NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NOTICE: 09-WFF-10

National Environmental Policy Act; Expansion of the Wallops Flight Facility Launch Range

AGENCY: National Aeronautics and Space Administration

ACTION: Finding of No Significant Impact

SUMMARY: Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321, *et seq.);* the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Parts 1500-1508); and National Aeronautics and Space Administration (NASA) policy and procedures (14 CFR Part 1216, Subpart 1216.3); NASA has made a Finding of No Significant Impact with respect to expansion of the Wallops Flight Facility (WFF) launch range. Under the Proposed Action, NASA and Mid-Atlantic Regional Spaceport facilities would be upgraded to support up to and including medium large class suborbital and orbital Expendable Launch Vehicles at WFF.

ADDRESS: Copies of the Final Environmental Assessment (EA) may be viewed at the following locations:

Eastern Shore Public Library, 23610 Front Street, Accomac, Virginia 23301
Hours: Mon, Tues, Wed, Fri: 9 a.m. - 6 p.m.; Thurs: 9 a.m. - 9 p.m.; Sat: 9 a.m. - 1 p.m.
Phone: (757) 787-3400

Chincoteague Island Library, 4077 Main Street, Chincoteague, Virginia 23336
Hours: Mon: 10 a.m. - 2 p.m.; Tues: 10 a.m. - 5 p.m.; Wed, Fri, Sat: 1 p.m. - 5 p.m.
Phone: (757) 336-3460

NASA WFF Technical Library, Building E-105, Wallops Island, Virginia 23337
Hours: Mon – Fri: 8 a.m. - 4:30 p.m.
Phone: (757) 824-1065

On the Internet at: http://sites.wff.nasa.gov/code250/docs/EWLR_FEA.pdf

A limited number of copies of the Final EA are available by contacting:

Joshua A. Bundick
NEPA Program Manager
NASA Wallops Flight Facility, Code 250.W
Wallops Island, VA 23337

FOR FURTHER INFORMATION CONTACT: Joshua A. Bundick, (757) 824-1579 (phone); (757) 824-1819 (fax)

SUPPLEMENTAL INFORMATION: The National Aeronautics and Space Administration **(**NASA) has reviewed the Environmental Assessment (EA) prepared for the expansion of the launch range at the NASA Goddard Space Flight Center's (GSFC) Wallops Flight Facility (WFF) and has concluded that the EA represents an accurate and adequate analysis of the scope and level of associated environmental impacts. NASA hereby incorporates the EA by reference in the Finding of No Significant Impact (FONSI). NASA solicited public and agency review and comment on the environmental impacts of the proposed action through:

1. Publishing a notice of availability of the Draft EA in the Eastern Shore News on April 25, 2009 and the Chincoteague Beacon on April 30, 2009;
2. Making the Draft EA available at the Eastern Shore Public Library, Chincoteague Island Library, and WFF Technical Library;
3. Publishing the Draft EA on the WFF Environmental Office Web site;
4. Consulting with federal, state, and local agencies; and
5. Mailing the Draft EA directly to interested parties.

Comments received were taken into consideration in the Final EA.

WFF is a NASA GSFC field installation located in Accomack County on the Eastern Shore of Virginia. The EA addresses the proposed expansion of the launch range at WFF, and describes the potential impacts from the No Action Alternative and two Proposed Action Alternatives.

Under the No Action Alternative, NASA and the Mid-Atlantic Regional Spaceport (MARS) MARS would not expand their respective facilities to accommodate the transportation, processing, and launching of larger Expendable Launch Vehicles (ELVs) and spacecraft at WFF.

Under both Proposed Action Alternatives, NASA and MARS facilities would be upgraded to support up to and including medium large class suborbital and orbital ELV launches at WFF. Existing facilities at WFF are currently unable to adequately support such missions. Additional infrastructure would be needed to support larger civil, defense, commercial, and academic missions, including those needed by the United States to re-supply the International Space Station with cargo following the retirement of the Space Shuttle.

Alternative One would include site improvements required to support launch operations (such as facility construction and infrastructure improvements); testing, fueling, and processing operations; up to two static fire tests per year; and launching of up to six ELVs and associated spacecraft per year from MARS Pad 0-A on south Wallops Island. A variety of ELVs could be launched from Pad 0-A; however Orbital Sciences Corporation's Taurus II ELV would be the largest.

All construction would occur on Wallops Island. NASA would make minor modifications to its north boat dock; construct a Payload Processing Facility (PPF), Payload Fueling Facility (PFF), and a Horizontal Integration Facility (HIF). NASA would also construct new roads and make minor upgrades to existing roads; and make minor modifications to the interiors of existing launch support facilities. MARS would construct a new launch complex and Liquid Fueling Facility (LFF) in approximately the same location as the existing Pad 0-A.

Implementation of Alternative One would maximize WFF's ability to accommodate the nation's future medium class ELV needs and would result in a maximum of 18 orbital-class launches from MARS Launch Complex 0 per year (12 existing launches from Pad 0-B, and 6 additional launches from Pad 0-A).

Under Alternative Two, NASA and MARS would maximize the use of existing facilities at WFF. Alternative Two would include site improvements required to support launch operations; testing, fueling, and processing operations; and up to two static fire tests per year. As with Alternative One, a variety of ELVs could be launched from Pad 0-A. Taurus II would be the largest.

All construction under Alternative Two would occur on Wallops Island. NASA would make minor modifications to its north boat dock; construct a "high-bay" addition to Building V-45 to be used for ELV and payload processing; construct new roads and make minor upgrades to existing roads; and make minor interior modifications to existing launch support facilities. MARS would construct a new launch complex and LFF in approximately the same location as the existing Pad 0-A.

A maximum of three orbital-class launches per year would occur from Pad 0-A, resulting in a maximum of 15 orbital-class launches from MARS Launch Complex 0 per year (12 existing launches from Pad 0-B, and 3 additional launches from Pad 0-A). Although Alternative Two would increase WFF's ability to support larger orbital class ELVs, the reduced infrastructure investment would not allow WFF to fully accommodate the nation's expected future medium class ELV needs.

SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS: Potential environmental impacts resulting from NASA's Proposed Action, Alternative One, are summarized below:

Topography: Site improvement activities would not substantially alter topography; therefore, changes to natural drainage patterns would be minor.

Geology and Soils: Construction activities and spills or leaks that may occur during storage or transportation of materials would have the potential to affect soils. To mitigate impacts, NASA and MARS would implement site-specific best management practices for vehicle and equipment fueling and maintenance, and spill prevention and control measures. Driven piles would create long-term changes to the subsurface geology immediately around the driven piles; however, the changes would be site specific and negligible.

Surface Waters Including Wetlands: Construction activities, spill or leaks during storage or transportation of materials, launch emissions, and launch failures would all have the potential to affect surface waters including wetlands. Approximately 1.7 hectares (4.1 acres) of wetlands would be affected by construction. To mitigate such impacts, NASA and MARS would complete additional wetland delineations if needed, and obtain all necessary federal, state, and local permits prior to construction. During the permitting process, NASA would work with regulatory agencies to develop and implement mitigation measures; including compensatory wetland restoration, enhancement, and preservation to ensure no net loss of wetlands and to improve habitat conditions on WFF property.

Marine Waters: Temporary adverse impacts on marine waters in the area immediately surrounding the north Wallops Island boat basin would occur during improvements to the dock. Spent ELV stages falling into the ocean would impact the marine environment. Marine waters would be affected if a barge or vessel were to accidentally spill its fuels or lubricants into the ocean or estuary environment. Toxic concentrations are not anticipated in the open ocean due to the mixing and dilution rates associated with the wave movement and the vastness of the ocean environment; therefore, adverse impacts on marine waters would be short term and localized.

Floodplains: All facility construction and infrastructure improvements would take place within the 100-year and 500-year floodplains. Because Wallops Island is the location for WFF's core launch range functions, and is entirely within the floodplain, no practicable alternatives exist. The functionality of the floodplain on Wallops Island would not be substantially reduced due to the presence of proposed facilities because the footprint of the facilities would not cover a substantial area of the island.

Coastal Zone Management: All construction activities and rocket launches would occur within Virginia's Coastal Management Area. The Virginia Department of Environmental Quality (VDEQ) concurred with NASA's determination that the Proposed Action is consistent with the enforceable policies of the Virginia Coastal Resources Management Program.

Stormwater: Construction activities would result in minor changes to stormwater conveyance due to disruptions of the natural drainage. To mitigate impacts, NASA and MARS would design facilities in accordance with the Virginia Stormwater Management Law and Regulations and obtain Virginia Stormwater Management Program permits prior to construction. Up to 4 hectares (10 acres) of impervious area would be added. Addition of impervious area would result in a long-term adverse impact; however, with the incorporation of permanent stormwater management practices into site design, the impact would be localized and would not present a substantial adverse effect.

Wastewater: No adverse impacts would occur as the WFF wastewater treatment plant has the capacity to treat the approximately 4.5 percent increase from the new facilities and personnel.

Groundwater: NASA would provide potable water to the PPF, PFF, and HIF for drinking water supply, fire suppression, and industrial water use. In addition, static fire testing and launches would require the use of deluge water. Although WFF's water use would increase, maximum withdrawal amounts would be within the limit allowed by NASA's existing groundwater withdrawal permit.

Air Quality: Construction activities would generate fugitive dust and combustion emissions. Operation of generators and boilers would result in minor emissions of pollutants. NASA and MARS would mitigate adverse impacts to air quality by obtaining air emission permits from the VDEQ and by implementing site-specific best management practices such as fugitive dust control and regular engine/system maintenance. No far-field impacts from rocket exhaust are anticipated. Short-term adverse impacts in the area immediately surrounding the launch pad, resulting from rocket exhaust, include high temperature exhaust gas mixture and elevated carbon monoxide concentrations.

Noise: Construction and transportation activities would have the potential to generate temporary increases in noise levels from heavy equipment operations. To mitigate impacts, NASA and MARS would require that workers wear hearing protection in accordance with Occupational Safety and Health Administration standards. Launches and static test firing would create loud instantaneous noise that may be heard for several miles from WFF. To mitigate public disturbance, NASA and MARS would continue to notify the public in advance of planned operations via widely available media outlets, including the internet, local radio stations, and newspapers.

Orbital and Reentry Debris: ELV upper stages and spacecraft placed into orbit would generate orbital debris that could re-enter the Earth's atmosphere. All orbital missions originating from WFF would comply with sponsoring or licensing agency processes for limiting generation of orbital debris, assessing the risk of reentry, and ensuring public safety.

Hazardous Materials and Hazardous Waste Management: The principal hazardous materials used would be liquid propellants (primarily liquid oxygen and rocket-grade kerosene), hypergolic propellants, pressurized gases, and various solvents and compounds used to process the ELV and spacecraft. The greatest potential impact to the environment would result from an accident (e.g., leak, fire, or explosion) at a storage location or from an accidental release during fueling, payload processing, or launch activities (e.g., spills or human exposure). To mitigate potential impacts, NASA and MARS would manage all hazardous materials and waste in accordance with applicable federal, state, and local regulations. Additionally, NASA and MARS would develop and implement emergency response plans, including the WFF Integrated Contingency Plan, to ensure that impacts would be minimized in the unlikely event of a hazardous substance release.

Radiation: Spacecraft processed and launched at WFF could result in a potential source of radiation. However, the amount of radioactive materials would be very small and the materials would be managed in accordance with federal licensing and safety regulations.

Munitions and Explosives of Concern: Ground disturbances during construction may have the potential to uncover munitions and explosives of concern (MEC) on Wallops Island. To mitigate potential impacts, a qualified MEC specialist would evaluate the area proposed for ground disturbance and conduct a survey of the area if necessary prior to construction activities.

Vegetation: Long-term adverse impacts to vegetation would occur due to the removal of 0.45 hectares (1.1 acres) of trees and 1.7 hectares (4.1 acres) of wetland vegetation due to the construction of the PPF, PFF, and road improvements. Impacts would be localized and would not present a substantial adverse effect. Minor adverse effects on vegetation from launches would also occur, but would be limited to a localized area around Pad 0-A. To mitigate impacts to wetlands, NASA and MARS would provide compensatory wetland restoration, enhancement, and preservation to ensure no net loss of wetlands and to improve habitat conditions on WFF property.

Terrestrial Wildlife and Migratory Birds: Short-term adverse impacts to wildlife and migratory birds may occur during construction activities, launches, and static fire activities. Long-term impacts may occur due to the loss of wetland and forest habitat. To mitigate impacts to wetland habitats, NASA and MARS would compensate for such losses by restoration, preservation, and enhancement of wetlands.

Threatened and Endangered Species: NASA determined that the proposed boat dock improvements would not likely adversely affect federally listed sea turtles or marine mammals; the National Marine Fisheries Service (NMFS) concurred with NASA's determination. NASA consulted informally with the U.S. Fish and Wildlife Service (USFWS) regarding effects of the proposed action on listed sea turtles, piping plover, seabeach amaranth, and the candidate red knot. During this consultation, NASA found that proposed construction would not adversely affect listed species. However, the exterior lighting on proposed facilities and the noise and vibration associated with larger ELV operations (i.e., static fire testing and launches) may adversely affect nesting sea turtles and piping plovers. To mitigate impacts, NASA would implement lighting management procedures, as appropriate, during sea turtle nesting season, and would continue to manage the piping plover by regular monitoring and establishment of "off limits" areas during nesting season. Due to the historically low density of nesting sea turtles within the action area, and with the implementation of the above described mitigation measures, no substantial effect to listed species would be expected. NASA has prepared a Biological Assessment for the Proposed Action in accordance with the Endangered Species Act and would formally consult with USFWS prior to activating exterior lighting or conducting static fire testing or launches when sea turtles or plovers may be present. NASA would adhere to additional mitigation measures developed during formal consultation with USFWS.

Marine Mammals and Essential Fish Habitat: Spent ELV stages would fall into the ocean many miles offshore; no adverse effects on marine species are anticipated as a result. Although highly unlikely, debris and toxic materials from launch failures have a small potential to adversely affect marine mammals or managed fish species and their habitats in the vicinity of the project area. Implementation of emergency cleanup procedures would mitigate any impacts. NASA consulted with NMFS regarding impacts to Essential Fish Habitat (EFH) from the proposed action; NMFS responded that the north Wallops Island boat dock improvements would not result in substantial adverse effects to EFH, managed species, or their prey species.

Population, Employment, and Income: Construction activities would temporarily increase local employment opportunities and benefit local stores and businesses, and launch support activities would bring up to125 new jobs to the area. Tax revenue would increase as a result, and the local economy would benefit from launches (tourism, services and commodities support, lodging, etc.).

Environmental Justice: Disproportionately high or adverse impacts to low-income or minority populations are not anticipated.

Health and Safety: Construction activities at the WFF site could result in short-term impacts to human health and safety and the increased usage of local fire, police, and medical services. Operation of spacecraft fueling and processing facilities and ELV launches would not present substantial impacts to public safety as all operations would be conducted in accordance with mission-specific ground and flight safety plans.

Cultural Resources: Ground disturbance would be located outside of areas designated as having moderate or high potential for archeological resources. No adverse effects on aboveground historic properties are anticipated. NASA consulted with the Virginia Department of Historic Resources (VDHR). VDHR concurred with NASA's determination that the proposed action would not adversely affect any historic properties.

Transportation: Temporary impacts to traffic flow would occur during construction activities and during the transportation of ELV and spacecraft components. To meet flight safety requirements, roads could be temporarily closed prior to and during a launch. However, such closures would be of short duration and infrequent. To mitigate impacts, NASA and MARS would coordinate closely with state and local officials regarding launch-related road closures, and would provide the public with prior notice to minimize disruption.

Cumulative Impacts: Cumulative impacts were evaluated for potentially affected resources including wetlands, groundwater, air quality, biological resources, and socioeconomic resources. No substantial cumulative impacts are anticipated from the Proposed Action when added to other known past, present, and reasonably foreseeable future actions within the WFF area.

Conclusion: NASA has identified no other issues of potential environmental concern. Based on the Final EA for the Expansion of the Wallops Flight Facility Launch Range, and review of underlying reference documents, NASA has determined that the environmental impacts associated with the Proposed Action will not individually or cumulatively have a significant impact on the quality of the human environment. Therefore, an environmental impact statement is not required.

Dr. John H. Campbell
Director
NASA Wallops Flight Facility

August 29, 2009
Date

FINAL REPORT

ENVIRONMENTAL ASSESSMENT FOR THE EXPANSION OF THE WALLOPS FLIGHT FACILITY LAUNCH RANGE

Prepared for

National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337

August 2009

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FINAL ENVIRONMENTAL ASSESSMENT
EXPANSION OF THE WALLOPS FLIGHT FACILITY LAUNCH RANGE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
WALLOPS FLIGHT FACILITY
WALLOPS ISLAND, VA 23337

Lead Agency:	National Aeronautics and Space Administration
Cooperating Agency:	Federal Aviation Administration Office of Commercial Space Transportation
Proposed Action:	Expansion of the Wallops Flight Facility Launch Range on Wallops Island, Virginia
For Further Information:	Joshua A. Bundick NEPA Program Manager Code 250.W Goddard Space Flight Center’s Wallops Flight Facility National Aeronautics and Space Administration Wallops Island, VA 23337 (757) 824-1579
Date:	August 2009

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ABSTRACT

This Environmental Assessment addresses the proposed expansion of the launch range at the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) Wallops Flight Facility (WFF), which is located on the Eastern Shore of Virginia. Under the Proposed Action, NASA and Mid-Atlantic Regional Spaceport (MARS) facilities would be upgraded to support up to and including medium large class suborbital and orbital expendable launch vehicle (ELV) launch activities from WFF.

The Proposed Action would have both adverse and beneficial impacts to environmental and socioeconomic resources; however, most adverse impacts are minor and of short duration. Adverse impacts would be mitigated to the greatest extent practicable to minimize the effects on resources.

PURPOSE AND NEED FOR THE ACTION

The purpose of the Proposed Action is to expand and enhance the respective NASA and MARS facilities at WFF such that they are able to accommodate a wider variety of new launch vehicles and payloads. The expansion would be consistent with national space policies, including the National Aeronautics and Space Act of 1958 and the 1994 National Space Transportation Policy, both of which contain the primary objective of keeping the United States at the forefront of space transportation technology.

The Proposed Action is needed to support NASA's mission and further the objectives of the U.S. space policy by enhancing the ability of NASA's WFF and MARS to serve the rapidly growing civil, defense, academic, and commercial aerospace market. Additionally, WFF and MARS are located within the only NASA-controlled launch range, and therefore they provide an established location solely under NASA control and focused on NASA's schedule, budget, and mission objectives.

Additionally, under Title II of the Omnibus Appropriations Act of 2009 (Public Law 111-8), the U.S. Congress appropriated $14,000,000 specifically to WFF and stated "WFF is an important national asset that can be better utilized by focusing on emerging technologies that meet national needs and NASA priorities." Implementation of the Proposed Action would fulfill this Congressional directive.

ALTERNATIVE DESCRIPTIONS

No Action Alternative

Under the No Action Alternative, NASA and MARS would not expand launch activities at WFF. The full potential of the launch range capacity at WFF would not be utilized in support of the WFF and MARS missions. Existing launch activities, which consist of a maximum of 12 orbital rocket launches per year from Pad 0-B, would continue.

