6 NOISE

Noise is often defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, diminishes the quality of the environment, or is otherwise annoying. The impact of noise is described through the use of noise metrics which depend on the nature of the event and who or what is affected by the sound. The following section provides metrics for in-air and underwater noise.

3.6.1 AFFECTED ENVIRONMENT

3.6.1.1.1 Airborne Noise

Airborne noise is represented by a variety of metrics that are used to quantify the noise environment. Human hearing is more sensitive to medium and high frequencies than to low and very high frequencies, so it is common to use maximum A-weighted decibel (dBA) metrics (also shown as dB L_{Amax}) to represent the maximum sound level over a duration of an event such as an aircraft overflight. A-weighting provides a good approximation of the response of the average human ear and correlates well with the average person's judgment of the relative loudness of a noise event.

The project area would be dominated by noise from wind and wave action along the shoreline. Background noise levels in the area range from 30 to almost 50 dBA, with a constant low level of low-frequency sound likely caused by wind and waves. The southern end of Wallops Island has slightly higher sound levels ranging from 40 to 50 dBA, which is likely due to the proximity to the surf zone (NASA 2013). Noise levels increase during rocket launch activities and other operations at WFF; however, these noise levels are occasional and temporary in nature.

3.6.1.1.2 Underwater Noise

Underwater noise behaves much like noise in the air but, due to the denser medium, the sound waves can propagate much farther in-water. Unlike airborne noise, underwater noise is not weighted to match frequencies that can be heard by the human ear. Two common descriptors of underwater noise are

instantaneous peak sound pressure level (dB_{peak}) and the Root Mean Square (dB_{RMS}) pressure level during the impulse. The dB_{peak} is the instantaneous maximum overpressure or underpressure observed during each sound pulse and can be presented in Pascals (Pa) or sound pressure level in dB, referenced to a pressure of 1 micropascal at one meter (dB re:1µPa-m). The dB_{RMS} is the square root of the energy divided by the duration of the sound pulse. This level is often used by the NMFS to describe disturbance related effects to marine mammals from underwater impulse sounds. Potential injury to fish from noise is estimated using the dB_{peak} metric (Washington State Department of Transportation [WSDOT] 2015).

During the initial beach fill in summer 2012, NASA partnered with BOEM and USACE to record background in-water noise levels at both the offshore borrow area and the nearshore pumpout area. Data were collected at two listening depths at each site; approximately 10- and 30-foot depths at Unnamed Shoal A and 10 and 20 foot depths at the nearshore sites. During the study, the majority of data were collected when winds were at least 4 to 7 miles per hour and wave heights were at least 1 to 2 feet. Therefore, the data do not reflect "calm" sea conditions.

Background sound pressure levels (SPLs) averaged 117 dB across all sampling days, sites, water depths and weather conditions. Minimum measured SPLs ranged from 91 dB to 107 dB depending on sampling location and water depth; maximum levels ranged from approximately 128 dB to just under 148 dB (Rein *et. al* 2014). Highest SPLs were found at frequencies of less than 200 hertz. The authors note that sea state and the associated sounds generated by waves interacting with the survey vessel likely contributed to the elevated readings.

3.6.2 ENVIRONMENTAL CONSEQUENCES

3.6.2.1 No Action Alternative

Under the No Action Alternative, breakwater construction and beach renourishment would not occur. As such, the shoreline would continue to be dominated by the sounds of winds and wave action.

3.6.2.2 Alternative 1

The operation of heavy equipment along the beach would be the most pronounced source of noise under Alternative 1. This would include engine noise, back-up alarms, and generators running lighting. Heavy construction vehicles, the major source of noise during construction projects, are constantly moving in unpredictable patterns; therefore no one receptor is expected to be exposed to construction noise of long duration. However, during the backpassing of sand from the north to the south, heavy equipment would continually traverse the length of the island. Therefore, conservative estimates of "point source" noise levels can be determined using construction equipment noise level data collected by the Federal Highway Administration (FHWA) (2006). Assuming the immediate work site would include four bulldozers, a front-end loader, and two generators (one for office power, one for nighttime lighting), the total received sound level at 50 feet from the site would be approximately 90 dBA. Typically, sound drops off at a rate of 6 dB for each doubling of the distance from a point source (FHWA 2007). Employing this methodology, noise levels would fall within the upper range of background levels (50 dBA) at approximately 0.9 mile from the work site. The nearest residence is over 1.5 miles away from the project area.

However, it should be noted that wind and surf conditions would play a major role in dictating the distances at which the construction-related sounds could be heard by nearby receivers. Studies have shown that the effects of wind on sound propagation can be substantial, with upwind attenuation

approaching 25 to 30 dB more than downwind at the same distance from the source (Wiener and Keast 1959). Therefore, received construction-related noise levels would vary, however, they would not be expected to be substantial.

Under Alternative 1, the underwater noise environment could be altered by land-based equipment operating in and near the intertidal zone. Sand would be removed from the north Wallops Island beach and moved south to the deposition area and distributed using heavy equipment. Noise from the equipment may be detectable in the underwater environment, but may be masked by the noise of the surf. For instance, the noise of heavy D8 bulldozers was imperceptible through half-meter surf, to the unaided ear of scuba divers 260 feet offshore during a similar beach renourishment (M. Lybolt personal observation). The intensity of potential noise impacts to the underwater environment would be low and the duration of impacts, if created, would be temporary.

3.6.2.3 Alternative 2

Airborne noise for Alternative 2 would be very similar to that described in Alternative 1. Heavy equipment would continue to be the primary source of project related noise. Additionally, there would be some noise from the dredge outfall pipe, as it pumped the sand slurry onto the beach. Under this Alternative, noise would likely remain concentrated near the dredge discharge pipe and move steadily northward as the project progressed.

It is expected that in-water noise levels generated by the Proposed Action would be similar to those reported by Rein *et. al* (2014), which summarizes recorded noise levels from hopper dredges operating in the nearshore waters off Wallops Island. Though the referenced study presents noise levels from three individual dredges, the noise levels presented for this analysis were logarithmically averaged into a single SPL for each activity in the dredging cycle. Similar to in-air noise, the distance to which project related underwater noise would be potentially audible varies with environmental conditions like surf, wind, waves, and water temperature.

Based upon data collected by Rein *et. al* (2014), sediment removal and the transition from transit to pumpout would be expected to produce the highest noise levels at an estimated source level (SL) of 172 dB at 3 feet. The two quietest dredging activities would be expected to be seawater pumpout (flushing pipes) and transiting (unloaded) to the borrow site, with expected SLs of approximately 159 and 163 dB at 3 feet, respectively.

These expected noise levels generally correlate with those presented in the *2010 Final SRIPP PEIS*, which were based upon levels recorded by Clarke *et al.* (2003). However, the new information does suggest that SLs and the region of elevated noise around the dredges could be higher than originally anticipated, although not substantially different. In-water noise imparts are discussed in more detail in **Section 3.10, Marine Mammals**. Based upon attenuation rates observed by Rein *et. al* (2014), it would be expected that at distances approximately 1.6 to 1.9 miles from the source, underwater noise generated by the dredges would attenuate to background levels.

3.6.2.4 Alternative 3

In-air noise impacts would be the same as those identified for Alternatives 1 and 2.

In-water noise would be the same as those identified for Alternative 2, with the addition of the breakwater construction. This would involve the use of a barge and excavator to place large stone in the water to construct the breakwater. It is anticipated that the barge would be anchored in place using “spuds”, a set

of 1 to 4 vertical steel beams that are lowered into the seafloor through slides on the barge hull and raised each time the barge is repositioned. Most spuds rely on gravity but some applications require spuds to be pressed into the sediment. Spuds are moved using mechanical or hydraulic winches; no additional vibratory or impact noise would be produced. Therefore, it is unlikely there would be any detrimental underwater noise impacts from breakwater construction.

3.7 BENTHOS

Bottom dwelling invertebrates provide a critical link in the productivity of the marine waters off of Wallops Island. The benthos includes organisms that live on the sediment surface (epifauna) such as starfish and sand dollars, as well as organisms that live within the sediment (infauna) such as clams and worms. The majority of the benthos live in the upper 6 inches of sediment. Benthic organisms are an important food resource for fish, including those caught by recreational and commercial fishermen.

Section 3.2.5 of the *2010 Final SRIPP PEIS* describes in detail the benthic organisms that inhabit the project site. This section provides a summary.

3.7.1 AFFECTED ENVIRONMENT

Air-breathing crustaceans such as ghost crabs (*Ocypode quadrata*) dominate the uppermost zone of the Wallops Island beach, while the swash zone is dominated by isopods, amphipods, polychaetes, and mole crabs (*Emerita talpoida*). Below the mid-tide line is the surf zone where coquina clams (*Donax variabilis*) and a variety of amphipods are prevalent. All such organisms are important prey species for a variety of waterbirds and fish. Studies reviewed in preparing the *2010 Final SRIPP PEIS* indicated that manually nourished beaches can be devoid of living benthos for up to a year following project completion.

As presented in Section 3.2.5 of the *2010 Final SRIPP PEIS*, 2009 underwater photographic studies conducted of Unnamed Shoal A during the development of the *2010 Final SRIPP PEIS* determined that the dominant epifaunal benthos included sand dollars (*Echinarachinus parma*), hermit crabs (*Pagurus* spp.), crabs (*Libinia* spp., *Cancer* spp.), moon shell (*Polinices* spp.), and whelk (*Busycon* spp.).

Similar to the discussion regarding onshore benthic resources, while the dredged area may not have fully recovered to 2014 pre-dredge conditions, it is reasonable to expect that the benthos in the affected area have recovered considerably.

3.7.2 ENVIRONMENTAL CONSEQUENCES

Section 4.3.5 of the *2010 Final SRIPP PEIS* describes in detail the expected effects of dredging and beach nourishment on benthic organisms. This section provides both a summary and updated information obtained since its publication.

3.7.2.1 No Action Alternative

Under the No Action Alternative, the proposed beach renourishment would not occur. Therefore, there would be no project related impacts to benthos, along the beach, in the intertidal zone, nearshore, or offshore. The offshore borrow area would continue to recover from previous dredging operations.

3.7.2.2 Alternative 1

Under Alternative 1, organisms living in the sandy beach area of the northern part of Wallops Island would experience direct mortality from the sand removal and relocation. This would be due to disturbance and crushing from excavators removing sand and burial in the renourishment area. The physical

oceanographic conditions would be essentially unchanged, and after the renourishment reaches equilibrium, there would be no net change in the physical environment available for benthos.

Recovery time of benthos in the surf zone renourishment area under Alternative 1 could be more rapid than under Alternative 2 because the sediment is more closely matched. Burlas *et al.* (2001) estimated that the recovery time for benthos in a New Jersey study ranged from approximately 2 to 6 months when there is a good match between the fill material and the natural beach sediment. Dalfsen and Essink (2001) noted that recolonization is generally defined by two patterns: the rapid development of "opportunistic" species, and the subsequent recovery of community composition and structure. The USACE recently reviewed the subject, and benthos recovery times for scenarios similar to the proposed action ranged from about 6 months to about 2 years (USACE 2015). Under Alternative 1, it is expected that organisms from adjacent areas would recolonize the new beach in relatively short time (i.e., on the order of 6 to 12 months post-project).

