United States Department of the Interior

FISH AND WILDLIFE SERVICE

Virginia Field Office
6669 Short Lane
Gloucester, VA 23061

December 22, 2015

Mr. Joshua A. Bundick
Lead, Environmental Planning
Code 250.W
Wallops Flight Facility
Wallops Island, VA 23337

Re: Wallops Flight Facility Proposed and Ongoing Operations and Shoreline Restoration/Infrastructure Protection Program, Accomack County, VA, Project # 2015-F-3317

Dear Mr. Bundick:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the National Aeronautics and Space Administration's (NASA) proposed and ongoing launch operations at the Mid-Atlantic Regional Spaceport (MARS), and the Shoreline Restoration and Infrastructure Protection Program (SRIPP) at the Wallops Flight Facility (WFF) in Accomack County, VA, and the effects on the federally listed threatened piping plover (*Charadrius melodus*) (plover), red knot (*Calidris canutus rufa*) (knot), and loggerhead sea turtle (*Caretta caretta*) Northwest Atlantic Ocean distinct population segment (loggerhead) in accordance with section 7 of the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884), as amended (ESA). Your August 18, 2015 request for formal consultation was received on August 18, 2015.

This biological opinion is based on information provided in the August 18, 2015 biological assessment (BA), the project proposal, telephone conversations, field investigations, and other sources of information. A complete administrative record of this consultation is on file in this office.

NASA determined in its BA that the proposed and ongoing actions may affect, but are not likely to adversely affect the federally listed endangered roseate tern (*Sterna dougalii dougalli*), and leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidechelys kempii*), and green (*Chelonia mydas* [rangewide listed and proposed North Atlantic distinct population segment]) sea turtles, and the federally listed threatened seabeach amaranth (*Amaranthus pumilius*). The Service concurs with NASA's determination and these species are not considered further in this biological opinion.

We concur with your determination that the federally listed threatened Northern long-eared bat (*Myotis septentrionalis*) (NLEB) is not likely to be adversely affected by the proposed and ongoing actions if the proposed avoidance and minimization measures are followed. However, if identified roost trees are proposed for removal at any time, additional consultation may be required. Activities consistent with the conservation measures outlined in the April 2, 2015, species-specific rule pursuant to section 4(d) of the ESA for the NLEB (80 Federal Register 17973-18033) and the proposed avoidance and minimization measures provided in the BA will be considered not likely to adversely affect the NLEB.

MARS ongoing launch operations include launching scientific balloons. Balloons launched from WFF may be latex balloons 600 to 3,000 grams in mass, or polyethylene balloons up to 1,132,673 cubic meters (m) in volume. Latex balloons will burst at altitude, dropping the scientific payload into the Atlantic Ocean. Polyethylene balloons are terminated by remotely detonating a small charge to puncture the balloon and separate the payload from the balloon. The process of launching and detonating balloons is gradual enough that plovers and knots will be able to avoid colliding with balloons. Noise associated with launch and detonation is not expected to startle plovers, knots or loggerheads. Scientific balloons are large enough that they will not be ingested by plovers, knots, or loggerheads after they burst. Polyethylene balloons and the associated payload are generally recovered so they will not pose a hazard to marine life after detonation. The Service has determined that use of scientific balloons is not likely to adversely affect listed species over which the Service has jurisdiction.

NASA developed a plan to reduce the hazard posed by *Phragmites australis* stands on Wallops Island, with the highest priority being those in the vicinity of the launch area (NASA 2014a). A combination of control methods are employed including aerial spraying (via rotary-wing aircraft), hand spraying, controlled burning, and mowing; in addition to “cleanliness” requirements for operating heavy equipment in *Phragmites* infested areas (NASA 2014a). Small fixed or rotary wing unmanned aerial systems (UAS) may be employed to monitor effectiveness of the program. Due to the lack of suitable habitat for listed species in locations where burns will occur, the Service has determined that *Phragmites* control is not likely to adversely affect listed species.

This biological opinion is valid from the date of signature through January 1, 2031. No later than June 1, 2030, the Service and NASA will meet to discuss the process for the next iteration of consultation.

CONSULTATION HISTORY

05-10-2010 The Service issued NASA a non-jeopardy biological opinion for expansion of WFF and ongoing operations.

07-30-2010 The Service issued NASA a non-jeopardy programmatic biological opinion on the SRIPP.

09-22-2011 The Service provided concurrence on NASA's no effect determination for construction of a UAS airstrip at the northern portion of the island. The Service provided a not likely to adversely affect determination for several species associated with the operation of the new airstrip.

9-11-2014 The Service provided concurrence on the U.S. Navy's (Navy) not likely to adversely affect determinations for installation and operation of a 5 inch powder gun and electromagnetic railgun at WFF.

11-20-2014 The Service provided concurrence on NASA's not likely to adversely affect determination for relocation of the 50k sounding rocket launcher and construction of a new flat pad to support sounding rocket launches.

01-12-2015 Red knot federally listed as threatened.

08-18-2015 The Service received NASA's request to reinitiate formal consultation on the 2010 biological opinions.

09-28-2015 The Service acknowledged receipt of initiation of formal consultation request.

10-16-2015 A Service biologist conducted a site visit of the project areas.

BIOLOGICAL OPINION

This biological opinion consolidates 2 biological opinions issued in 2010. The first analyzed effects associated with proposed and ongoing launch operations at MARS and the second analyzed effects associated with implementation of the SRIPP at WFF. Only proposed, undocumented, or ongoing activities are analyzed in this document.

DESCRIPTION OF PROPOSED ACTION

The proposed action includes completing and continuing several actions to support proposed and ongoing launch operations at MARS and SRIPP at WFF (Wallops Main Base, South Wallops Island, North Wallops Island). Table 1 provides a summary of the individual actions and each is described in further detail following the table.

Table 1. Proposed and ongoing launch operations at MARS and SRIPP at WFF.

Action	Location	Frequency	Time of Year	Time of Day
Liquid Fueled Expendable Launch Vehicle (ELV) Launches	Pad 0-A	6/year	Year-round	Either
Solid Fueled ELV launches	Pad 0-B	12/year	Year-round	Either
ELV Static Fires	Pad 0-A	2/year	Year-round	Either
Sounding Rocket Launches	Current: Pad 1 and Pad 2 Future: Pad 2 and south UAS airstrip flat pad	60/year	Year-round	Either
Sounding Rocket Static Fires	Pad 2	33.5 tons double base & 38.3 tons composite propellants/12-month period	Year-round	Either
Disposal of Defective or Waste Rocket Motors	Open Burn Area, south Wallops Island		Year-round	Either
Drone Target Launches	Pad 1, 2, 3 or 4	30/year	Year-round	Either
UAS Flights	Wallops Main Base, South Wallops Island, North Wallops Island	75 missions/week	Year-round	Either
Piloted Aircraft Flights	Wallops Main Base and adjacent airspace	61,100 operations/year	Year-round	Either
Restricted Airspace Expansion	Main Base, Wallops Island, and adjoining airspace	No change in type or tempo or aircraft activity	Year-round	Either
Range Surveillance/Facility Security	Wallops Island	N/A	Year-round	Either
Construction	Wallops Island	N/A	Year-round	Either
Routine Facility Maintenance	Wallops Main Base, Wallops Island	As needed	Year-round	Day
Launch Pad Lighting	Wallops Island	30 days/launch	Year-round	Night
Recreational/ Off-road Vehicle (ORV) Beach Use	Wallops Island	N/A	Year-round	Day
Protected Species Management	Wallops Island	N/A	Spring and Summer	Day
Miscellaneous Activities on Wallops Island Beach	Wallops Island	As needed	Year-round	Day
Education Use of Wallops Island Beach	Wallops Island	Several trips/week	Year-round	Day
Seawall Repair	Wallops Island	As needed	Year-round	Day
Shoreline Reconstruction Monitoring	Wallops Island	2/year	August – October and March - May	Day
Beach Renourishment and Long-term Project Maintenance	Wallops Island	Every 2-7 years	Year-round	Day

Proposed and Ongoing Launch Operation Activities

<u>Liquid and Solid Fueled ELV Launches and Static Fires</u> - ELVs are launched from Launch Complex 0 at the south end of Wallops Island, between the southernmost extent of the sea wall and the UAS runway. Pad 0-B is topped with a permanent gantry. A transporter erector launcher raises and launches rockets from Pad 0-A. Both launch pads are illuminated with broad spectrum night lighting for up to several weeks on either side of the launch window; effectively resulting in up to 30 calendar days of night lighting per launch event. Exhaust ports on each launch pad direct rocket motor exhaust to the east, across a narrow strip of steep sandy beach and over the Atlantic Ocean. Launches from either pad may occur at any time of day, on any day of the year, as dictated by weather conditions and program needs.

Rockets launched from Pad 0-B use solid fuel systems based on an ammonium perchlorate/aluminum (AP/AL) or nitrocellulose/nitroglycerine (NC/NG) combination. Many classes of rockets may be launched from this site, the largest of which would be equivalent to the

LMLV-3(8). Rockets launched from Pad 0-A will use liquid fuel systems with refined petroleum (RP-1) or liquid methane and liquid oxygen (LOX) as propellants, thus requiring liquid nitrogen prior to launch for cooling the propellants, and gaseous helium and nitrogen as pressurants and purge gases. The largest vehicle proposed to launch from Pad 0-A would be Orbital ATK's Antares 200 Configuration ELV. Orbital rockets deliver spacecraft into orbit that may utilize hypergolic propellants.

The Antares 200 Configuration ELV employs 2 NPO Energomash provided RD-181 engines, which also use LOX and RP-1. These motors will be more powerful (up to 17 percent more thrust at sea level) than the previous AJ-26 engines and consequently will allow for a heavier payload to be placed into orbit. The Antares 200 Configuration also utilizes modifications to valves and piping in the first stage fuel feed system, modifications to structural and thermal components in the first stage, and changes to avionics and wiring, and requires slightly different ground support equipment (used to handle and test rocket components) and fueling infrastructure. The Antares 200 Configuration will be launched from Pad 0-A, with up to 6 launches per year, and 2 static test fires per year.

<u>Sounding Rocket Launches</u> - Sounding rockets are currently launched from 2 launch pads in the vicinity of Launch Pad 1 and 2. In the future, sounding rockets will be launched from 2 launch pads in the vicinity of Launch Pad 2 and the south UAS airstrip flat pad. These launch pads are topped with mobile shroud sheds rather than gantries, and temporary rail launchers are used to orient the rockets for launch. Sounding rockets do not have a long loiter time on the launch pad after ignition, therefore these launch pads are not equipped with exhaust ports. Many classes of sounding rockets are used at these sites, the largest of which is the Black Brant XII burning 3,350 kilograms (kg) of solid propellant. Propellants used are based on an AP/AL or NC/NG combination. Sounding rockets do not deliver spacecraft into orbit, and therefore do not carry hypergolic propellants. As many as 60 sounding rockets are launched per year, at any time of day, on any day of the year, as dictated by weather conditions and mission needs.

<u>Sounding Rocket Motor Static Fire Testing</u> - NASA performs sounding rocket motor static fire tests so that motor operations can be observed in a non-flight position. Rocket motors may be static test fired from either a horizontal or vertical position. WFF has been authorized by the Virginia Department of Environmental Quality (VDEQ) Air Division to perform static fire tests on solid propellant sounding rocket motors from Pad 2. The envelopes for static fire tests are governed by the limits set forth in the Wallops Island State operating permit. Exhaust from static test firings will be directed through a trench and over the Atlantic Ocean. The deluge system used for orbital launches from Pad 0-A will be used to cool the launch pad and dampen vibration during static firing tests. Sounding rocket motor static fire testing encompasses 33.5 tons of double base and 38.3 tons of composite propellants over a 12-month period.

<u>Disposal of Defective or Waste Rocket Motors</u> - Defective or waste rocket motors are ignited at the open burn area south of the UAS runway on the south end of Wallops Island. Motors that cannot be returned to the manufacturer or repurposed for other projects are placed on a concrete pad or bolted to a subunit and ignited to burn off any stored propellant. Multiple motors can be

consolidated into a single burn. Ash remaining after a burn is burned again or shipped off-site for disposal. The remaining motor casings are steam cleaned and disposed of as scrap metal. The water used for steam cleaning is captured and tested for toxins before disposal under a VDEQ permit. The maximum amount of propellant to be disposed of per year at the open burn area for sounding rocket static fires and disposal of defective or waste rocket motors is 33.5 tons double base and 38.3 tons composite propellants. Burns are infrequent and have not approached the disposal permit limit.