Alternative One

Under Alternative One NASA and MARS would expand and upgrade facilities to support up to and including medium large class suborbital and orbital ELV launch activities from WFF. Components of Alternative One include site improvements required to support launch operations (such as facility construction and infrastructure improvements); testing, fueling, and processing operations; up to two static fire tests per year; and launching of up to six ELVs and associated spacecraft per year from Pad 0-A. Orbital Sciences Corporation's Taurus II ELV would be the largest ELV that would be launched from Pad 0-A. Implementation of Alternative One would result in a maximum of 18 orbital-class launches from MARS Launch Complex 0 per year (12 existing launches from Pad 0-B, and 6 additional launches from Pad 0-A).

Site Improvements to Support Launch Operations

NASA would implement the following:

- Minor modifications to the boat dock on the north end of Wallops Island;
- Construction of a Payload Processing Facility (PPF);
- Construction of a dedicated Payload Fueling Facility (PFF);
- Construction of a Horizontal Integration Facility (HIF);
- Construction of new roads and minor upgrades to existing roads; and
- Minor interior modifications to launch support facilities.

MARS would implement the following:

- Construction of a new launch complex in approximately the same location as the existing Pad 0-A, including a Liquid Fueling Facility (LFF).

Transportation, Handling, and Storage

The transportation and handling of various cargo, launch vehicle, and payload components would be ongoing as the components are delivered to Wallops Main Base or Wallops Island via truck, barge, rail, or airplane, and then transported via road to various facilities and the launch pad.

Alternative Two

Under Alternative Two, NASA and MARS would maximize the use of existing facilities to support up to and including medium large class suborbital and orbital ELV launch activities from WFF. Alternative Two includes site improvements required to support launch operations; testing, fueling, and processing operations; and up to two static fire tests per year. A maximum of three orbital-class launches per year would occur from Pad 0-A with Orbital Sciences Corporation's Taurus II ELV being the largest ELV. Implementation of Alternative Two would result in a maximum of 15 orbital-class launches from MARS Launch Complex 0 per year (12 existing launches from Pad 0-B, and 3 additional launches from Pad 0-A).

Site Improvements to Support Launch Operations

NASA would implement the following:

- Minor modifications to the boat dock on the north end of Wallops Island;
- Construction of a "high-bay" addition to Building V-45 to be used for payload processing;
- Construction of new roads and minor upgrades to existing roads; and
- Minor interior modifications to launch support facilities.

MARS would implement the following:

- Construction of a new launch complex in approximately the same location as the existing Pad 0-A, including an LFF.

Transportation, Handling, and Storage

The transportation and handling of various cargo, launch vehicle, and payload components would be ongoing as the components are delivered to Wallops Main Base or Island via truck, barge, rail, or airplane, and then transported via road to various facilities and the launch pad.

SUMMARY OF ENVIRONMENTAL IMPACTS

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to environmental resources. Potential environmental impacts resulting from the proposed action alternatives are summarized below.

Resource	Alternative One	Alternative Two
Topography	Site improvement activities would not substantially alter topography; therefore, changes to natural drainage patterns would be minor.	Under Alternative Two, less ground disturbance would occur compared to Alternative One, so there would be fewer changes to topography from site improvements.
Geology and Soils	Construction activities along with spills or leaks of pollutants that may occur during construction or transportation of materials would have the potential to affect soils. NASA and MARS would implement site-specific best management practices for vehicle and equipment fueling and maintenance, and spill prevention and control measures. Driven piles would create long-term changes to the subsurface geology immediately around the driven piles; however, the changes would be site specific and negligible.	Impacts to soils and geology would be the same as those described for Alternative One, although fewer impacts would occur due to 50 percent less site disturbance.
Surface Waters Including Wetlands	Construction activities, spills or leaks of pollutants during construction activities, spill or leaks during transportation of materials or from storage facilities, expected launch emissions, and launch failures that may result in release of liquid propellants would all have the potential to affect surface waters including wetlands. NASA and MARS would minimize adverse impacts to surface waters by acquiring permits as necessary, and implementing site-specific best management practices to reduce potential impacts. Approximately 1.7 hectares (4.1 acres) of wetlands would be affected. Prior to construction, NASA and MARS would	Under Alternative Two, up to 0.3 hectare (0.8 acre) of wetlands would be affected. Prior to construction, NASA and MARS would complete additional wetland delineations as needed, and obtain a USACE jurisdictional determination and necessary permits. NASA would implement mitigation measures to ensure no net loss of wetlands. Impacts to surface waters from construction would be the same as Alternative One, although fewer ELV launches under Alternative Two would create less potential for spills.

Resource	Alternative One	Alternative Two
	complete additional wetland delineations if needed, and obtain a U.S. Army Corps of Engineers (USACE) jurisdictional determination and necessary permits. NASA would implement mitigation measures to ensure no net loss of wetlands.	
Marine Waters	Localized temporary adverse impacts on marine waters in the area immediately surrounding the Wallops Island boat basin would occur during improvements to the dock. Dredging of the boat basin and channel would also result in temporary adverse impacts on water quality due to suspended sediments. Spent ELV stages falling into the ocean are a potential source of pollution to marine environments. Marine waters would be affected if a barge or vessel were to spill fuels or other substances that could contaminate the open ocean or estuary environment. Toxic concentrations are not anticipated in the open ocean due to the mixing and dilution rates associated with the wave movement and the vastness of the ocean environment; therefore, adverse impacts on marine waters would be short term and localized.	Impacts to marine waters would be the same as those described for Alternative One, although fewer ELV launches would result in less pollutants entering the ocean.
Floodplains	All facility construction and infrastructure improvements would take place within the 100-year and 500-year floodplains. Because Wallops Island is the location for WFF's core launch range functions, and is entirely within the floodplain, no practicable alternatives exist. The functionality of the floodplain on Wallops Island is not substantially reduced due to the presence of existing or proposed facilities because the footprint of the facilities does not cover a substantial area of the island.	Impacts and mitigation measures would be the same as those described for Alternative One, although fewer site improvements would result in lesser impacts to the floodplain.
Coastal Zone Management	All activities under the Alternative One occur within Virginia's Coastal Management Area. NASA has determined that Alternative One is consistent with the enforceable policies of the Coastal Zone Management Program.	All activities under Alternative Two occur within Virginia's Coastal Management Area. NASA has determined that Alternative Two is consistent with the enforceable policies of the Coastal Zone Management Program.

Resource	Alternative One	Alternative Two
Stormwater	Construction activities would result in temporary minor changes to stormwater conveyance due to disruptions of the natural drainage. NASA and MARS would obtain necessary permits and minimize impacts to stormwater conveyance and stormwater quality during construction. Up to 4 hectares (10 acres) of impervious area would be added, causing a long-term adverse impact; however, it would be localized and would not present a substantial adverse effect.	Impacts would be the same as those described under Alternative One, but with less potential for a spill because fewer rockets would be launched. However, only 2.5 hectares (6 acres) of impervious area would be added under Alternative Two, decreasing the amount of adverse effect.
Wastewater	No adverse impacts would occur, because the WFF wastewater treatment plant (WWTP) has the capacity to treat the approximately 4.5 percent increase in wastewater from the new facilities.	Impacts would be the same as those described for Alternative One. There will only be a 3 percent increase in wastewater from the new facilities.
Groundwater	NASA would provide potable water to the PPF, PFF, and HIF for drinking water supply, fire suppression, and industrial water use. In addition, static fire testing and launches would require the use of deluge water. Implementation of Alternative One would increase the system's annual water use but withdrawal amounts would be within the limit allowed by NASA's existing groundwater withdrawal permit.	NASA would provide potable water to the Building V-45 addition for drinking water supply, fire suppression, and industrial water use. In addition, static fire testing and launches would require the use of deluge water. Implementation of Alternative Two would increase the system's annual water use, but withdrawal amounts would be within the limit allowed by NASA's existing groundwater withdrawal permit.
Air Quality	Construction activities would generate fugitive dust and combustion emissions would occur as a result of site improvements. Operation of generators and boilers would result in emissions of pollutants. NASA and MARS would minimize adverse impacts to air quality by implementing site-specific construction and industrial best management practices such as fugitive dust control and engine/system maintenance and testing. Release of hazardous chemicals including propellants and halon would be minimized by the use of good operating procedures and the implementation of the WFF Spill Prevention Control and Countermeasures Plan. No far-field impacts from rocket exhaust are anticipated. Short-term adverse impacts in the area immediately surrounding the launch pad, resulting from rocket exhaust, include	Impacts on air quality described under Alternative One would also apply to Alternative Two; however, impacts would be less because fewer rockets would be launched and there would be less construction.

Resource	Alternative One	Alternative Two
	high temperature exhaust gas mixture and elevated carbon monoxide concentrations.	
Noise	Construction and transportation activities have the potential to generate temporary increases in noise levels from heavy equipment operations. Launch activities would create loud instantaneous noise that may be heard for several miles from WFF. The Proposed Action is not expected to have noise impacts on the surrounding areas in excess of applicable thresholds of significance.	Impacts described under Alternative One would also apply to Alternative Two; however, there would be less noise because fewer rockets would be launched and there would be less construction.
Orbital and Reentry Debris	During atmospheric reentry, vehicle parts could survive to impact. During a controlled reentry, debris would land in a predetermined area of the ocean. Uncontrolled reentries cannot be guaranteed to avoid impacting a land mass and would be subject to additional design considerations for public safety. All NASA orbital missions originating from WFF would comply with guidelines and regulations for limiting generation of orbital debris, and assessing risk of collision or impact.	The types of impacts from orbital and reentry debris under Alternative Two would be the same as described under Alternative One; however impacts would be less due to fewer launches.
Hazardous Materials and Hazardous Waste Management	The principal hazardous materials used under the Proposed Action would be liquid propellants (primarily liquid oxygen [LOX] and rocket propellant 1 [RP-1]), hypergolic propellants, pressurized gases, and various solvents and compounds used to process the ELV and spacecraft. The greatest potential impact to the environment would result from an accident (e.g., leak, fire, or explosion) at a storage location or, to a lesser degree, from an accidental release during fueling, payload processing, or launch activities (e.g., spills or human exposure). The short- and long-term effects of an accident on the environment would vary greatly depending upon the type of accident and the substances involved. NASA has implemented various controls to prevent or minimize the effects of an accident involving hazardous materials on NASA property.	Impacts would be the same as those described under Alternative One; however, there would be less generation of hazardous wastes and decreased potential for a spill to occur because fewer rockets would be launched and there would be less construction.
Radiation	Operation of the PPF, PFF, HIF, and handling of the ES could result in a potential source of radiation. However, the amount of	Impacts would be the same as those described under Alternative One.

Resource	Alternative One	Alternative Two
	radioactive materials is very small and the materials are encapsulated; therefore, the use of radioactive materials in payloads would not present any substantial impact or risk to the public or to the environment during normal or abnormal launch conditions.	
Munitions and Explosives of Concern	Ground disturbances such as excavations and clearing may have the potential to encounter munitions and explosives of concern (MEC) on Wallops Island during construction. A qualified MEC expert would evaluate the area proposed for ground disturbance and conduct a survey of the area if necessary prior to construction activities.	Impacts would be the same as those described under Alternative One.
Vegetation	Long-term adverse impacts to vegetation would occur due to the removal of 0.45 hectare (1.1 acres) of trees and 1.7 hectares (4.1 acres) of wetland vegetation due to the construction of the PPF, PFF, and road improvements; however, they would be localized and would not present a substantial adverse effect. Minor adverse effects on vegetation from launches would also occur, but would be limited to a localized area around Pad 0-A.	Alternative Two would also result in long-term adverse impacts to vegetation due to the removal of 0.45 hectare (1.1 acres) of trees, and 0.21 hectare (0.73 acre) of wetland vegetation. Due to the construction of the addition to Building V-45 and road improvements However, impacts would be less than under Alternative One, and would not present a substantial adverse effect. Minor adverse effects on vegetation from launches would also occur, but they would be limited to a localized area around Pad 0-A.
Terrestrial Wildlife and Migratory Birds	Short-term adverse impacts to wildlife and migratory birds may occur during construction activities, launches and static fire activities. Long-term impacts may occur due to the loss of wetland and forest habitat. Implementation of mitigation measures such as limiting the removal of existing vegetation for construction would minimize the impacts.	Impacts under Alternative Two would be less than under Alternative One because less vegetation removal, construction and, fewer launches would occur.
Threatened and Endangered Species	NASA determined that the boat dock improvements "are not likely to adversely affect" federally listed sea turtles or marine mammals; the National Marine Fisheries Service concurred with NASA's determination. NASA prepared a Biological Assessment that stated the Proposed Action "may affect, but is not likely to adversely affect" the red knot and seabeach amaranth;	Impacts would be the same as those described under Alternative One; however, impacts would be less due to fewer launches.

Resource	Alternative One	Alternative Two
	and "may affect and likely to adversely affect" some federally listed sea turtles and piping plover. The conclusion of the endangered species consultation process is pending. No effects to Delmarva Peninsula fox squirrel or Northeastern Beach Tiger Beetle are anticipated.	
Marine Mammals and Essential Fish Habitat	Spent stages would fall into the ocean many miles offshore; no adverse effects on marine species are anticipated as a result of spent stages falling into the ocean. Debris and toxic materials from launch failures have a small potential to adversely affect marine mammals or managed fish species and their habitats in the vicinity of the project area. Implementation of emergency cleanup procedures would minimize the impacts. NASA consulted with NMFS regarding impacts to EFH from the proposed action. On August 11, 2009, NMFS responded that "the proposed bulkhead construction will not result in substantial adverse effects to EFH, managed species or their prey species."	Impacts would be the same as those described under Alternative One; however, impacts would be less due to fewer launches.
Population, Employment, and Income	Construction activities would temporarily increase local employment opportunities and benefit local stores and businesses, and launch activities would bring 125 new jobs to the area. Tax revenue would increase as a result, and the local economy would benefit from launches (tourism, services and commodities support, hotel, meals, etc.)	Launch activities would bring 80 new jobs to the area. Beneficial impacts would be the same type as those described under Alternative One, but less due to fewer launches and fewer new jobs.
Environmental Justice	Disproportionately high or adverse impacts to low-income or minority populations are not anticipated because there would be no displacement of residences or businesses.	Impacts would be the same as those described under Alternative One.
Health and Safety	Construction activities at the WFF site could result in short-term impacts to human health and safety and the increased usage of local fire, police, and medical services.	Impacts would be the same as those described under Alternative One.
Cultural Resources	All ground disturbance is located outside of areas designated as having moderate or high potential for archeological resources. No adverse effects on aboveground historic properties are anticipated. In a letter dated August 24, 2009, Virginia Department of Historic Resources stated that it concurred	Impacts would be the same as those described under Alternative One.

Resource	Alternative One	Alternative Two
	with NASA's determination that the project alternatives would not adversely affect any historic properties.	
Transportation	Temporary impacts to traffic flow would occur during construction activities and launch activities. With implementation of mitigation and safety measures related to launch-day traffic closures, no substantial impacts on transportation are anticipated.	Impacts would be the same as those described under Alternative One; however, there would be fewer times traffic closures would be needed due to fewer launches.
Cumulative	Cumulative impacts were evaluated for potentially affected resources including wetlands, groundwater, air quality, biological resources, and socioeconomic resources. No substantial cumulative impacts are anticipated from Alternative One when added to other known and foreseeable WFF and regional actions.	Cumulative impacts were evaluated for potentially affected resources including wetlands, groundwater, air quality, biological resources, and socioeconomic resources. No substantial cumulative impacts are anticipated from Alternative Two when added to other known and foreseeable WFF and regional actions.

Summary – Both alternatives would result in adverse and beneficial impacts to environmental or socioeconomic resources. Adverse impacts to wetlands, vegetation, and terrestrial wildlife and migratory birds are anticipated; no other adverse impacts would occur to environmental or socioeconomic resources. Adverse impacts would be minimized to the greatest extent practicable, and mitigation measures would be implemented as necessary. Beneficial impacts would occur to employment and income.

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Figures

°C	Degrees Celsius
°F	Degrees Fahrenheit
ACAM	Air Conformity Applicability Model
ACHP	Advisory Council on Historic Preservation
AEGL	Acute exposure guideline level
AIAA	American Institute for Aeronautics and Astronautics
Al_2O_3	Aluminum oxide
ALOHA	Areal Locations of Hazardous Atmospheres Model
amsl	Above mean sea level
ANSI	American National Standards Institute
AP	Ammonium Perchlorate
APE	Area of Potential Effects
AST	Aboveground storage tank
BA	Biological Assessment
BMPs	Best management practices
CAA	Clean Air Act
CBRA	Coastal Barrier Resources Act
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CH_4	Methane
cm	Centimeters
CMA	Coastal Management Area
CNWR	Chincoteague National Wildlife Refuge
CO	Carbon monoxide
CO_2	Carbon dioxide
COMET	Commercial Experiment Transporter
COPUOS	Committee on the Peaceful Uses of Outer Space
CRA	Cultural Resources Assessment
CSLA	Commercial Space Launch Act
CWA	Clean Water Act
CZM	Coastal Zone Management
dB	Decibel
dBA	Decibel weighted to the A-scale
DCR	Department of Conservation and Recreation
DOD	Department of Defense
DOT	Department of Transportation
EA	Environmental Assessment
EFH	Essential Fish Habitat
EG&G	EG&G Technical Services
EHS	Extremely hazardous substance
EIS	Environmental Impact Statement
EJIP	Environmental Justice Implementation Plan
ELV	Expendable Launch Vehicle
EO	Executive Order
EPA	Environmental Protection Agency
ERPG	Emergency Response Planning Guideline
ES	Envelope Spacecraft
ESA	Endangered Species Act

FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
GDC	General Duty Clause
GEO	Geosynchronous Orbit
GHG	Greenhouse Gas
GSFC	Goddard Space Flight Center
GTO	Geosynchronous Transfer Orbit
H_2	Hydrogen
H_2O	Water
HAP	Hazardous Air Pollutant
HCl	Hydrogen chloride
HERO	Hazards of Electromagnetic Radiation to Ordnance
HERP	Hazards of Electromagnetic Radiation to Personnel
HIF	Horizontal Integration Facility
HTPB	Hydroxyl-terminated polybutadiene
Hz	Hertz
ICP	Integrated Contingency Plan
IIP	Instantaneous Impact Point
in.	Inch(es)
IPA	Isopropyl alcohol
ISS	International Space Station
JPA	Joint Permit Application
kg	Kilogram
km	Kilometers
kph	Kilometers per hour
kW	Kilowatt
L_{10}	Sound level exceeded 10 percent of the time
L_{90}	Sound level exceeded 90 percent of the time
lb	pound
LEO	Low Earth Orbit
L_{eq}	Time-averaged sound level
LFF	Liquid Fueling Facility
LH_2	Liquid hydrogen
LHA	Launch hazard area
LOC	Level of concern
LOX	Liquid oxygen
LWCA	Land and Water Conservation Act
μ/m^3	Micrograms per cubic meter
MACT	Maximum Achievable Control Technology
MARS	Mid-Atlantic Regional Spaceport
MBTA	Migratory Bird Treaty Act
MEC	Munitions and Explosives of Concern
mi	Miles
MLAS	Max Launch Abort System

MMH	Monomethylhydrazine
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MONs	Mixed oxides of nitrogen
mph	Miles per hour
MSDS	Material Safety Data Sheet
N_2	Nitrogen
N_2H_4	Hydrazine
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFSAM	Nuclear Flight Safety Assurance Manager
NHPA	National Historic Preservation Act of 1966
NIOSH	National Institute for Occupational Safety and Health
NMFS	National Marine Fisheries Service
NO_2	Nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOTAMS	Notices to Airmen
NOTMARS	Notices to Mariners
NO_X	Nitrogen oxide
NPD	NASA Policy Directive
NPDES	National Pollutant Discharge Elimination System
NPR	NASA Procedural Requirements
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NSR	New Source Review
NTO	Nitrogen tetroxide
O_3	Ozone
ORK	Orbit Raising Kit
OSHA	Occupational Safety and Health Administration
OSMA	Office of Safety and Mission Assurance
OSPL	Overall sound pressure level
Pb	Lead
PFF	Payload Fueling Facility
P.L.	Public Law
PLDA	Pre-launch danger area
PM_{10}	Particulate matter less than or equal to 10 microns
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns
POL	Petroleum, oils, lubricants
PPF	Payload Processing Facility
ppm	Parts per million
ppt	Parts per thousand
PSD	Prevention of Significant Deterioration
PTE	Potential to emit
RCRA	Resource Conservation and Recovery Act
REC	Record of Environmental Consideration
REEDM	Rocket Exhaust Effluent Dispersion Model

RF	Radio frequency
RICE	Reciprocating internal combustion engines
RP	Rocket Propellant
PTE	Potential to emit
REC	Record of Environmental Consideration
SHPO	State Historic Preservation Office
SO_2	Sulfur dioxide
SRIPP	Shoreline Restoration and Infrastructure Protection Program
STSC	Scientific and Technical Subcommittee
SWPPP	Stormwater Pollution Prevention Plan
TE	Transporter Erector
TEEL	Temporary Emergency Exposure Limit
TLV	Threshold Limit Value
TWA	Time Weighted Average
UAV	Unmanned Aerial Vehicle
UDMH	Unsymmetrical dimethylhydrazine
UN	United Nations
URS	URS Group, Inc.
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
UST	Underground Storage Tank
VAC	Virginia Administrative Code
VCSFA	Virginia Commercial Space Flight Authority
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries
VDHR	Virginia Department of Historic Resources
VEC	Virginia Employment Commission
VMRC	Virginia Marine Resources Commission
VOC	Volatile organic compound
VPDES	Virginia Pollutant Discharge Elimination System
VSMP	Virginia Stormwater Management Program
WFF	Wallops Flight Facility
WRP	Wallops Research Park
WWTP	Wastewater Treatment Plant

SECTION ONE MISSION, PURPOSE AND NEED, AND BACKGROUND INFORMATION

1.1 INTRODUCTION

This Environmental Assessment (EA) has been prepared to evaluate the potential environmental impacts from the proposed expansion of the launch range at Wallops Flight Facility (WFF).