Under Alternative 1, there would be no offshore dredging. Therefore there would be no project related impacts to benthic organisms at the offshore borrow area.

3.7.2.3 Alternative 2

Impacts from renourishment activities to benthic organisms living onshore and in the nearshore environment would be similar to those described under Alternative 1 with two differences. Impacts to onshore benthos at the north Wallops Island beach borrow area would be eliminated. Under Alternative 2, the fill material would be slightly different than native material and the rate of recovery could be slower than under Alternative 1.

Within the OCS borrow area, bottom dwelling organisms would be entrained in the dredge. Based upon reports by biological monitors onboard the dredges during the initial beach fill cycle, the most commonly encountered macrobenthos included horseshoe crab (*Limulus polyphemus*), whelk (*Busycon canaliculatum*), and blue crabs (*Callinectes sapidus*).

Because of the dynamic nature of OCS benthic communities and their variability over time, the recovery of benthos at offshore borrow areas varies. A summary of post-dredge faunal recovery rates in Europe by Hitchcock, Newell, and Seiderer (2002) show a range from several weeks to more than ten years. Recovery rates for borrow areas in a recent review by USACE were similar, and ranged from several months to no detectable recovery (USACE 2015). The most rapid recovery rates were observed for highly mobile organisms (i.e., several months up to two years); whereas the longest recovery periods (i.e., a decade or more) were associated with sessile and uncommon low-fecundity benthos. Given the benthic assemblages known from Unnamed Shoal A, recovery of most benthos would be likely within two years.

3.7.2.4 Alternative 3

Under Alternative 3, impacts to benthos living nearshore and onshore would be the same as those described for Alternative 1 or for Alternative 2, with the addition of bottom disturbance for the construction of the breakwaters. Direct mortality of all benthos within the footprint of breakwater construction would be likely. The footprint of the breakwaters would be permanently converted from sand to approximately 0.34 acres of new hardbottom habitat. However, because the regional coastline has very little hardbottom habitat in the surf zone the concept of recovery is not applicable and colonization of the breakwaters would provide habitat for an essentially novel community of benthos. Potential direct benefits to native benthos would be minimal, but the breakwaters would provide attachment points for

sessile creatures as well as refuge and cover for mobile macrobenthos such as polychete worms or amphipods and could offer some minor beneficial impacts in the long term.

Offshore impacts to benthos from Alternative 3 would be identical to either Alternative 1 or Alternative 2, depending on the sand source.

3.8 WILDLIFE

This discussion of wildlife addresses the variety of species found on and near the onshore and offshore environments of Wallops Island.

3.8.1 AFFECTED ENVIRONMENT

Section 3.2.2 of the *2010 Final SRIPP PEIS* describes in detail the wildlife species that may inhabit the project site. This section provides both a summary and updated information obtained since its publication.

Wallops Island is home to a diverse array of wildlife species. The Assateague Island National Seashore extends from the northern (Maryland) portion of Assateague Island through Virginia. The southern (Virginia) portion located closest to Wallops Island is part of Chincoteague National Wildlife Refuge (CNWR). Assawoman Island to the south of Wallops is also owned by the USFWS and is part of CNWR. Both protected areas provide high quality habitat for a variety of wildlife.

3.8.1.1 Onshore

Avifauna: The Wallops Island beach provides important nesting and foraging habitat for a number of migratory waterbirds, including gulls, terns, and sandpipers. Waterbird numbers on the beach peak during the fall and spring migrations, during which the beach provides stopover habitat for resting and feeding as the birds transit between breeding and wintering grounds. Important food sources include fish mollusks, insects, worms, and crustaceans.

Recently filled beaches are expected to be mostly devoid of food sources making habitat value limited. However, since the post-Hurricane Sandy beach fill, recruitment has likely replenished the invertebrate food sources for foraging avifauna to near normal levels. Also noteworthy is that following the initial fill cycle, the most northern end of Wallops Island (which would remain unaffected by the Proposed Action) has developed an expansive area of tidal pools; these are expected to be important sources of forage for bird species.

In accordance with its Protected Species Monitoring Program, NASA continues to conduct regular monitoring of the Wallops Island beach between March and September to determine the level of bird nesting activity within and adjacent to the project area. The most recent Protected Species Monitoring Reports observed one American oystercatcher (*Haematopus palliatus*) nest in 2017 and in 2018 with no chicks surviving to fledge (NASA 2017, NASA 2018). No Wilson's plover (*Charadrius wilsonia*) nests were observed for 2017 or 2018. Wallop's staff also monitor for piping plover (*Charadrius melodus*) and the red knot (*Caladris canutus rufa*), and these are discussed in **Section 3.11, Special Status Species**. No colonial waterbird nesting activity has been observed on the Wallops Island beach since NASA began its regular beach nesting bird surveys in spring 2010 (NASA 2018). In general, the wildlife abundances measured under the monitoring program have remained constant since 2010, or have declined (NASA 2016, NASA 2017, NASA 2018).

Herpetofauna: Though Wallops Island is home to a number of amphibians and reptiles, the species most likely affected by activities on or adjacent to the beach is the diamondback terrapin (*Malaclemys*

terrapin), which in the past has regularly nested on the north beach and locations on the west (bay) side of the island. However now that portions of the rock seawall have sand overtopping them, the species has easier access to the beach for its late spring to early summer nesting. During the initial 2012 beach fill, the diamondback terrapin was observed frequently within the project site during the late May to early June timeframe. Sea turtles are discussed in **Section 3.11, Special Status Species**.

3.8.1.2 Offshore

Seabirds including scoters, loons, and gannets use the offshore portion of the project area as foraging grounds during winter months.

Existing scientific literature supports that recovery of the forage value of a dredged shoal likely occurs within 2 years. Therefore, similar to the discussion above regarding the nearshore environment, given that the last dredging occurred within the borrow area on Unnamed Shoal A during 2014, it is expected that the forage value of the affected area has returned to pre-dredge conditions.

3.8.2 ENVIRONMENTAL CONSEQUENCES

3.8.2.1 No Action Alternative

Under the No Action Alternative, there would be no project related impacts onshore or offshore to wildlife in the vicinity of Wallops Island.

3.8.2.2 Alternative 1

3.8.2.2.1 Onshore

Avifauna: Temporary noise and visual disturbances from construction equipment and personnel could adversely affect beach foraging and nesting birds. Direct effects could include eliciting a startle or flee response, which for foraging birds could temporarily interrupt feeding activities or cause individuals to relocate to other areas of the beach. If nesting birds were to flush from nests, it could lead to an elevated risk of egg overheating or predation. It would also be possible for equipment to inadvertently crush or bury nests or chicks if the nests were undetected. Adverse effects would also occur from a reduction in available food sources during and following the placement of sand on the Wallops Island shoreline. Potential impacts to wildlife would be reduced by the avoidance measures employed for Special Status Species (i.e., no activity at the north Wallops Island borrow area from piping plover and loggerhead sea turtle nesting season).

However, beach renourishment would occur well south of the areas of the beach that have historically hosted the greatest level of nesting activity. It is unknown to what extent the newly created Wallops Island beach in the shoreline infrastructure protection area would be used by waterbirds. The actual usage patterns would play a large role in dictating potential impacts. Effects on prey availability are expected to be a contributing factor, and given that the newly placed beach is likely in a biologically suppressed state, it is possible that bird species would congregate closer to more forage-rich areas outside of the affected area. As discussed in **Section 3.7, Benthos**, available forage would most likely recover within one year.

Long term, the renourished beach could create suitable waterbird nesting habitat. At a time when storm intensity and frequency are expected to increase, having an elevated, sparsely vegetated beach and dune along the entire length of Wallops Island is expected to be of notable benefit to all beach nesting species.

Herpetofauna: Diamondback terrapins, while noted to be abundant on Wallops Island, have only been found on the west (bay) side of the island and are not a protected species. Therefore, no potential impact

is anticipated to this species and no mitigation would be required. However, NASA would continue to monitor this species to the extent practicable.

3.8.2.2.2 Offshore

Under Alternative 1, there would be no project related impacts offshore, as no OCS dredging would occur.

3.8.2.3 Alternative 2

3.8.2.3.1 Onshore

Avifauna: Impacts to avifuana would be similar to those described under Alternative 1, as construction equipment would move sand pumped from the offshore borrow area into the areas to be renourished.

Herpetofauna: Impacts to herpetofauna would be similar to those described under Alternative 1, as construction equipment would move sand pumped from the offshore borrow area into the areas to be renourished.

3.8.2.3.2 Offshore

Dredging Unnamed Shoal A would be done in a way so as not to substantially change shoal topography and to minimize the impact to the availability of seabird food sources as considered in the *2010 Final SRIPP PEIS*. Though the additional dredging would increase the water depths at the borrow area, diving species could still effectively forage on the shoal. As discussed in **Section 3.7, Benthos**, forage sources would most likely recover within two years. All additional sand would be removed within areas already disturbed; therefore it would not expand the footprint of the area having reduced available forage following the dredge event. Both adjacent undisturbed areas on Unnamed Shoal A and neighboring shoals would provide adequate forage should seabirds avoid the directly affected area. Additionally, the dredge portion of the project is expected to be completed within a 3-month window. Impacts from disturbance would be limited to that active dredging phase.

3.8.2.4 Alternative 3

3.8.2.4.1 Onshore

Avifauna: Impacts to avifuana would be similar to those described under Alternative 1, as construction equipment would move sand pumped from the offshore borrow area into the areas to be renourished.

Herpetofauna: Impacts to herpetofauna would be similar to those described under Alternative 1, as construction equipment would move sand pumped from the offshore borrow area into the areas to be renourished.

3.8.2.4.2 Offshore

Impacts to wildlife under Alternative 3 would be similar to those described under Alternative 2, with the additional disturbance from the construction of offshore breakwaters. The breakwaters would alter the nearshore bottom and create adverse impacts from direct disturbance during construction. Post-construction of the breakwaters would potentially provide resting areas for avifauna. It is unlikely that the breakwaters would contribute to any lasting negative impacts to offshore wildlife in the vicinity of Wallops Island.

3.9 FISHERIES AND ESSENTIAL FISH HABITAT

3.9.1 REGULATORY CONTEXT

In accordance with the Magnuson-Stevens Fishery Conservation and Management Act of 1976, federal agencies must consult with the National Marine Fisheries Service (NMFS) for activities that may adversely affect Essential Fish Habitat (EFH) that is designated in a federal Fisheries Management Plan. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Both the offshore borrow area and the nearshore discharge location are designated EFH for multiple life stages of managed fish species, therefore the EFH consultation requirement applies to the Proposed Action.