Drone Target Launches - Drone targets are launched from WFF or air launched from military aircraft in support of Navy missile training exercises. These targets use a variety of fuels, including liquids such as JP-5 jet fuel or hydrazine derivatives, or solid fuels such as AP/AL or NC/NG. Drones travel on preprogrammed flight paths and are engaged by shipboard interceptor systems over the Virginia Capes Operating Area (VACAPES OPAREA), with all debris from the intercept falling within the VACAPES OPAREA boundary. Drone flights may occur at any time of day, on any day of the year, as dictated by training needs and may occur up to 30 times per year.

UAS Flights - UAS are used at WFF in support of scientific missions. UAS flights may use the UAS runway on the south end of Wallops Island, between Pad 0-B and the open burn area, as well as the runways on the Main Base. The largest anticipated UAS that may be flown from the WFF Main Base runways will have engines and fuel capacity one-fifth those of a Boeing 757, though most are considerably smaller.

A new UAS airstrip is planned for construction on the north end of Wallops Island. When this airstrip is operational, the south Wallops Island airstrip will be decommissioned. UAS flown from the North Wallops Island UAS airstrip cannot exceed the noise generated by the Viking 300 or the size (in terms of physical size and quantities of onboard materials) of the Viking 400 (NASA 2012a). UAS operations are projected to occur at a frequency of 75 missions per week and will not exceed 1,040 sorties per year.

Piloted Aircraft Operations - Piloted aircraft use the runways on WFF Main Base. Aircraft using the runways range from small single propeller designs up to the Boeing 747, and include such military designs as the F-16 and F-18. Many of the airfield operations conducted at WFF include military pilot proficiency training that consists primarily of "touch-and-go" exercises in which the aircraft wheels touch down on the airstrip but the aircraft does not come to a complete stop. The U.S. Air Force, Air National Guard, U.S. Army, U.S. Coast Guard, and Navy conduct pilot proficiency training at WFF runways.

An airfield operation represents the single movement or individual portion of a flight in the WFF airfield airspace environment, such as 1 takeoff, 1 landing, or 1 transit of the airport traffic area. The baseline airfield operation level for WFF of 12,843 was established in 2004 using annual airfield operations data for that year with an envelope that included a 25 percent increase above the total. Since 2013, WFF's piloted aircraft operating envelope was increased to include an additional 45,000 operations. The current operating envelope is limited to 61,000 operations per year. Air traffic from Wallops Main Base flies over Wallops Island.

Restricted Airspace Expansion - NASA has requested the Federal Aviation Administration (FAA) grant additional Restricted Airspace such that NASA can conduct experimental aircraft test profiles with a lower risk of encountering non-participating aircraft. No changes are proposed to either the types of aircraft or the types and number of operations conducted within the airspace adjacent to WFF. Consistent with existing practices, aircraft operating within the new restricted airspace would be required to maintain at least a 610 m altitude when operating above the Service's Chincoteague National Wildlife Refuge (CNWR).

Range Surveillance/Facility Security - In general, UH-1 helicopter surveillance flights occur twice per launch countdown and range in altitude from 61 m above ground level (AGL) to 1,524 m AGL. Each flight is approximately 2.5 hours in duration, with the helicopter's primary surveillance responsibility being the lagoon area between Wallops Island and the mainland Eastern Shore of Virginia; however, flights can range up to 1.85 kilometers (km) offshore.

Contracted fixed wing radar surveillance aircraft operate the majority of the time at 4,572 m AGL and remain within the VACAPES OPAREA airspace. Fixed wing spotter aircraft operate in the same area but their altitude varies between 152 m and 4,572 m AGL. The spotters spend less than 10 percent of their flight time below 457 m; only descending to low altitudes to visually obtain a call sign from an intruding boat or get the attention of the crew. Most of the spotters fly for around 4 hours total; the radar planes fly between 4 and 5.5 hours per mission. A typical ELV mission requires 1-2 fixed wing surveillance aircraft.

Surface surveillance and law enforcement vessels can include up to 8 inboard- or outboard-powered boats, up to approximately 13 m in length. Generally, the larger inboard vessels range between 10 and 12 knots (kt) cruising speed, whereas the small inboard vessels cruise between approximately 25 and 30 kt.

Navy and NASA facilities on Wallops Island are equipped with exterior lights at ground level, along catwalks, and at FAA mandated heights for aircraft orienteering. Security of facilities on Wallops Island is maintained by a private contractor. Individuals on foot or in vehicles tour the perimeter of Wallops Island, including the beach areas on the north and south end of the island. These patrols may be performed as often as deemed necessary to maintain base security. Security may transition from the current system of frequent roving patrols to a closed circuit television system. If the closed circuit surveillance system is installed, security officer beach access would be reduced to the minimum required to augment the cameras in providing facility security.

Construction - NASA is currently relocating the Wallops Island fire station adjacent to Navy Building V-024. Consistent with the external lighting employed on the Horizontal Integration Facility (HIF) and Pad 0-A, the new fire station will employ long wavelength exterior lighting to reduce potential effects on nesting loggerheads and their hatchlings (Witherington and Martin 2003).

Routine Facility Maintenance - The operation of WFF requires continuing routine repairs and ongoing maintenance of buildings, grounds, equipment, aircraft, vehicles, laboratory equipment, and instrumentation. Existing infrastructure, such as roads and utilities are maintained on a regular basis to ensure their safety and operational capacity. Existing buildings also require ongoing maintenance. Buildings or utility systems may be rehabilitated or upgraded to meet specific project needs. Brush and trees may be removed to construct a new building, keep the airfield's clear airspace free of intrusions, maintain the facility's perimeter fence, manage wildlife, maintain radar and tower line of sight, or enhance operation of other radio frequency equipment. Routine repairs are often required after hurricanes or intense storms. NASA contractors use heavy equipment to clear roads and stormwater systems.

The boat dock at the north end of Wallops Island receives equipment such as rocket components that cannot be delivered to the island by truck. The existing access channel and boat basin will be maintained via dredging to a depth of 4 feet at low tide to accommodate deliveries at any time of day.

Launch Pad Lighting - During orbital and suborbital launch operations, bright, broad-spectrum area lighting is required. Observations of operations at both Pads 0-A and 0-B have shown that broad spectrum night lighting can be required for up to several weeks on either side of the launch window, effectively resulting in up to 30 calendar days of night lighting per launch event. During non-critical operations, the launch pad area will be illuminated by a combination of amber light emitting diode (LED) and low pressure sodium (LPS) fixtures.

Recreational/ORV Beach Use - WFF personnel and their families are allowed to use the north end of Wallops Island for recreation outside of NASA operations periods. Recreational use may involve operation of vehicles on the beach, in addition to foot traffic. Users access the beach by the north Wallops Island ORV access. Beach access is year-round and is not expected to increase in frequency from the level previously considered. The northernmost extent of Wallops Island beach is closed to all recreational use from March 16 through August 31, or until the last plover chicks fledge. The south end of Wallops Island is closed to recreational use year-round.

Protected Species Management - In accordance with its Protected Species Management Plan (NASA 2015a), NASA will continue to monitor Wallops Island beach for beach nesting species activity. Protected species management activities involve conducting frequent monitoring surveys, implementing area closures and posting signage, placing plover nest exclosures, and similar actions. Additional protective measures, including employee education, seasonal closure of the northernmost extent of Wallops Island beach, nest exclosures, and predator management will continue.

Miscellaneous Shoreline Activities - Occasional shoreline debris (biotic and abiotic) removal is necessary within all areas of Wallops Island beach. For example, if a large tree limb is deposited on the shoreline during a storm, it will be removed. Likewise, following rocket launches from Launch Complex 0, particularly Pad 0-B, miscellaneous metallic and non-metallic debris is often deposited on the nearby shoreline. Similarly, these items will be removed. While in recent years such debris could be reasonably removed by hand, it is possible that in certain cases mechanized equipment will be required to extract a partially buried or heavy item. Finally, there could be instances where mechanized equipment will be necessary within this area to conduct miscellaneous activities that do not relate to typical beach debris removal or periodic renourishment activities. An example of such an instance occurred in July 2013, when a deceased juvenile humpback whale (*Megaptera novaeangliae*) was buried on the north Wallops Island beach; requiring use of a backhoe.

Educational Use of Wallops Island Beach - Students affiliated with NASA and the Chincoteague Bay Field Station of the Marine Science Consortium education programs regularly use Wallops Island beach for field trips and related activities. Such use of the beach occurs year-round with activity levels peaking during the summer months. Groups range in size from 5 to 20 students. These groups access the beach by either the north Wallops Island ORV access or the path east of the Island helicopter pad. Groups may only access the beach on-foot and must be under the supervision of a trained faculty or staff member.

Proposed and Ongoing Shoreline Restoration and Beach Renourishment Activities

The SRIPP is intended to use a multi-tiered approach to reduce damages to Wallops Island facilities from ongoing beach erosion and storm wave damage incurred during normal coastal storms including tropical systems and nor'easters. NASA has identified the SRIPP’s design target performance of providing significant defense against a 100-year return interval storm with respect to storm surge and waves. The performance is provided by a combination of the reconstruction of a beach, berm, and dune that will help to absorb and dissipate wave energy before it nears NASA infrastructure, and a rock seawall embedded within the dune that will protect against the most severe energy. For these features to provide reliable protection for the SRIPP’s design lifetime of 50 years, the beach must be maintained routinely throughout 50 year lifetime. The shoreline on the southern end of Wallops Island has been retreating at a rate of approximately 10 feet (ft) per year as a result of erosion (U.S. Army Corps of Engineers [Corps] 2010).

Seawall Repair - A seawall composed of large rock is currently located along 15,900 ft of the Wallops Island shoreline. This seawall was built in 1992 and protects WFF infrastructure within the northern portion of the eroding shoreline from damage due to storms and large waves. The wall has prevented overwash and storm damage, but erosion of the shoreline seaward of the wall has continued, resulting in an increased risk of damage to the seawall. NASA may repair and extend the existing rock seawall up to an additional 4,600 ft. Additional maintenance of the existing seawall may include operation of heavy equipment and placing or replacing dirt and/or rock in previously disturbed areas behind the seawall to maintain and augment the function of the existing seawall and protection resulting from these features.

In conjunction with construction activities, qualified biologists will continue to regularly survey the beaches in the vicinity of the project for use by sea turtles, plovers, and other species. If nesting activity of protected species is recorded, NASA will avoid work in areas where nesting occurs and/or implement other appropriate mitigation measures.

Shoreline Reconstruction Monitoring - As part of the SRIPP, NASA is conducting a shoreline monitoring program to record and document changes in shoreline characteristics over time as the project is subjected to normal weathering and storm events. The monitoring effort began prior to construction of the seawall, beach, and dune to establish a baseline condition and record any changes that occur between design and implementation.

A monitoring survey of the shoreline in the vicinity of Wallops Island is conducted twice a year. The first monitoring event is conducted along the entire lengths of Wallops and Assawoman Islands, a distance of approximately 8.5 miles. The second monitoring event is limited to the length of shoreline from Chincoteague Inlet south to the former Assawoman Inlet, which defines the south end of Wallops Island. In the cross-shore direction, elevation data is collected from behind the dune line to seaward of the depth of closure (the eastern edge of the underwater fill profile), estimated to be at approximately -15 to -20 ft below mean low water (MLW). Near Chincoteague Inlet the ebb shoal complex creates a large shallow offshore area; therefore, surveys in this area extend a maximum of 2 miles offshore if the depth of closure is not reached. These surveys will be repeated annually once at the end of summer (August to October) and once at the end of winter (March to May).

Cross-sections of the beach have been taken along new and/or previously established baselines on set stations every 500 ft from Chincoteague Inlet to Assawoman Inlet and every 1,000 ft from Assawoman Inlet to Gargathy Inlet. The beach surveys extend from the baseline to a depth of -4 ft below MLW offshore. An offshore hydrographic survey along the previously established baseline on set stations every 500 ft was conducted. The offshore survey extended from -3 ft below MLW to the depth of closure, anticipated to be between -15 to -20 ft below MLW. The hydrographic survey was conducted within 2 weeks of the beach survey. LIDAR data will continue to be obtained for the monitoring area approximately once a year. Both horizontal and vertical survey datum will be obtained. The survey of the beach, surf zone, and offshore area, will document changes in the Wallops Island shoreline in addition to areas adjacent to Wallops Island. The results of these monitoring efforts are being used to measure shoreline changes to evaluate the performance of the project, potential impacts to resources, and to aid in planning renourishment when needed to ensure continued project function.

Beach Renourishment and Long-Term Project Maintenance - To maintain a beach and dune at a fixed location in a condition to effectively buffer wave energy, NASA plans beach renourishment cycles throughout the 50-year life of the SRIPP as determined by the proposed monitoring program. The location, extent, and magnitude of renourishment events may vary significantly as a result of the frequency and severity of storm activity and subsequent shoreline erosion. The availability of funding, logistical constraints, and other issues may also affect the implementation of renourishment. Even if renourishment is needed based on the modeled project performance and intent, NASA may choose to forego or delay renourishment because the project will retain most of its intended and designed storm protection function even if renourishment is not implemented as envisioned in the Programmatic Environmental Impact Statement (PEIS) (NASA 2010a).