In 1997, the National Aeronautics and Space Administration (NASA) prepared an *Environmental Assessment for Range Operations Expansion at the National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility* (Launch Range Operations Expansion EA) for the expansion of the Mid-Atlantic Regional Spaceport (MARS) at WFF. Specific actions addressed included construction of a new launch pad, minor modifications to an existing launch pad, minor modifications to utility infrastructure, expansion of capabilities to accommodate both solid- and liquid-fueled rockets, and increasing launch frequency to 12 orbital-class launches per year. NASA and MARS are proposing to again expand facilities at WFF to accommodate larger rockets and payloads. As the launch range expansion would require Federal actions (as defined in Title 40 of the Code of Federal Regulations [CFR] Section 1508.18) involving both NASA and the Federal Aviation Administration (FAA) Office of Commercial Space Transportation, this EA has been prepared to satisfy the National Environmental Policy Act (NEPA) obligations of both agencies. NASA, as the WFF property owner and Lead Agency, is responsible for ensuring overall compliance with applicable environmental statutes, including NEPA. The FAA Office of Commercial Space Transportation has served as a Cooperating Agency in the preparation of this EA because of its role in licensing the Virginia Commercial Space Flight Authority (VCSFA) to operate MARS as a commercial launch site, as well as licensing the launches of commercial vehicles that may be launched from MARS. The FAA will use this EA to support the modification or renewal of VCSFA's Launch Site Operator License and issuance of launch licenses for commercial vehicles.

This EA has been prepared in accordance with NEPA, as amended (Title 42 of the United States Code (U.S.C.) 4321–4347), the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR 1500–1508), NASA's regulations for implementing NEPA (14 CFR Subpart 1216.3), and the *NASA Procedural Requirement (NPR) for Implementing NEPA and Executive Order (EO) 12114* (NPR 8580.1). NEPA requires the preparation of an EA for Federal actions that do not qualify for a Categorical Exclusion and may not require an Environmental Impact Statement (EIS). If this EA determines that the environmental effects of the proposed action are not significant, a Finding of No Significant Impact (FONSI) will be issued. Otherwise, a Notice of Intent to prepare an EIS will be published.

This EA will be reviewed any time major changes to the Proposed Action are under consideration or substantial changes to the environmental conditions occur. As such, the document may be supplemented in the future to assess new proposals or to address changes in existing conditions, impacts, and mitigation measures.

1.2 BACKGROUND

1.2.1 Project-Related Missions

1.2.1.1 Wallops Flight Facility

WFF is a NASA facility under the management of the Goddard Space Flight Center (GSFC). During its early history, the mission of WFF was primarily to serve as a test site for aerospace technology experiments. Over the last several decades, the WFF mission has evolved toward a focus on supporting scientific research through carrier systems (i.e., airplanes, balloons, rockets, and uninhabited aerial systems) and mission services. NASA owns the WFF property and has multiple tenants, including MARS, the U.S. Navy, the U.S. Coast Guard (USCG), and the National Oceanic and Atmospheric Administration (NOAA). Each tenant relies on NASA for some of its institutional and programmatic services, but also has its own missions.

1.2.1.2 Mid-Atlantic Regional Spaceport

MARS is an FAA-licensed commercial spaceport on Wallops Island. MARS' mission is to develop and operate a multi-user spaceport at WFF that provides low-cost, safe, reliable, "schedule friendly" space access for commercial, government, and academic users (MARS, 2008). The VCSFA, of Norfolk, Virginia, is responsible for the development and operation of MARS. A use agreement between NASA and VCSFA gives VCSFA non-exclusive privileges to operate the site. NASA provides project management, range operations, safety, and environmental support of launch activities via reimbursable service contracts (NASA, 1997). Additionally, for certain missions, roles may reverse, and VCSFA can provide reimbursable launch services to NASA, the U.S. Department of Defense (DOD), and other government customers.

1.2.1.3 Federal Aviation Administration

FAA's mission is to ensure public health and safety and the safety of property, while protecting the national security and foreign policy interests of the United States during commercial launch and payload reentry operations. Reentry operations at WFF would include the preparation of a payload for reentry and the process of the payload reentering the atmosphere. In addition, FAA is directed to encourage, facilitate, and promote commercial space launches and reentries (FAA, 2008).

The FAA Office of Commercial Space Transportation regulates U.S. commercial space launch and reentry activities, as well as the operation of non-Federal launch and reentry sites (the locations on Earth to which space vehicles are intended to return), as authorized by EO 12465 and Title 49 U.S.C., Subtitle IX, Chapter 701 (formerly the Commercial Space Launch Act [CSLA] of 1984). FAA issued a Launch Site Operator License to VCSFA to operate MARS in December 1997, which allows VCSFA to operate the MARS site as a commercial space launch site. The FAA renewed the license in November 2002 and again in December 2007.

1.2.2 Site Location

WFF is located in the northeastern portion of Accomack County, Virginia, on the Delmarva Peninsula, and is comprised of three separate land masses: the Main Base, Wallops Mainland, and Wallops Island (Figure 1). The MARS facilities are located on Wallops Island and include Launch Complex 0, comprised of Launch Pads 0-A and 0-B (Figure 2).

Title: **Vicinity Map**

URS Proj No: 15301614

Figure: 1

Client : NASA

Expansion of the Launch Range at Wallops Flight Facility

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Title: Wallops Island Viewed from the South

URS Proj No:15301614

Figure: 2

Client : NASA

Expansion of the Launch Range at Wallops Flight Facility

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WFF has been located on Wallops Island since its inception in 1945 because of its unique location on the coast, controlled airspace, adjacency to Department of Defense Atlantic operational areas, and large hazard buffer zones that are necessities for the WFF launch range to operate in a safe and effective manner.

Figure 3 shows the primary existing NASA and MARS facilities, described below, that would be used to support the Proposed Action.

1.2.3 Existing MARS Facilities

1.2.3.1 Launch Complex 0

Launch Complex 0, which includes Pads 0-A and 0-B, is located on the southern end of Wallops Island and is used for launching suborbital and orbital rockets. Launches may be conducted any time of the year and at any time of the day or night.

Pad 0-A is a facility for launch vehicles with up to a 90,909-kilogram (kg) (200,000-pound [lb]) maximum load. Originally designed for the Conestoga vehicle, which was launched once in October 1995, Pad 0-A has been inactive; its launch service gantry (a large vertical structure with platforms at different levels used for erecting and servicing expendable launch vehicles [ELVs] before launch) and portions of the existing launch pad were removed in fall 2008, because they were dilapidated, rendering Pad 0-A unusable for launching until a new gantry is built.

Pad 0-B is a 1,766-square-meter (19,000-square-foot) pad with a 31-meter (102-foot) high gantry, which supports the launching of vehicles with gross lift-off weights up to 227,273 kg (501,000 lbs) into orbit. Vehicle and payload handling within the pad and service tower area are accomplished by a transporter-erector vehicle and a mobile crane. Recent launches from Pad 0-B include the U.S. Missile Defense Agency’s Near Field Infrared Experiment in April 2007, the Alliant Techsystems/NASA HyBolt-Soarex-ALV-X1 suborbital rocket launched in August 2008, and the U.S. Air Force’s Tactical Satellite-3 mission in May 2009.

1.2.4 NASA Facilities

MARS may use NASA assets, depending on the particular mission, including but not limited to:

- Range Control Center
- Test laboratories and machine shops
- Mobile and fixed launchers
- Blockhouses
- Dynamic balancing equipment
- Wind measuring devices
- Communications and control instrumentation
- Television and optical tracking stations
- Surveillance and radar tracking units

1.2.4.1 Payload Processing Facilities

MARS actions associated with payload processing at WFF include storage, transportation, assembly, and fueling. These actions take place at the Main Base, Wallops Mainland, and Wallops Island.

Payload processing occurs on the Main Base in several buildings (H-100, F-7, F-10, M-16, and M-20), and on Wallops Island in Buildings X-15, W-65, and Y-15. WFF can support multiple payload processes simultaneously, including fabrication, environmental testing, integration, telemetry ground stations, and clean room facilities. Work areas are available to perform preparatory and post-integration inspections (NASA, 2005).

1.2.4.2 Boat Docks

There are two existing boat docking facilities at WFF. One consists of a 98-square-meter (1,055-square-foot) concrete platform at the boat basin behind the WFF Visitor Information Center on the Main Base. The other boat docking facility is the same size and is located at the boat basin adjacent to the old USCG Station on north Wallops Island (labeled as the “Boat Dock” on Figure 3). These facilities are utilized for docking and unloading cargo that is too large for over-the-road transportation.

The existing approach channel and basin area on the north end of Wallops Island (labeled as “Barge Path” on Figure 3) is dredged as needed to maintain a water depth of at least 1.2 meters (4 feet) at low tide. Adequate water depths in the Main Base approach channel and basin have precluded the need to perform maintenance dredging at this facility in recent years.

1.2.5 Launch Trajectories

WFF’s geographic location provides ideal access to Low Earth Orbit (LEO) for ELVs, where an object, typically a satellite, orbits the Earth at altitudes between approximately 80 and 2,000 kilometers (50 and 1,250 miles) above the Earth, offering a wide array of launch vehicle trajectory options that are directed away from populated areas (Figure 4). The ground-based range is only limited by land masses, and the coastline of Wallops Island is oriented such that a launch azimuth (the initial heading of the launch vehicle) of 135 degrees is perpendicular to the shoreline. Generally, launch azimuths from WFF vary between 90 and 160 degrees (Figure 4) depending on flight safety parameters (such as predicted impact areas of spent stages and launch vehicle reliability) and specific mission objectives. Trajectory options outside of these launch azimuths can be achieved by in-flight azimuth maneuvers.

Title: **Wallops Island Existing Facilities**

URS Proj No: 15301614

Figure: 3

Client : NASA

Expansion of the Launch Range at Wallops Flight Facility

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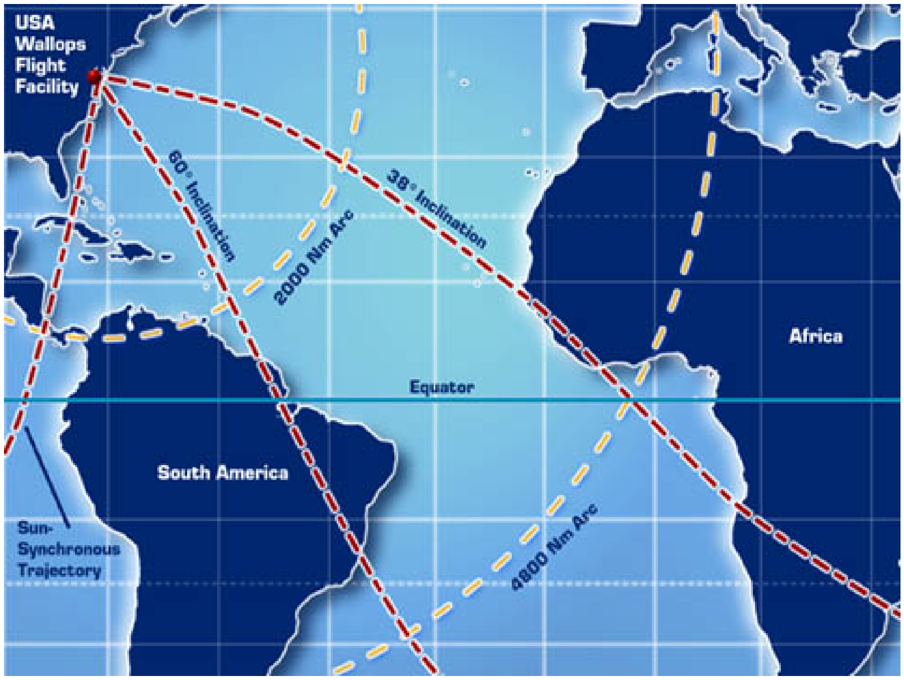


Figure 4: Wallops Flight Facility Launch Vehicle Trajectory Options

MARS launches occur within the WFF Research Range, which extends over the Atlantic Ocean for 4.8 kilometers (3 miles) and includes the airspace above that distance to conduct flight operations. The WFF Research Range routinely employs a variety of support infrastructure that includes ground-based and mobile systems for tracking and surveillance, a range control center for launch operations management, and digital photographic and video services for Range Safety support, surveillance, and post-launch analysis. Launch clearances are coordinated by the WFF Test Director and may include those clearances required for airspace and oceanic impact areas from the FAA, North American Aerospace Defense Command, the U.S. Navy Fleet Area Control and Surveillance Facility, and the USCG.

1.3 PURPOSE AND NEED FOR THE PROPOSED ACTION

1.3.1 Purpose

The purpose of the Proposed Action is to expand and enhance the respective NASA and MARS facilities at WFF to accommodate a wider variety of new launch vehicles and payloads. The expansion would be consistent with national space policies, including the National Aeronautics and Space Act of 1958 and the 1994 National Space Transportation Policy, both of which contain the primary objective of keeping the United States at the forefront of space transportation technology.

Additionally, under Title II of the Omnibus Appropriations Act of 2009 (Public Law 111-8), the U.S. Congress appropriated $14,000,000 specifically to WFF and stated “WFF is an important national asset that can be better utilized by focusing on emerging technologies that meet national needs and NASA priorities.” Implementation of the Proposed Action would fulfill this Congressional mandate.

Furthermore, the Proposed Action would be consistent with WFF's vision to be a national resource for enabling low-cost, aerospace-based science and technology research through the following mission elements:

- Enabling scientific research through the development and deployment of low-cost, highly capable suborbital and orbital research carriers, project management, and mission services;
- Enabling aerospace technology advances supporting NASA's Science, Exploration Systems, and Aeronautics Mission Directorates through advanced technology development, testing, and operational support; and
- Enabling education, the commercial development of space, and other innovative partnerships by leveraging WFF's unique capabilities and expertise to collaborate with industry, academia, and other government agencies.

1.3.2 Need

The Proposed Action is needed to further the objectives of the U.S. space policy and to support NASA's mission and WFF's vision. A minimum of two medium-class ELV launches annually from WFF are projected as part of the requirements to resupply cargo to the International Space Station (ISS). Additional launches would allow NASA and MARS to optimize support for the rapidly growing civil, defense, academic, and commercial aerospace markets. Missions may include technology development, communication systems, and Earth and space sciences. The existing facilities at WFF do not meet the requirements to launch additional ELVs.

WFF and MARS are located within the only NASA-controlled launch range, and therefore they provide an established location solely under NASA control and focused on NASA's schedule, budget, and mission objectives. Such range control is critical to mission success as budgets tighten and program requirements dictate short turn-around times that are often difficult to accomplish at a launch range controlled by a non-NASA entity.

1.4 FEDERAL AVIATION ADMINISTRATION INVOLVEMENT

The CSLA (Public Law [P.L.] 98-575), as codified (49 U.S.C. Subtitle IX, Ch. 701, Commercial Space Launch Activities, 49 U.S.C. Sections 70101-70119) (1994) declares that the development of commercial launch vehicles and associated services are in the national economic interest of the United States. To ensure that launch services provided by private enterprises are consistent with the national security and foreign policy interests of the United States and do not jeopardize public safety and safety of property, the CSLA authorizes the Department of Transportation (DOT) to license and regulate U.S. commercial launch activities. Within the DOT, the Secretary of Transportation's authority under the CSLA has been delegated to the FAA's Office of Commercial Space Transportation. The FAA's proposed modification of the license to operate MARS and any future licensure of individual commercial launch vehicles would be consistent with its responsibilities under the CSLA.

1.5 USE OF THIS ENVIRONMENTAL ASSESSMENT

This EA evaluates the environmental effects of both NASA and MARS facility expansion at WFF and the launch of larger vehicles and spacecraft from MARS Pad 0-A.

As several different launch vehicles and spacecraft could launch from MARS Pad 0-A, the largest launch vehicle and payload, in terms of size, weight, and dimension, was chosen as the demonstration, or “envelope,” vehicle and payload to provide a benchmark for assessing impacts on resources at WFF and the surrounding environment. The envelope concept is described below in more detail.

1.5.1 Envelope Concept

Under the envelope concept, existing and future launch vehicles and spacecraft (satellites that are launched into space aboard ELVs, also called payloads) smaller than the “envelope” launch vehicle and spacecraft would be expected to have fewer impacts; for example, if the envelope ELV has an insignificant impact on a resource, a smaller ELV would fall within the same range of impacts and also have an insignificant impact.

The envelope ELV and the envelope spacecraft (ES) define the upper limits of the quantities and levels of commonly used materials and systems of the launch vehicle or payload. Orbital Sciences Corporation’s Taurus II would be the largest ELV expected to be launched from MARS Pad 0-A under the Proposed Action; therefore, the Taurus II has been selected as the envelope launch vehicle for the purposes of this EA. Other smaller launch vehicles that may be launched from MARS Pad 0-A are described in Section 2.2.3; however, the environmental impacts were analyzed for the Taurus II only. Future launch vehicles not specifically mentioned in this EA would be considered within the scope of this document if analysis determines that their impacts do not exceed those associated with the envelope launch vehicle. The subsequent analysis and final determination would be documented in a Record of Environmental Consideration (REC) to be kept in the official project files. If the analysis finds that the impacts are outside the scope of this EA, further NEPA documentation (a separate EA or an EIS) would then be prepared.