A separate EFH Assessment was prepared (**Appendix F**), which references extensive previous EFH consultations that occurred in conjunction with the *2010 Final SRIPP PEIS* and the *2013 Post-Hurricane Sandy EA* and summarizes the affected environment and environmental consequences to EFH under the Proposed Action. Previous EFH consultations concurred that beach restoration would not substantially adversely affect EFH. Note that using sand from the north Wallops Island beach for renourishment, under either Alternative 1 or Alternative 3, would result in a smaller spatial footprint and less intense stressors than use of materials from Unnamed Shoal A (under Alternatives 1 or 3) and prior actions. NASA anticipates that the magnitude of potential consequences under Alternative 1 and Alternative 3 would be smaller than similar actions. In a letter dated November 19, 2018, NMFS concurred with NASA's determination stating that the project will not substantially adversely affect EFH, if the following conservation recommendations are initiated:

1. If Alternative 2 is implemented, target accretion areas of Unnamed Shoal A for dredging to obtain the necessary beach fill material.
2. If Alternative 2 is implemented, dredge over a large area, leaving undisturbed areas between dredged areas to provide for benthic recruitment and recolonization of impacted areas and avoid creating deep pits; follow the existing bathymetry/morphology of shoal to the extent possible, limit depth of cut not to exceed 10 ft. and confirm by conducting post-dredge survey.
3. Construct proposed offshore breakwaters with sand tombola such that the beach connects with the structures to reduce starving down-drift beaches of sand.
4. If Alternative 1 is implemented, conduct bi-annual post-construction monitoring of the accretion area at northern end of Wallops Island and adjacent erosion area at Chincoteague Inlet. Adaptively manage any unforeseen consequences of "backpassing" sand to the southern project area.

3.9.2 AFFECTED ENVIRONMENT

Most major invertebrate groups are found on inshore and nearshore sandy areas including mollusks (e.g., clams and whelks), crustaceans (e.g., crabs, shrimp, and amphipods), and polychaetes (marine worms). Inshore tidal marsh grasses of WFF act as nursery grounds for a variety of fish species including the spot (*Leiostomus xanthurus*), the northern pipefish (*Syngnathus fuscus*), the dusky pipefish (*Syngnathus floridae*), and bay anchovy (*Anchoa mitchilli*) (USFWS 2015). Salinity and water depth play major roles in determining which coastal fish species are present in bays and inlets. An example of this is the sandbar

shark (*Carcharhinus plumbeus*), which is common in summer months if the inshore channels are at least 12 feet deep and the salinity is at least 30 parts per thousand (Chesapeake Bay Program 2009).

Common finfish in both inshore and nearshore waters of WFF include the Atlantic croaker (*Micropogonias undulates*), sandbar shark, sand shark (*Carcharisa taurus*), smooth dogfish (*Mustelus canis*), smooth butterfly ray (*Gymnura micrura*), bluefish (*Pomatomidae saltatrix*), spot, and summer flounder (*Paralichthys dentatus*) (NASA 2016).

The Endangered Species Act (ESA)-listed Atlantic Sturgeon and Giant Manta Ray are discussed briefly in **Section 3.11, Special Status Species**. They could be present, but their low abundance and distribution makes project related impacts possible but not plausible. As described in section 3.11, trained observers would be onboard the dredge(s) to monitor for protected species. If any are encountered, NASA will require its contractor to slow the vessel to a safe speed to allow the protected species to leave the vicinity before continuing operations.

3.9.2.1.1 Fisheries

The project area associated with using sand from the north Wallops Island beach is geographically coincident with 21 managed fishery species. Unnamed Shoal A is geographically coincident with an additional nine managed fishery species. Commercially important shellfish fisheries include the sea scallop (*Plactopecten magellanicus*) and blue crab. Other nearshore shellfish fisheries species include decapod crustaceans, stomatopod crustaceans, and cephalopods. Common finfish fisheries in the waters near WFF include the menhaden (*Brevoortia tyrannus*), Atlantic croaker (*Micropogonias undulatus*), summer flounder, and bluefish.

Chincoteague is one of six major ports in Virginia where large, ocean-going fishing vessels unload their catches (McCay and Cieri 2000). Throughout Virginia, the total value of the commercial fishery is dominated by two species: sea scallop and menhaden. Prominent but relatively minor commercial and recreational fishery species also include blue crab, northern quahog clam (*Mercenaria mercenaria*), Atlantic croaker, summer flounder, and striped bass (*Morone saxatilis*) (NMFS 2018a; 2018b).

3.9.2.1.2 Essential Fish Habitat

The project area associated with using sand from the north Wallops Island beach is geographically coincident with eight EFH designations, no habitat areas of concern (HAPC) designations, and 21 managed species (**Table 3.9-1**). Unnamed Shoal A is geographically coincident with an additional three EFH designations, no HAPC designations, and an additional nine managed species. Only two EFH habitat types occur within the project area, water column and unconsolidated sand.

Table 3.9-1. Essential Fish Habitat and Managed Species for the Proposed Action Area on North Wallops Island Beach

Species	Scientific Name	Life Stage				
		Eggs	Larvae	Juveniles	Adults	Spawning Adults
Northeast Multispecies Fishery Management Plan – Amendment 14 (New England FMC)						
Red hake	*Urophycis chuss*	X	X	X		
Windowpane flounder	*Scopthalmus aquosus*	X	X	X	X	X
Northeast Skate Complex Fishery Management Plan – Amendment 2 (New England FMC)						
Clearnose skate	*Raja eglanteria*			X	X	
Winter skate	*Leucoraja ocellata*			X	X	

Table 3.9-1. Essential Fish Habitat and Managed Species for the Proposed Action Area on North Wallops Island Beach

Species	Scientific Name	Life Stage				
		Eggs	Larvae	Juveniles	Adults	Spawning Adults
Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan – Amendment 12 (Mid-Atlantic FMC)						
Black sea bass	*Centropristis striata*	X	X	X	X	
Summer flounder	*Paralichthys dentatus*	X(1)	X	X	X	
Atlantic Herring Fishery Management Plan – Amendment 3 (New England FMC)						
Atlantic sea herring	*Clupea harengus*	X(2)	X	X	X	X(2)
Atlantic Bluefish Fishery Management Plan – Amendment 1 (Mid-Atlantic FMC)						
Bluefish	*Pomatomus saltatrix*	X	X	X	X	
Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan – Amendment 11 (Mid-Atlantic FMC)						
Atlantic butterfish	*Peprilus triacanthus*	X(3)	X(3)	X(3)	X(3)	X(3)
Coastal Migratory Pelagics(4) – Amendment 26 (South Atlantic FMC)						
Cobia(4)	*Rachycentron canadum*	X(4)	X(4)	X(4)	X(4)	
King mackerel(4)	*Scomberomorus cavalla*	X(4)	X(4)	X(4)	X(4)	
Spanish mackerel(4)	*Scomberomorus maculatus*	X(4)	X(4)	X(4)	X(4)	
Atlantic Highly Migratory Species Fishery Management Plan – Amendment 10 (Secretarial)						
Albacore tuna*	*Thunnus alalunga*			X(4)		
Skipjack tuna*	*Katsuwonus pelamis*			X(4)(5)	X(4)	
Atlantic angel shark	*Squatina dumeril*	X				
Blacktip shark* (Atlantic stock)	*Carcharhinus limbatus*	X		X	X	
Common thresher shark	*Alopias vulpinus*	X				
Dusky shark	*Carcharhinus obscurus*	X		X(5)	X(5)	
Sand tiger shark	*Carcharias taurus*	X		X	X	(6)
Sandbar shark	*Carcharhinus plumbeus*	X		X	X	(6)
Smoothhound shark complex* (Atlantic stock)	*Mustelus canis*	X				

Notes: (*) Not covered under previous EFH consultations for the Proposed Action Area.
(1) Less likely in affected area under Alternative 1 and Alternative 3. Eggs are most likely from 30 to 360 feet. (9 to 110 meters [m]).
(2) Less likely in affected area under Alternative 1 and Alternative 3. Eggs and spawning adults are most likely from 15 to 300 feet. (5 to 90 m).
(3) Less likely in affected area under Alternative 1 and Alternative 3. All life stages are most likely deeper than 30 feet. (10 m).
(4) Coastal migratory pelagics and some highly migratory species are not year round residents of the Proposed Action Area and are generally absent in winter. These species are much less likely in the affected area under Alternative 1 and Alternative 3.
(5) Less likely in affected area under Alternative 1 and Alternative 3. Juveniles and adults are most likely deeper than 60 feet. (20 m).
(6) No HAPC near the Proposed Action area, but HAPC is approximately 60 mi (100 km) north and south, at Delaware Bay and Chesapeake Bay.
Legend: FMC = Fishery Management Council.

Completion of the proposed offshore breakwaters under Alternative 3 would convert approximately 0.34 acres of unconsolidated sand into hardbottom seafloor EFH. However, because the regional coastline has very little hardbottom habitat in the surf zone the potential direct benefits to designated EFH or managed species would be minimal. For a discussion of impacts to benthos, refer to **Section 3.7**.

Table 3.9-1 was excerpted from the separate EFH Assessment. Other EFH elements are incorporated by reference to minimize duplication.

3.9.3 ENVIRONMENTAL CONSEQUENCES

3.9.3.1 No Action Alternative

Under the No Action Alternative, the proposed breakwater construction, dredging, and beach renourishment would not occur. Therefore, there would be no project related impacts to fisheries and EFH.

3.9.3.2 Alternative 1

The nature and intensity of turbidity and water quality stressors imposed under Alternative 1 would be measurable, but would be substantially less than in previous consultations. Hauling sand by truck from the north Wallops Island beach would not require the large volumes of water to move sand slurries through pipes from a dredge site, and consequently would not produce a similarly intense turbidity plume. Taken together, turbidity and water quality stressors imposed on EFH and managed species would be substantially less than in previous consultations, e.g., stressors would be concentrated within the swash zone, projected to dissipate approximately 1,000 to 2,000 feet alongshore, and to last only several hours after cessation of work. Physical strike and disturbance stressors would be limited to vehicles operating in the surf zone. Other potential stressors imposed under Alternative 1 (i.e., artificial lighting, noise, ingestion, entanglement, and chemical stressors) are not relevant because their nature and magnitude is discountable, stressor and receptor are not co-located, and EFH and managed species have little to no meaningful susceptibilities in this context. Therefore, these other stressors were not carried forward for analysis for Alternative 1.

Most motile fishery species would be displaced from the project area under Alternative 1. Displacement would range from temporary to long term, and most consequences would be temporary or short term. Sessile fishery species (e.g., clams) are conservatively assumed to have 100 percent mortality within the project area under Alternative 1, and species recovery could begin almost immediately after completion of the renourishment activities.

3.9.3.2.1 Nearshore

Under Alternative 1, all of the nearshore intertidal and subtidal fishery species and EFH would be exposed to moderate and episodic turbidity stressors for the duration of the project. Construction equipment and materials would displace water column EFH, fish species, and their prey.

In accordance with NMFS conservation recommendation for EFH, NASA would continue to conduct bi-annual post-construction monitoring of the accretion area at northern end of Wallops Island and adjacent erosion area at Chincoteague Inlet and would adaptively manage any unforeseen consequences of "backpassing" sand to the southern project area.

3.9.3.2.2 Offshore

Under Alternative 1 there would be no dredging of sand from the Unnamed Shoal A and no offshore impact to fishery species and EFH.