The projected renourishment frequency and amounts are based on the modeled average rates of sand loss, with models based on the historic meteorological conditions recorded at and near the project area. Based on available modeling of project performance over time, the SRIPP identified an expected renourishment frequency of approximately every 5 years for the 50-year life of the project, but which may be as frequent as every 2 years or may be delayed to every 7 years. Based on the general characterization of function, the SRIPP estimates that each renourishment cycle will require approximately 806,000 cubic yards ($yd^{3)}$ of sand placed on the beach in each of the 9 renourishment events, for a total expected renourishment volume of 7,254,000 yd^3 of sand over the life of the project, excluding the amount required for the initial beach and dune reconstruction.

If future renourishments use sand of smaller grain size or reduced quality, more frequent renourishment or larger volumes of sand may be required. If there are changes in the pattern of sand movement along the shoreline, such as reduced southerly transport over time, renourishment may be needed less frequently. In the PEIS, NASA considers the addition of breakwaters or groins, and while not included in the current proposed action, addition of these features may result in reduced sand requirements.

The Wallops Island shoreline will experience effects of future sea level rise, and this has been anticipated by providing an additional sediment volume during each renourishment event that would raise the level of the entire beach fill by an amount necessary to keep pace with the projected rise rate (Corps 2010). Applying the Corps' standard sea level rise equation based on local measurements to a 50-year project at Wallops Island yields sea level elevations between 0.84 ft and 2.53 ft above present levels. For project planning purposes, a target fill volume 85 percent of the upper estimates of the amount needed to match the 50-year projected sea level rise was selected, but the SRIPP includes adding that volume in constant increments over time instead of in a pattern that would match anticipated increases. This means that in the early years of the project the amount of fill being added will exceed the amount necessary to match the expected amount with the crossover point being in the 28th year (2038) of the project. This way, the sea level fill volume could be increased, if needed, during later renourishment events. The sea level rise volume, which is an additional amount added during each renourishment event (assuming a 5-year interval between events), is 112,000 yd^3. Deviations from existing modeled or projected sea level rise scenarios may change the amount of sand needed for renourishment.

The number of uncertainties included in the projections resulting from the modeling, model assumptions, limitations of the records of past meteorological and climatological measurements in the area, current understanding of meteorological and climatic patterns, and future decisions of NASA and other agencies are likely to result in deviations from the projected renourishment.

Based on the information provided by NASA, we are analyzing effects of the proposed action assuming a renourishment frequency of every 5 years.

Sources of Sand for Renourishment – Three borrow sites have been identified as sources for potential future beach renourishment: the on-shore north Wallops Island borrow area, unnamed shoal A (the source of material for the initial beach/dune reconstruction), and unnamed shoal B (located east of shoal A). All of these sites have been determined to be consistent with the project purpose and suitable, but all have different costs and concerns associated with their use that must be evaluated prior to use in each proposed future renourishment.

Unnamed shoal A, the source of sand for the initial reconstruction, may be used as the source for renourishment. The shoal covers an area of approximately 1,800 acres and the total predicted volume of shoal A is approximately 40 million yd^3. The sand grain size (0.46 mm) is the largest of the 3 sources.

Unnamed shoal B is located offshore approximately 12 miles east of the southern portion of Assateague Island. This shoal covers an area of approximately 3,900 acres. The total predicted sand volume of this shoal is approximately 70 million yd^3. The average sand grain size is 0.34 mm and the transit distance from the shoal to the pump out location is approximately 19 miles.

The north Wallops Island borrow area is located on NASA property in the sand accretion zone on the northern end of Wallops Island. It is delineated for planning purposes as the seaward-most portion of the beach area where sand has accreted in recent years. The borrow area is approximately 150 acres in size. Excavation depth is expected to be limited to about 3.5 ft below the ground surface due to tidal fluctuations and high soil permeability. Up to half of the projected fill volume for each renourishment cycle could be provided by the north Wallops Island borrow site. The remaining half of the expected needed volume, or the entire volume, would be obtained from one of the offshore borrow areas. The mean grain size (0.20 millimeters [mm]) at the north Wallops Island borrow area is the smallest of the 3 sites considered and is currently below the target grain size for renourishment (but still within the suitable range). The average grain size in this borrow area is expected to increase following placement of material from shoal A in the initial beach and dune reconstruction as this larger material is transported to this accretion area. Material from a combination of the sources may be feasible for future renourishments, subject to constraints of future funding, permitting, logistics, and other considerations.

Sand Removal Methods – The proposed sand removal, transportation, and placement from either of the 2 offshore sites for future renourishment is planned to be the same as that discussed for the initial beach reconstruction project.

Sand from north Wallops Island will be removed from the beach using a pan excavator or other heavy earth-moving equipment. Sand will be stockpiled, loaded onto trucks, trucked to the off-loading point on the beach, and spread by bulldozers. Off-road dump trucks will likely be used and travel up and down the beach from the stockpile area to the fill site. However, road dump trucks could also be used in some circumstances. No constraints have been placed on the timing and methods of excavation at the north Wallops Island borrow area, but NASA has identified the intent to avoid excavation and disturbance near any plover nests, sea turtle nests, or occurrences of other listed species.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. In their BA, NASA determined that the action area encompasses the entire land area of Wallops Island, the shoreline and beaches of Assawoman Island, the aquatic environment adjacent to these lands, 3 borrow sites including unnamed shoals A and B, and north Wallops Island, and the waters through which dredges could transit from borrow sites to pump out areas. In addition to the action area defined by NASA, the Service has determined that the action area includes the: Hook and Overwash segments of Assateague Island; all of barrier islands from Metompkin Island to the south through the northern end of the Public Beach on CNWR; sea space over which rockets, projectiles, UAS, and surveillance aircraft can fly; sea space within which surface surveillance vehicles will operate; sea space within which jettisoned flight hardware can land under nominal or off-nominal flight conditions; and airspace within which Wallops-launched vehicles and surveillance aircraft can fly (Figure 1).

Figure 1. Action area for proposed and ongoing launch operations and SRIPP at WFF.

STATUS OF THE SPECIES AND CRITICAL HABITAT RANGEWIDE

Plover

The species description, life history, population dynamics, status and distribution, and critical habitat description, if applicable are at: Bent 1929; Wilcox 1939, 1959; Palmer 1967; Cairns 1977, 1982; Burger 1981, 1987, 1991, 1993, 1994; Johnsgard 1981; Tate 1981; Welty 1982; Tull 1984; Griffin and Melvin 1984; Haig and Oring 1985, 1988; Gibbs 1986; Gilpin 1987; Goodman 1987; MacIvor et al. 1987; Patterson 1988; Fleming et al. 1988; Canadian Wildlife Service 1989; Nicholls 1989; Riepe 1989; Cross 1990, 1996; Goldin 1990, 1993, 1994; MacIvor 1990; Strauss 1990; Rimmer and Deblinger 1990; Coutu et al. 1990; Eddings et al. 1990; McConnaughey et al. 1990; Bergstrom 1991; Patterson et al. 1991; Haig 1992; Loegering 1992; Hoopes et al. 1992; Melvin et al. 1992, 1994; Hake 1993; Hoopes 1993; Cross and Terwilliger 1993, 2000; Howard et al. 1993; Elias-Gerken 1994; Hoopes 1994; Thomas 1994; Jenkins and Nichols 1994; Melvin and Gibbs 1994; Loegering and Fraser 1995; Service 1996, 1998, 2002, 2009b, c; Watts et al. 1996; Canale 1997; Wolcott and Wolcott 1999; Jenkins et al. 1999; Erwin et al. 2001; Lauro and Tanacredi 2002; Mostello and Melvin 2002; National Park Service 2003, 2007; Melvin and Mostello 2003; Seymour et al. 2004; Amirault et al. 2005; Noel et al. 2005; Daisey 2006; Stucker and Cuthbert 2006; Cohen et al. 2006, 2009; Boettcher et al. 2007; Brady and Inglefinger 2008; Hecht and Melvin 2009; Miller et al. 2010; Hecht et al. 2014; Davis 2015.

Knot

The species description, life history, population dynamics, status and distribution, and critical habitat description, if applicable are at: Wander and Dunne 1982; Dunne et al. 1982; Davis 1983; Kochenberger 1983; Harrington et al. 1986, 1988, 2007, 2010; Summers and Underhill 1987; Morrison and Ross 1989; Titus 1990; Tomkovich 1992, 2001; Morrison and Harrington 1992; Piersma and Davidson 1992; Zwarts and Blomert 1992; Piersma et al. 1993, 1999; Harrington 1996, 2001, 2005a, 2005b, 2008; Antas and Nascimento 1996; Cadee et al. 1996; Gonzalez et al. 1996, 2006; Nordstrom 2000; Piersma and Baker 2000; Brown et al. 2001; Nordstrom and Mauriello 2001; Morrison et al. 2001a, b, 2004, 2006; Atkinson et al. 2002; Blomqvist et al. 2002; Buehler 2002; Greene 2002; Ferrari et al. 2002; Scavia et al. 2002; Philippart et al. 2003; Schekkerman et al. 2003; Piersma and Lindstrom 2004; Baker et al. 2004, 2005; Gonzalez 2005; Buehler and Baker 2005; Peterson and Bishop 2005; van Gils et al. 2005a, b; Morrison 2006; Buehler et al. 2006; Guilfoyle et al. 2006, 2007; Karpanty et al. 2006, 2011, 2012, 2014; Peterson et al. 2006; Anderson 2007; Burger et al. 2007, 2011, 2012a, b; Kuvlesky et al. 2007; Meltlofte et al. 2007; Kalasz 2008; Niles et al. 2008, 2010, 2012; Andres 2009; Gerasimov 2009; Rice 2009, 2012; Watts 2009, 2010; Clark et al. 2009; Cohen et al. 2009, 2010, 2011; Defeo et al. 2009; Lott et al. 2009; Titus et al. 2009; Service 2011b, 2012, 2014c; Schneider and Winn 2010, Bhatt et al. 2010; Carlos et al. 2010; Conklin et al. 2010; Smith et al. 2010; Dey et al. 2011, 2014; Duerr et al. 2011; Niles 2011a, b, 2013, 2014; Piersma and van Gils 2011; McGowan et al. 2011; Smith et al. 2011; Hurlbert and Liang 2012; Scherer and Petry 2012; Anderson et al. 2012; Escudero et al. 2012; Feng et al. 2012; Musmeci et al. 2012; Schwarzer et al. 2012; Burger and Niles 2013a, b; Smith and Stephenson 2013; Carmona et al. 2013; Gill et al.

2013; Grabowski et al. 2013; Iwamura et al. 2013; Newstead et al. 2013; Root et al. 2013; Bauers 2014; Jordan 2014; Newstead 2014; Russell 2014; Bimbi et al. 2014; Galbraith et al. 2014; Liebezeit et al. 2014; Wallover et al. 2014.

Loggerhead

The species description, life history, population dynamics, status and distribution, and critical habitat description, if applicable are at: Dolan et al. 1973; Hosier et al. 1981; Carr 1982; Mrosovsky et al. 1984; Anders and Leatherman 1987; Nelson and Dickerson 1987, 1988; Nelson et al. 1987; Dodd 1988; Christens 1990; National Research Council 1990; National Marine Fisheries Service (NMFS) and Service 1991, 2007, 2008; Cox et al. 1994; Witherington and Martin 1996, 2003; Bouchard et al. 1998; Hanson et al. 1998; Steinetz et al. 1998; Bollmer et al. 1999; Turtle Expert Working Group 2000; Snover 2002; Avens 2003; Bolten 2003; Lohmann and Lohmann 2003; Carthy et al. 2003; Ehrhart et al. 2003; Miller et al. 2003, Schroeder et al. 2003; Bowen et al. 2005; Hawkes et al. 2007; Service 2011a, 2014b.

ENVIRONMENTAL BASELINE

Status of the Plover Within the Action Area - Plovers use wide sandy beaches on Metompkin, Assawoman, Wallops, and Assateague Islands for courtship and nesting. Suitable habitat has a variable distribution along the seaward edge of islands within the action area year-to-year due to the competing effects of erosion and vegetation succession. Annual plover production within the action area indicates that all islands possess some nesting habitat, with the most extensive areas of suitable beach occurring on Assawoman Island and in the Hook, Overwash, and Public Beach portions of Assateague Island (Service 2009a). Metompkin Island supports large numbers of plovers, with larger numbers occurring in the portion owned by The Nature Conservancy (TNC) (Smith et al. 2009). Little potential habitat is available for plover nesting on the south end of Wallops Island, but the north end of Wallops Island has been rapidly accreting and appears to offer increasing quantities of wide sandy beach on which plovers may seek to nest. Shoreline restoration created a substantial increase in beach available on Wallops Island north of the reconstructed seawall and south of the north Wallops Island area (NASA 2015b).