No specific spacecraft has been identified as the ES; instead, the ES should be considered a hypothetical payload whose components, materials and associated quantities, and flight systems represent a comprehensive bounding reference design (refer to Section 2 for the parameters of the ES). Any proposed payload that presents lesser or equal values of environmentally hazardous materials or sources in comparison to the ES would fall within the same range of impacts as the ES described in this EA. Again, as with the launch vehicles, spacecraft analyses would be documented in a REC; additional NEPA documentation would be prepared as needed.

1.6 RELATED ENVIRONMENTAL DOCUMENTATION

NASA has a long history of environmental stewardship. The following NEPA documents and environmental resources reports were used as the basis for describing the current operations and existing conditions, and to provide information on various spacecraft and programs discussed in this EA.

- *Environmental Resources Document NASA Goddard Space Flight Center’s Wallops Flight Facility, Wallops Island, Virginia*. (NASA, 2008a)
- *Record of Environmental Consideration (REC) for the Max Launch Abort System (MLAS) Test, Goddard Space Flight Center Wallops Flight Facility, Wallops Island, Virginia 23337*. (NASA, 2008b)
- *Falcon 9 Launch from Wallops Flight Facility*. *Preliminary Appraisal of Impacts*. (NASA, 2007a)

- *Environmental Assessment for the Operation and Launch of FALCON 1 and FALCON 9 Space Vehicles Cape Canaveral Air Force Station, Florida*. (NASA, 2007b)
- *Final Environmental Assessment for the Orbital/Sub-Orbital Program Space and Missile Systems Center, Kirtland Air Force Base, New Mexico*. (Detachment 12/RP, 2006)
- *Final Site-Wide Environmental Assessment, Wallops Flight Facility, Goddard Space Flight Center*. (NASA, 2005)
- *Environmental Assessment for a Payload Processing Facility, National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility, Wallops Island, Virginia 23337*. (NASA, 2003a)
- *Final Environmental Assessment Update for Launch of NASA Routine Payloads on Expendable Launch Vehicles*. (NASA, 2002a)
- *Volume 1: Programmatic Environmental Impact Statement for Licensing Launches*. (FAA, 2001)
- *Environmental Assessment for Range Operations Expansion at the National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility*. (NASA, 1997)

SECTION TWO ALTERNATIVES

NASA evaluated the No Action Alternative as well as two Proposed Action alternatives.

Because Congress allocated funding specifically to WFF in the Omnibus Appropriations Act of 2009 to improve launch pad infrastructure, WFF contains the only NASA-owned and operated launch range, and hundreds of millions of dollars in existing NASA and MARS infrastructure are already available for use, WFF is the only launch site that can meet the Purpose and Need of the proposed action. Therefore no other launch sites were considered to be reasonable alternatives.

Both alternatives only address improvements to facilities and infrastructure on Wallops Island due to mission safety requirements. These requirements cannot be accommodated on the Main Base or Mainland without public evacuations for each hazardous operation (e.g., spacecraft fueling and transport, and ordnance handling) or launch event. To ensure public safety, existing launch facilities and supporting infrastructure have been located on Wallops Island, away from population centers. NASA and MARS facilities need to remain on Wallops Island where the appropriate hazard buffers can be maintained (a minimum of 3 kilometers [2 miles] around Launch Complex 0). During a launch countdown, the areas within the hazard buffers must be completely evacuated. To quantify the potential effects of locating a launch pad on Wallops Mainland, NASA performed a Geographic Information System-based analysis in conjunction with this EA. With orbital-class launch pads such as those operated by MARS on Wallops Island, approximately three residences would require evacuation prior to launch; if the pad were located on Wallops Mainland, approximately 87 residences would require evacuation as a go/no go criterion for executing the launch. Additionally, to maintain the required flight safety corridors downrange of the launch pads, large portions of Chincoteague Island would require evacuation. Operating under such constraints would not only cause unacceptable public disturbance, but it would also prohibitively restrict NASA and MARS from successfully performing their respective missions. As such, all launch pads and support facilities must be located on Wallops Island.

In addition to public safety, there are multiple constraints to siting new facilities at Wallops Island that result in very limited available space for the development of new facilities and infrastructure. These constraints include current land use (potential for conflict with known or reasonably foreseeable mission-related uses), interference with mission-critical communications and radar, established hazard arcs surrounding some buildings, and sensitive resources such as wetlands and cultural resources.

2.1 NO ACTION ALTERNATIVE

Under the No Action Alternative, NASA and MARS would not proceed with expansion activities at Pad 0-A. The full potential of the launch range capacity at WFF would not be utilized in support of the WFF and MARS missions. Existing launch activities, which consist of a maximum of 12 orbital rocket launches per year from Pad 0-B, would continue.

2.2 ALTERNATIVE ONE

Under Alternative One, the Preferred Alternative, NASA and MARS would expand and upgrade facilities to support up to and including medium large class suborbital and orbital ELV launch activities from WFF. Components of Alternative One include site improvements required to support launch operations (such as facility construction and infrastructure improvements);

testing, fueling, and processing operations; up to two static fire tests per year; and launching of up to six orbital-class launches per year from Pad 0-A. Implementation of Alternative One would result in a maximum of 18 orbital-class launches from MARS Launch Complex 0 (12 existing launches from Pad 0-B, and 6 additional launches from Pad 0-A).

A description of potential launch vehicles and spacecraft is provided in Section 2.4 below.

2.2.1 Site Improvements

Figure 5 shows a view of Wallops Island with the facilities proposed for construction under Alternative One.

2.2.1.1 Modifications to Boat Dock

To accommodate unloading of ELVs and spacecraft, NASA would make minor modifications to the boat dock on the north end of Wallops Island, such as installing additional fendering, sheet piling, and armor stone (Figure 6). Ongoing maintenance dredging would continue at the North Wallops Island Boat Basin to ensure a navigable channel and docking area. After unloading at the boat dock, the ELV would be transported to the Horizontal Integration Facility (HIF) and the spacecraft would be transported to the Payload Processing Facility (PPF).

2.2.1.2 Payload Processing Facility

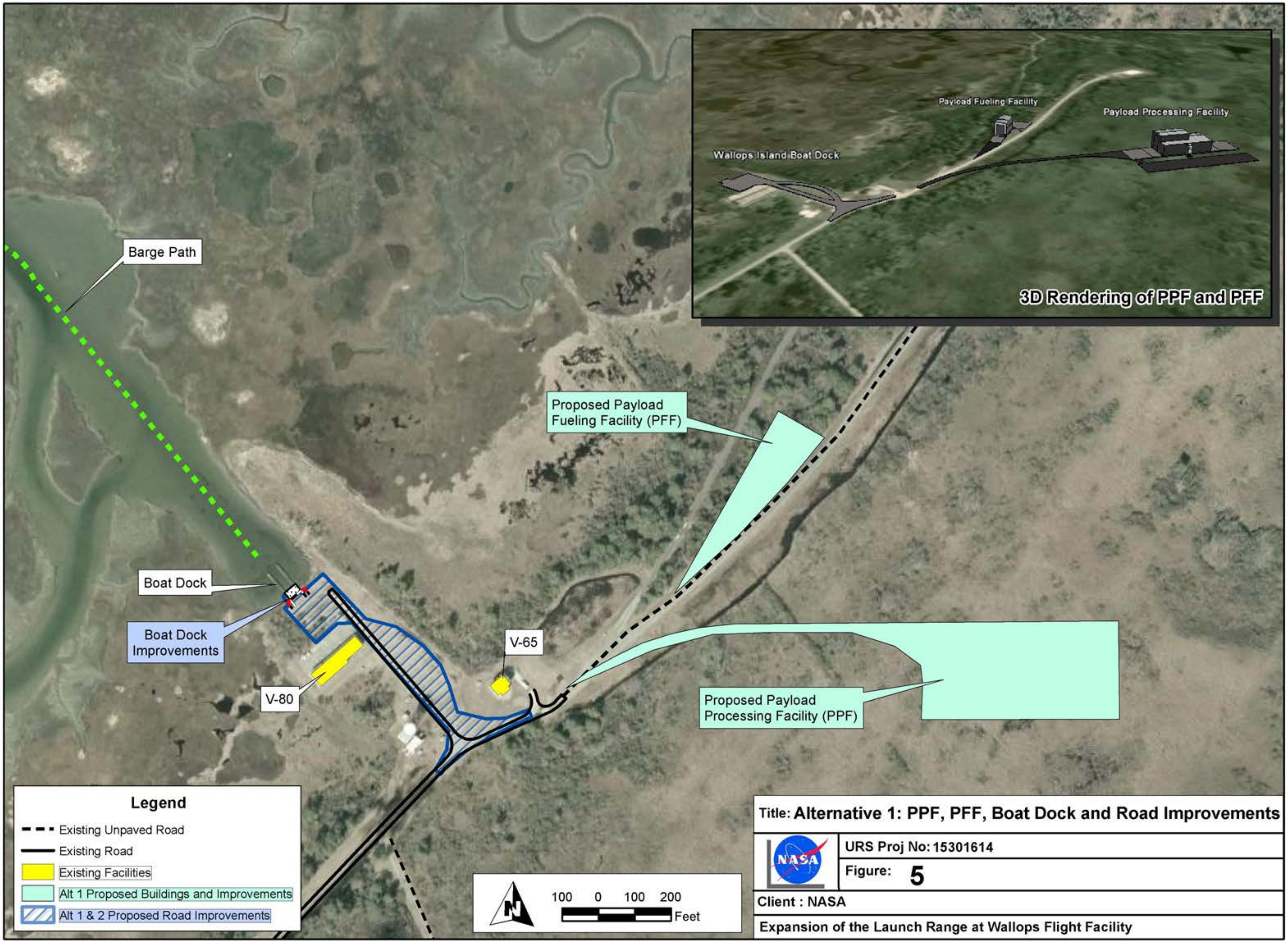
NASA would construct an approximately 1,100 square-meter (12,000 square-foot) PPF dedicated to payload processing and storage on north Wallops Island approximately 180 meters (600 feet) east of the proposed Payload Fueling Facility (PFF) (Figure 5). Payloads would be transported from offsite locations to this facility prior to fueling for initial assembly, inspection, cleaning, and testing. Following fueling, the fueled payload could be transported back for final assembly prior to being integrated into the launch vehicle. Following final payload processing, the payload would be transported south to the HIF for integration into the launch vehicle.

2.2.1.3 Payload Fueling Facility

Before launch on an ELV, a spacecraft (payload) must be prepared for its mission. The preparations include such activities as checking electrical circuits, testing lines or tanks for leaks, and loading liquid propellants into fuel tanks. Because these and other preparations must be done under controlled conditions in clean environments (e.g., free of dust and particulates) and because some of the materials (i.e., liquid and solid propellant and explosives) that are handled or loaded are hazardous, special facilities are utilized for these operations.

NASA would construct a facility dedicated to payload fueling on the north end of Wallops Island (Figure 5). The new PFF would include a high bay, employee dress-out room, several equipment rooms, and a loading dock. Payloads would be handled by bridge cranes located within the high bay area. The footprint of the PFF would occupy approximately 700 square meters (7,500 square feet).

Loading of hypergolic propellants, which could be hydrazines (e.g., anhydrous hydrazine, monomethylhydrazine [MMH], or unsymmetrical dimethylhydrazine [UDMH]), as fuels for mono or bipropellant systems would be conducted by highly trained personnel in a dedicated area in the PFF. The oxidizers used for these systems could include nitrogen tetroxide (NTO) and mixed oxides of nitrogen (MONs). Each loading operation would be independent, sequential, and conducted using a closed loop system.



Title: **Alternative 1: PPF, PFF, Boat Dock and Road Improvements**

URS Proj No: 15301614

Figure: 5

Client : NASA

Expansion of the Launch Range at Wallops Flight Facility

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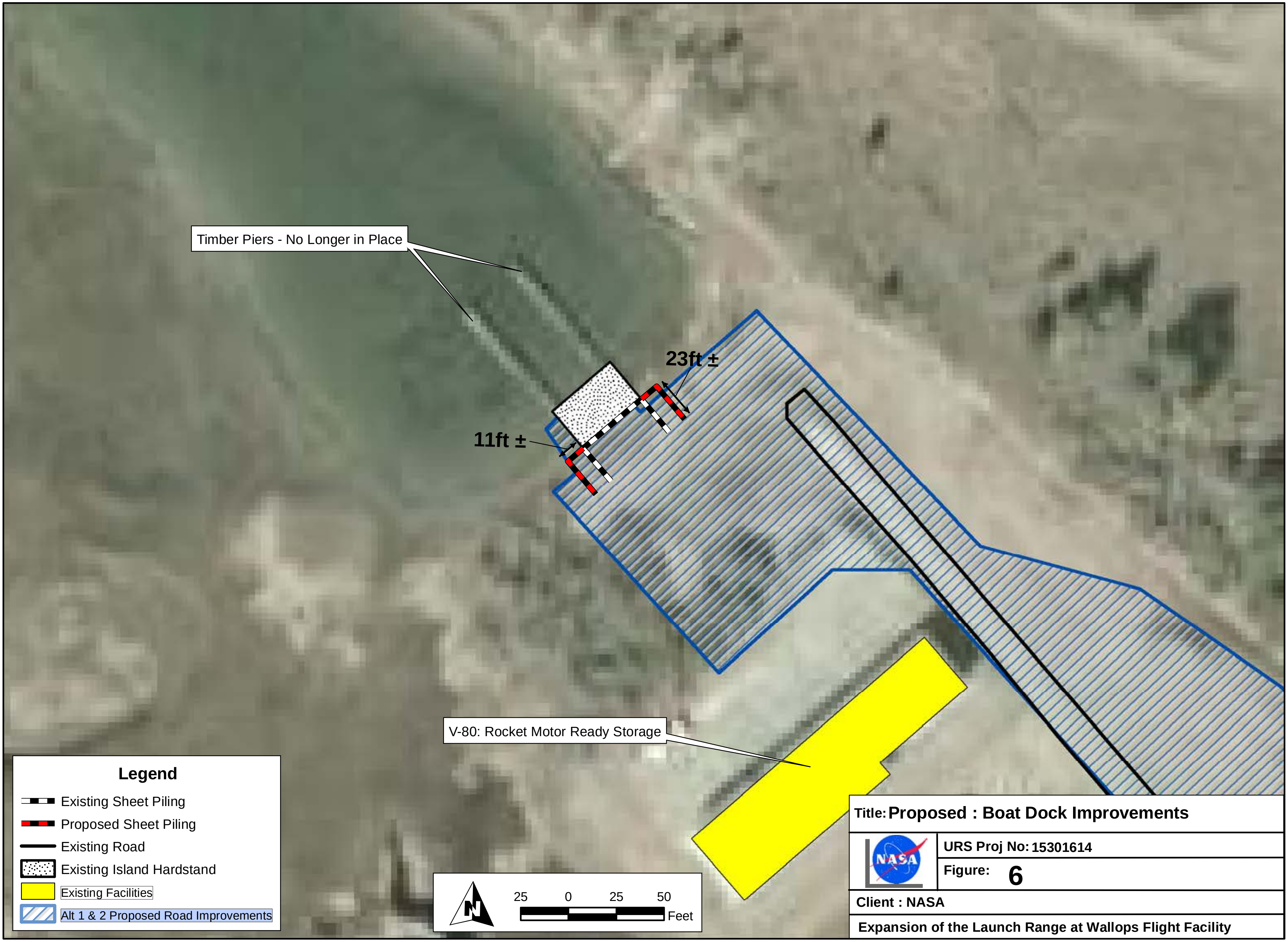

Title: Proposed : Boat Dock Improvements

URS Proj No: 15301614

Figure: 6

Client : NASA

Expansion of the Launch Range at Wallops Flight Facility

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Upon completion of PFF activities, the payload would be prepared for transportation to a separate PPF or to the HIF.

2.2.1.4 Horizontal Integration Facility

A HIF that will support the pre-flight processing, horizontal integration, and preparation of launch vehicles and payloads would be constructed in the middle of Wallops Island (Figure 7). The HIF will cover approximately 2,322 square meters (25,000 square feet) and has been designed to accommodate temporary storage of fueled spacecraft and vehicle stages. It will be 21 meters (70 feet) tall and include a cooling tower that will run approximately six months per year.

Activities in the HIF will include but are not limited to removal of flight hardware from cargo containers, inspection, testing, and encapsulation of launch vehicle motors and stages, and final integration of the payload within the launch vehicle. The HIF design would allow for simultaneous processing of two ELVs.

2.2.1.5 Transportation Infrastructure

NASA would make transportation improvements necessary to transport cargo from the existing boat dock on the north end of Wallops Island to the proposed PFF or PPF, from the PPF or PFF to the HIF, and from the HIF to the launch pad. Infrastructure improvements include construction of new roads and minor upgrades to existing roads (Figure 7). New road construction along with widening or straightening of existing roads could add up to an additional 1 hectare (2.5 acres) of asphalt pavement.

2.2.1.6 Pad 0-A Improvements

A new MARS launch complex including a pad access ramp, launch pad, and deluge system would be constructed in approximately the same location as the existing pad (Figures 8 and 9).

The combined improvements to Pad 0-A would result in an overall pad complex footprint of approximately 2.6 hectares (6.4 acres). New construction would add approximately 0.9 hectare (2.2 acres) of impervious surface (primarily concrete pavement) to the existing 0.2 hectare (0.5 acre) of existing impervious surface for a total of 1.1 hectares (2.7 acres) of impervious surface within the pad complex footprint. Because demolition of portions of the launch pad and the entire gantry at Pad 0-A have been completed, only minor additional demolition activities would occur.

Pad Access Ramp

MARS would construct a new ramp to the launch pad to transport the ELV from an existing road to the elevated launch mount. The ramp would consist of both an earthen and concrete portion located on the northwest side of the pad and connect to an existing road. The earthen part of the ramp would be 7.3 meters (24 feet) wide and 23 meters (75 feet) long. The concrete portion of the ramp would be an open pile causeway type structure 7.3 meters (24 feet) wide, and 114 meters (375 feet) long.

Launch Pad

The launch pad would have an elevated launch stool and deck, a wind monitor, a lightning protection system, a perimeter security fence, audible and visual warning systems, and camera towers. A launch services building approximately 500 square meters (5,000 square feet) in size would be constructed below the pad deck and would provide equipment storage and pad crew support functions (restrooms, telephone service, etc.). A partially below-grade flame duct and a hydraulic system for the Transporter/Erector/Launcher (the vehicle that carries and elevates the ELV into launch position) would also be built (shown as Transporter Erector [TE] Actuator on Figure 9). Launch Pad 0-A would include a flame duct to direct heat and combustion products and the initial sound blast toward the ocean.

Deluge System

As the new launch pad would be designed to support both normal launches and on-pad static firing for launch vehicle testing, there is a risk to the launch pad resulting from exposure to extended heat load and excessive vibration and noise; therefore, a water deluge system would be constructed to absorb the heat load and suppress vibration and noise from the engines. The deluge system would include a 950,000-liter (250,000-gallon) aboveground water storage tank, pumps, and a trench and retention basin for the deluge water. Each launch would utilize nearly the entire capacity of the tank for water suppression of engine vibration and noise. Up to 1,325,000 liters (350,000 gallons) of water would be used for static fire tests, and up to two static fire tests per year could occur.