3.9.3.3 Alternative 2

The nature and intensity of turbidity and water quality stressors and physical strike and disturbance stressors imposed under Alternative 2 would be identical to prior permitted actions. Most motile fishery species would be displaced from the project area without injury or mortality under Alternative 2. Displacement would range from temporary to long term, with most consequences temporary or short

term. Sessile fishery species (e.g., clams) are conservatively assumed to have 100 percent mortality within the entire project area under Alternative 2, and species recovery could begin almost immediately after completion of the action. Most consequences would be temporary to short term because the stressors are reduced to background intensity shortly after cessation of construction. Other potential stressors imposed under Alternative 2 (i.e., artificial lighting, noise, ingestion, entanglement, and chemical stressors) are not relevant because their nature and magnitude is discountable, stressor and receptor are not co-located, and EFH and managed species have little to no meaningful susceptibilities in this context. Therefore, these other stressors were not carried forward for analysis for Alternative 2.

3.9.3.3.1 Nearshore

The nature and intensity of stressors affecting nearshore fish and EFH under Alternative 2 would be identical to prior permitted actions (NASA 2010, 2013). Fishery species and EFH in the inshore waters of Chincoteague Bay could conceivably be temporarily affected by turbidity and vessel traffic but no other direct or indirect stressors would be imposed by the Proposed Action. Inshore impact is possible but not probable. At minimum, a conservative estimate is that impacts to nearshore fish would be temporary, and impacts to their benthic prey would be several months up to 2 years (see **Section 3.7.2, Benthos**).

3.9.3.3.2 Offshore

The consequences to fishery species and EFH under Alternative 2 would be identical to prior permitted actions (NASA 2010, 2013). Alternative 2 would affect approximately 206 acres of offshore shoal habitat, would have 100 percent mortality for sessile species in the area dredged, and would remove the seafloor habitat. Most motile fish species would be displaced without injury or mortality. But dredging Unnamed Shoal A under Alternative 2 would have greater incidence of injury or mortality to motile demersal species (e.g., flatfish, dogfish, angel shark), including mortality from entrainment into the sand excavation equipment. However, the probability of large-bodied animals being entrained through the dragheads is lower than during prior permitted actions because screening was added since 2014 to minimize potential uptake of Unexploded Ordnance (UXO). The overall magnitude of adverse impacts are expected to be minimal, temporary and localized.

In accordance with NMFS EFH conservation recommendations, NASA would

- target accretion areas of Unnamed Shoal A for dredging to obtain the necessary beach fill material;
- dredge over a large area, leaving undisturbed areas between dredged areas to provide for benthic recruitment and recolonization of impacted areas and avoid creating deep pits;
- follow the existing bathymetry/morphology of shoal to the extent possible;
- limit depth of cut not to exceed 10 feet; and
- confirm by conducting post-dredge survey.

3.9.3.4 Alternative 3

Under Alternative 3, impacts to fishery species and EFH nearshore and onshore would be the same as those described for Alternative 1 or for Alternative 2, with the addition of bottom disturbance for the construction of the breakwaters. The nature and intensity of turbidity and water quality stressors imposed by breakwater construction under Alternative 3 would be different, but not meaningfully increased relative to Alternative 1 and Alternative 2. Other potential stressors imposed under Alternative 3 by the addition of breakwater construction (i.e., artificial lighting, noise, ingestion, entanglement, and chemical

stressors) are not relevant because their nature and magnitude is discountable, stressor and receptor are not co-located, and EFH and managed species have little to no meaningful susceptibilities in this context. Therefore, these other stressors were not carried forward for analysis for Alternative 3.

3.9.3.4.1 Nearshore

Most motile fishery species would be displaced from the entire breakwater footprint under Alternative 3. Displacement would range from temporary to long term, and most consequences would be temporary or short term, as recovery could begin almost immediately after completion of the action. Most motile fish species are attracted to structures, and the breakwater would likely cause localized increases in fish density. Sessile fishery species (e.g., clams) are conservatively assumed to have 100 percent mortality within the breakwater footprint. The footprint of the breakwaters would permanently convert approximately 0.34 acres of sand to hardbottom habitat. Colonization of the new habitat could begin almost immediately after completion of the breakwater construction. However, because the regional coastline has very little hardbottom habitat in the surf zone the concept of recovery is not applicable and colonization of the breakwaters would provide habitat for an essentially novel community of benthos. Potential direct benefits to native fishery species and EFH would be minimal.

In accordance with NMFS EFH conservation recommendations, and based upon the design elements of the breakwater construction, NASA anticipates that natural sand tombola would form that connect the beach with the breakwater structures, thereby, reducing the potential to starve down-drift beaches of sand.

3.9.3.4.2 Offshore

Offshore impacts to fishery species and EFH from Alternative 3 would be identical to either Alternative 1 or Alternative 2, depending on the sand source.

3.10 MARINE MAMMALS

3.10.1 REGULATORY CONTEXT

Marine mammals are protected under the Marine Mammal Protection Act (MMPA) of 1972. The MMPA protects all marine mammals and prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas. The MMPA also prohibits the importation of marine mammals and marine mammal products into the U.S. NMFS maintains jurisdiction of the majority of the marine mammal species found worldwide. The USFWS has jurisdiction for eight marine mammal species that are not regulated by NMFS (i.e., walrus, polar bear, two marine otter species, three manatee species, and the dugong) (USFWS 2018a).

Under the MMPA, NMFS has defined noise-related levels of harassment for marine mammals. The current Level A (injury) threshold is 190 and 180 dB_{RMS} for pinnipeds (e.g., seals) and cetaceans (e.g., whales and dolphins), respectively. The current Level B (disturbance) threshold for underwater impulse noise (e.g., pile driving) for both cetaceans and pinnipeds is 160 dB_{RMS} from a non-continuous noise source. The Level B (disturbance) threshold for continuous noise (e.g., dredging) is 120 dB_{RMS} for both cetaceans and pinnipeds.

3.10.2 AFFECTED ENVIRONMENT

Section 3.2.9 of the *2010 Final SRIPP PEIS* describes in detail the marine mammals that may occur within the project area. This section provides a summary. Federally listed (i.e., ESA) species are discussed in **Section 3.11, Special Status Species** of this EA.

Of the approximately nineteen marine mammal species not listed by ESA that could occur within or adjacent to the project area, the bottlenose dolphin (*Tursiops truncatus*) is the most common, with the potential to occur at any time of year but most commonly encountered during non-winter months. During winter, the species is rarely observed north of the North Carolina-Virginia border. Those individuals encountered would be expected to be the coastal morphotype; the offshore morphotype are primarily found farther offshore.

3.10.3 ENVIRONMENTAL CONSEQUENCES

3.10.3.1 No Action Alternative

Under the No Action Alternative, there would be no project related impacts to marine mammals.

3.10.3.2 Alternative 1

Under Alternative 1, there would be no dredging or offshore construction activities. Therefore, there would be little to no impact to marine mammals, aside from the potential for increased turbidity in the very nearshore environment during the sand placement activities. These impacts would be minor, would occur in relatively shallow water, and would be temporary in nature. No long term impacts to marine mammals would occur under Alternative 1.

3.10.3.3 Alternative 2

Potential adverse impacts to marine mammals would be associated with physical disturbance to habitats during dredging and placement of material which would result in temporary increases in-water turbidity, a reduction in prey availability, vessel strike, and increased noise from vessel activities. However, given the relatively slow speed of the dredge, the limited extent of habitat affected, and with the implementation of mitigation measures described below, effects are expected to be minimal.

During the development of the *2013 Post-Hurricane Sandy EA*, NASA participated in a study (Reine *et al*. 2014) to better characterize dredge noise within its project site. Reine *et al.* (2014) found that in-water noise levels associated with dredging would not reach the 180 and 190 dB_{RMS} Level A thresholds (for cetaceans and pinnipeds, respectively); 160 dB_{RMS} non-continuous Level B would only be reached several yards from the dredge; and 120 dB_{RMS} continuous noise Level B would be reached at between 0.1 and 1.2 miles from the dredge, depending on the specific activity within the dredging cycle.

As with previous projects that involved dredging, NASA would ensure that an NMFS-approved bridge watch is stationed on each dredge at all times of year to scan the horizon for up to 1.2 miles for marine mammals. At this distance, marine mammals could be readily detected with the aid of binoculars. Should an individual be detected, the vessel would be required to turn off its pumps until the animal has left the immediate vicinity, upon which the dredging activity could resume.

In consideration of the above described mitigation measures, it would be highly unlikely that marine mammals within or adjacent to the project area would be subjected to noise levels in excess of those prescribed by the MMPA. Therefore, the Proposed Action would not result in the harassment of any non-listed marine mammals. In 2012, NMFS issued a revised Biological Opinion based on the best available information, and concluded that the effects of dredge noise on listed species of whales are discountable (see **Section 3.11, Special Status Species**).

3.10.3.4 Alternative 3

Under Alternative 3, impacts to marine mammals would be similar to those described under Alternatives 1 or 2, depending on the source of sand for renourishment, with the additional construction of breakwaters at two locations approximately 200 feet offshore, in shallow (4 to 8 feet deep) water. During breakwater construction, barge-mounted heavy equipment would place geotextile mattresses and large stones, per the breakwater design. Due to the shallow water, larger marine mammals would likely not be in the vicinity and therefore, would not be impacted. Bottlenose dolphins may be found at these water depths, but would likely avoid the area due to construction activity and noise. Disturbances to any potential foraging or movement of bottlenose dolphins would be temporary, and there would be no long term impacts to marine mammals under Alternative 3.

3.11 SPECIAL STATUS SPECIES

Special status species include any species which is listed, or proposed for listing, as threatened or endangered by the USFWS or NMFS under the provisions of the ESA; species protected under other federal laws including the Bald and Golden Eagle Protection Act; species that are considered to be threatened or endangered under Virginia's ESA; or those species or habitats of conservation concern identified by the Commonwealth of Virginia. Marine mammals are also protected under federal regulations and are discussed in **Section 3.10, Marine Mammals**.

3.11.1 REGULATORY CONTEXT

Section 7 of the ESA requires federal agencies to evaluate the effects of their actions on listed species and consult with either the USFWS or NMFS if the agency determines that its action "may affect" a listed species or designated critical habitat.

The Virginia ESA (29 VAC 1-563 – 29.1-570) is administered by Virginia Department of Game and Inland Fisheries and prohibits the taking, transportation, processing, sale, or offer for sale of any federally or state-listed threatened or endangered species. As a federal agency, NASA voluntarily complies with Virginia's ESA.

3.11.2 AFFECTED ENVIRONMENT

Section 3.2.10 of the *2010 Final SRIPP PEIS* describes in detail the federally listed species that inhabit the project site. This section provides both a summary and updated information obtained since its publication.

3.11.2.1.1 Onshore

A review of the federal threatened and endangered species list for Accomack County indicates that the species potentially within the project area have not changed from those discussed in the *2010 Final SRIPP PEIS*, with the exception of the addition of the Northern long-eared bat (*Myotis septentrionalis*) (USFWS 2018b). In preparing the *2010 Final SRIPP PEIS*, NASA determined that project activities may affect the threatened seabeach amaranth (*Amaranthus pumilus*), threatened piping plover, threatened red knot, and several species of nesting sea turtles, including loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys kempii*), and Atlantic green (*Chelonia mydas*). Although there is suitable seabeach amaranth habitat present on the Wallops Island beach, recent biological surveys have not identified any of these listed plants (NASA 2016a). While habitat does exist on Wallops Island and within the boundaries of WFF for the Northern long-eared bat, no habitat exists

within the project area. Therefore, seabeach amaranth and the Northern long-eared bat are not discussed further, and this section will focus on piping plovers, red knots, and sea turtles.