In 2009, the Service documented 3 plover nests that fledged 1 chick on the Assateague Island Overwash and 23 pairs that fledged 12 chicks on Assateague Island Hook (Service 2009a). In 2009, 42 pairs of plovers nested on Metompkin Island and fledged 51 chicks (Smith et al. 2009). In 2009, 26 pairs of plovers nested on Assawoman Island and fledged 31 chicks (Service 2009a). In 2010, the Service documented 32 plover nests on Assateague Island that fledged 54 chicks and 24 plover nests on Assawoman Island that fledged 35 chicks. On North Metompkin Island, 3 plover nests fledged 4 chicks (Service 2014a).

In 2011, the Service documented 27 plover nests on Assateague Island that fledged 41 chicks and 32 plover nests on Assawoman Island that fledged 52 chicks. On North Metompkin Island, 8 plover nests fledged 11 chicks. In 2012, the Service documented 20 plover nests on Assateague Island that fledged 9 chicks and 39 plover nests on Assawoman Island that fledged 78 chicks. On

North Metompkin Island, 11 plover nests fledged 15 chicks. In 2013, the Service documented 31 plover nests on Assateague Island that fledged 29 chicks and 40 plover nests on Assawoman Island that fledged 60 chicks. On North Metompkin Island, 14 plover nests fledged 15 chicks. In 2014, the Service documented 33 plover nests on Assateague Island that fledged 58 chicks and 40 plover nests on Assawoman Island that fledged 71 chicks. On Metompkin Island, 10 plover nests fledged 18 chicks. In 2014, the Service documented 42 plover nests on Assateague Island that pledged 70 chicks, and 40 plover nests on Assawoman Island that fledged 71 chicks. On Metompkin Island, 53 plover nests fledged 82 chicks. In 2015, the Service documented 47 plover nests on Assateague Island that fledged 59 chicks, and 33 plover nests on Assawoman Island that fledged 28 chicks. On Metompkin Island, 61 plover nests fledged 78 chicks (Service 2014a).

NASA documented 4 plover nests on the northern end of Wallops Island in 2009, which successfully fledged 10 chicks. NASA initiated a formal monitoring program in 2010, and documented 4 plover nests on the northern end of Wallops Island. Two nests were washed out before eggs hatched, 1 was predated and the final nest fledged 4 chicks successfully (NASA 2010b). The 2011 nesting season produced 3 plover nests on Wallops Island with 1 nest on the south beach and 2 nests on the north beach. The 3 nests fledged 3 chicks each (NASA 2011).

The 2012 nesting season yielded 6 nests on north Wallops Island and the recreational beach; however, due to predation and inundation from storm tides, only 1 nest fledged chicks (NASA 2012b). In 2013, NASA undertook a similar monitoring effort, during which 3 nests were found on north Wallops Island and the recreational beach. Two nests had a 100 percent fledge rate and the third had a 50 percent fledge rate (NASA 2013).

In 2014, 5 nests were found on the recreational beach and the north end of Wallops Island. Nest success during 2014 ranged from 66 percent with 2 of 3 chicks fledging from 1 nest, to another being completely unsuccessful with 0 of 3 chicks fledging due to predation. The remaining 3 nests experienced fledge rates of 25 percent (n=2) and 50 percent (n=1) (NASA 2014b).

In 2015, NASA conducted plover surveys 3-4 times per week from March through August and documented 6 nests. Three nests were found on the recreational beach, 2 nests were found on north Wallops Island, and for the first time since renourishing the beach, 1 nest was discovered between the 2 Navy facilities (V-010/V-020 and V-024) on mid-Wallops Island (NASA 2015b). The 6 nests fledged a total of 8 chicks (NASA 2015b).

Most plovers that nest farther north within the Atlantic population are likely to pass through the action area during migration between mid-February and mid-May in the spring and from mid-July to mid-October in the fall. This may involve birds passing through in flight, but many of these birds may stop and roost or feed on beaches, tidal flats, and overwash areas within the action area. Little is known about the extent of use of the action area by migrating plovers beyond knowledge that they use the area.

<u>Status of the Knot Within the Action Area</u> – Following migration from southern overwintering areas, the majority of knots arrive in the mid-Atlantic between late April and early June. The

Delaware Bay has long been regarded as the final and most crucial stopover during the springtime northern migration. At this stopover, the birds gorge on eggs of spawning horseshoe crabs (*Limulus polyphemus*) in preparation for their nonstop flight to the Arctic (Karpanty et al. 2006). Wallops Island also provides important stopover habitat (Watts and Truitt 2015).

The majority of knot activity on Wallops Island historically occurred on the north end of the island, well north of launch Complex 0 (NASA 2012b, 2013, 2014b). During monitoring efforts in 2012, observed flocks ranged in size from less than 10 to approximately 675 individuals (NASA 2012b). All observed knots were on the recreational beach and north end “curve” of Wallops Island (NASA 2012b, 2013, 2014b). In May 2013, NASA observed flocks of knots on Wallops Island ranging in size from approximately 20 to 1,160 individuals (NASA 2013). During 2014, the fewest numbers of knots, 87 individuals, were observed on Wallops Island since NASA began its protected species monitoring in 2010 (NASA 2014b). In 2015, the numbers of knots on Wallops Island beach peaked in late May, during which total counts exceeded 500 individuals (NASA 2015b). Although the potential exists for knot foraging activity to occur within the renourished beach area adjacent to the launch pads, their presence on the regularly nourished beach is unlikely due to the suppressed forage base and resultant lower habitat value.

Knots have been observed on Assawoman, Metompkin, and Assateague Islands. Assawoman Island had a range of knots, from 26 birds in 2009 to 420 in 2013; averaging 73 birds per survey. Metompkin Island averaged 376 birds per survey; from approximately 30 birds in 2008 to a high of 1,853 birds in 2014. Assateague Island averaged 154 birds per survey; from approximately 60 birds in 2005 to 522 birds in 2007.

<u>Status of the Loggerhead Within the Action Area</u> – The loggerhead occurs in waters adjacent to and offshore of islands within the action area. Loggerheads are known to occasionally nest within the action area. In mid-July 2008, a loggerhead nest was discovered by NASA personnel on north Wallops Island. Following flood inundation from several fall storms, CNWR personnel recovered approximately 170 non-viable eggs from the nest in October 2008.

In 2010, NASA documented 4 nests and 2 false crawls. Three nests were located on the recreational beach, with the fourth located to the south in front of the rockwall. The recreational beach nests showed a hatch success from 49 to 52 percent. The southern nest showed a much lower success rate of approximately 2 percent. DNA analysis determined that all 4 nests were dug by a single female (NASA 2010b). No loggerhead nesting activity was observed in 2011. In 2012, NASA documented 2 loggerhead nests. The first nest was located in June within the recreational beach and was ultimately predated. In early July, 2 false crawls on different days led to a nest on the crest of the newly constructed dune just east of Navy Building V-010. After the closure of the hatch window, the nest was excavated and showed a success rate of approximately 78 percent (NASA 2012b). In late July 2013, NASA located a false crawl and 2 loggerhead nests on Wallops Island beach. The first nest was located just north of launch pad 0-A, and the second was discovered north of the HIF (NASA 2013). The southernmost nest had an approximately 80 percent hatch rate, whereas the nest near the HIF was inundated during an October storm and was unsuccessful. No evidence of sea turtle nesting was documented on Wallops Island in 2014 or 2015 (NASA 2014b, 2015a).

A low level of sea turtle nesting has become relatively common on CNWR (Service 2009d). Table 2 provides recorded nesting behavior for loggerheads within the action area.

Table 2. Loggerhead nest activity within the action area from 1974 - 2015 (Service 2009d, 2015).

Location	**False Crawls**	**Nests**	**Total Activity**
Metompkin Island	0	0	0
Assawoman Island	1	0	1
Wallops Island	9	13	22
Assateague Island - Hook	19	5	24
Assateague Island - Overwash	7	5	12

<u>Factors Affecting the Species Environment Within the Action Area</u> – Listed species on Wallops Island are affected by a suite of existing actions associated with flight operations and support operations performed by NASA, various military branches, MARS, and private contractors. Wallops Island is primarily owned and managed by NASA with operations by the Navy onsite. The portions of Assateague and Assawoman Islands within the action area are part of the Service's CNWR. Metompkin Island is composed of private lands with the majority owned by TNC and managed as a natural area. Wallops, Assateague, Assawoman, and Metompkin Islands are managed to conserve natural resources, including listed species. Plovers, knots, and loggerheads are potentially impacted by ongoing rocket launches and related training, testing, and preparation; maintenance of existing buildings and infrastructure; shoreline restoration and construction of shoreline stabilization structures; and operation of UASs and aircraft overhead, primarily launched from Wallops Main Base.

On Wallops Island, Service lands, and TNC lands within the action area, personnel actively manage to minimize and prevent invasive vegetation. *Phragmites* is found on all islands within the action area and is controlled with herbicides on Wallops, Metompkin, and Assawoman Islands, and in the Hook and Overwash areas of Assateague Island. NASA, the Service, Virginia Department of Game and Inland Fisheries (VDGIF), TNC, contractors, and universities conduct surveys for breeding birds and sea turtle nests. Predator control of mammalian and avian predators occurs on both Wallops Island and CNWR. These efforts affect both plover and loggerhead reproduction within the action area by increasing human activity in areas of use by plover, knot, and loggerheads. Plovers and knots may be startled by increased activity and plover nesting attempts may be disturbed, causing a reduction in nesting success. Activity in the vicinity of beaches used by loggerhead for nesting may reduce nesting attempts or hatching success.

Recreational use of CNWR and the northern portion of Wallops Island (NASA personnel after-hours recreational area) occurs seasonally, with most activity concentrated in spring and summer months. On CNWR, limited seasonal use of recreational vehicles on the beach occurs. Other recreational use includes wildlife observation, sunbathing, and other typical beach recreation. CNWR staff post signage and implement closures to aid in protecting sensitive resources and routinely patrol the beach and recreational use areas. Plovers and knots may be disturbed during foraging or sheltering by activity on the beach during shorebird migration. Seasonal recreational use overlaps with plover and loggerhead nesting season and may disturb nesting attempts or reduce hatching success for loggerhead or hatching and fledging success for plovers in these areas.

Storms and ocean currents contribute to erosion, accretion, and sand transport along the islands within the action area. NASA reports an erosion rate of 3.3 m/year on southern Wallops Island. Similar erosion has occurred on portions of Assawoman Island. In contrast, the beach on the north end of Wallops Island has been rapidly accreting, and the feature known as Fishing Point, the southernmost point of land on the Hook section of CNWR, has been similarly accreting. This mass movement of sand influences where exposed sandy beach habitat will be available for plovers and loggerheads in any given year. Storms occur frequently, with widely varying effects on the shoreline and beach habitats. Both tropical storms and nor-easters (winter low pressure systems that tend to hug the Atlantic coast) can greatly alter the profile and amount of beach habitat among years, and these storms create and maintain the overwash areas where most plovers nest.

The beach and dune habitat found on the seaward side of islands within the action area is prone to stabilization and vegetation succession proceeding from sheltered areas toward areas more exposed to overwash and erosion during storms. This can render areas unsuitable for plover use and loggerhead nesting. Wild bean (*Strophostyles holvola*) has been discovered on the southern end of Assawoman Island. The growth habit of this native plant may limit plover nesting habitat on the island in the future. Asiatic sand sedge (*Carex kobomugi*) has been found on the beach dune near the southern end of Wallops Island. This invasive non-native species has not spread significantly from where it was first observed, but it represents a potential threat because of its potential to spread and reduce the suitability of habitat for plovers and possibly loggerheads.

Recreational boating and fishing is common immediately offshore of all of islands within the action area. Some boat landings and recreational use of otherwise inaccessible beaches occurs, both permitted and illegally. The Chincoteague inlet, a well-used channel located between CNWR and Wallops Island, is maintained to provide boat passage from the ocean to Chincoteague Bay. Use of these beaches has caused disturbance to migrating, foraging and rest plovers and knots and may have discouraged nesting by loggerheads.

During launches, NASA implements closures of areas of both land and water adjacent to launch sites to ensure safety. The U.S. Coast Guard enforces such closures. NASA also has controlled airspace in the vicinity of both Wallops Island and Wallops Main Base. Controlled airspace is closed during launches and potentially during military air operations and training; however, during periods when operations are not ongoing, civilian flight traffic may occur. Civilian flight traffic may cause a startle response in plovers or knots, reducing their ability to forage, shelter or nest within controlled airspace. Loggerheads may be discouraged from nesting attempts.