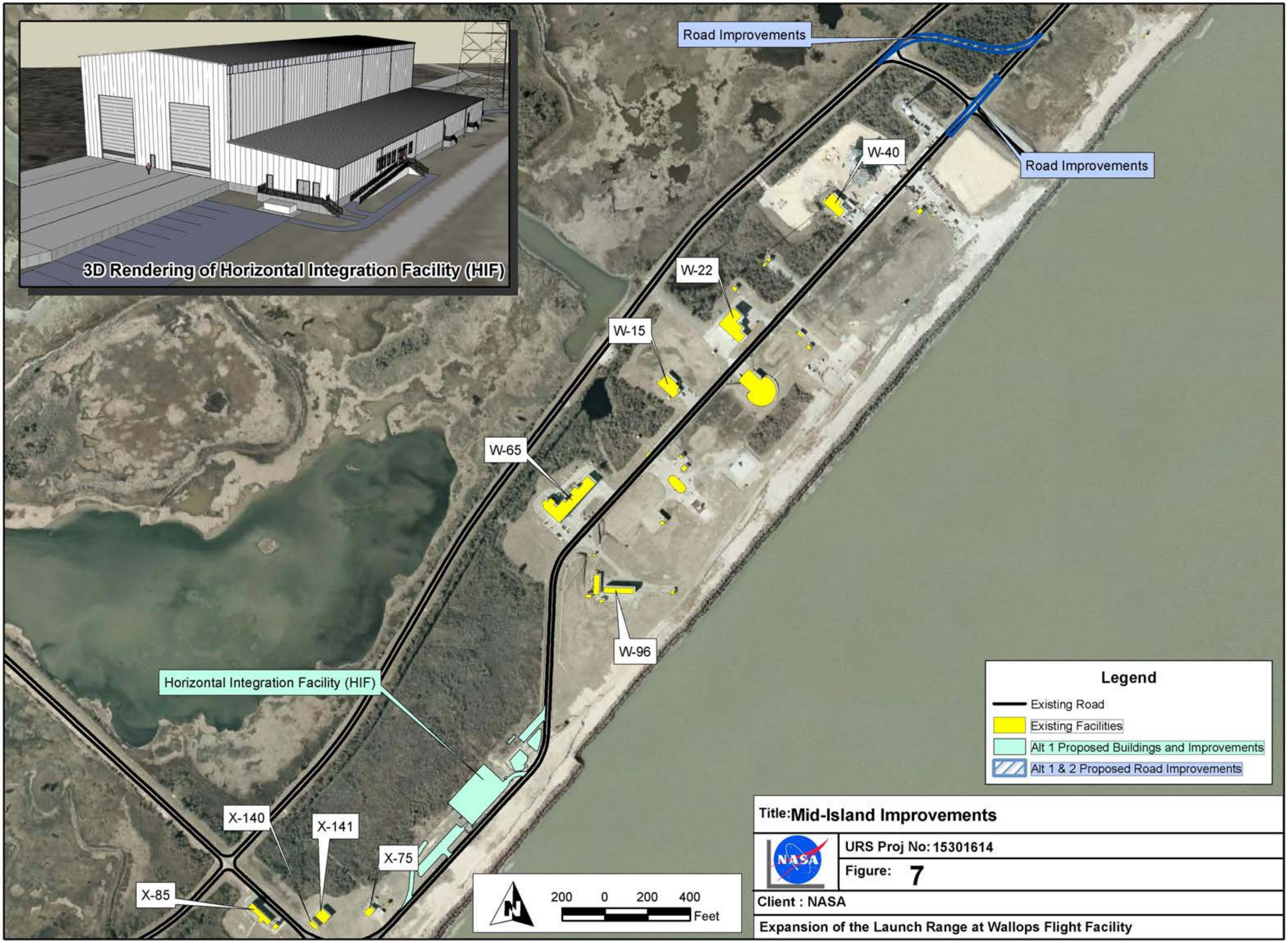
The additional water required for static fire testing would be withdrawn from temporary water tanks placed on the south side of Pad 0-A prior to the static fire test date. The temporary water tanks would be stored off site when not in use at Pad 0-A. The water source for the deluge system would be NASA's potable water system, which is permitted by the Virginia Department of Environmental Quality (VDEQ) to withdraw groundwater from the underlying aquifer.

Used deluge water for both launch and static fire testing would be discharged to a newly constructed 1,200-square-meter (12,500-square-foot), lined earthen retention basin (lined for imperviousness). The deluge water would then be tested and approved for release via a manual gate to a newly constructed unlined stormwater basin. If necessary, the deluge water would be treated (i.e., pH adjusted) before release, or removed for disposal if it does not meet the standards for discharge to surface water. If the deluge water is discharged to the unlined stormwater basin, the release period may last several days due to the large quantity of water to be discharged.

2.2.1.7 Liquid Fueling Facility

MARS would construct a Liquid Fueling Facility (LFF) adjacent to Pad 0-A that would include the following infrastructure:

- One 115,000 liter (30,000 gallon) kerosene (RP-1) aboveground storage tank;
- One 300,000 liter (80,000 gallon) aboveground cryogenic storage tank and one 30,000 liter (8,000 gallon) stainless steel aboveground cryogenic storage tank; both would be used for liquid oxygen (LOX) storage;
- One 11,000 liter (3,000 gallon) liquid methane stainless steel aboveground cryogenic storage tank;
- Two 106,000 liter (28,000 gallon) liquid nitrogen stainless steel cryogenic aboveground storage tanks;
- Assorted high-pressure aboveground steel tanks that would hold up to 85 cubic meters (3,000 cubic feet) of high pressure gaseous helium and/or gaseous nitrogen;


3D Rendering of Horizontal Integration Facility (HIF)
Road Improvements
Road Improvements
W-40
W-22
W-15
W-65
W-96
Horizontal Integration Facility (HIF)
X-140
X-141
X-75
X-85
200 0 200 400
Feet
Legend
Existing Road
Existing Facilities
Alt 1 Proposed Buildings and Improvements
Alt 1 & 2 Proposed Road Improvements
Title: Mid-Island Improvements
URS Proj No: 15301614
Figure: 7
Client : NASA
Expansion of the Launch Range at Wallops Flight Facility

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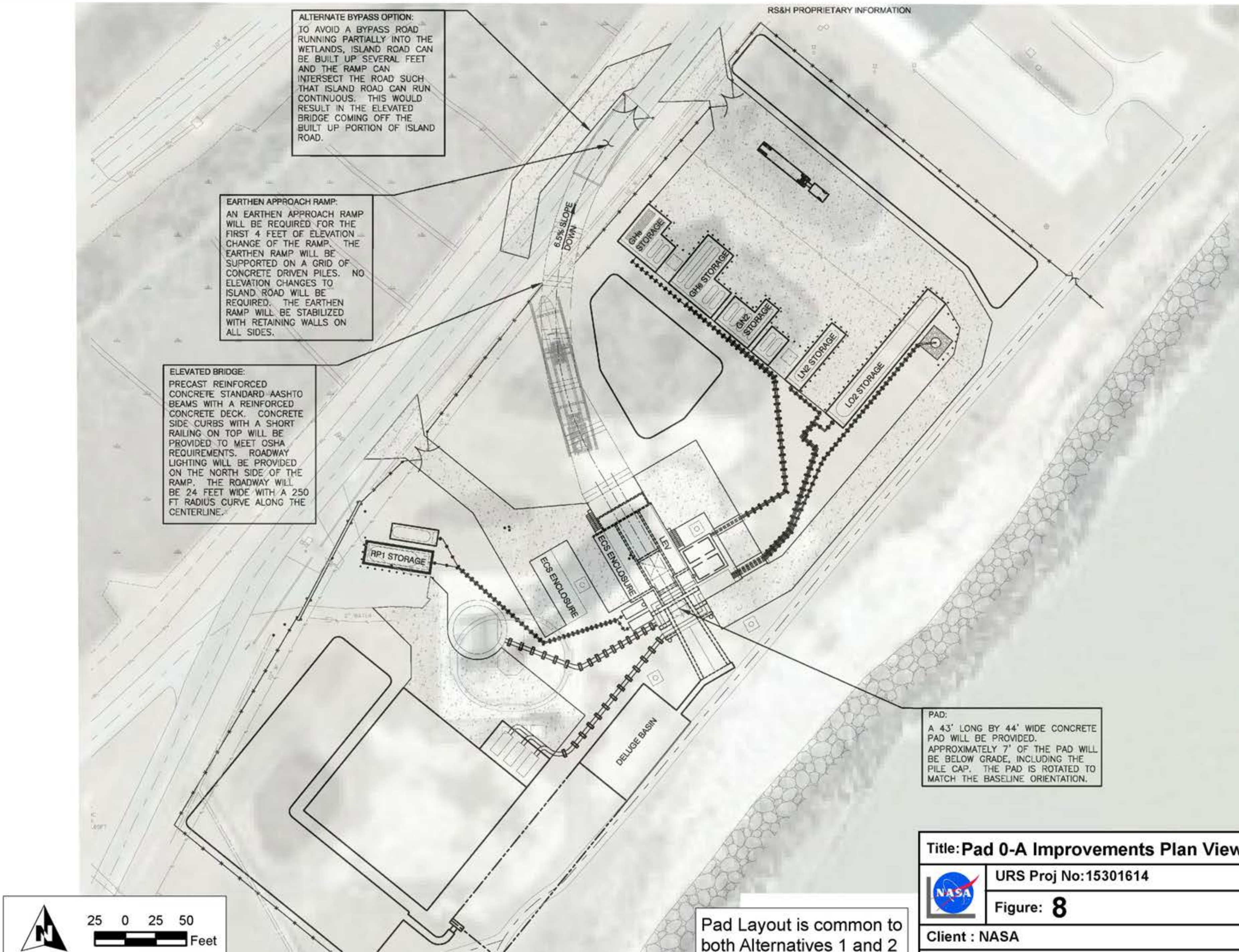

Title: Pad 0-A Improvements Plan View

URS Proj No: 15301614

Figure: 8

Client : NASA

Expansion of the Launch Range at Wallops Flight Facility

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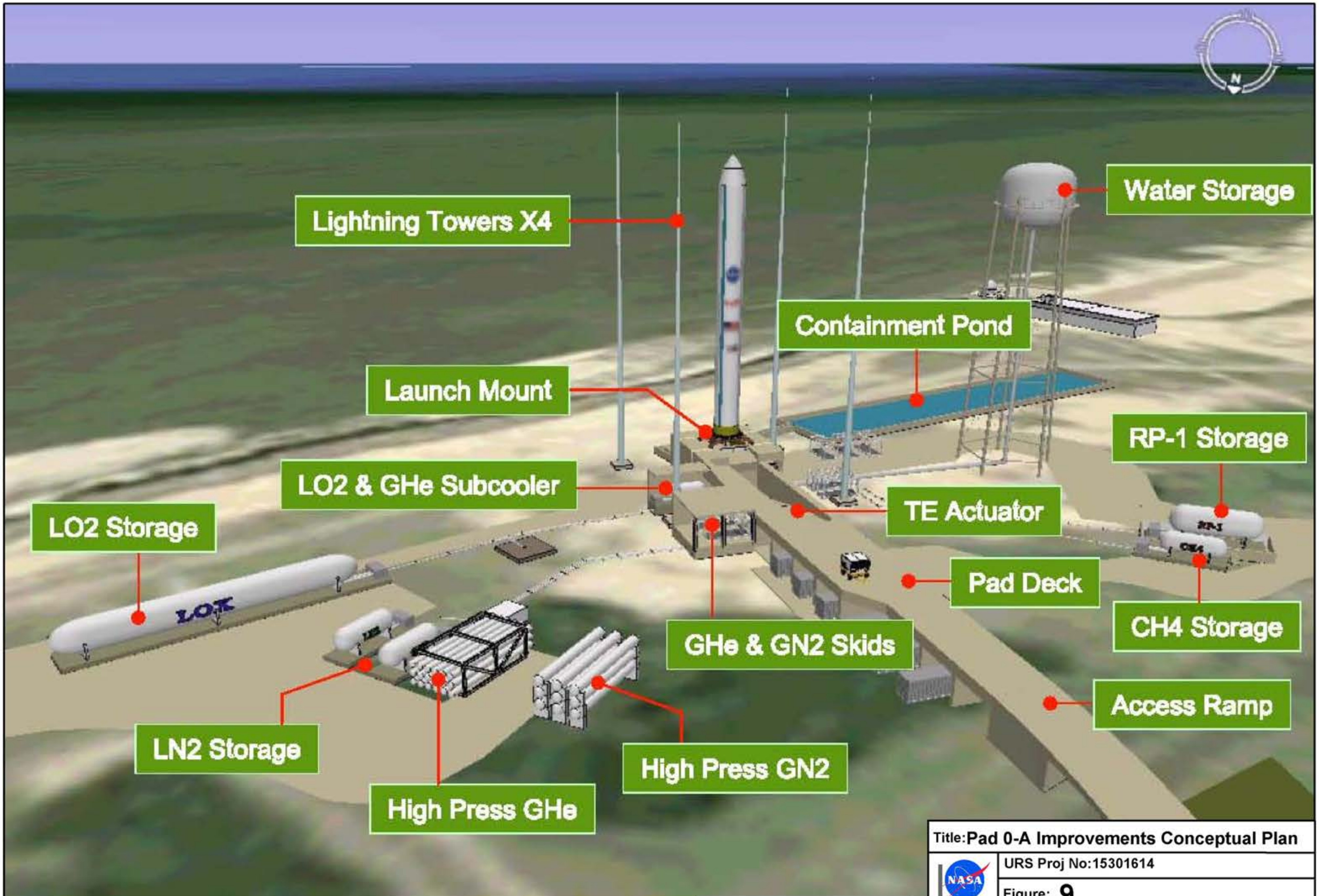

Pad Layout is common to both Alternatives 1 and 2

Title: Pad 0-A Improvements Conceptual Plan	
	URS Proj No:15301614
	Figure: 9
Client : NASA	
Expansion of the Launch Range at Wallops Flight Facility	

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- Assorted aboveground steel tanks containing up to 115 cubic meters (4,000 cubic feet) of medium pressure gaseous nitrogen; and
- Support equipment that would include piping, pumps, heat exchangers, vaporizers, valves, control systems, concrete pads and pedestals, and other miscellaneous items.

2.2.1.8 Modifications to Existing Launch Support Facilities

Several existing facilities could undergo minor interior modifications to support the launch of medium large class orbital rockets and spacecraft; these facilities would include the blockhouses (launch control buildings), communication support systems, radar, and antennas.

In addition to constructing a dedicated PFF, NASA would make minor interior modifications to building V-55 so that it could also serve as a temporary PFF. Modifications would include the installation of explosion-proof electrical outlets, ventilation system changes, and the installation of vapor monitoring devices. Fueling operations would generally be the same as in the PFF; however, use of this building for fueling would be occasional and only if the primary PFF was not available.

2.2.1.9 Construction Timeline Estimate

Table 1: Estimated Construction Timeline

Project Component	Start Date	Finish Date	Length of Time
Modifications to Boat Dock	November 2009	May 2010	6 months
PPF	March 2012	March 2013	12 months
PFF	March 2012	March 2013	12 months
HIF	September 2009	September 2010	12 months
Transportation Infrastructure	November 2009	May 2010	6 months
Pad 0-A Improvements	November 2009	November 2010	12 months
Existing Facility Modification	November 2009	Ongoing	Ongoing

2.2.2 Transportation and Handling of Components

The transportation and handling of various cargo, launch vehicle, and payload components would be ongoing as the components are delivered to Wallops Main Base or Island via barge, truck, or airplane, and then transported via road to various facilities and the launch pad.

Hazardous materials would be brought to Wallops Island via barge or truck and stored and handled in a PPF, the PFF, the HIF, and the LFF. Approximately two barges per launch would deliver the launch vehicle, payload, and related cargo to one of the NASA boat docks several months prior to launch. Cargo would then be offloaded for land-based transport to launch vehicle or PPFs. Some of the cargo to be unloaded may contain hazardous materials.

Hazardous operations include ordnance handling and installation, loading of liquid propellants, hazardous systems tests, mating of a payload to a solid propellant motor (solid motors would be utilized as ELV upper stages, as explained in Section 2.2.3), and propellant leak tests. Hazardous materials may include liquid and solid propellants, small explosive charges for stage separation or flight termination, batteries, solvents, and various materials in small quantities within a payload. Hypergolic propellants (described in Section 4.2.6) would be transported to WFF several days to a week prior to fueling, and would be stored in DOT-approved shipping containers inside controlled access facilities on Wallops Island. Payloads would be fueled directly from the containers. Following fueling operations, any remaining propellant would be returned to the manufacturer. No bulk or permanent storage for hypergolic propellants (those that ignite spontaneously without an external aid such as a spark) is anticipated.

2.2.3 Launch Activities

Under Alternative One, a maximum of six additional orbital-class launches per year would occur from Pad 0-A, resulting in a maximum of 18 orbital-class launches from MARS (12 existing launches from Pad 0-B, and 6 additional launches from Pad 0-A). Launches may be conducted during any time of the year, and at any time of the day or night. Over the first several years of implementing Alternative One, launch frequency would likely be 2-3 flights per year, increasing to 6 flights per year after all required infrastructure is built. A maximum launch rate (and associated infrastructure investment) of an additional 6 flights per year from MARS is based upon the expected medium-class ELV needs of NASA, DOD, commercial, and weather satellite customers between the years 2011-2015.

In addition to launches, static test firing of rocket engines would occur at Pad 0-A. Static test firing is conducted while the ELV is held stationary on the launch pad. The purpose of the test is to assess the functionality of engine design in a non-flight situation. While no more than one static test firing a year is planned, a test anomaly may necessitate a second test within months. Accordingly, this EA assumes two static fire tests to be conducted within every 12-month period under Alternative One. A description of potential launch vehicles and spacecraft is provided in Section 2.4 below.

2.3 ALTERNATIVE TWO

Under Alternative Two, NASA and MARS would maximize the use of existing facilities to support up to and including medium large class suborbital and orbital ELV launch activities from WFF. Alternative Two includes site improvements required to support launch operations; testing, fueling, and processing operations; and up to two static fire tests per year. Under Alternative Two, a maximum of three orbital-class launches per year would occur from Pad 0-A. Implementation of Alternative Two would result in a maximum of 15 orbital-class launches from MARS Launch Complex 0 (12 existing launches from Pad 0-B, and 3 additional launches from Pad 0-A).

All payload fueling would take place in Building V-55. Building H-100 on the Main Base would be used for non-hazardous materials storage and payload processing of unfueled spacecraft (the HIF would not be used under this alternative). An ELV processing bay, referred to as a “high bay,” would be constructed as an addition to the existing Building V-45, and Building V-50 would be used as a personnel support and laboratory facility.

Due to competition from other NASA and partner missions for the use of payload fueling activities in Building V-55 and payload processing activities in Building H-100, use of these two buildings for Proposed Action activities would be limited. Additionally, because the processing bay constructed as an addition to Building V-45 would only accommodate one ELV at a time, the number of launches that could occur from Pad 0-A under Alternative Two would be limited to a maximum of three per year, half of what is expected to be needed by U.S. space customers by 2011.

2.3.1 Site Improvements

Figure 10 shows a view of Wallops Island with the facilities that are proposed for expansion under Alternative Two.

2.3.1.1 Modifications to Boat Dock

Under Alternative Two, modifications to the boat dock on the north end of Wallops Island would be the same as under Alternative One (Figure 6). After unloading at the boat dock, the ELV would be transported to the Building V-45 high bay.

2.3.1.2 Building V-45 High Bay

Before launch on an ELV, a spacecraft (payload) must be prepared for its mission. The preparations include such activities as checking electrical circuits, testing lines or tanks for leaks, and loading liquid propellants into fuel tanks. Because these and other preparations must be conducted under controlled conditions in clean environments (free of dust and particulates) and because some of the materials (liquid and solid propellant and explosives) that are handled or loaded are hazardous, special facilities are used for these operations.