The Virginia Department of Game and Inland Fisheries (VDGIF) maintains a listing of endangered, threatened, and species of greatest conservation need. Federal-level listings are mirrored in state-level listings. While no other state-listed plants, reptiles, or mammals have been documented in the project area, two state-listed birds Wilson's plover (*Charadrius wilsonia*) and gull-billed tern (*Sterna nilotica*) are present (VDGIF 2018).

In accordance with its Protected Species Monitoring Program, NASA continues to conduct regular monitoring of the Wallops Island beach between March and September to determine the level of federally-listed bird and sea turtle nesting activity within and adjacent to the project area. In general, the wildlife abundances measured under the monitoring program have stayed about the same since 2010, or have declined (NASA 2016, NASA 2017, NASA 2018).

Piping Plover: Since 2010, NASA has conducted annual piping plover surveys 3 to 4 times weekly between March and September. Six piping plover (*Charadrius melodus*) nests were observed in 2017 with four chicks surviving to fledge, and three nests were observed in 2018 with three chicks surviving to fledge (NASA 2017, NASA 2018).

Red Knot: NASA has observed and recorded red knot (*Caladris canutus rufa*) numbers since 2010. Red knot counts were 415 birds in 2017 and 393 in 2018. Since 2010 the high was over 3,000 birds in 2012 and the low was less than 100 birds in 2014 (NASA 2017, NASA 2018).

Sea Turtles: While NASA has observed loggerhead sea turtles and sea turtle nesting activity in the past, numbers are low and some years have no observations of sea turtle nesting. Between 2010 and 2013 NASA observed a total of 8 nests and 5 false crawls on Wallops Island beach. DNA analysis determined that all 4 nests in 2010 were dug by a single female loggerhead sea turtle (NASA 2010b; USFWS 2016). No sea turtle nesting activity was observed in 2014, 2015, 2016, 2017, and 2018 (NASA 2017, NASA 2018).

Gull-billed Terns and Wilson's Plovers: Since 2010, no nesting activity has been observed on Wallops Island for either gull-billed terns or Wilson's plovers.

3.11.2.1.2 Offshore

In preparing the *2010 Final SRIPP PEIS*, NASA determined that project activities have the potential to affect in-water sea turtles (species listed above under **Section 3.11.2.1.1 Onshore**) and several whale species, including right whale (*Eubalaena glacialis*), fin whale (*Balaenoptera physalus*), sperm whale (*Physeter macrocephalus*), sei whale (*Balaenoptera borealis*), and blue whale (*Balaenoptera musculus*). Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) was added into the Supplemental Biological Assessment (NASA 2011b), Biological Opinion (NMFS 2012), and the *2013 Post-Hurricane Sandy EA* (incorporated by reference into this section). The NMFS issued a revised 2012 Biological Opinion based on the best available information, and concluded that the effects of dredge noise on listed species of whales are discountable. Protected species monitoring conducted by observers onboard the three dredges during the post-Sandy beach fill cycle reported no in-water sightings of listed species.

The giant manta ray (*Manta birostris*) was listed as threatened in January of 2018. It is found worldwide in tropical, subtropical, and temperate oceanic waters and near productive coastlines. It is sometimes

found in waters as cool at 66° F and one individual was recently observed just offshore of Assateague Island (Swann 2018). Though not observed inside Chincoteague Inlet, the giant manta ray has been observed in other estuarine waters near oceanic inlets (NOAA 2018).

The VDGIF maintains a listing of endangered, threatened, and species of greatest conservation need, including marine animals. Federal-level listings are mirrored in state-level listings, and there are no other state-level listed marine plants or animals known from the proposed project area (VDGIF 2018).

3.11.3 ENVIRONMENTAL CONSEQUENCES

3.11.3.1 No Action Alternative

Under the No Action Alternative, there would be no project related impacts to any special status species onshore or offshore at Wallops Island.

3.11.3.2 Alternative 1

The north Wallops Island beach borrow area under Alternative 1 is within the historical nesting areas utilized by piping plover and loggerhead sea turtles.

Avifauna: Impacts on piping plover and red knot would be generally the same as those discussed for non-listed avian species in **Section 3.8, Wildlife** of this EA. In summary, these effects would include the potential for startle or disruption of foraging, reduction in prey availability, and for plovers, the potential for disruption of courtship and nesting activities.

In a letter dated December 14, 2018, to the USFWS Virginia Field office, NASA submitted its determinations of impacts from the proposed action to threatened and endangered species. The USFWS issued a Biological Opinion on June 7, 2019, and concur with NASA's determinations that the SERP is not likely to adversely affect the northern long-eared bat, roseate tern, hawksbill sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, green sea turtle, and seabeach amaranth. The Biological Opinion included an Incidental Take Statement for red knot, piping plover, and loggerhead sea turtle, anticipating the incidental take of 17 plovers during the beach backpassing and renourishment activities and 12 individuals in the subsequent two years as habitat improves. The USFWS anticipates incidental take of 180 red knots in the first year of activities and 90 in each of the 2 years following beach renourishment, as a result of disturbance from heavy equipment and decreased habitat suitability for foraging during spring migration. As such, the Biological Opinion requires the following measures to minimize impacts to these species.

- Sand excavation on north Wallops Island will not begin until after the last plover chick has fledged or the last loggerhead has hatched, whichever is later.
- Preparation and distribution of a fact sheet containing this information to all project personnel.
- Minimization of foot traffic during construction.
- Inspection of all vehicles for leaks immediately prior to work in beach habitat.
- Notification to the USFWS regarding the projected and actual start dates, progress, and completion of the project and verify that the 5.4 miles of beach habitat alteration was not exceeded and all conservation measures were followed.

- Submission of an annual report summarizing the survey and monitoring efforts, location and status of all occurrences of listed species recorded, and any additional relevant information to the USFWS by December 31 of each year.

The VMRC permit for this project prescribes a number of terms and conditions that also aim to reduce impacts to special status species as detailed in the conditions listed below.

- Activities shall not begin until the last piping plover or American oystercatcher chicks have fledged or the last sea turtle nest has hatched or been deemed nonviable by VDGIF staff, whichever is later.
- Every effort shall be made to complete activities by March 15 of any year. If work must continue past the March 15, deadline, daily monitoring for red knot migrants and nesting piping plovers and American oystercatchers shall begin on March 15 and continue until the last chicks of either species fledges. Daily sea turtle nest patrols shall begin on May 1, and continue until the last nest hatches or is deemed nonviable by VDGIF staff.
- If a piping plover or sea turtle nest is found before sand mining and renourishment activities are completed, all activities must cease until the WFF staff has notified the USFWS and VDGIF and VDGIF has completed an on-site determination about whether or not construction activities may continue.
- If an American oystercatcher nest is found before sand mining and renourishment activities are completed, all activities must cease until the VDGIF staff has completed an on-site determination about whether or not construction activities may continue.
- Predator screens will be placed over sea turtle nests and predator exclosures shall be erected around all piping plover nests.
- Equipment and materials shall be staged in upland areas westward of the beach and outside of sensitive habitats (e.g., marshes, mudflats, dunes).

If a piping plover or sea turtle nest is found before sand mining and renourishment activities are complete, VMRC has committed to arriving on site to evaluate nests within an average of 24 hours (maximum of 48 hours) after receiving a report of a nest.

Herpetofauna: Impacts to nesting sea turtles could include interference with nesting attempts during nighttime construction activity (particularly artificial lighting) on the beach, unintentional burial of a newly dug nest if it were to go undetected, disorientation of hatchlings (due to project related light sources), or obstruction to hatchlings during their emergence and subsequent trip to the ocean.

It is unlikely that that the replenished beach would prove unsuitable to nesting turtles because the beach fill material is not substantially different from nearby native beaches. Moreover, as evidenced by the sea turtle nesting that occurred on the Wallops Island beach during the initial beach fill cycle, it is possible that the additional elevated beach would provide suitable nesting habitat, a net benefit to the species. The USFWS Biological Opinion anticipates the incidental take of 1 adult loggerhead sea turtle and 1 loggerhead nest (1 nest equaling 128 hatchling turtles) to result from beach renourishment that may bury nests or place sand of a grain size that does not support loggerhead nesting attempts.

Atlantic Sturgeon and Giant Manta Ray: Under Alternative 1, no impacts to Atlantic sturgeon or giant manta ray are anticipated, as no in-water work would occur. Impacts would be limited to temporary increased turbidity in the nearshore environment as sand placement occurs.

Cetaceans: Under Alternative 1, no impacts to cetaceans are anticipated, as no in-water work would occur. Impacts would be limited to temporary increased turbidity in the nearshore environment as sand placement occurs.

3.11.3.3 Alternative 2

Avifauna: Impacts to avifauna from renourishment activities under Alternative 2 would be similar to those described under Alternative 1. No impacts are plausible to piping plover or red knot from the dredge operating at Unnamed Shoal A.

Herpetofauna: Impacts to sea turtles under Alternative 2 would be similar to those described for Alternative 1, with the addition of impacts from the dredge operating at Unnamed Shoal A. Impacts on in-water sea turtles could include entrainment in the dredge, interaction with the sediment plume, reduction in available forage, direct strike, and disturbance due to vessel created noise. However, the probability of interaction is very low because turtle numbers in the area are low. Nesting females number few to zero, and there were zero observations of sea turtles by protected species observers onboard each of the three dredges during the two prior fill cycles. Additionally, the probability of large-bodied animals being entrained through the dragheads is lower than during prior permitted actions because of turtle deflectors on the dragheads, implementation of NMFS BO Terms and Conditions (NMFS 2012 and **Section 3.11.3.5, Section 7 Consultations**), and screening to minimize potential uptake of UXO. The NMFS anticipates incidental take of 1 adult sea turtle for every 1.6 million cubic yards of offshore dredging as a result of entrainment – in addition to the USFWS anticipated incidental take on land.

Atlantic Sturgeon: Impacts to the Atlantic sturgeon would be similar to those of in-water sea turtles and could include entrainment in the dredge, interaction with the sediment plume, reduction in available forage, direct strike, and disturbance due to vessel created noise. However, given the limited number of sturgeon expected to use the borrow area as habitat and the limited portion of available habitat that would be affected, the potential for interaction is limited. Similar to in-water sea turtles, this conclusion is supported by the recently completed initial beach fill cycle. Endangered species observers stationed onboard each of the three dredges did not observe an Atlantic sturgeon. NMFS anticipates incidental take of 1 Atlantic sturgeon for every 9.4 million cubic yards of offshore dredging as a result of entrainment.

Giant Manta Ray: Impacts to the giant manta rays would be similar to those of Atlantic sturgeon with the exception of entrainment in the dredge. Considering the behavior and distribution of giant manta rays relative to the operating parameters of hopper dredges, it is not anticipated that dredging entrainment poses a risk. Additionally, the probability of large-bodied animals being entrained through the dragheads is lower than during prior permitted actions because of turtle deflectors on the dragheads and screening to minimize potential uptake of UXO. Giant manta rays were not federally listed during the previous dredging event so protected species observers did not search for them.