Navy and NASA facilities on Wallops Island are equipped with exterior lights at ground level, along catwalks, and at FAA mandated heights for aircraft orienteering. Exterior lights can disorient hatchling loggerheads and may cause them to crawl toward the light rather than into the surf (NASA 2010a).

EFFECTS OF THE ACTION

Direct and Indirect Effects – Direct effects are the direct or immediate effects of the project on the species, its habitat, or designated critical habitat. Indirect effects are defined as those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR 402.02).

Table 3. Expected direct and indirect effects of the proposed actions.

	Direct and Indirect Effects					
Action	**Noise**	**Vibration**	**Rocket Exhaust**	**Use Related Disturbance**	**Lighting**	**Habitat Loss/Suitability**
Liquid Fueled ELV Launches	X	X	X		X	
Solid Fueled ELV Launches	X	X	X		X	
ELV Static Fires	X	X	X		X	
Sounding Rocket Launches	X	X	X		X	
Sounding Rocket Static Fires	X	X	X		X	
Disposal of Defective or Waste Rocket Motors	X		X			
Drone Target Launches	X	X	X		X	
UAS Flights	X	X			X	
Piloted Aircraft Flights	X	X			X	
Restricted Airspace Expansion	X					
Range Surveillance/Facility Security	X			X		
Construction	X				X	
Routine Facility Maintenance	X					
Launch Pad Lighting					X	
Recreational/ ORV Beach Use				X		
Protected Species Management				X		
Miscellaneous Activities on Wallops Island Beach				X		
Education Use of Wallops Island Beach				X		
Seawall Repair				X		
Shoreline Reconstruction Monitoring				X		
Beach Renourishment				X		X

Noise

Effects on plover, knot, and loggerhead from liquid fueled ELV launches, solid fueled ELV launches, ELV static fires, sounding rocket launches, sounding rocket static fire testing, disposal of waste rocket motors, drone target launches

Support activities prior to a rocket launch include transportation of rocket parts between storage facilities and the launch complex and other associated activities. Support activities often result in an increase in noise and general activity due to additional presence of people in the vicinity of the rocket launch areas. Increased noise from support activities may disturb loggerheads attempting to nest and nesting plovers on the sound end of Wallops Island.

Ignition of rocket engines for orbital launches or static tests will produce instantaneous noise audible for a considerable distance from Launch Complex 0. In close proximity to the launch sites, the noise generated will be high intensity across a broad range of frequencies. Sound intensity may exceed 160 decibel (dB) on the beach and dune in close proximity to launch sites. The WFF Range Safety Office, using the NASA rocket size/noise equation (NASA 2009), estimated noise levels expected to occur during launches of envelope vehicles from each launch pad in the complex. An LMLV-3(8) rocket launched from pad 0-B will produce a noise level of 129 dB at 1.1 kilometer (km), attenuating to 108 dB up to 12.6 km from pad 0-B. As many as 12 such launches could be performed per year at pad 0-B. Noise levels from static tests performed at pad 0-A would reach 124 dB within a 1.55 km radius, attenuating to 108 dB at a distance of 9.6 km from pad 0-A. As many as 6 launches and 2 static tests could be performed per year at pad 0-A. These noise levels are expected to be sustained for 30 to 60 seconds during a launch and for up to 52 seconds during a static test. Plover and loggerhead nests may occur within 100 m of the launch sites, and when they occur between 100 m and 1.55 km of launches, they will be subjected to high intensity sound. The majority of knot activity on Wallops Island occurs on the north end of the island, more than 3 km north of Pad 0-A (NASA 2012b, 2013, 2014b). Knot presence on the regularly nourished beach is unlikely due to the suppressed forage base. It is unlikely that knot would be subjected to high intensity sound on north Wallops Island.

Deafening of plovers, knots, and loggerheads is not expected at the decibel levels predicted at 1.1 to 1.5 km from launches, but progressively closer to the rockets, the noise intensity may reach levels that could cause tissue damage. While not known in birds specifically, sound intensity of near 180 dB can result in nearly instantaneous tissue damage (McKinley Health Center 2007). Exposure to noises within these radii could deafen plovers or knots present during ignition if exposed to high intensity noise. Deafness would significantly impair the ability of a plover or knot to breed, shelter, and behave normally. In addition to deafening, low frequency and high intensity sound expected in very close proximity to the launch sites may be debilitating and cause disorientation or loss of balance, but these effects are not well established (Leventhall et al. 2003). Birds may be able to recover from sound-induced deafening over time (Adler et al. 1995), but some period of deafness may result from loud noises. Birds may recover from disorientation and other sound-induced effects, but the amount of time required is not known for plover or knot.

Debilitated birds will be subject to increased vulnerability to predators and physiological stress, resulting from inability to detect and avoid predators, feed, care for eggs/young, and seek shelter.

Burger (1981) demonstrated startle effects in birds exposed to anthropogenic sound pressure of 108 dB. Within 9.6 km of pad 0-A, such noise levels will occur as a result of rocket launches or static tests as many as 20 times per year. Several other sources of loud noises exist in the action area. Anthropogenic sources include: sounding rocket and drone target launches from Wallops Island, waste engine disposal at the open burn area on Wallops Island, and aircraft landing and taking off from Wallops Main Base and the UAS runway on Wallops Island. Collectively, several thousand such events take place within WFF annually (NASA 2005, 2015b). Some of these activities produce noise levels similar to the noise expected to be produced by the large rocket launches. While many of these sounds are of similar intensity, the frequency of the sounds varies, with noise generated from rocket launches generally in the low frequency range and aircraft noise generally in higher frequency ranges.

Plovers and knots not debilitated by high intensity noise are expected to be disturbed by launches and exhibit a startle response that interferes with normal behaviors, including breeding, feeding, and sheltering. It is not likely that plovers and knots will startle or flush from all of the relatively intense sound disturbances. Individual birds may become habituated to the noises. Some of the noises are likely below the disturbance threshold, will be attenuated by atmospheric conditions, or may occur during periods of elevated natural noise intensity (e.g., strong winds, large waves) so that the noises would be less intense relative to background noise levels.

In response to high intensity noises, plovers are not expected to permanently abandon nests, but may flush from nests. More significant effects result from exposure to predators as a result of flushing. This species relies largely on its cryptic coloration and concealment for protection from predators, and flushing from nests will alert predators to the location of the nest and leave eggs or chicks exposed. Startle responses to noises and associated visual stimuli are expected to result in an incremental reduction in nest success and/or chick survival. Knots are not expected to permanently abandon migratory stopover locations, but may flush from Wallops Island roosting or foraging locations, resulting in an expenditure of energy.

Atmospheric noise has been demonstrated to prevent loggerheads from entering an area (Manci 1988). In the beach areas adjacent to rocket launch pads, the high intensity noise that occurs during rocket launches is expected to prevent loggerheads from coming ashore to nest. The intensity of noise close to launch pads may be sufficient to impair development of loggerhead eggs. Sand above the eggs is expected to attenuate the sound, but the degree of attenuation is not known. Noise is not expected to have an effect on loggerheads that come ashore to nest in habitat not located in the vicinity of the launch pads.

Effect on plover and knot from UAS flights, piloted aircraft operation, expansion of restricted airspace, range surveillance, and facility security

Jones et al. (2006) reported that wading birds were not disturbed by UAS overflights in excess of 100 m above the birds. Similarly, Sarda-Parlomera et al. (2012) did not observe notable responses when they repeatedly overflew black-headed gull (*Chroicocephalus ridibundus*) colonies with small UAS at altitudes between 20 and 40 m AGL. Most UAS flights originating from the north Wallops Island airstrip are expected to maintain at least 152 m AGL except during landing and take-off (NASA 2012a). Therefore, UAS flights conducted from north Wallops Island airstrip have a minimal potential for disturbing plovers or knots.

Peak noise levels generated by aircraft at WFF range from 67 dB for a single-engine propeller airplane landing on Wallops Main Base to 155 dB for an F-18 conducting a touch and go maneuver at Wallops Main Base. Studies of the effects of helicopter overflight on waterbirds have shown (1) temporary behavioral response to low-altitude overflight, ranging from assuming an alert posture to taking flight; (2) responses decreasing in magnitude as overflight elevation increases; and (3) rapid resumption of the behaviors exhibited prior to the overflight (Komenda-Zehnder et al. 2003). Early research in Florida detected limited adverse effects when a helicopter overflew nesting waders (Kushland 1979). The majority of birds overflown did not exhibit any response to the stimulus and those that left their nests returned in less than 5 minutes. Smit and Visser (1993) found shorebirds and curlew to be particularly sensitive to helicopter overflights at less than 250 m AGL, resulting in flushing of 33 to 75 percent of birds overflown, depending on the species. Flushing a bird from its nests can result in a range of potential adverse effects, from predation or abandonment of the chicks to unnatural energy expenditure of the parents.

Plovers may be disturbed by the operation of aircraft maneuvering or overflying the area where nesting occurs. Not all aircraft operation is likely to result in disturbance, and plovers are most likely to be disturbed by flights at low altitude down the beach or just offshore. Effects to plovers may include flushing from nests when incubating eggs, interruption of feeding or courtship, or similar responses. Effects to knots may include interruption of feeding or sheltering behaviors. Most noises are of short duration and plovers and knots are expected to return to normal behavior within a few minutes of the noise.

Potential effects on waterbirds can be reduced substantially if helicopters maintain minimum altitudes of at least 450 m (Komenda-Zehnder et al. 2003). Birds may become habituated to aircraft overflight in an area of somewhat regular disturbance, such as the marshes between Wallops Main Base and Island or along the Wallops Island beach. Birds in more remote areas subject to surveillance flights, such as the barrier islands south of Wallops Island, could be more sensitive to overflights. NASA determined in their BA that maintaining an altitude in excess of 450 m would be possible for aircraft transiting from the Main Base airfield to an offshore surveillance area; however, aircraft conducting surveillance operations between Wallops Mainland and Island will be required to fly below 450 m, which is expected to startle plovers and knots. Most noises are of short duration and plovers and knots are expected to return to normal behavior within a few minutes of the noise.

There is potential for a bird strike to occur (Washburn et al. 2014). Bird strikes are most common in months when plovers and knots are not expected to be present, with 51 percent of strikes occurring between September and February (Washburn et al. 2014). In addition, airfield activities conducted at Wallops Main Base are not expected to strike plovers or knots, as there is no suitable habitat present adjacent to the airfield. The new UAS airstrip is located in closer proximity to suitable habitat for plovers, although it will be located inland and away from nesting, foraging and roosting areas. Although it is possible that plovers or knots may be involved in a bird strike with aircraft it is likely to be a rare occurrence.

The expansion of restricted airspace is likely to result in similar effects to those expected as a result of UAS and piloted aircraft operation, simply in an expanded area. There is no expected change to either the types of aircraft or the types and number of operations conducted within the airspace adjacent to WFF. As a result, the scale of overall impacts will not change, rather, they will be spread over a larger geographic area. Knots or plovers may be impacted by flights at low altitude or just offshore by disturbance to migrating behavior as described above.

Effect on plover, knot, and loggerhead from construction and routine facility maintenance

Construction will increase noise as a result of the presence of additional people and associated activities. Potential effects will be confined to the vicinity of the new fire station location adjacent to Navy Building V-024 and are not expected to result in more than minor behavioral responses from all 3 species.

Road resurfacing and infrastructure replacement will use heavy equipment and may elicit a startle response from plovers and knots in response to increased noise. Effects to loggerheads are unlikely as infrastructure projects are not located in proximity to areas used for nesting attempts.

Routine repairs are often required after hurricanes or intense storms. Heavy equipment is used to clear roads and stormwater systems. Activities conducted away from the beach are less likely to affect listed species. Maintenance activities on the beach are likely to create a startle response and may cause plovers or knots to temporarily cease foraging or resting and plovers may temporarily cease nesting.

Effects of noise from construction and routine maintenance to plovers may include flushing from nests when incubating eggs, interruption of feeding or courtship, or similar responses. Effects to knots may include interruption of feeding or sheltering behaviors. Most noises are of low intensity but long duration and plovers and knots are expected to habituate to the noise and return to normal behavior over time.