NASA would use the existing Building V-45, located in the center of Wallops Island (see Figure 9) for payload processing. A new addition called a high bay would be constructed on the west side of Building V-45. Payloads would be handled by bridge cranes located within the high bay area. The footprint of the new construction would be 0.1 hectare (0.25 acre) for high bay and 0.6 hectare (1.35 acres) for the access roads and parking.

2.3.1.3 Building V-55 Payload Fueling Facility

NASA would make interior modifications to building V-55 so that it could also serve as a PFF. Modifications could include the installation of explosion-proof electrical outlets, ventilation system changes, and the installation of vapor monitoring devices.

2.3.1.4 Transportation Infrastructure

The transportation and handling of various cargo, launch vehicle, and payload components would be ongoing as the components are delivered to Wallops Main Base or Island via barge, truck, or airplane, and then transported via road to various facilities and the launch pad.

NASA would make transportation improvements necessary to transport cargo and the ELV from the existing boat dock on the north end of Wallops Island to Building V-45. The unfueled spacecraft would be transported via truck to Building H-100 on the Main Base for processing. After processing, the spacecraft would be trucked to Building V-55 on Wallops Island for fueling. Following fueling, the spacecraft would be trucked south to the new high bay addition on Building V-45 for integration with the launch vehicle. The integrated ELV would be transported via truck to Pad 0-A.

Infrastructure improvements would include construction of new roads to Building V-45 and minor upgrades to existing roads. New road construction along with widening or straightening of existing roads could add up to an additional 1 hectare (2.1 acres) of asphalt pavement.

2.3.1.5 Pad 0-A Improvements

Under Alternative Two, the improvements at Pad 0-A would be the same as those described under Alternative One. A new MARS launch pad complex including a pad access ramp, launch pad, and deluge system would be constructed in approximately the same location as the existing pad (Figures 8 and 9; see Section 2.2.1.6).

2.3.1.6 Liquid Fueling Facility

The LFF described under Alternative One would be constructed under Alternative Two in the same location adjacent to Pad 0-A and would include the exact same components and infrastructure (see Section 2.2.1.7).

2.3.1.7 Modifications to Existing Launch Support Facilities

Several existing facilities could undergo minor interior modifications to support the launch of commercial medium large class orbital rockets; these facilities would include the blockhouses (launch control buildings), communication support systems, radar, and antennas.

2.3.1.8 Construction Timeline Estimate

Table 2: Estimated Construction Timeline

Project Component	Start Date	Finish Date	Length of Time
Modifications to Boat Dock	November 2009	May 2010	6 months
Modifications to V-45	November 2009	November 2010	12 months
Modifications to V-55	November 2009	Ongoing	Ongoing
Transportation Infrastructure	November 2009	May 2010	6 months
Pad 0-A Improvements	November 2009	November 2010	12 months

2.3.2 Transportation and Handling of Components

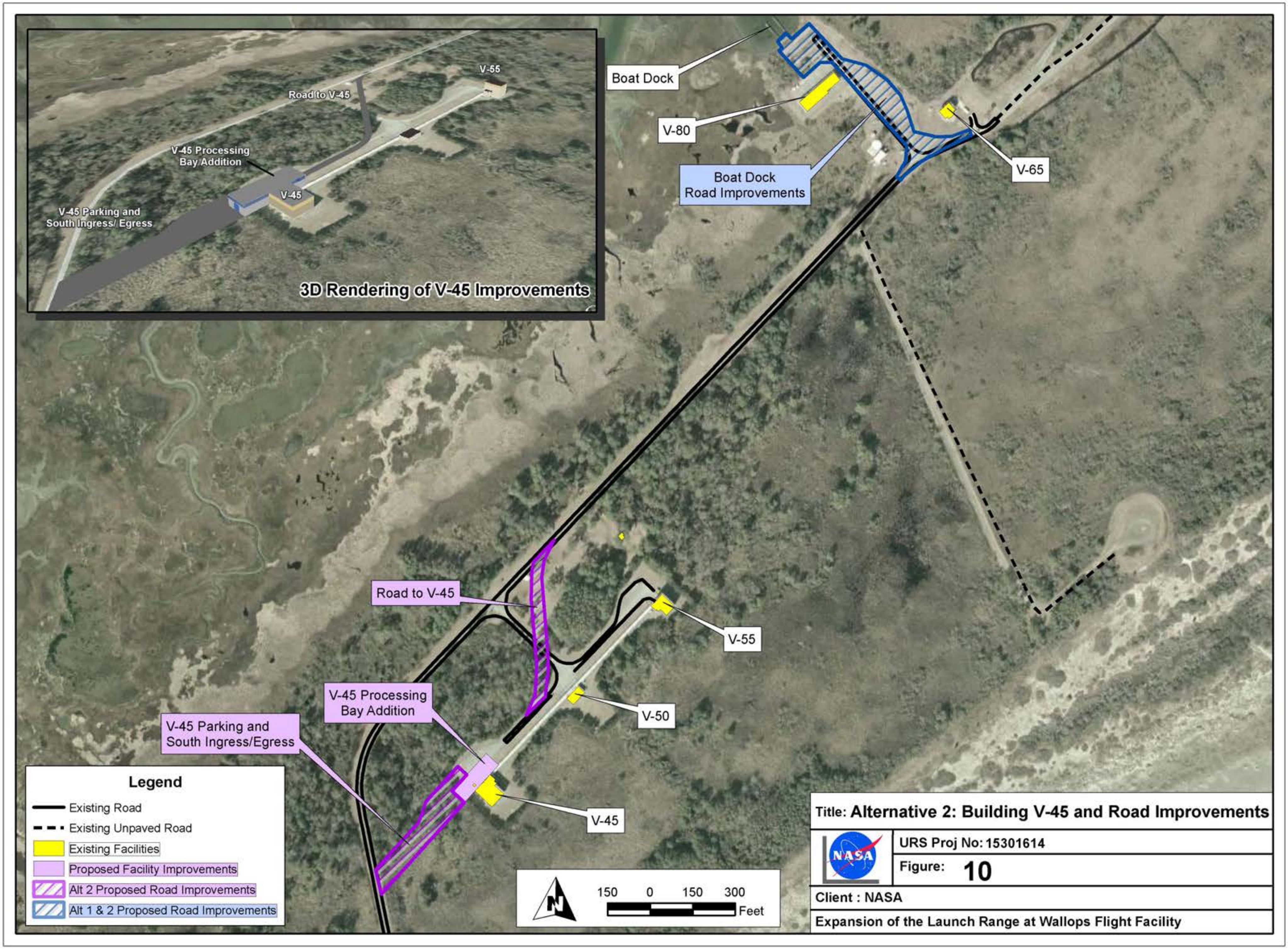
The transportation and handling of various cargo, launch vehicle, and payload components would be ongoing as the components are delivered to Wallops Main Base or Wallops Island via truck, barge, or airplane, and then transported via road to various facilities and the launch pad.

Hazardous materials would be brought to Wallops Island via barge or truck and stored and handled in existing buildings including H-100, V-55, V-45, and the LFF. Approximately two barges per launch would deliver the launch vehicle, payload, and related cargo to one of the NASA boat docks several months prior to launch. Cargo would then be offloaded for land-based transport to launch vehicle or Payload Processing Facilities. Some of the cargo to be unloaded may contain hazardous materials.

Hazardous materials would be managed as described in Section 2.2.3 under Alternative One.

2.3.3 Launch Activities

Under Alternative Two, a maximum of three additional orbital-class launches per year would occur from Launch Complex 0, resulting in a maximum of 15 orbital-class launches from MARS (12 existing launches from Pad 0-B, and 3 additional launches from Pad 0-A). Launches would be conducted during any time of the year, and at any time of the day or night. During the first several years of implementing Alternative Two, launch frequency would likely be two flights per year with a gradual increase to three flights per year.



3D Rendering of V-45 Improvements
V-55
Road to V-45
V-45 Processing Bay Addition
V-45
V-45 Parking and South Ingress/ Egress
Boat Dock
V-80
Boat Dock Road Improvements
V-65
Road to V-45
V-55
V-45 Processing Bay Addition
V-50
V-45 Parking and South Ingress/Egress
V-45
Legend
Existing Road
Existing Unpaved Road
Existing Facilities
Proposed Facility Improvements
Alt 2 Proposed Road Improvements
Alt 1 & 2 Proposed Road Improvements
150 0 150 300
Feet
N
Title: Alternative 2: Building V-45 and Road Improvements
URS Proj No: 15301614
Figure: 10
Client : NASA
Expansion of the Launch Range at Wallops Flight Facility

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In addition to launches, static test firing of rocket engines would occur at Pad 0-A. Static test firing is conducted while the ELV is held stationary on the launch pad. The purpose of the test is to assess the functionality of engine design in a non-flight situation. While no more than one static test firing a year is planned, a test anomaly may necessitate a second test within months. Accordingly, this EA assumes two static fire tests to be conducted within every 12-month period under both alternatives.

2.4 LAUNCH VEHICLES

Both alternatives would use the same launch vehicles; therefore, one discussion on launch vehicles that applies to both Alternative One and Alternative Two is provided below.

An ELV is composed of stages, each of which contains its own engines and fuel (also known as propellant). A launch vehicle is considered to be expendable if any significant part of it (a stage) is not retrieved and refurbished. Stages are either mounted on top of one another, or attached alongside another stage. The first stage is at the bottom and is usually the largest, and the second stage and subsequent upper stages are above it, usually decreasing in size. In a typical case, the first stage engines fire to propel the entire rocket upward. When the engines run out of fuel, they are detached from the rest of the rocket (usually with some kind of small explosive charge) and fall away. This leaves a smaller rocket, with the second stage on the bottom, which then fires; this process is repeated until the final stage's motor burns to completion.

Commercial ELVs are divided into four classes based on the weight of the payload (Table 3) as defined in 14 CFR Subsection 420.19. A payload is anything carried by the launch vehicle that is not essential to its flight operations, including but not limited to spacecraft, cargo, scientific instruments, and experiments.

Table 3: ELV Weight Classes Based on Payload Weight

100 nautical mile orbit	Weight Class in Kg (Lbs)			
	Small	Medium	Medium Large	Large
28 degrees* inclination	≤ 1,996 (4,400)	>1,996 (4,400) to ≤5,035 (11,100)	>5,035 (11,100) to ≤8,391 (18,500)	>8,391 (18,500)
90 degrees inclination	≤1,497 (3,300)	>1,497 (3,300) to ≤3,810 (8,400)	>3,810 (8,400) to ≤6,834 (15,000)	>6,834 (15,000)

*28 degrees inclination orbit from a launch point at 28 degrees latitude

There are a variety of ELV systems available for commercial or government missions: the Taurus II and the Falcon family of ELVs would be launched from MARS Pad 0-A, and are covered within this EA. The Taurus II is the largest liquid-propelled launch vehicle and will serve as the envelope launch vehicle as described in Section 1. The Taurus II and Falcon family of ELVs would accommodate the desired range of payload masses, provide the needed trajectory capabilities, and meet NASA's requirements for highly reliable launch services.

Launch vehicles can use either liquid or solid propellants. In a liquid-propellant rocket, an oxidizer is combined with the fuel during launch to produce thrust. The propellant and oxidizer are stored in separate tanks. Liquid propellants used in rockets can be categorized into three different types: petroleum, cryogens, and hypergolics. Petroleum propellants are derived from crude oil, with RP-1 being the most common petroleum used in rockets. Cryogenic propellants are liquefied gases such as liquid hydrogen (LH_2) and LOX. Hypergolic propellants are those that ignite spontaneously without an external aid (such as a spark) and include hydrazine, MMH, and UDMH. NTO, MONs, or nitric acid is usually used as an oxidizer for hypergolic propellant systems.

Solid-propellant rockets have casings filled with a mixture of solid compounds (propellant and oxidizer combined) that burn rapidly and emit hot gases from a nozzle to produce thrust. Solid propellants used in rockets are classified as either homogenous (having the same composition throughout) or composite (composed of different compounds). ELVs typically use composite solids. Composite propellants consist of powders or mixtures that use a finely ground mineral salt (typically ammonium perchlorate) as an oxidizer. The propellant itself is usually aluminum. Composite propellants are identified by the type of binder that is used. The most common binders are polybutadiene acrylic acid acrylonitrile and hydroxyl-terminated polybutadiene (HTPB). Table 4 includes specifications on the type of motors and propellants associated with the Taurus and Falcon ELVs.

Table 4: Falcon Family and Taurus II Motors and Propellants

Name	Motor type	Potential Maximum Propellant
Taurus II	1st stage: 2 AJ26-62 engines	155,220 L (41,005 gal) LOX/79,237 L (20,932 gal) RP-1
	2nd stage: ATK Castor-30 solid motor	12,814 kg (28,250 lb) HTPB (12% HTPB, 20% Al, 68% NH4ClO4)
	Optional 2nd stage: High Energy Second Stage (HESS)	13,250 L (3,500 gal) LOX/ 10,600 L (2,800 gal) liquid methane
	3rd stage (optional) Orbit Raising Kit (ORK): Helium pressure regulated bi-propellant propulsion system	322 kg (710 lb) NTO/358 kg (789 lb) MMH
	3rd stage (optional) Star 48V: solid kick motor	2,010 kg (4,431 lb) HTPB
Falcon 1	1st stage: SpaceX Merlin 1A or 1C	12,708 L (3,357 gal) LOX/8,245 L (2,178 gal) RP-1
	2nd stage: SpaceX Kestrel	2,203 L (582 gal) LOX/1,325 L (350 gal) RP-1
Falcon 1e	1st stage: 1 SpaceX Merlin 1C+	44,300 kg (97,665 lb) LOX and RP-1 combined
	2nd stage: 1 SpaceX Kestrel 2	4,028 kg (8880 lb) LOX and RP-1 combined
Falcon 9	1st stage: 9 SpaceX Merlin engines	114,372 L (30,213 gal) LOX/74,205 L (19,602 gal) RP-1
	2nd stage: 1 SpaceX Merlin engine	12,708 L (3,357 gal) LOX/8,245 L (2,178 gal) RP-1

Sources: NASA, 2002a; SpaceX, 2008; Orbital, 2008

Payloads on ELVs are typically launched into one of the following orbits:

1. LEO, which is between 80–2,000 kilometers (50–1,250 miles) above the Earth's surface
2. Geosynchronous orbit (GEO), a circular orbit at an altitude of 35,000 kilometers (22,000 miles) above the Earth's surface
3. A geosynchronous transfer orbit (GTO), which is between a LEO and a GEO, is mathematically derived based on the vehicle's velocity
4. A sun-synchronous orbit, which is 800–1,000 kilometers (500–625 miles) above the Earth's surface and rotating approximately 8 degrees off the polar orbit

Below is a general description of the Taurus and Falcon ELVs. Appendix A contains detailed ELV descriptions.

2.4.1.1 Taurus II

The Taurus II (Figure 11) is a two-stage launch vehicle with a gross lift-off weight of 290,000 kg (640,000 lbs) (Orbital, 2008). An optional third stage can be added. Taurus II incorporates both solid and liquid stages; the first stage uses LOX and RP-1 as the propellants, the second stage is either a solid motor propelled by HTPB or a liquid-propelled motor using LOX and methane, and the optional third stage uses either NTO and hydrazine or solid HTPB as propellant.

Figure 11: Artist's Rendering of the Taurus II Launch Vehicle at WFF.

Source: Orbital Taurus II Fact Sheet, 2008

2.4.1.2 Falcon Family

The Falcon family of launch vehicles utilizes a partially refurbishable launch system designed and manufactured by Space Exploration Technologies Corporation (SpaceX, 2008). The Falcon launch vehicles (Figure 12), which include the Falcon 1, Falcon 1e (not pictured), and Falcon 9, are two-stage and use liquid propellant (LOX and RP-1) for both stages.

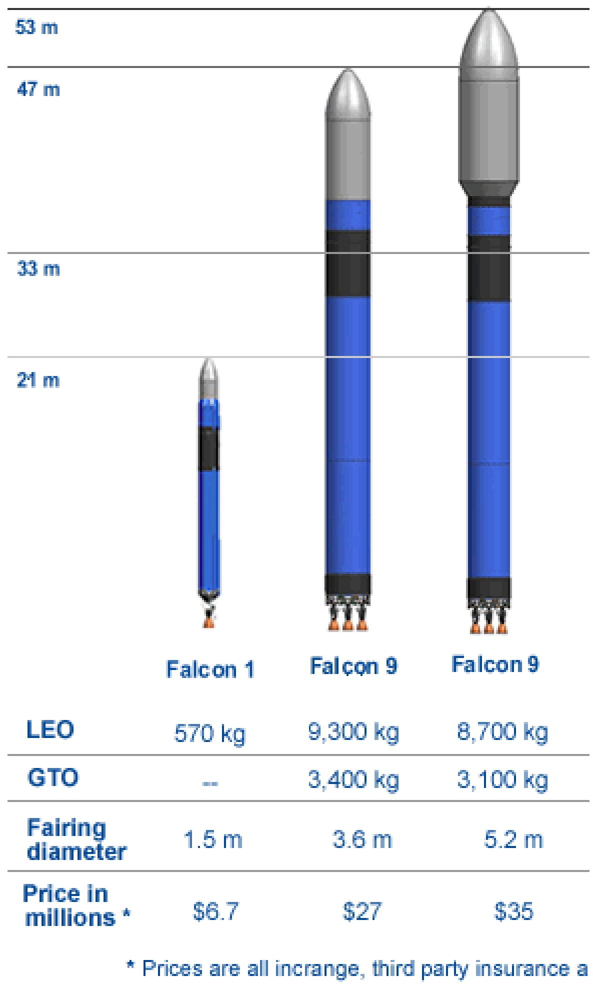


Figure 12: Falcon Family of Launch Vehicles

Source: Global Security, 2008

Falcon 1 and 1e

The Falcon 1 is a two-stage, liquid-propelled vehicle with a gross lift-off weight of approximately 27,000 kg (60,000 lbs) that can carry small-class payloads between 125 to 570 kg (275 to 1,257 lbs). The Falcon 1 measures 21.3 meters (70 feet) in length with a diameter of 1.68 meters (66 inches), tapering to 1.52 meters (60 inches) on the second stage.

The Falcon 1e, which is planned to replace the Falcon 1 in mid-2010, is based on the Falcon 1; however, it has an extended first stage tank. The Falcon 1e has a gross lift-off weight of approximately 35,000 kg (77,000 lbs) and an overall length of approximately 27 meters (88.5 feet). Falcon 1e can carry small-class payloads up to 1,000 kg (2,200 lbs) into LEO (SpaceX, 2008).

Falcon 9

The Falcon 9 has a gross lift-off weight of approximately 333,000 kg (735,000 lbs) and a maximum length of 54 meters (177 feet). Typical maximum payload weights are 6,800 kg (15,000 lbs) for LEO, but can be much higher (as shown on Figure 12) depending on the altitude of the orbit (lower orbits support higher weights). For GTO, the Falcon 9 Block 2 design can carry payloads up to a maximum of 4,500 kg (10,000 lbs) (typical, not maximum masses are shown in Figure 12).

2.4.2 Envelope Spacecraft (ES)

Spacecraft (also called payloads) are satellites that are launched into space to be used in communications systems, for weather tracking, for remote sensing or planetary exploration, and as scientific experiments. Spacecraft may contain mechanical structures, batteries or solar power cells, transmitters, receivers, antennas, other communication system components, small radioactive sources, recovery systems, in-space maneuvering systems, and scientific and technological instruments (e.g., lasers, sensors, atmospheric sampling devices, optical devices, and biological experiments). No specific spacecraft has been identified as the ES; instead, the ES should be considered a hypothetical payload whose components, materials, associated quantities, and flight systems represent a comprehensive bounding reference design. Any proposed payload that presents lesser or equal values of environmentally hazardous materials or sources in comparison to the ES may be considered within the purview of this EA.