Cetaceans: Impacts to cetaceans under Alternative 2 may include reduction in available forage, direct strike, and disturbance due to vessel created noise. According to the July 22, 2010, NMFS Biological Opinion, the potential of marine mammal strikes would be mitigated by operating the dredges at low speeds. Dredge speeds are anticipated to be approximately 3 knots while dredging and 10 knots while

transiting between the borrow site and the nearshore pump-out buoy. Therefore, there would be a low risk of vessel strike. NMFS issued a revised 2012 Biological Opinion based on the best available information, and concluded that the effects of dredge noise on listed species of whales are discountable because it is extremely unlikely for listed whales to be within 1 kilometer (km; 0.6 miles) of the dredge. In addition, NASA would ensure that the dredge contractor followed the updated mitigation measures summarized in the NMFS BO (summarized in **Section 3.11.3.5, Section 7 Consultations**) including protected species observers and all dredge pumps turned off upon a whale observation within 1 km of the dredge.

3.11.3.4 Alternative 3

Avifauna: Impacts to avifauna under Alternative 3 would be similar to those described under Alternative 1 or 2 depending upon the sand source, with the addition of disturbance caused by breakwater construction. The breakwaters are planned to be constructed well south of the historical areas used by piping plover and red knots, and would be constructed approximately 200 feet offshore of the renourished shoreline. It is unlikely that any long term impacts would occur from breakwater construction to listed bird species.

Herpetofauna: Impacts to sea turtles from Alternative 3 would be similar to those described under Alternative 1 or 2 depending upon the sand source, with the addition of disturbance caused by breakwater construction. The construction of breakwaters could potentially cause disturbance and area avoidance by sea turtles, depending on the time of year construction was initiated. Additionally, if work continued throughout the night, lighting could cause confusion for swimming sea turtle hatchlings. Although breakwaters have been shown to impact the ingress and egress of nesting sea turtles and hatchlings, it is unlikely that six breakwaters with a total length of 780 feet (4 percent of the 19,000 foot replenishment project) would provide a significant impediment to sea turtle ingress and egress of the beach.

Atlantic Sturgeon and Giant Manta Ray: Impacts to Atlantic Sturgeon and Giant Manta Ray would be similar to those described under Alternative 1 or 2 depending upon the sand source, with the addition of potential disturbance during breakwater construction. These species are highly mobile and would likely avoid the breakwater construction area during construction activities. Long term impacts due to breakwater construction would be unlikely.

Cetaceans: Impacts to cetaceans under Alternative 3 would be the same as those under Alternative 1 or 2 depending upon the sand source, with the addition of the disturbance during breakwater construction. During breakwater construction, barge-mounted heavy equipment would place large stone, per breakwater design in approximately 8 feet of water. It is extremely unlikely that larger marine mammals would be in water this shallow and potential for impact is discountable.

3.11.3.5 Section 7 Consultations

On March 20, 2013, USFWS responded that the impacts resulting from the beach renourishment proposed by the *2013 Post-Hurricane Sandy EA* would be within that already considered in its July 30, 2010 programmatic Biological Opinion (BO). USFWS also submitted a newer consolidated BO in June 2016 to replace and consolidate opinions and terms for ongoing operations at WFF that included a 2-7 year cycle for beach renourishment (USFWS 2016).

On March 21, 2013, NMFS determined that the action proposed in the *2013 Post-Hurricane Sandy EA* were not significantly differ from the actions considered in the 2012 NMFS Biological Opinion and did not warrant re-initiation. On September 26, 2014, following discovery of UXO in a hopper intake basket, NMFS concurred with NASA's determination that installation of UXO screens would prevent onboard

observers from monitoring intake baskets after each load, thereby focusing observer efforts on inspecting the dragheads versus the baskets for the presence of entrained or impinged protected species remains.

In developing the BOs, NMFS and USFWS provided mandatory terms and conditions that NASA must follow to reduce potential effects to listed species. As such, NASA and USACE would ensure that their contractors implemented these measures on their behalf. These measures include all specifications in Incidental Take Statements, Terms and Conditions, Reasonable and Prudent Measures, and other mitigation measures stipulated in each BO for dredging, backpassing, and renourishment.

NASA re-initiated informal consultation with NMFS and USFWS in 2018. On November 20, 2018, NMFS responded to NASA's submittal of additional effects analysis, that based on the effect analysis from the previous consultations, the information provided regarding changes to the project description, and the fact that no new listed species or designated critical habitat overlap with the action area, impacts from the proposed actions in this SERP EA do not warrant re-initiation of consultation. NASA reinitiated consultation with the USFWS on September 27, 2018, and subsequently on December 14, 2018, provided background supporting information. The December correspondence summarized NASA's conclusion that impacts associated with the project would be substantially the same as those considered in the 2010 and 2016 BOs: that is these proposed activities *may affect, are likely to adversely* affect piping plovers, red knots, and loggerhead sea turtles; proposed observation of time of year restrictions to minimize impacts to listed species; and requested USFWS concurrence with the determination. On June 7, 2019, the USFWS issued a consolidated Biological Opinion which included concurrence with NASA's determinations of effect for northern long-eared bat, roseate tern, hawksbill sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, green sea turtle, and sea beach amaranth. The Biological Opinion included incidental take statement for piping plover, red knot, and loggerhead sea turtle and included several terms and conditions required to minimize impacts (refer to Section 3.11.3.2 above). Correspondence related to special status species consultation for this EA are included as **Appendix G**.

3.12 CULTURAL RESOURCES

Cultural resources are defined as prehistoric or historic sites, buildings, structures, objects, or other physical evidence of human activity that are considered important to a culture or community for scientific, traditional, or religious reasons.

3.12.1 REGULATORY CONTEXT

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and as implemented by 36 CFR Part 800, requires federal agencies to consider the effects of their actions on historic properties before undertaking a project. A historic property is defined as any cultural resource that is included in, or eligible for inclusion in, the National Register of Historic Places (NRHP). The NRHP, administered by the National Park Service (NPS), is the official inventory of cultural resources that are significant in American history, prehistory, architecture, archaeology, engineering, and culture. The NRHP also includes National Historic Landmarks. In consideration of 36 CFR 800, federal agencies are required to initiate consultation with the State Historic Preservation Office (SHPO) informing them of the planned action and requesting their comments or concerns.

In accordance with Sections 106 and 110 of the NHPA, NASA developed a Programmatic Agreement with the Virginia SHPO and Advisory Council on Historic Preservation to outline how WFF manages its cultural resources as an integral part of its operations and missions (NASA 2014, 2016c). As part of this

process, NASA identified a number of parties who have an interest in, or knowledge of, cultural resources at WFF and included them in the development of the terms of the Programmatic Agreement.

3.12.2 AFFECTED ENVIRONMENT

3.12.2.1 Aboveground Resources

Section 3.3.7 of the 2010 *Final SRIPP PEIS* describes in detail the effects on cultural resources that may occur within or adjacent to the project site. One NRHP-eligible resource has been identified at WFF: the Wallops Beach Life Saving Station (DHR ID #001-0027-0100; WFF #V-065) and the associated Coast Guard Observation Tower (DHR ID #001-0027-0101; WFF #V-070). The resources were surveyed in the 2004 *Historic Resources Survey and Eligibility Report* (NASA 2015). The survey determined the Wallops Beach Life Saving Station (DHR ID #001-0027-0100; WFF #V-065) to be eligible for listing in the NRHP under both Criterion A and Criterion C for its association with the Coast Guard and for architectural significance for exemplifying the Colonial Revival Style. The Coast Guard Observation Tower (DHR ID #001-0027-0101; WFF #V-070) was not considered eligible individually but as a contributing structure to the Life Saving Station.

WFF considered various options for the Wallops Beach Life Saving Station and Coast Guard Observation Tower disposition including their removal from WFF and transfer from Federal ownership or demolition or deconstruction. In accordance with the mitigation terms of the Programmatic Agreement, WFF prepared a Historic American Building Survey (HABS)/Historic American Engineer Record (HAER) recordation of the Station and Observation Tower and short documentary video of their history (VDHR 2016a). VDHR accepted the HABS/HAER recordation and documentary and concurred with the disposition proposals (VDHR 2016b). Currently, NASA and the General Services Administration are considering moving and transferring the building to a private buyer (Miller personal communication 2018).

NASA has prepared two architectural resource surveys at WFF since the *2010 Final SRIPP PEIS.* In 2011, a Section 110 architectural survey identified and evaluated buildings and structures built between 1956 and 1965. Out of the total 76 buildings and structures that were identified, 34 are located on Wallops Island. None were recommended eligible for listing in the NRHP. The VDHR concurred with these findings in 2011 (NASA 2015).

In 2018, a reconnaissance-level architectural survey of buildings and structures built between 1965 and 1981 and one resource constructed in 1963 was conducted. The survey identified and evaluated 52 resources, 16 of which are located on Wallops Island, and concluded that none of the resources were eligible for listing in the NRHP (NASA 2018b). The VDHR concurred with these findings in August 2018 (VDHR 2018).

3.12.2.2 Archaeological Resources

The Area of Potential Effects (APE) for archaeology is defined as the area where ground disturbing activities would take place. For the SERP EA, this includes areas of beach renourishment, sand dredging, and construction of offshore breakwaters.

Two archaeological surveys were completed to investigate the APE for the *2010 Final SRIPP PEIS.* In 2009, an investigation of the proposed groin, breakwater, and shoreline that would be impacted by the SRIPP project was completed. This investigation included pedestrian survey of the Wallops Island shoreline, archaeological monitoring of the installation of geotextile tubes along the shoreline, a diving

survey of the proposed groin location, and a remote sensing survey of the proposed breakwater area. The investigation did not identify any archaeological resources in the areas and no additional work was recommended (Randolph et *al*. 2009).

The second investigation for the Final SRIPP EIS was conducted in 2010. This survey investigated the proposed offshore sand borrow areas using underwater remote sensing. No underwater archaeological resources were identified during the survey and no additional work was recommended for the borrow area (Randolph *et al.* 2010).

No previously identified archaeological sites are located in the APE for the project. Three previously identified archaeological sites are located on Wallops Island in the vicinity of the APE. The Military Earthworks site (44AC0089) is a Revolutionary War gun emplacement located at the northern end of Wallops Island. The site was subjected to additional investigations and recommended eligible for listing on the NRHP. Site 44AC0159 is an unnamed site located at the southern end of Wallops Island. The site is described as a shell pile or shell midden and has been determined not eligible for listing on the NRHP. Site 44AC0459 is a trash scatter associated with the Coast Guard Life Saving Station and Observation Tower. This site was also determined not eligible for the NRHP (NASA 2015).

3.12.3 ENVIRONMENTAL CONSEQUENCES

3.12.3.1 No Action Alternative

Under the No Action Alternative, the proposed renourishment of the beach and breakwater construction would not occur. Therefore, cultural resources would not be impacted.

3.12.3.2 Alternative 1

North Wallops Island has been previously surveyed for cultural resources. Only the Wallops Beach Life Saving Station (DHR ID #001-0027-0100; WFF #V-065) and the Coast Guard Observation Tower (DHR ID #001-0027-0101) are considered eligible for listing in the NRHP. Potential effects are likely to be minimal since the resources are located approximately 3,000 feet north of the APE. If sand from north Wallops Island beach were used for the renourishment of the shoreline, the potential effects are likely to be visual effects occurring during the harvesting phase. The visual effects would be short term and would not affect the integrity of the resource. Construction may create noise, but that would be minimal.