Vibration

Effect on plover, knot, and loggerhead from liquid fueled ELV launches, solid fueled ELV launches, ELV static fires, sounding rocket launches, sounding rocket static fire testing, drone target launches, UAS flights, piloted aircraft flights

Some energy from rocket launches, static tests, drone target launches, UAS flights, and piloted aircraft flight on Wallops Island will manifest as vibration in the ground near the launch pad or airstrip. Vibration may be significant from rocket launches, engine tests, and open burns. Effects from vibrations are likely to be confined to an additive disturbance to adult plovers, adult knots, and nesting loggerheads that may cause birds and turtles to temporarily cease normal behaviors. Due to the distance between rocket launch sites and nesting habitat for plovers and loggerheads, it is unlikely that vibrations will be significant enough to affect egg viability. Vibration at other NASA launch facilities has not been demonstrated to harm bird or sea turtle eggs (NASA 2009). In potential habitat close to launch sites, vibrations may be significant enough to affect egg viability for both plovers and loggerheads nesting within the new beach. Knot activity in the vicinity of Launch Complex 0 is low; therefore effects to knots from vibration are unlikely.

Rocket Exhaust

Effect on plover, knot, and loggerhead from liquid fueled ELV launches, solid fueled ELV launches, ELV static fires, sounding rocket launches, sounding rocket static fire testing, disposal of waste rocket motors, drone target launches

Rocket exhaust from Pad 0-B is directed over the Atlantic Ocean by a vent located in the base of the gantry. Exhaust from launches and static tests at Pad 0-A is directed over the Atlantic Ocean through a flame trench in the launch pad. Wildlife within 200 to 300 m of the exhaust ports during engine ignition may be injured or killed. Plovers, knots, or loggerheads exposed directly to the exhaust could be burned by hot gas or by caustic combustion products. To be exposed, birds would need to be flying through the path of the exhaust plume at the time of ignition. Given the distribution of knot and plover habitat north and south of the launch complex and the likelihood that individual plovers will move around while establishing breeding territories or feeding and a plover or knot will likely pass through the area during migration, plovers and knots may be injured due to rocket exhaust, but the likelihood of this occurring is low. In 2013, a loggerhead nest was located just north of Pad 0-A suggesting that loggerheads may nest in proximity to the launch pads in the future and may be injured by hot exhaust.

Aluminum oxide particles in the atmosphere are efficient scavengers of water vapor and hydrogen chloride, and these particles produce hydrochloric acid. The combination of atmospheric and oceanic dilution and the buffering capacity of the ocean will prevent hydrochloric acid from impacting pH of habitats within the action area. Hydrogen chloride vapor may exist in hazardous quantities in the immediate vicinity of launch pad 0-B at the completion of a launch. A plover or knot flying through the area could be exposed to a caustic cloud of such vapor; however the disturbance of the launch event itself would likely repel birds from the immediate area for some time after engine ignition. Therefore, hydrochloric acid is not expected to adversely affect plovers, knots, or loggerheads (NASA 2005, 2009).

Estimates of carbon monoxide concentrations on the beach at the south end of Wallops Island following a launch or static test at either pad in Launch Complex 0 are between 0.9 and 1.1 parts per million, depending on weather conditions. These are below human exposure thresholds and believed to be below observable effects thresholds in wildlife. Atmospheric mixing and conversion of carbon monoxide to carbon dioxide will quickly diminish these concentrations; therefore, the concentration of carbon monoxide is not expected to adversely affect plovers, knots, or loggerheads (NASA 2005, 2009).

Lighting

Effect from liquid fueled ELV launches, solid fueled ELV launches, ELV static fires, sounding rocket launches, sounding rocket static fire testing, drone target launches, UAS flights, piloted aircraft flights, construction, launch pad lighting

Plover and knot - Rockets staged at Launch Complex 0 are up lit with metal halide lighting for up to several weeks prior to and several weeks following a launch. Other structures within the launch complex use amber LEDs or low pressure sodium bulbs for exterior night lighting. The close proximity of several facilities to the newly created beach is likely to result in elevated levels of light at this beach.

Other structures within the launch complex, as well as Payload Fueling Facility, Payload Processing Facility, and HIF, use amber LEDs or low pressure sodium bulbs for exterior night lighting. Additional lighting may also be used during construction of new facilities. Most of the existing and new facilities are not located immediately adjacent to the beach, which limits the potential effects on listed bird species; however, they do contribute to elevated levels of ambient lighting, and are some of the only lights on barrier islands within the action area. Amber LED and low-pressure sodium fixtures reduce the potential for negative impacts to wildlife. Such night lighting is expected to affect nesting plovers by leading to nest failure.

Anthropogenic lighting attracts migrating birds, especially during times of reduced visibility. Potential effects can range in intensity from collision with structures resulting in injury or mortality, to lesser effects including expenditure of energy or delay in arrival at breeding or wintering grounds (Gauthreaux and Belser 2006). The majority of Atlantic Coast piping plover migratory movements are thought to take place along a narrow flight corridor, including the outer beaches of the coastline, with rare offshore and inland observations (Service 1996). Plover visual acuity and maneuverability are known to be good (Burger et al. 2011), including night vision (Staine and Burger 1994), suggesting that plovers may be able to identify and avoid structures in their flight paths. Plover collisions with fixed structures in the coastal zone are rarely documented (Service 2008). The ability to avoid structures, such as the infrastructure on Wallops Island, could be reduced in poor visibility conditions (Burger et al. 2011). Migrating plovers may be attracted by the lighting on Wallops Island.

Migrating knots may be exposed to similar risks. Burger et al. (2011) report knot migration flights occurring at altitudes between 1,000 and 3,000 m AGL, well above the structures on Wallops Island. The most serious risk is likely to occur when northbound long-distance migrants make landfall at foraging areas. Wallops Island is a known stopover site for northerly migrating knots; however, the high-use areas are located well north of the Wallops Island infrastructure that may pose a risk to birds landing to rest or forage, resulting in a low likelihood of collision. Southbound migrants are at comparatively less risk due to their farther offshore flight paths. Although visual acuity and maneuverability of knots are known to be good (Burger et al. 2011, Cohen et al. 2011), inclement weather conditions could increase collision risk.

Lighting on Wallops Island may attract migrating plovers or knots and effects are expected to result in temporary diversion of flight or excess energy expenditure.

<u>Loggerhead</u> - Anthropogenic light sources have documented negative effects on sea turtles. Unshielded lights can deter females from crawling onto a beach to nest. Bright full-spectrum or white lighting within view from the beach can cause female sea turtles to abandon nest attempts (Witherington 1992). At hatching, juveniles emerge and seek the nearest available light source, which on an undeveloped beach is the horizon over the ocean. Bright full-spectrum or white lighting shining in the vicinity of a nest can disorient emerging hatchlings, leading them away from the ocean and leaving them more vulnerable to predation, desiccation, or crushing by vehicles (Witherington and Bjorndal 1991). Hatchlings that reach the surf can become disoriented by lighting and leave the surf (Witherington 1991, NMFS and Service 2007).

Amber LED and low-pressure sodium fixtures are considered to be “turtle friendly” lights (Witherington and Martin 2003), that reduce the potential for negative impacts. Night lighting at airstrips used are not in close proximity to areas used by loggerheads for nesting and effects are not expected. Effects on adult loggerheads from night lighting at facilities other than the launch complex are expected to be minor and may cause nesting loggerheads to avoid sections of the beach in proximity to the lighting. Hatchling loggerheads may be disoriented by the lights and effects may result in injury or death if they travel towards the lights and into the dunes rather than towards the surf.

UAS flights are occasionally conducted at night in response to special circumstances or for hurricane monitoring. Safety lighting at the airstrip will be minimal intensity and downward shielded, and over flying UAS will not use running lights. We expect some behavioral effects on adult turtles and disorientation of young turtles to occur.

Disturbance

Effect on plover, knot, and loggerhead from facility security, recreational/ORV beach use, and miscellaneous activities on and education use of Wallops Island beach

WFF personnel and their families are allowed to use the north end of Wallops Island for recreation outside of NASA operations periods. Recreational use, miscellaneous maintenance activities and security patrols conducted on the beach have similar effects on listed species because they may involve operation of vehicles or heavy equipment on the beach, in addition to people on foot in areas where plovers, knots, or loggerheads may occur. Security patrols have been ongoing at WFF for a number of years, and have likely presented some level of disturbance to plovers and nesting loggerheads.

Plover - Effects of foot traffic to nesting plovers can range from relatively minor disturbance that temporarily interferes with normal breeding, feeding, and sheltering behavior to injury or death of chicks, destruction of an entire nest, or sustained disturbance resulting in nest abandonment. Vehicle use on the beach can crush nests, eggs, or hatchlings. Vehicles can also create ruts capable of trapping plover chicks.

Closure of a plover nesting area will avoid these effects to the extent that the closure is observed; however, plovers may nest outside of the established closure area. In these cases, monitoring, placing nest exclosures, and posting signage will minimize potential effects to the identified nests. After hatching, young plovers are likely to move away from nesting areas, making them vulnerable to these effects throughout a much larger area. Even with surveys and monitoring conducted at a high frequency, there is potential that undetected nests will be disturbed or young plovers may be killed or injured. Plovers that migrate along the barrier islands between wintering grounds and breeding grounds may also be impacted by human activity and vehicle use interfering with their ability to forage.

Loggerhead - Security patrols and recreational use may inadvertently disturb nesting females, crush eggs within the nest, or crush, entrap, or disturb hatchlings attempting to leave the nest. Vehicle use on the beaches may compact beach sand and/or disturb female turtles attempting to nest. Monitoring for turtle activity followed by erecting exclosures to protect nests will avoid adverse impacts due to the low level of nesting activity exhibited at Wallops Island.

Plover and loggerhead - Effects to plovers and loggerheads are likely to include an increased predation rate due to human activity. Human activity may result in trash on the ground, which could both attract predators and increase the carrying capacity of the predators due to increased food availability. The increased numbers of predators may increase risk of disturbance, nest loss, and adult mortality of plovers and increase losses of loggerhead eggs and nests. Plovers may expend more energy in predator surveillance and avoidance and that energy expenditure could decrease overall fitness. However, use of these sites for recreation and security patrols is generally light and not continuous; therefore effects to plovers and loggerheads are expected to be minimal.

Knot - Both recreational and operational uses of Wallops Island beach have the potential to disturb foraging and resting knots. The presence of vehicles on the beach has been shown to result in fewer individuals as compared to an area without the disturbance, as affected shorebirds shift their preferred habitat (Pfister et al. 1992). A study in Massachusetts suggests that knots may be more susceptible to human disturbance (based on pedestrian induced flight-initiation distance) than other species commonly found on the beach during spring migration (Koch and

Paton 2014). In Virginia, Watts and Truitt (2015) demonstrated that the majority of knots are only present on the barrier islands for an approximately 4 to 5 week period in late spring.

Therefore, although knots could be exposed to beach use-induced stressors in the action area, impacts would be for a short duration. In addition, the majority of north Wallops Island is closed to recreational use (NASA 2015b) during the plover nesting season (April 15 to August 31), corresponding to the location on Wallops Island where a majority of knots have been observed in recent years. Additionally, Schlacher et al. (2008) demonstrated *Donax* spp. mortality when exposed to vehicle traffic; however, vehicle use at Wallops Island is far less than the area studied and impacts are not expected to be significant. Therefore, the knot is not expected to be adversely affected by alterations to its foraging base from facility security, recreational/ ORV beach use or miscellaneous activities on or education use of Wallops Island beach.

Effect on plover, and knot from protected species management and shoreline reconstruction monitoring

Monitoring activities involve conducting frequent surveys, implementing area closures and posting signage, placing plover nest enclosures, and similar actions. While the intent of monitoring activities is to reduce or avoid impacts to listed species by detecting them early, the increased human activity within beach habitats results in some adverse effects to listed species. Knots are generally disturbed to some degree during monitoring, causing them to temporarily cease normal behaviors. Plovers are generally disturbed to some degree during monitoring and efforts to locate nests, causing them to temporarily cease normal behaviors. This disturbance, while limited, may increase the likelihood of plover nest predation. Observers may inadvertently crush plover nests or young while accessing areas to conduct monitoring or management.

Effect on plover, knot, and loggerhead from seawall repair and beach renourishment

The operation of heavy equipment and presence of personnel on the beach in conjunction with seawall repair and sand placement will result in disturbance to plovers and knots using the area for foraging or passing through the area while moving among foraging areas. Any plovers or knots using these areas are expected to temporarily cease normal foraging, roosting, or flight behavior and fly to adjacent suitable areas where there is no disturbance, or alter their flight paths to avoid areas where activity is occurring. Similarly, during the nesting season loggerheads may be temporarily disturbed by onshore activities and move to other nearby areas where there is no disturbance. However, habitat quality for plovers and knots in degraded shoreline areas where seawall repair and sand placement will be occurring is low, so these species are not expected and these effects are expected to be insignificant and discountable. Habitat quality for loggerheads is also expected to be low, but loggerheads may attempt to nest in these locations. Loggerheads in the vicinity of the beach undergoing renourishment are likely to be disturbed by the activities; however, suitable nesting habitat is available on adjacent beaches and overall effects on nesting success are expected to be low.