Launches with two or more payloads on a single ELV would be covered by this EA if, when combined, they do not exceed the ES characteristics. However, if the payloads exceed the ES characteristics defined in this EA, additional NEPA review would be required.

For this EA, the ES characteristics do not incorporate any components with unusual potential for substantial environmental impact (including payloads involving radioisotope thermoelectric generators and radioisotope heater units). Spacecraft that would return air, soil, or other materials from any extraterrestrial body or from interplanetary space are not covered by this EA. This includes spacecraft that would return a sample to the Earth’s surface and spacecraft that would return a sample only to Earth orbit.

Figure 13 illustrates the relevant features of the ES, which would be launched into Earth orbit or toward another body in the solar system.

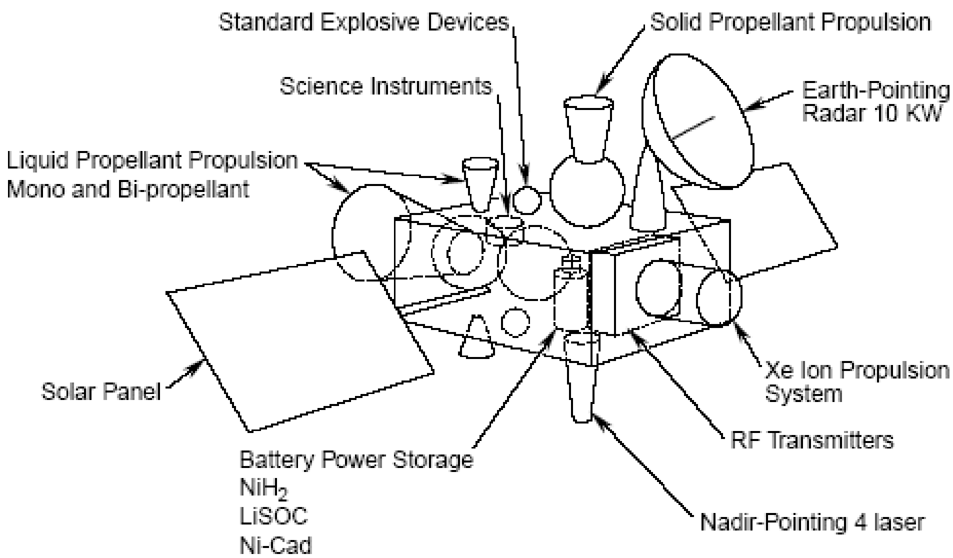


Figure 13: Envelope Spacecraft

Table 5 lists the major materials together with the maximum quantities that would be carried by the ES (see also Payload Checklist, Appendix B). Minor materials that are not listed may be included on the ES as long as they pose no substantial hazard to the human environment. The Payload Checklist in Appendix B provides steps to evaluate whether the ES fits within the envelope characteristics.

Table 5: Summary of Envelope Spacecraft Subsystems and Characteristics

Component	Envelope
Structure	Unlimited: aluminum, magnesium, carbon resin composites, titanium, and other materials unless specified as limited. Limited: beryllium, nanomaterials, limits based on specific material to be evaluated on a case-by-case basis.
Radio Frequency	Electromagnetic fields must be within American National Standards Institute (ANSI)-recognized acceptable levels as stated in Institute of Electrical and Electronics Engineers C95.1-1991. Documentation requirement for REC is radio frequency data confirming compliance.
Lasers	Meets ANSI safety standards (ANSI Z136.1-2000 and Z136.6-2000). Documentation requirement for REC is laser data confirming compliance.
Radioactive Materials	Quantity and type of radioactive material are within the approval authority level of the NASA Nuclear Flight Safety Assurance Manager (NFSAM). Documentation requirement for REC is copy of Radioactive Materials Report as per NPR 8715.3 Section 5.5.2.
Biological Agents	Biological agents must meet conditions of Biosafety Level 1 of the National Institute of Health and Centers for Disease Control Biosafety in Microbiological and Biomedical Laboratories. Documentation requirement for REC is laboratory data confirming compliance.
Chemical Release	Must not pose a substantial hazard and cannot have a significant adverse effect on the atmosphere.

Component	Envelope
Orbital Debris Generation and Reentry	Must comply with the requirements of NASA Procedural Requirement (NPR) 8715.6A for Limiting Orbital Debris and NASA Standard (NASA-STD) 8719.14, Process for Limiting Orbital Debris, or sponsoring/licensing agency equivalent. A debris assessment would be prepared as required by these policies.
Propulsion	Mono- and bipropellant hypergolic fuel/oxidizer; 1,450 kg (3,197 lbs) of combined hydrazine, MMH, NTO, and nitrogen oxide (NO_X); spacecraft and any upper stage hypergolic propellant quantities shall be added together to determine if the spacecraft is within the ES bounding case. Solid rocket motor; 2,010 kg (4,430 lbs) ammonium perchlorate (AP)-based solid propellant (examples of solid rocket motor propellant that might be on a spacecraft are a Star-48 kick stage, descent engines, an extra-terrestrial ascent vehicle, etc.).
Communications	Various 10–100 Watt (radio frequency) transmitters.
Power	Unlimited solar cells; 5 kiloWatt-hour nickel-hydrogen or lithium ion battery, 300 amp-hour lithium-thionyl chloride, or 150 amp-hour hydrogen, nickel-cadmium, or nickel-hydrogen battery
Science Instruments	10 kiloWatt radar ANSI safe lasers (Section 4.1.2.1.3)
Other	DOT Class 1.4 Electro-Explosive Devices for mechanical systems deployment Radioisotopes in quantities limited to the amounts that are within the approval authority for launch by the NFSAM as per NPR 8715.3B Chapter 6 (see NPR 8715.3B in the references for website link) Propulsion system exhaust and inert gas venting Sample returns are considered outside of the scope of this EA. Must comply with the requirement of NASA Policy Directive (NPD) 8700.3A, Safety and Mission Assurance Policy for NASA Spacecraft, Instruments, and Launch Services.

2.4.2.1 Cygnus Spacecraft

In addition to an ES, the Taurus II vehicle may also carry a capsule as a payload to deliver cargo to the ISS under contract with NASA. This capsule, named Cygnus, is composed of two primary components: the Pressurized Cargo Module and the Service Module. The Pressurized Cargo Module has an external diameter of 3 meters (10 feet) and a total length of 3.7 meters (12 feet). The Service Module has an external (cylindrical) diameter of approximately 2.7 meters (9 feet) and a depth (including the thruster nozzles) of approximately 1.8 meters (6 feet). Prior to launch, the Cygnus would be processed similarly to any other ES. After completion of its mission to deliver cargo to the ISS, the Cygnus would return to Earth. The capsule may contain down-cargo from the ISS for return to Earth, and may also carry trash for disposal. The returning Cygnus would reenter the atmosphere on a pre-planned trajectory with most of its contents burning up during the controlled, destructive reentry. Any surviving return cargo would be expected to land in the ocean.

Figure 14: Cygnus Spacecraft
Source: Orbital, 2009

2.4.2.2 Dragon Spacecraft

Similarly to the Taurus II, the Falcon 9 vehicle may also carry a capsule as a payload to deliver cargo to the ISS. This capsule, called Dragon, is between 3.7 and 5.2 meters (12 to 17 feet) tall and similar in design to the Apollo command capsule. Dragon is composed of two main elements: the Capsule for pressurized cargo and the Unpressurized Cargo Module or “Trunk.” The Capsule contains the Pressurized Section, the Service Section, and the Nosecone. Prior to launch, the Dragon would be processed similarly to any other ES. After completion of its mission to deliver cargo to the ISS, the Dragon would reenter the atmosphere on a pre-planned trajectory, land in the ocean, and be recovered by a recovery vessel, similar to the Falcon 9 first stage. The capsule may contain down-cargo from the ISS for return to Earth, and may also carry trash for disposal. All materials brought down from the station would be delivered to NASA unless directed otherwise. The capsule may or may not be refurbished and re-used.

Figure 15: Dragon Spacecraft
Source: SpaceX, 2007

SECTION THREE AFFECTED ENVIRONMENT

Section 3 presents information regarding existing resources at Wallops Island that may be affected by the proposed alternatives. This section contains discussions on resources under the three main categories of Physical Environment, Biological Environment, and Social and Economic Environment. Because the majority of the Proposed Action that could affect the environment would take place on Wallops Island (as opposed to the Main Base or Wallops Mainland), this section does not provide a comprehensive description of conditions (e.g., soil types, air emissions, etc.) for these two additional land areas. For more information about the existing conditions on the Main Base or Wallops Mainland, please refer to the 2008 WFF Environmental Resources Document (NASA, 2008a).

3.1 PHYSICAL ENVIRONMENT

3.1.1 Land Resources

This section is based on information taken from the 1994 soil survey for Accomack County, Virginia (U.S. Department of Agriculture [USDA], 1994); the 2005 WFF Site-Wide EA (NASA, 2005); and the 2008 WFF Environmental Resources Document (NASA, 2008a). Discussed in this section are Topography and Drainage, Geology, Soil, Atlantic Ocean Substrate, and Land Use within the WFF operating area.

3.1.1.1 Topography and Drainage

Wallops Island is a barrier island approximately 11 kilometers (7 miles) long and 807 meters (2,650 feet) wide. It is bordered by Chincoteague Inlet to the north, Assawoman Inlet to the south, the Atlantic Ocean to the east, and marshland to the west. Assawoman Inlet is often filled in and opens only intermittently during and after major storm events; under most conditions the silt effectively connects Wallops Island to the north end of Assawoman Island.

Much of the Atlantic shoreline of Wallops Island has been lined with an armor stone seawall to protect critical NASA, U.S. Navy, and MARS infrastructure. The beach has nearly or completely eroded in areas armored with the seawall. The unarmored shoreline segments at the north and south ends of the island consist of low sloping sandy beaches. The sandy portion of Wallops Island has an elevation of about 2.1 meters (6.9 feet) above mean sea level (amsl) (NASA, 2008a). The highest elevation on Wallops Island is approximately 4.6 meters (15 feet) amsl (NASA, 2005). Most of the island is below 3.0 meters (10 feet) amsl (NASA, 2005).

Wallops Island is separated from the mainland by a marshy bay. The marshes flood regularly with the tides and are drained by an extensive system of meandering creeks. Surface water on Wallops Island flows east through numerous tidal tributaries that subsequently flow to the Atlantic Ocean. Additionally, Wallops Island has storm drains that divert the water flow to several individual discharge locations.

Barrier islands are dynamic geologic features. They migrate, erode, and accrete in response to physical processes such as waves, tides, and wind. The Atlantic shoreline of Wallops Island has experienced erosion throughout the 6 decades that WFF has occupied the site. On the southern portion of the island, near the MARS facility, shoreline retreat averaged about 3.7 meters (12 feet) per year from 1857 to the present (NASA, 2008a). Further south, adjacent to Assawoman

Inlet, shoreline retreat exceeded 5 meters (16.4 feet) per year during that same time period (NASA, 2008a).

As is typical of barrier islands, Wallops Island exhibits environmental zonation related to changes in topography across the island profile. Generally, dunes and maritime forest are found at the highest elevations, and beaches and marshes are found at the lowest. On Wallops Island, previous hardened structures, such as groins, weirs, beach beams, and beach prisms, have disturbed natural sediment transport processes, thereby changing the island's structure. The seawall that was constructed to protect critical infrastructure on the island has fixed the shoreline position, but has resulted in complete erosion of the beach seaward of the wall, preventing long-term natural maintenance of the gently sloping near-shore and beach systems that would have existed under natural conditions. In addition, without a beach to provide a source of sand, the island's ability to create and maintain natural dunes is limited.

3.1.1.2 Geology

Located within the Atlantic Coastal Plain Physiographic Province, Wallops Island is underlain by approximately 2,133 meters (7,000 feet) of sediment. The sediment lies atop crystalline basement rock. The sedimentary section, ranging in age from Cretaceous to Quaternary (approximately 145.5 to 2.5 million years ago), consists of a thick sequence of terrestrial, continental deposits overlain by a much thinner sequence of marine sediments. These sediments are generally unconsolidated and consist of clay, silt, sand, and gravel.

The regional dip of the soil units is eastward, toward the Atlantic Ocean. The two uppermost stratigraphic units on Wallops Island are the Yorktown Formation and the Columbia Group, which is not subdivided into formations. The Yorktown Formation is the uppermost unit in the Chesapeake Group and was deposited during the Pliocene epoch of the Tertiary Period (approximately 5.3 to 1.8 million years ago). The Yorktown Formation generally consists of fine to coarse glauconite quartz sand, which is greenish gray, clayey, silty, and in part, shelly. The Yorktown Formation occurs at depths of 18 to 43 meters (60 to 140 feet) in Accomack County (NASA, 2008a).

3.1.1.3 Soil

The soil classifications for Wallops Island, shown in Table 6, are based on the 1994 USDA Soil Survey of Accomack County, Virginia.

Table 6: Predominant Soil Types at Wallops Island

Location	Soil Type	Typical Slopes (percent)	Description
Wallops Island – eastern portion	Chincoteague silt loam	0–1	Nearly level, very deep, very poorly drained hydric soils. This soil provides a suitable wildlife habitat.
Wallops Island – east of Chincoteague silt loam	Udorthents and Udipsamments	0–35	Nearly level to steep, very deep, and range from well-drained to somewhat poorly drained.
Wallops Island – southern end	Fisherman Assateague fine sands complex	0–35	Nearly level to steep, very deep, moderately well-drained, to excessively drained. This soil is used mainly for wildlife habitat and recreation.
Wallops Island – depressions and areas associated with dunes and salt marshes	Fisherman Comacca fine sands complex	0–6	Very poorly to moderately well-drained.
Wallops Island – central and western portions in depressions and on flats associated with dunes and saltmarshes	Comacca fine sand	0–2	Nearly level, very deep, very poorly drained. The soil is used mainly for wildlife habitat and recreation.
Wallops Island – eastern portion	Assateague fine sand	2–35	Gently to steeply sloping, very deep, excessively drained. This soil is rarely flooded and is used primarily for wildlife and recreation.
Wallops Island – eastern portion	Beaches	0-10	Moderately sloping and used mainly for wildlife habitat.

Source: NASA, 2008a

The Coastal Plain soils of the Eastern Shore are generally very level soils, and many soil types are considered to be prime farmland by the USDA. The dominant agricultural soils are high in sand content, which results in a highly leached condition, an acidic pH, and a low natural fertility (USDA, 1994). Adequate artificial drainage improves productivity for poorly drained soils. Prime and unique farmlands in Accomack County include the following soils:

- Bojac fine sandy loam soils
- Bojac loamy sand soils
- Munden fine sandy soil
- Munden loamy sand
- Dragston fine sandy loam, if adequately drained
- Nimmo fine sandy loam, well drained

No prime or unique soils are found on Wallops Island; therefore, the Farmland Protection Policy Act (7 U.S.C. 4201 *et seq*.) does not apply to this project and will not be discussed further (Figure 16).

3.1.1.4 Land Use

Wallops Island consists of 1,680 hectares (4,150 acres), most of which is marshland, and includes launch and testing facilities, blockhouses, rocket storage buildings, assembly shops, dynamic balancing facilities, tracking facilities, U.S. Navy facilities, and other related support structures (Figure 17). Wallops Island is zoned for industrial use by Accomack County. The marsh area between Wallops Mainland and Wallops Island is classified as marshland in the County's Comprehensive Plan. Wallops Mainland consists mostly of marshland and is bordered by agricultural land to the west, Bogues Bay to the north, and an estuary to the south. The area surrounding Wallops Island consists of rural farmland and small villages and is regulated by local county government and several town councils (NASA, 2008a). Corn, wheat, soybeans, cabbage, potatoes, cucumbers, and tomatoes are examples of the commodities produced on the surrounding farms.

Area businesses include fuel stations, retail stores, markets, and restaurants. The Town of Atlantic is located 8.05 kilometers (5 miles) to the northeast and has a land area of approximately 183 hectares (452 acres); Wattsville is located 12.5 kilometers (7.8 mile) to the north and has a land area of approximately 330 hectares (815 acres); and Assawoman is located 8.05 kilometers (5 miles) to the southwest and has a land area of approximately 33.6 hectares (83 acres). Each of these towns has a population of less than 500 people.

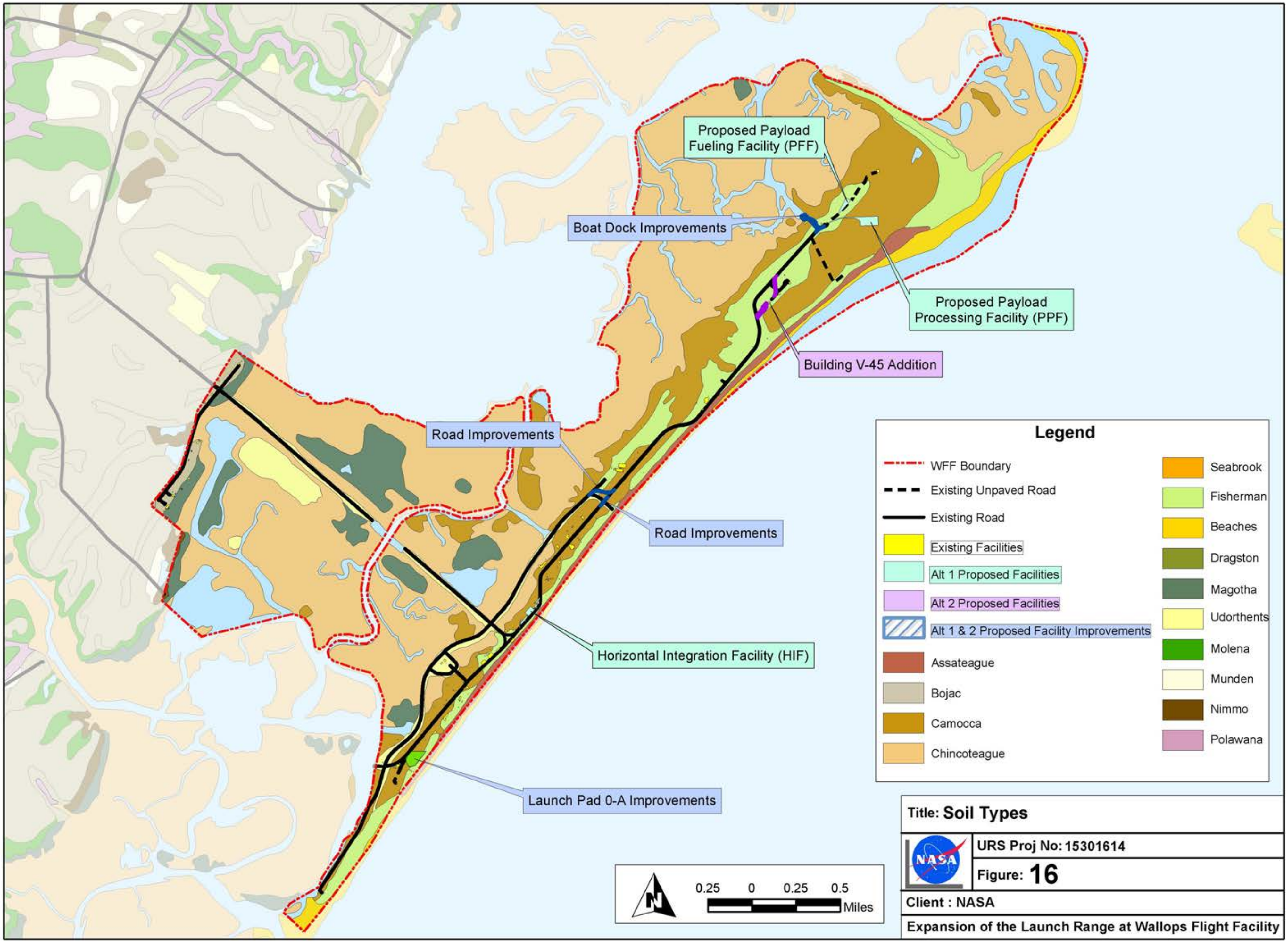
The Town of Chincoteague, located approximately 24 kilometers (15 miles) northeast of Wallops Island, on Chincoteague Island, Virginia, is the largest of the surrounding communities, with approximately 4,300 year-round residents. The island attracts a large tourist population during the summer months to visit the public beaches and attend the annual Assateague Island pony swim and roundup. Because of this, hotels and motels as well as other summer-season tourist businesses can be found on Chincoteague Island (NASA, 2008a).