Previous surveys of the APE for archaeological resources did not identify any archaeological resources; therefore, the proposed project would have no effect on NRHP-eligible archaeological sites. The inadvertent discovery of any previously unidentified archaeological resources would result in immediate cessation of work and notification of the WFF Cultural Resources Manager, who would contact the VDHR and Native American Tribes as appropriate.

3.12.3.3 Alternative 2

Previous surveys of Unnamed Shoal A and the pumpout buoy area did not identify any archaeological resources; therefore, the proposed project would have no effect on NRHP-eligible archaeological sites.

3.12.3.4 Alternative 3

Potential impact to cultural resources from beach renourishment would be the same as those described for Alternative 1 and 2, depending on the sand source. Additionally, prior surveys were conducted of the pumpout buoy area utilized during offshore dredging. Breakwaters would be constructed within the

pumpout buoy APE. As these surveys did not identify any archaeological resources, breakwater construction would have no effect on NRHP-eligible archaeological sites.

3.12.3.5 Section 106 Consultations

While preparing the *2010 Final SRIPP PEIS*, NASA consulted with the VDHR on the potential effects of the Proposed Action on historic properties. VDHR concurred with NASA's determination that the Proposed Action would have no adverse effect on historic properties. NASA requested comments from VDHR regarding potential impacts to historic resources by the proposed Shoreline Enhancement and Restoration Project prior to preparation of this EA. On August 14, 2018, the VDHR issued a finding of No Historic Properties Affected (VDHR 2018). Correspondence between NASA and the VDHR is included in **Appendix H** of this EA.

Three Native American Tribes were consulted during the scoping period for this EA, including the Pamunkey Indian Tribe, the Pocomoke Indian Nation, and the Catawba Indian Nation. The contact information for the tribes is listed in Chapter 6. The Pamunkey Indian Tribe became a federally recognized tribe in 2016. During scoping for this EA, the tribe requested to be notified in the event of the inadvertent discovery of archaeological resources (Gray 2018). The Thomasina E. Jordan Indian Tribes of Virginia Federal Recognition Act of 2017 (U.S. Public Law 115-121) federally recognized the Chickahominy Indian Tribe, the Chickahominy Indian Tribe – Eastern Division, the Upper Mattaponi Tribe, the Rappahannock Tribe, Inc., the Monacan Indian Nation, and the Nansemond Indian Tribe as Native American tribes in January 2018. These tribes will be notified of the public draft of the EA.

3.13 RECREATION RESOURCES

Recreation resources include primarily outdoor recreational activities that occur away from a participant's residence. This includes natural resources and built facilities that are designated or available for public recreational use. The setting, activity, and other resources that influence recreation are also considered.

3.13.1 AFFECTED ENVIRONMENT

There is one main area on Wallops Island designated for recreational use by permanently badged WFF employees, tenants, contractors, and their guests: a beach area north of the seawall and south of the beach cable barrier. In 2017, launch of non-motorized watercraft from U-070 and the North Island dock areas, and fishing and shell-fishing at the edge of these wetland areas was authorized. These areas are open after operational hours to permanently badged WFF employees and their guests unless temporarily restricted for mission/launch hazards. The northern portion of this recreational area is closed annually from March through August during piping plover and sea turtle nesting season. A second area designated for recreational use, the marsh under the Wallops Island Bridge that runs along the Virginia Inside Passage of the Intracoastal Waterway, is open year round; however, it may only be accessed via boat.

Virginia's Eastern Shore is a popular tourist destination. Many tourists and vacationers visit Accomack County throughout the late spring, summer, and early fall. Regional attractions include the Assateague Island National Seashore and CNWR. The Wallops Island National Wildlife Refuge is located south of the WFF Visitor Center and is under the jurisdiction of the USFWS. This refuge is not open to the general public. South of Wallops Island is Assawoman Island, a 1,420 acre parcel managed as part of the CNWR by the USFWS. The remainder of the CNWR lies mostly east and north of Wallops Island on Chincoteague Island. A string of undeveloped barrier islands, managed by The Nature Conservancy as part of the Virginia Coast Reserve, extends south down the coast to the mouth of the Chesapeake Bay.

Winter hunting season draws people to hunt local game including dove, quail, deer, and many types of geese and ducks. The Wallops Island shoreline is also a popular location for local fishermen who surf fish or fish from boats in the nearshore environment. Recreational boaters and divers utilize the marine waters offshore. Annually, ongoing operations at the WFF, including rocket launches and testing, result in issuance of Notices to Mariners for approximately 128 events totaling 467 hours (Miller personal communication 2018).

3.13.2 ENVIRONMENTAL CONSEQUENCES

3.13.2.1 No Action Alternative

If the Proposed Action were not implemented, no change to existing recreational opportunities would occur. The north Wallops Island beach would continue to be used by employees for recreation, subject to seasonal restrictions.

3.13.2.2 Alternative 1

If sand from the north Wallops Island beach were used for the renourishment of the shoreline infrastructure protection area, sand would be excavated to the mean low water line. The area would be closed during the excavation and transport phases of the project and a portion of the beach used by employees for recreation would be removed, potentially limiting recreation opportunities in the short term. However, this area is expected to continue to accrete as a result of the littoral transport of sand from the renourished beach as well as from Assateague Island and to fully recover within 5 to 6 years.

3.13.2.3 Alternative 2

Using sand from Unnamed Shoal A to renourish the shoreline infrastructure protection area would not affect recreational opportunities on land, however recreational boating in the immediate area would be limited during the excavation of material from the shoal and transporting sediment from the borrow area to the discharge site would result in an increase in boat and barge traffic. However, as stated in the *2010 Final SRIPP PEIS*, a Notice to Mariners would be issued, when necessary, to notify boaters in advance so that they can select alternate routes without substantially affecting their activities or experience.

3.13.2.4 Alternative 3

Alternative 3 would involve renourishing the shoreline infrastructure protection area using sand from the north Wallops Island beach or Unnamed Shoal A and the resulting impacts would be the same as those described for Alternatives 1 and 2. Additionally, a series of offshore breakwaters would be constructed resulting in boat and barge traffic for the duration of construction. Impacts are expected to be similar to those described for Alternative 2 though the construction would occur nearshore in relatively shallow water, unlikely to affect recreational fishing or boating. Breakwater construction would be outside the Wallops Island beach and would not impact recreational users.

4.0 CUMULATIVE EFFECTS

The cumulative effects analysis (CEA) is important to understanding how multiple actions that occur in a particular time and area affect the environment. The CEQ regulations (40 CFR § 1508.7) define cumulative impacts as:

> *"…the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions."*

Whereas the individual impacts of one project in a particular area or region may not be considered significant, numerous projects in the same area or region may cumulatively result in significant impacts. Cumulative effects are most likely to arise when a relationship exists between a Proposed Action and other actions occurring in a similar location or during a similar time period. Actions overlapping with or in proximity to the Proposed Action would be expected to have more potential for a relationship than those more geographically separated. Similarly, actions that coincide in time, even partially, have the potential for cumulative effects.

4.1 SCOPE OF CUMULATIVE EFFECTS ANALYSIS

Establishing an appropriate scope for cumulative effects analysis is vital to producing a meaningful analysis that appropriately informs agency decision-making. This involves properly delineating geographic and temporal boundaries within which to identify other activities that could contribute to cumulative impacts to resources; and providing an appropriate level of detail of those activities so their contribution to cumulative impacts is clear.

CEQ guidance advises that geographic boundaries for cumulative effects analysis should incorporate ecologically relevant boundaries, depending on the resource in question (CEQ 1997). EPA notes that geographic boundaries should not be extended to the point that the analysis "becomes unwieldy and useless for decision-making" and advises that the proper spatial scope of the analysis include the geographic areas that sustain the resources of concern (EPA 1999). On establishing an appropriate temporal scope, EPA advises estimating the length of time the effects of the Proposed Action would last (EPA 1999). Considering this, the focus of this CEA includes the projects and activities that affect Wallops Island (particularly the shoreline) that have occurred or are anticipated to occur in the next 5 years, at which time impacts are anticipated to have diminished to allow for a recovery state of analyzed resources.

CEQ (2005) provides guidance on the level of effort and detail that is appropriate in CEA:

> "*The scope of the cumulative impact analysis is related to the magnitude of the environmental impacts of the proposed action. Proposed actions of limited scope typically do not require as comprehensive an assessment of cumulative impacts as proposed actions that have significant environmental impacts over a large area. Proposed actions that are typically finalized with a Finding of No Significant Impact usually involve only a limited cumulative impact assessment to confirm that the effects of the proposed action do not reach a point of significant environmental impacts."*

Following this guidance, this CEA focuses only on those resources evaluated in Chapter 3 of this document that are expected to be measurably affected by the Proposed Action (see **Table 4.1-1**).

Table 4.1-1. Resources Considered in Cumulative Effects Analysis	
Resource	**Considered in Cumulative Effects Analysis?**
Coastal Geology and Processes	No, negligible impacts identified in this EA
Water Quality	No, negligible impacts identified in this EA
Coastal Zone Management	No, negligible impacts identified in this EA
Air Quality	No, negligible impacts identified in this EA
Noise	No, negligible impacts identified in this EA
Benthos	Section 4.3.1
Wildlife	Section 4.3.2
Fisheries and Essential Fish Habitat	Section 4.3.3
Marine Mammals	No, negligible impacts identified in this EA
Special Status Species	Section 4.3.4
Cultural Resources	No, negligible impacts identified in this EA
Recreation Resources	No, negligible impacts identified in this EA

4.2 PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS

The sections below provide a summary of the actions considered in this CEA. Section 4.7 of the *2010 Final SRIPP PEIS* provides a detailed CEA for all potentially affected resource areas throughout the 50-year design life of the shoreline restoration program, including effects of past actions dating to federal settlement of Wallops Island in the early 1940s. Section 3.4 of the *2013 Final Post-Hurricane Sandy EA* documents activities that occurred or were planned to occur after the publication of the *2010 Final SRIPP PEIS*. Both of these documents are incorporated by reference here. NASA is currently preparing a twenty-year planning horizon "master plan" PEIS, and accordingly it considered the relevance of those actions to this CEA. The launch activities detailed in that PEIS may overlap in location and time with the Proposed Action.

4.2.1 ONGOING OPERATIONS

A number of past and ongoing activities are detailed in the *2010 Final SRIPP PEIS, 2013 Final Post-Hurricane Sandy EA* including launch range operations for launches of suborbital and orbital rocket missions as well as targets and projectiles; operations of Mid-Atlantic Regional Spaceport Unmanned Aerial Systems airstrip and Payload Processing Facility, both on the north end of Wallops Island; Protective Service Division security patrolling; and protected species monitoring. NASA's *2018 Draft Site-wide PEIS* included these continuing actions and foreseeable future actions including replacement of the causeway bridge, maintenance dredging, and a north Wallops Island deep water port operations area.