Operation of the dredge is limited to offshore areas and will not affect the shoreline beyond delivery of sand; therefore, it will not affect the species considered in this opinion under the Service's jurisdiction. Effects to loggerheads at sea are addressed separately through NASA's section 7 consultation with NMFS.

In future renourishment efforts, NASA may obtain up to half of the sand for renourishment from the north Wallops Island borrow area instead of from offshore shoals. During plover and knot migration, operation of heavy equipment in the north Wallops Island borrow area is expected to result in frequent alteration of plover and knot feeding and sheltering behavior, causing physiological stress and increased vulnerability to predators. If sand removal is conducted during the nesting season, all aspects of plover breeding will be affected, resulting in lack of nesting, failure of nests, or mortality of chicks. Acquiring fill material from north Wallops Island will entail use of heavy equipment on the beach, which is expected to deter loggerhead nesting through frequent disturbance or result in reduced hatch success and hatchling survival by: increasing the chance of crushing nests, eggs, and hatchlings; compacting the sand in the nesting area; and trapping hatchling turtles in vehicle ruts. Equipment use on the beach at night may cause collisions that result in injury or death of female sea turtles attempting to nest and hatchling turtles on the beach.

After each renourishment cycle, shortly after construction of the beach and dune, beachgrass planting and sand fence installation will be conducted on the seaward side of the dune adjacent to the new beach. Depending on timing of installation, the increased presence of people on the beach may result in disturbance to plovers and knots. This disturbance is expected to cause plovers and knots to flush and move to other areas. However, because habitat quality for plovers and knots is low directly after beach renourishment, these species are not expected and effects are expected to be insignificant and discountable. The installation of sand fencing and planting are not expected to affect loggerheads because these activities will be conducted during the day and loggerheads are expected to be in close proximity to the beach during the night hours.

Once installed, the presence of sand fence may deter plover nesting close to the sand fence and may increase the risk of depredation by providing cover for predators in close proximity to plover nests. Migrating knots generally do not use the renourished beach for feeding and do not nest in Virginia; therefore, the presence of sand fence is not expected to affect knots. The sand fence is expected to allow movement of adult loggerheads above the berm and into the dune area and will not prevent them from returning to sea. If nests are located landward of the sand fence a small fraction of hatchling turtles may become trapped, particularly if the sand fence is not maintained or if debris entangled in the sand fence prevents hatchling movements.

Habitat Loss/Suitability

Effect from beach renourishment

<u>Plover</u> - The operation of heavy earthmoving equipment and other equipment involved in pumping and moving sand is expected to result in small amounts of fuel, oil, lubricants, and

other contaminants entering the water. Small quantities of these substances may result in death or impairment of invertebrate prey of plovers within limited areas. While toxicity to plovers is unlikely, reduction in prey may reduce the suitability of habitat for plovers in affected areas of the nourished beach.

The addition of sand dredged from offshore shoal A or B may result in a beach similar in appearance to a natural beach, but significantly different in sand density and compaction, grain size and assortment, and beach-associated fauna, including invertebrates, and nutrients and chemical characteristics of the sand. Immediately following sand placement, the suitability of the renourished beach for plovers is expected to be significantly less than a natural beach of similar size and configuration due to loss of invertebrate prey.

Over time, the faunal characteristics of a natural beach are expected to return as the created beach is recolonized by beach-associated fauna and plants, and as wave action, wind, rain, and other natural forces weather the beach (National Research Council 1995). After recolonization of the beach by invertebrates, the beach may become higher quality foraging habitat for plovers than surrounding natural beaches because the beach will remain free from vegetation for a period of time (Melvin et al. 1991) and may be higher and wider than nearby eroding beaches.

NASA monitoring data (NASA 2012b, 2013, 2014b, 2015b) shows that the number of plover nests is fairly consistent from year-to-year, suggesting that beach renourishment does not cause a decrease in the number of plover breeding territories on Wallops Island but that plovers may preferentially nest on north Wallops Island. Monitoring data shows that plovers nested on the renourished beach after 2 years (NASA 2014b, 2015b). Renourishment of the beach is not expected to result in a significant reduction in nesting success and survival on Wallops Island, although plovers may experience a decrease in their ability to rest or forage on the renourished beach and a temporary excess energy expenditure. Beach renourishment is expected to occur approximately once every 2 – 7 years. Based on the information provided by NASA, we are analyzing effects of the proposed action assuming a renourishment frequency of every 5 years. When renourishment is conducted, the beach and berm are expected to have eroded to the point where nesting by plovers is unlikely within the area identified to receive renourishment. Consequently, the effects of renourishment are expected to be limited to loss of habitat for migrant plovers that may use the area for feeding and sheltering.

In future renourishment efforts, NASA may obtain up to half of the sand for renourishment from the north Wallops Island borrow area instead of from offshore shoals. The delineated borrow area either includes or is immediately adjacent to areas used by plovers. The removal of sand from this area may result in a temporary decrease in habitat suitability or in temporary habitat loss as sand is physically removed from the area. If the activity is conducted during the nesting season, it is expected to interfere with all aspects of breeding including territory establishment, courtship, nesting, egg-laying, incubation, brooding, and feeding. This is expected to result in lack of nesting, failure of nests, or mortality of chicks. If borrow from North Wallops Island is conducted during the breeding season and all plover nests are located in proximity to the borrow site, complete reproductive failure may occur during that breeding season.

<u>Knot</u> - The area of Wallops Island beach that historically hosted the greatest number of knots during the northern migration – the north "curve" – is rapidly accreting and is outside the beach renourishment area (King et al. 2011). It is expected that this area of the beach will continue to provide knot habitat, effectively dampening the effects of beach renourishment when the fill material is sourced from offshore shoal A or B. If sand is obtained from offshore shoal A or B, beach renourishment is not likely to adversely affect knots.

The operation of heavy earthmoving equipment and other equipment involved in pumping and moving sand is expected to result in small amounts of fuel, oil, lubricants, and other contaminants entering the water. Small quantities of these substances may result in death or impairment of invertebrate prey of knots within limited areas. While toxicity to knots is unlikely, reduction in prey may reduce the suitability of habitat for knots in affected areas of the nourished beach.

Acquiring sand from north Wallops Island will affect the knot foraging base. Although the action will be conducted outside of peak spring avian activity, it could take several seasons for the excavated area to biologically recover, depending on the size and specific location of the removal action. In particular, *Donax* spp., a primary knot food source, could be suppressed if material were systematically removed from the intertidal zone. Conversely, should the material be removed only from the upper part of the seaward beach, the primary effect would be the displacement of wrack, another source of forage that would be expected to more rapidly regenerate as compared to *Donax*. As a result of removal of fill material from north Wallops Island, a majority of knots using this area are expected to shift their foraging requirements to other nearby barrier islands, which will provide sufficient resources to fulfill their foraging needs. Knots commonly use north Wallops Island beaches during migration, rather than the renourished beach. Therefore, effects to knots will be limited to migrant knots using the renourished area for feeding and sheltering and are expected to be insignificant and discountable.

<u>Loggerhead</u> - Loggerhead nesting occurred on Wallops Island beach following the initial beach fill cycle (NASA 2012b, 2013), which occurred prior to the 2012 nesting season. This suggests that the elevated beach can provide suitable nesting habitat after renourishment given time for conditions to return to suitable levels. However, Crain et al. (1995) concluded that effects of a beach renourishment on sea turtle nesting is not predictable based on other renourishments and potential effects should be considered on a case-by-case basis. The sand characteristics following beach and dune reconstruction are unlikely to be similar to those that occur on natural beaches in the area, especially shortly after deposition. The characteristics that may be important to loggerhead nesting and are likely to differ from those of natural beach include: gas exchange, moisture characteristics (drainage, desiccation, water potential), temperature, soil cohesion/shear characteristics, compaction, and others (Crain et al. 1995, Byrd 2004). Because of the relatively extensive beach following reconstruction and the relatively high elevation of the proposed berm compared to many natural beaches in the area, we expect loggerhead nesting to occur on the newly created beach after the physical characteristics of the sand return to a suitable condition.

Based on the large grain size of the sand from shoals A and B, the relatively long distance from the water line to the berm/dune interface where turtles would be expected to nest, and the placement of sand over and around the rock seawall for most of the project area, desiccation of the beach is expected because the sand will likely drain quickly, the rock seawall will interfere with maintaining a natural moisture gradient, and the area may be infrequently affected by waves. The sand color is expected to be similar to that which occurs on the beaches of the area because the material that occurs in the offshore shoals is eventually transported to the beaches and likely originates from the same material as that which occurs on the beach.

Differences in color, grain size, and moisture content affect sand temperatures. The gender of sea turtles is determined by incubation temperatures; as a result, even relatively slight changes in sand temperature may alter the sex ratio of hatchlings. The sand is expected to show less cohesiveness and lower shear strength than sand found on natural beaches, which may reduce the ability of nestlings to emerge from the egg chamber under some conditions.

Compaction of the sand is expected to occur as a result of the use of heavy equipment and pumping of heavy slurry during sand placement. The amount of equipment use and the associated degree of compaction is not known, but due to the need to place sand over the seawall and contour the beach to design specifications, compaction is expected to occur. This compaction can reduce the ability of females to excavate an egg chamber, and can also reduce gas exchange, drainage, and other sand characteristics.

Crain et al. (1995) and Byrd (2004) noted that differences in turtle use and nest success between nourished and natural beaches was reduced over time. As wave action weathers the beach profile and re-sorts the sediments, the suitability for turtle nesting changes. It is not possible to accurately predict the success of loggerhead nesting attempts that may occur within the area following beach and dune reconstruction because the characteristics and the relative suitability of the beaches in the area for loggerhead nesting are not well known. It is possible that the beach will be more suitable for loggerhead nesting than other beaches in the area due to its relatively high elevation and different sand characteristics, and nest attempts may be successful; however, nest failure and reduced rates of hatchling emergence are expected to occur on this beach for up to 2 years after sand placement due to one or more of the factors described above.

NASA expects to avoid sand placement that may affect nests, and monitoring is expected to determine location of nests prior to sand placement. These nests may be subject to reduced hatch success as a result of changes in the moisture regime, gas exchange, and physical characteristics of the beach that result from adjacent sand placement and operation of heavy equipment in the general vicinity of the nests.

Plover, knot, and loggerhead - Following placement of sand on the beach and dune, some portion of this material will be transported onto natural beaches adjacent to the project area. Natural wind and current patterns are likely to transport sand to the north and deposit it on north Wallops Island and portions of CNWR, and also to the south, where it will be deposited on Assawoman Island. The amount and degree of deposition on these islands is dependent on environmental conditions (e.g., storms, wave action) and other factors that may affect littoral sand transport. Over time, the deposition of the relatively large sand grains will affect mean sand grain size and other physical characteristics of these beaches. These changes may either improve or reduce the suitability of unnourished beaches for plover nesting and foraging, knot foraging, and loggerhead nesting. These changes may shift the areas that plovers and knots use for foraging, or that plovers and loggerheads use for nesting but total area used by these species is not likely to change.

Acquiring fill material from north Wallops Island will decrease habitat suitability of north Wallops Island for all listed species. Movement of sand material from the borrow area will result in beach compaction. Additionally, the borrow area is the most seaward portion of the beach; as a result, the remaining beach will have a steeper initial profile, be more vegetated, and have different physical properties (e.g., sand grain characteristics, drainage) than a natural beach. Movement of sand material using heavy equipment will result in extensive sand compaction in the renourished area. These characteristics will make it less suitable for use by plovers, knots, and loggerheads. As wave action and weathering affect the beach position and profile, vegetation will be killed or uprooted and the beach contour, sediment stratification, and other characteristics return, the beach suitability and amount of available habitat is expected to improve.

The sand placed on the renourished beach will initially be unsuitable for use by invertebrates and plants characteristic of natural beaches and much of the fauna on the beach will be killed or negatively impacted by the renourishment. The beach conditions are expected to be completely unsuitable for use by migrating knots, and nesting plovers and loggerheads during the first year following sand placement, with limited amounts of suitable habitat available 1 year following placement, and returning to conditions similar to those that existed prior to placement by 3 years following placement. Use of the north Wallops Island borrow area may allow some faster recovery of flora and fauna if seeds or fauna in the sand survive transportation and placement, but because at least half of the renourishment material will originate from offshore shoals the difference is not expected to significantly improve the recovery time of beach-associated flora and fauna.

Additive Effects of Proposed Activities

In addition to the effects of the proposed actions considered and described above, the additive effects of the different types of activities result in greater impacts than each activity conducted independently. For example, operations of UAS within the parameters described may result in infrequent disturbance and some launch operations, rocket tests, and monitoring may have similar effects. The combination of all of these activities, when considered together, results in more frequent disturbance and as a result we expect plovers and loggerheads to experience low levels of disturbance in the action area on a regular basis.

Frequent disturbance to plovers, knots, and loggerheads resulting from mission preparation and support may disturb the species to the extent that they avoid use of the south end of Wallops Island where mission related activities are concentrated. If they avoid use of the area, listed species may not be subjected to the most intense and severe effects expected to occur during rocket launches. In addition, because the suitability of the newly created beaches is expected to be relatively low for a period following sand placement, use by plovers and loggerheads may be reduced and as a result some of the most severe effects resulting from launches may be reduced. However, because some nesting loggerheads and migrant plovers and knots use the beach only for limited periods of time, frequent disturbance and/or low habitat suitability is not expected to completely prevent the most severe effects from occurring.

Interrelated and Interdependent Actions – An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. The Service is not aware of activities interrelated to or interdependent with the proposed action at this time.

Beneficial Actions – Shoreline restoration is a useful tool to reverse shoreline habitat loss and expand habitat availability for coastal species in a dynamic system. Following a short period of lower habitat suitability when sand is initially placed, the larger area of restored beach is expected to support feeding, sheltering, and nesting plovers; nesting loggerheads; and feeding and sheltering knots. Shoreline restoration may provide habitat to support larger populations of these listed species than currently exist and may contribute to increased productivity.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. The Service is not aware of any future State, tribal, local, or private actions within the action area at this time.

CONCLUSION

The combined effects of a variety of different activities on plovers and loggerheads are expected to result in reduction in either reproductive output or success. Although not common, nesting by plovers that occurs close to launch pads is most likely to be disturbed. Exposure to launch exhaust and extreme noise, or collision with UAVs or piloted aircraft may cause injury or death of a small number of plover or knots. Recreational use, security patrols, and species monitoring are expected to pose some risk to plovers, knots, and loggerheads because they occur within the habitats these species occupy and may directly and indirectly affect the species. Effects to loggerhead nests as a result of operational activities are expected to be minimal as a result of extensive monitoring for turtle crawls and marking of nests.

Sand placement on the renourished beach will result in temporary disturbance to plovers, knots, and loggerheads due to additional activity. Sand placement will also result in temporary habitat loss for plovers, and knots due to the reduction of prey base, and for loggerheads due to changing physical characteristics of the sand. Sand removal from north Wallops Island may cause collision with equipment to nesting loggerheads or disturbance from increased activity to nesting or migrating plovers, migrating knots, and nesting loggerheads. Sand removal from north Wallops Island will also result in temporary habitat loss for plovers, knots, and loggerheads as sand will be removed adjacent to areas used by these species. Sand removal from shoal A or B is not expected to result in effects to plovers, knots, or loggerheads. Because of the amount of listed species habitat available, the listed species management and monitoring proposed, and the relatively low intensity effects anticipated, we expect only a small portion of the occurrences of each of these species will be affected, and none of the activities are expected to significantly reduce the suitability of the habitats for these species.

After reviewing the status of the plover, knot, and loggerhead, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed and ongoing launch operations at the MARS and SRIPP at the WFF, as proposed, is not likely to jeopardize the continued existence of the plover, knot, or loggerhead, and is not likely to destroy or adversely modify designated critical habitat. Critical habitat for the plover and loggerhead has been designated; however, this action does not affect that area and therefore no destruction or adverse modification of critical habitat is anticipated. Critical habitat has not been proposed for the knot at this time.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken by NASA so that they become binding conditions of any grant or permit issued to any applicant/contractor, as appropriate, for the exemption in section 7(o)(2) to apply. NASA has a continuing duty to regulate the activity covered by this incidental take statement. If NASA (1) fails to assume and implement the terms and conditions or (2) fails to require any applicant/contractor to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, NASA must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

AMOUNT AND EXTENT OF TAKE

The Service anticipates incidental take of plovers, knots, and loggerheads will be difficult to detect and take may be masked by seasonal fluctuations in numbers and other environmental factors. Detecting mortality or injury of plovers (especially chicks), particularly on beaches where vehicles are being operated, is extremely difficult. Cryptic coloration is the species' primary defense mechanism, evolved to cope with natural predators, and nests, adults, and chicks blend with beach surroundings. Newly hatched chicks stand 2.5 inches high, weigh less than a quarter ounce, blend with the beach substrate, and often respond to approaching vehicles, pedestrians, and perceived predators by "freezing" in place to take advantage of their natural camouflage. Dead chicks may be covered by wind-blown sand, ground into the sand by other passing vehicles, washed away by high tides, or consumed by scavengers. Knots will be similarly difficult to detect, although their larger size and less cryptic coloration is likely to lead to higher detectability than plovers. Loggerhead nests are generally detected by observing crawl marks on the beach and nest locations are recorded and marked. If nests are not detected by crawl marks, it is unlikely that they, along with their success or failure, will be documented.

Plover - The average plover productivity from 2012 to 2015 on Wallops Island, 1.33 chicks/pair, is the best estimate of productivity (NASA 2015a). The Service anticipates incidental take of 2 plover nests (2 x 1.33 = 2.66) (3 eggs or chicks) in the first breeding season following each 5-year beach renourishment cycle. Additionally, incidental take of 1 plover nest (1 x 1.33 = 1.33) (2 eggs or chicks), through either adults failing to nest or nest failure, in the second year of each renourishment cycle. This take will be in the form of harass, harm, injury, or death.

Incidental take of 1 plover pair, resulting in loss of 1 nest (1 x 1.33 = 1.33) (2 eggs or chicks), is anticipated per year from disturbance associated with ongoing operations, including rocket launches, recreational use of the beach, UAVs and piloted aircraft. This take will be in the form of harass.

Incidental take of 2 plovers (adult or post-fledging) is anticipated per year from the effects of launch-related activities immediately adjacent to the beach, resulting from intense sound, exposure to rocket exhaust and contaminants, collision with aircraft, and similar launch activities. This take will be in the form of injury or death.

Knot – Aerial surveys conducted from 2005 through 2014 (Watts and Truitt 2014) documented an average of 276 knots using Wallops Island. The Service anticipates incidental take of 28 knots per year (10 percent of the average observations of knots on Wallops Island) over 2 years during each 5-year beach renourishment cycle resulting from borrowing sand from the north Wallops Island borrow area, as a result of disturbance from heavy equipment and decreased habitat suitability for foraging during spring migration. This take will be in the form of harass or harm.

Incidental take of 2 adult knots is anticipated per year from the effects of launch-related activities immediately adjacent to the beach, resulting from intense sound, exposure to rocket exhaust and contaminants, collision with aircraft and similar launch activities. This take will be in the form of injury or death.

Loggerhead - The Service anticipates incidental take of hatchlings from 2 loggerhead nests (1 nest = 128 hatchling turtles; 2 x 128 = 256)) (256 hatchlings) every 5 years as a result of beach renourishment that may bury nests or place sand of a grain size that does not support loggerhead nesting attempts. This take will be in the form of harass, injury or death.

Incidental take of 1 adult loggerhead is anticipated every 5-year beach renourishment cycle from beach renourishment and associated activities, including disturbance of a nesting female that prevents her from nesting successfully. This take will be in the form of harass, injury, or death.

Incidental take of 1 adult loggerhead is anticipated per year resulting from exposure to intense sound or exhaust gases and contaminants released during launch of rockets. This take will be in the form of injury or death.

Table 4. Summary of anticipated incidental take.

Amount of Anticipated Take	Cause of Anticipated Take	Form of Anticipated Take	Frequency of Anticipated Take	Length of Biological Opinion	Total Anticipated Take
Plover					
5 eggs or chicks	beach nourishment	harass, harm, injury, or death	every 5 years	15 years	15 eggs or chicks
2 eggs or chicks	ongoing operations, including rocket launches, recreational use of the beach, UAVs and piloted aircraft	harass	every year	15 years	30 eggs or chicks
2 individuals (adult or post-fledging)	launch-related activities immediately adjacent to the beach, resulting from intense sound, exposure to rocket exhaust and contaminants, collision with aircraft, and similar launch activities	injury or death	every year	15 years	30 individuals
Plover total					**75**
Knot					
56 individuals	borrowing sand from the north Wallops Island borrow area, as a result of disturbance from heavy equipment and decreased habitat suitability for foraging during spring migration	harass or harm	every 5 years	15 years	168 individuals

2 adults	launch-related activities immediately adjacent to the beach, resulting from intense sound, exposure to rocket exhaust and contaminants, collision with aircraft and similar launch activities	injury or death	every year	15 years	30 individuals
Knot total					**198**
		Loggerhead			
256 hatchlings	beach renourishment	harass, injury, or death	every 5 years	15 years	768 hatchlings
1 adult	beach renourishment and associated activities	harass, injury, or death	every 5 years	15 years	3 adults
1 adult	exposure to intense sound or exhaust gases and contaminants released during launch of rockets	injury or death	every year	15 years	15 adults
Loggerhead total					**786**

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of listed species:

1. Conduct routine surveys and monitoring for the species addressed in this biological opinion and implement measures to avoid potential impacts whenever possible.

2. Conduct surveys and monitoring to determine the effects of the proposed action on listed species and their habitat.

3. Actively manage habitats and human activity on the beaches to avoid and minimize potential impacts to listed species.

TERMS AND CONDITIONS

To be exempt from the prohibitions of section 9 of the ESA, NASA must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1. Implement the Wallops Island Protected Species Management Plan for the duration of the proposed action and provide an annual report summarizing the survey and monitoring efforts, location and status of all occurrences of listed species recorded, and any additional relevant information. Reports should be provided to the Service in digital format, at the email address provided below by December 31 of each year.

2. Report any evidence of previously undocumented listed species located on Wallops Island to the Service at the email address provided below within 5 business days of observation.

3. Develop a training and familiarization program for all security personnel conducting patrols in areas where listed species may occur. This training program shall include basic biological information about all listed species and be sufficient to allow personnel to tentatively identify the species and its likely habitat to allow them to incorporate appropriate avoidance and minimization measures into their activities.

4. Excavate sand from the north Wallops Island borrow area for beach renourishment outside of plover and sea turtle nesting season (March 15 through November 30 or the last date of potential sea turtle hatchling emergence based on laying dates of all nests). Stockpile sand outside the north Wallops Island borrow area, and outside potential nesting habitat for plovers and sea turtles prior to placement for renourishment.

5. Following launches of rockets, conduct surveys for injured, dead, or impaired birds and sea turtles. These surveys must be conducted as soon as safety permits following launches. Provide reports of survey results to the Service in digital format, at the email address below, within 15 business days of each launch event.

6. Care must be taken handling any dead specimens of proposed or listed species that are found to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the ESA. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective. Upon locating a dead specimen, notify the Service's Virginia Law Enforcement Office at 804-771-2883, 7721 South Laburnum Avenue, Richmond, Virginia 23231, and the Service's Virginia Field Office at 804-693-6694 at the address provided on the letterhead above.

The Service believes that no more than 75 plovers, 198 knots, and 786 loggerheads will be incidentally taken as a result of the proposed action over the 15-year term of the biological opinion. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

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

1. NASA is encouraged to develop an integrated habitat conservation and management plan for Wallops Island. Due to the significance of the area for the conservation of migratory birds and other species, nearly all habitats that occur on WFF provide value to these species. Active efforts to manage habitat, including activities such as control of non-native invasive plants, may significantly improve the value of these areas as habitat.

2. NASA is encouraged to collect data on the characteristics of beaches and habitat where sea turtle nests and plover nests occur and share this information with the Service and VDGIF, or work with other interested parties to develop protocols for data collection and analysis throughout Virginia to improve our understanding of plover and sea turtle habitat characteristics.

3. NASA is encouraged to transition security from the current system of frequent roving patrols to a closed circuit television system to reduce beach access to the minimum required to augment the cameras in providing facility security.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If you have any questions, please contact Sarah Nystrom of this office at 804-824-2413, or Sarah_Nystrom@fws.gov.

Sincerely,

FOR

Cindy Schulz
Field Supervisor
Virginia Ecological Services

cc: Corps, Norfolk, VA (Attn: William T. Walker)
FAA, Washington, DC (Attn: Daniel Czelusniak)
NMFS, Gloucester, VA (Attn: David O'Brian)
Service, Chincoteague Island, VA (Attn: Kevin Holcomb)
Service, Chincoteague Island, VA (Attn: Kevin Sloan)
VDCR, DNH, Richmond, VA (Attn: René Hypes)
VDGIF, Machipongo, VA (Attn: Ruth Boettcher)
VDGIF, Richmond, VA (Attn: Ernie Aschenbach)

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