4.2.2 WALLOPS ISLAND SHORELINE STABILIZATION ACTIVITIES

The *2010 Final SRIPP PEIS* evaluated extending the existing rock seawall on Wallops Island by up to 4,600 feet south of its southernmost point and renourishing 3.7 miles of shoreline with sand dredged from an OCS sand shoal. An initial seawall extension of approximately 1,430 feet was implemented between August 2011 and March 2012 and further seawall extension may be completed in the future as funding becomes available. In addition, between April and August 2012, approximately 3,200,000 cubic yards of fill was placed along the Wallops Island shoreline (from approximately 1,500 feet north of the Wallops Island-Assawoman Island property boundary and extending north to the terminus of the existing rock seawall), creating an approximately 100 foot wide beach and dune (NASA 2016b).

The *2013 Final Post-Hurricane Sandy EA* evaluated the impacts of repairing damage to the rock seawall and renourishing the recently filled beach. Between July and September 2014, approximately 667,000

cubic yards of material was dredged from the same location as the initial beach fill and placed along the southern 13,000 feet of Wallops Island (NASA 2016b). With the exception of a shortened period between initial fill and the first renourishment, the proposed project was essentially the same as that described in the *2010 Final SRIPP PEIS*, which estimated that up to 806,000 cubic yards of material would be needed every three to seven years.

The *2010 Final SRIPP PEIS* examines the potential impacts of the project's 50-year design life, which includes beach renourishment occurring every three to seven years. Accordingly, over the next 5 years, an additional beach renourishment may occur. Sand for this renourishment could be sourced from offshore shoals or from the north Wallops Island beach.

4.2.3 FEDERAL NAVIGATION PROJECTS

On a periodic basis, the USACE dredges the Chincoteague Inlet, just north of Wallops Island to maintain channel depth, typically removing 80,000 to 100,000 cubic yards of material from the channel and placing it in the Atlantic Ocean east of Wallops Island. The Inlet has not required dredging in recent years and was most recently dredged in September – October 2018 (see **Table 3.2-1**). Additionally, USACE occasionally dredges the navigation channel in Bogues Bay, just west of Wallops Island.

4.2.4 RECREATIONAL AND MOTORIZED VEHICLE USE OF WALLOPS ISLAND BEACH

The WFF Protective Services Division performs daily vehicle patrols of the Wallops Island beach according to a defined protocol. Patrols use the same points of access and operate within the intertidal zone, except under emergency conditions. A portion of the north Wallops Island beach is open to WFF employees for recreational use, subject to seasonal restrictions protective of nesting piping plovers and sea turtles. All areas south of the northern terminus of the rock seawall are closed to recreation year round in accordance with launch range safety regulations.

4.2.5 PEST AND PREDATOR MANAGEMENT

The U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS) Division of Wildlife Services personnel perform regular predator removal on Wallops Island to control the depredation of eggs or young of beach nesting turtles and shorebirds (NASA 2013). Efforts focus primarily on the management of raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), red fox (*Vulpes vulpes*), laughing gull (*Larus atricilla*), herring gull (*Larus argentatus*), great black-backed gull (*Larus marinas*), fish crow (*Corvus ossifragus*), American crow (*Corvus brachyrhynchos*), and common grackle (*Quiscalus quiscula*). Activities are conducted year round as needed but are concentrated in the winter, spring, and early summer months to coincide with predator dispersal and with breeding and nesting.

4.2.6 PROTECTED SPECIES MONITORING

In accordance with the USFWS 2016 Biological Opinion, WFF administers a Protected Species Monitoring Plan, which establishes procedures for monitoring a number of protected species that are likely to occur at Wallops Island including: seabeach amaranth, red knot, piping plover, Wilson's plover, gull-billed terns, American oystercatcher, and sea turtles (NASA 2016a). Annually between March and September, NASA regularly performs 3 to 4 surveys per week of Wallops Island beach for these species as a component of its Natural Resources Management Program. Any nests discovered are identified with signage and predator exclosures. Program staff provide outreach to beach users, including security staff and recreational users (NASA 2013).

4.2.7 VESSEL TRAFFIC

Commercial, recreational, and military maritime traffic all use the area off the coast of Virginia, one of the busiest areas in the world for maritime traffic. Traffic Separation Schemes (TSS), defined in 33 CFR Part 167 – *Offshore Traffic Separation Schemes*, are used to regulate ship traffic at busy confined areas by routing and separating opposing ship traffic. One-way ship traffic lanes that are marked by buoys. The nearest TSS lanes to WFF are the southernmost approaches to the Delaware Bay, which are approximately 50 nautical miles (nm) north of Wallops Island, and the northernmost lanes of the Chesapeake Bay approach, which are approximately 55 nm south of Wallops Island.

4.2.8 U.S. NAVY ATLANTIC FLEET TESTING AND TRAINING ACTIVITIES

The Navy conducts ongoing military readiness training and research, development, testing, and evaluation activities within the Atlantic Fleet Testing and Training (AFTT) area, which includes the Virginia Capes Operations Area located off Virginia and North Carolina (U.S. Navy 2017).

4.2.9 CLIMATE CHANGE AND RESILIENCY

The Eastern Shore lies within one of the U.S's most vulnerable coastal regions. Coastal Virginia is especially susceptible to the impacts of climate change, primarily resulting from sea level rise and increased storm intensity. Sea levels are rising at three to four times the global average and storms are intensifying. Sea-level rise rates on Virginia's Eastern Shore show a MSL rise of between 4.5 to 7 feet by 2100. On the Eastern Shore, tens of millions of dollars have been spent on traditional "gray" infrastructure approaches, such as sea walls, groins, jetties, bulkheads and revetments, as defenses against mounting coastal hazards. Often, the gray infrastructure has only exacerbated the area's vulnerability and undermined the region's abundant natural resilience by interrupting critical environmental processes.

Currently, 12 % of Chincoteague Island, which is close proximity to Wallops Island, experiences chronic inundation, or tidal flooding. Under a low impact forecast scenario, the percentage of land in this locality experiencing chronic inundation will increase to 74% by 2100. Under the intermediate impact forecast scenario, 34% of the land area will reach this level of flooding by 2035, with 85% by 2100. In the high impact scenario, Chincoteague Island is virtually completely inundated by 2100 (UCS 2017).

The Main Base of Wallops Flight Facility sits at approximately 42 feet above sea level. As a result, chronic inundation is not likely to threaten all of the facility, though some low lying areas will experience the threat. Storm surge, however, could be very damaging, particularly if coupled with increased sea levels and rising tide cycles.

While the exact extent of inundation of the coastal, Atlantic-facing areas of the Eastern Shore are not currently known, the general long term impacts of chronic flooding and storm flooding potentials will be significant, altering the geography, and placing great strain on existing infrastructure. Long term coastal resilience master planning such as Governor Northam has called for in his recent Executive Order (EO 24 2018) are required to assess the best methods of coastal protection where practicable. The populated areas of the Eastern Shore and other areas of coastal Virginia will necessarily change as communities and citizens are ultimately relocated to reduced impact areas as a result of permanent flooding of low lying areas.

4.3 POTENTIAL CUMULATIVE EFFECTS

4.3.1 BENTHOS

Despite the minor increase in frequency of shoreline renourishment as compared to that which was assessed in the *2010 Final SRIPP PEIS*, the nature of potential cumulative impacts to benthos would be the same with or without this Proposed Action. Shoreline stabilization, replacement of the causeway bridge, maintenance dredging, a north Wallops Island deep water port operations area, Navy AFTT actions, and federal navigation projects would expose the benthos to infrequent but repeated impacts that are essentially identical to the Proposed Action. The consequences of each action results in delayed recovery, but does not cumulatively degrade the capacity for recovery.

4.3.2 WILDLIFE

The impacts to wildlife, particularly birds and sea turtles, resulting from the Proposed Action would add to those resulting from other past, present, and reasonably foreseeable projects. These include: disturbance from human presence, noise, and lighting associated with WFF infrastructure and its use; accidental injury or death resulting from vehicle use on beaches; and potential impacts to benthic prey base resulting from this and other shoreline stabilization projects. Additionally the creation of foraging and nesting habitat for birds and sea turtles could offset negative impacts from other activities occurring on or near the project area and add to the beneficial impacts of predator control projects.

4.3.3 ESSENTIAL FISH HABITAT

Despite the minor increase in frequency of shoreline renourishment as compared to that which was assessed in the *2010 Final SRIPP PEIS*, the nature of potential cumulative impacts to fisheries and EFH would be the same with or without the Proposed Action. Shoreline stabilization, replacement of the causeway bridge, maintenance dredging, a north Wallops Island deep water port operations area, Navy AFTT actions, and federal navigation projects will expose fisheries and EFH to infrequent but repeated impacts that are essentially identical to the Proposed Action. The consequences of each action results in delayed recovery, but does not cumulatively degrade the capacity for recovery of fisheries and EFH.

4.3.4 SPECIAL STATUS SPECIES

Impacts to special status species on land are similar to those described above for wildlife. A reduction in nesting habitat for piping plovers and loggerhead sea turtles and foraging habitat for red knot would result if sand from the north Wallops Island beach were used for renourishment. Disturbance from lighting, noise, and human presence could also occur. Additionally, inadvertent loss of individuals or eggs could occur if sand movement from this beach occurred during the breeding season and onsite monitors did not detect nests. These potential negative impacts to special status species on land could add to disturbance resulting from ongoing use of adjacent roads and infrastructure, beach patrols and species monitoring. The potential exists for nesting habitat to be created in the area renourished resulting in possible countervailing impacts when considered with past, present and reasonably foreseeable activities.

The proposed offshore work could result in the impacts to in-water sea turtles, protected fish, and whales including entrainment in the dredge, interaction with the sediment plume, reduction in available forage, and disturbance due to vessel created sounds. Though such impacts are considered unlikely, they could add to impacts resulting from federal navigation projects, launch events, replacement of the causeway bridge, maintenance dredging, a north Wallops Island deep water port operations area, Navy AFTT actions, and ongoing shoreline stabilization activities.

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Harrison, Michael	Noise, Benthos, Wildlife, Marine Mammals, and Special Status Species	B.S. Biology M.S. Environmental Sciences Years of Experience: 14
Hoffman, Chareé	Technical Review, Quality Control	B.S. Biology Years of Experience: 18
Lowenthal, John	Water Quality	B.S. Biology M.S. Biology/Plant Ecology Years of Experience: 31
Lengel, Sonja	Cultural Resources	B.F.A. Interior Design M.S. Historic Preservation Years of Experience: 10
Lybolt, Matt	EFH and Fisheries, Biological Resources Review	B.S. Biology M.S. Biological Oceanography Ph.D. Marine Ecology Years of Experience: 18
Simpson, Sharon	Production Coordinator	A.S. Science Years of Experience: 19

NAME	TITLE/AREA OF RESPONSIBILITY	EDUCATION AND EXPERIENCE
Swain, Ken	Technical Review	B.S. Geology M.S. Geology, Coastal Processes Years of Experience: 23
Thursby, Lori	Cultural Resources	B.S. Environmental Design in Architecture M.S. Architectural History Years of Experience: 22
Wetland Design and Restoration		
Priest, Walter	Coastal Geology	B.S. in Biology M.S. in Biology Years of Experience: 44