3.1.2 Water Resources

The southern and eastern portions of Wallops Island are part of the Eastern Lower Delmarva watershed. The western portion of Wallops Island is part of the Chincoteague Bay watershed, while the remaining Wallops Island surface waters flow into many small unnamed watersheds. The Chincoteague Bay watershed has a relatively small population, with an average density of less than 105 people per square kilometer (40 per square mile), little topographic relief, and a high water table. Large areas of the watersheds on Wallops Island are comprised of tidal wetlands.

3.1.2.1 Surface Waters

Chincoteague Inlet forms the northern boundary of Wallops Island and its western side is bounded by water bodies that include (from north to south) Ballast Narrows, Bogues Bay, Cat Creek, and Hog Creek. This western boundary of Wallops Island includes a section of the Virginia Inside Passage, a federally maintained navigational channel frequently used by commercial and recreational boaters alike. The Atlantic Ocean lies to the east of Wallops Island.



Title: **Soil Types**

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Figure: **16**

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Expansion of the Launch Range at Wallops Flight Facility

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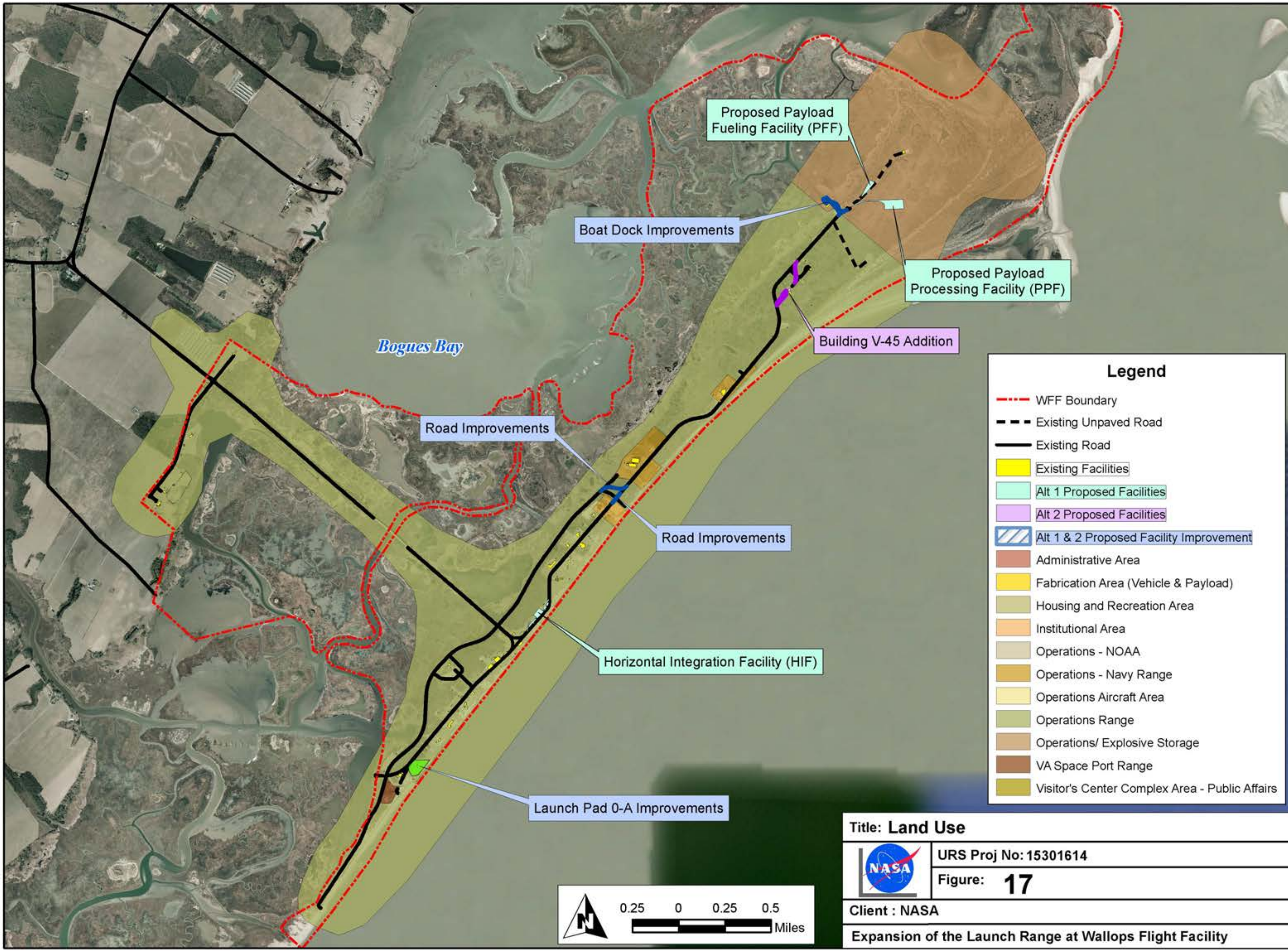

Title: Land Use

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Figure: 17

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Expansion of the Launch Range at Wallops Flight Facility

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Surface waters in the vicinity of Wallops Island are saline to brackish and are influenced by the tides. Outgoing tidal flow is generally north and east to Chincoteague Inlet and out to the Atlantic Ocean; incoming tides flow in the reverse direction. The VDEQ has designated the surface waters around Wallops Island as Class II – Estuarine Waters (NASA, 2008a). The Atlantic Ocean is designated as Class I – Open Ocean. Surface waters in Virginia must meet the water quality criteria specified in 9 Virginia Administrative Code (VAC) 25-260-50. This set of criteria establishes limits for minimum dissolved oxygen concentrations, pH, and maximum temperature for the different surface water classifications in Virginia. In addition, Virginia surface waters must meet the surface water criteria specified in 9 VAC 26-260-140. This set of criteria provides numerical limits for various potentially toxic parameters. For the Class I and II waters in the vicinity of Wallops Island, the saltwater numerical criterion is applied. Both sets of standards are used by the Commonwealth of Virginia to protect and maintain surface water quality.

No wild or scenic rivers are located on, or adjacent to, Wallops Island; therefore, the Wild and Scenic Rivers Act (16 U.S.C. 1271-1287) does not apply to this project and will not be discussed further.

3.1.2.2 Wetlands

EO 11990 (Wetland Protection) directs Federal agencies to minimize the destruction, loss, and degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetland communities. In accordance with the Clean Water Act (CWA) (33 U.S.C. §1251 et seq.), projects at WFF that involve dredging or filling wetlands require Section 404 permits from the U.S. Army Corps of Engineers (USACE). Title 14 of CFR Part 1216.2 (NASA regulations on Floodplain and Wetland Management) directs WFF and its tenants to minimize wetland impacts.

In addition, permits may be required from the Virginia Marine Resources Commission (VMRC), Accomack County Wetlands Board, and the VDEQ for work that may impact wetlands. A Joint Permit Application (JPA), filed with VMRC, is used to apply for permits for work in the waters of the United States, including wetlands, within Virginia. The VMRC plays a central role as an information clearinghouse for local, State, and Federal levels of review; JPAs submitted to VMRC receive independent yet concurrent review by local wetland boards, VMRC, VDEQ, and USACE (NASA, 2008a).

Extensive wetland systems border Wallops Island. The island has non-tidal freshwater emergent wetlands and several small freshwater ponds in its interior, and freshwater forested/shrub wetlands, estuarine intertidal emergent wetlands, and maritime forests on its northern and western edges**.** Marsh wetlands also fringe Wallops Mainland along Arbuckle Creek, Hog Creek, and Bogues Bay. Figure 18 provides further details on the types and locations of wetland communities present on Wallops Island.

3.1.2.3 Marine Waters

The NASA and MARS launch complexes are located on Wallops Island, a barrier island directly on the Atlantic Ocean. Continental slope waters in this area maintain a fairly uniform salinity range (32 to 36 parts per thousand [ppt]) throughout the year, with pockets of high salinity water (38 ppt) found near the Gulf Stream in the fall (NASA, 2003b). There are distinct differences in stratification of the Mid-Atlantic Ocean water column between summer and winter. In the winter, the water column temperature is vertically well-mixed, while in the summer, the temperature is more vertically layered (NASA, 2003b).

3.1.2.4 Floodplains

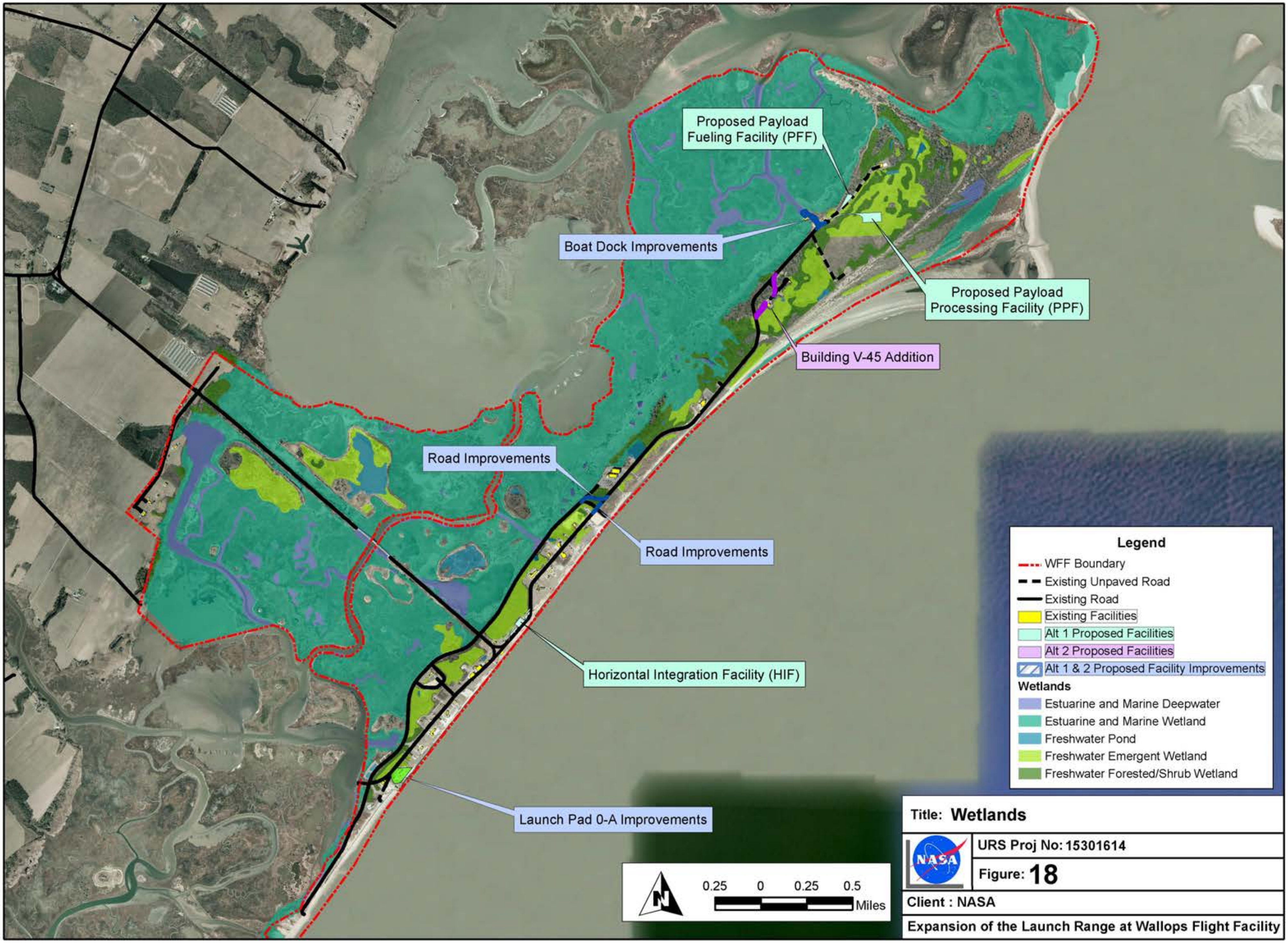
EO 11988 (Floodplain Management) requires Federal agencies to take action to minimize occupancy and modification of the floodplain. Specifically, EO 11988 prohibits Federal agencies from funding construction in the 100-year floodplain unless there are no practicable alternatives. As shown on the Flood Insurance Rate Maps (FIRMs) produced by the Federal Emergency Management Agency (FEMA), the 100-year floodplain designates the area inundated during a storm having a 1-percent chance of occurring in any given year. The 500-year floodplain designates the area inundated during a storm having a 0.2-percent chance of occurring in any given year.

FIRM Community Panels 5100010070B and 5100010100C indicate that Wallops Island is located entirely within the 100-year and 500-year floodplains (see Figure 19). Wallops Island is a barrier island that receives flood waters primarily during major storm events (nor'easters, tropical storms, or hurricanes) from both the ocean to the east and from the marshes and bays to the west. Wallops Island retains floodwaters during storm events and therefore reduces flood impacts to the mainland during storms.

3.1.2.5 Coastal Zone Management

Wallops Island is one of a limited number of barrier islands along the Atlantic Coast of the United States. Barrier islands are elongated, narrow landforms that consist largely of unconsolidated and shifting sand, and lie parallel to the shoreline between the open ocean and the mainland. Barrier islands provide protection to the mainland, prime recreation resources, important natural habitats to unique species, and valuable economic opportunities to the country. Wallops Island also contains coastal primary sand dunes that serve as protective barriers from the effects of flooding and erosion caused by coastal storms (NASA, 2008a).

The Coastal Barrier Resources Act (CBRA [P.L. 97-348], 16 U.S.C. 3501-3510), enacted in 1982, designated various undeveloped coastal barrier islands as units in the Coastal Barrier Resources System. Designated units are ineligible for direct or indirect Federal financial assistance programs that could support development on coastal barrier islands; exceptions are made for certain emergency and research activities. Wallops Island is not included in the Coastal Barrier Resources System; therefore, the CBRA does not apply. VDEQ is the lead agency for the Virginia Coastal Zone Management (CZM) Program, which is authorized by NOAA to administer the Coastal Zone Management Act of 1972. Any Federal agency development in Virginia's Coastal Management Area (CMA) must be consistent with the enforceable policies of the CZM Program. Although Federal lands are excluded from Virginia's CMA, any activity on Federal land that has reasonably foreseeable coastal effects must be consistent with the CZM Program (VDEQ, 2008b). Enforceable policies of the CZM Program that must be considered when making a Federal Consistency Determination include:



Title: **Wetlands**

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Figure: **18**

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Expansion of the Launch Range at Wallops Flight Facility

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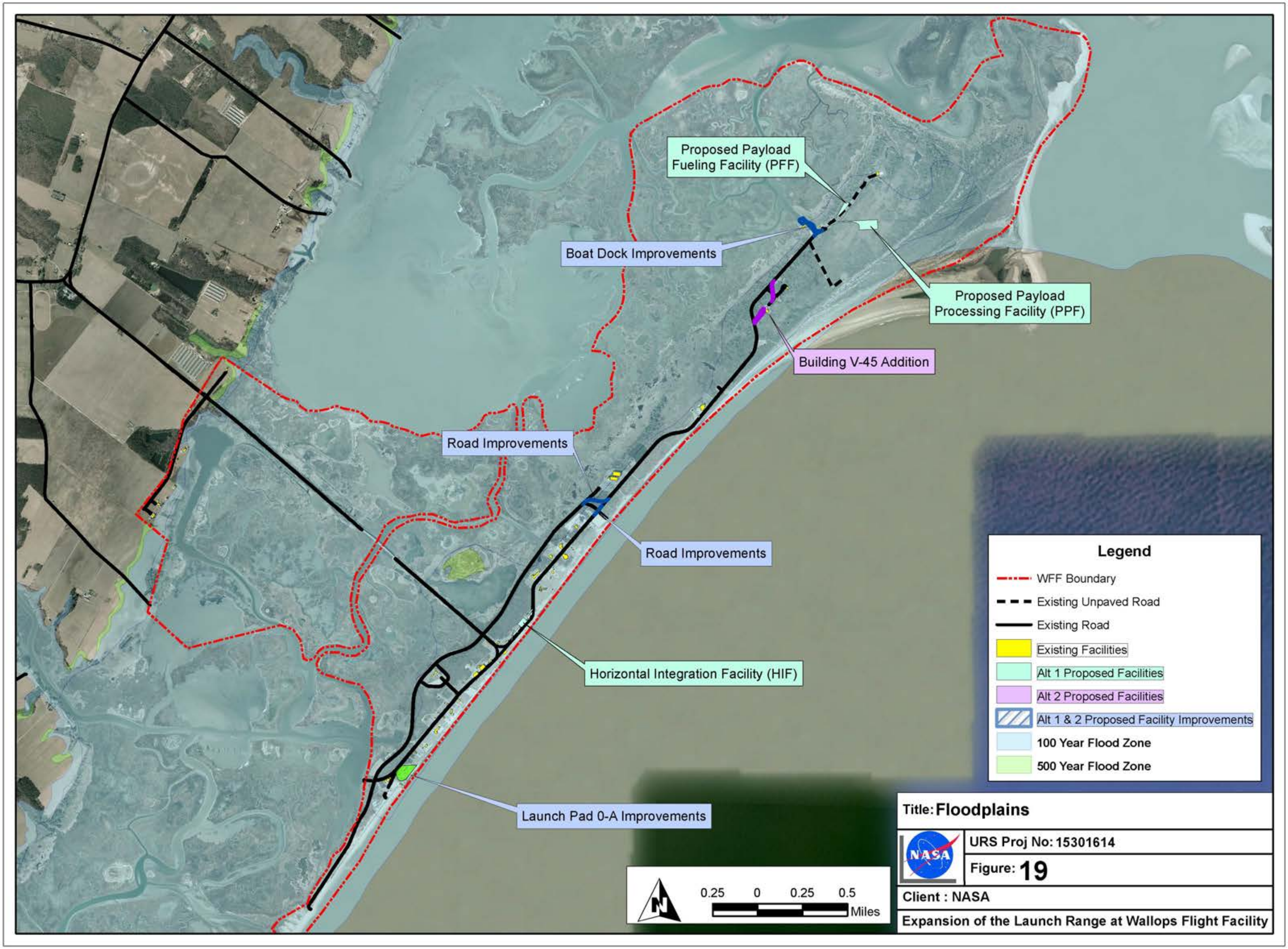
Proposed Payload Fueling Facility (PFF)
Boat Dock Improvements
Proposed Payload Processing Facility (PPF)
Building V-45 Addition
Road Improvements
Road Improvements
Horizontal Integration Facility (HIF)
Launch Pad 0-A Improvements
Legend
WFF Boundary
Existing Unpaved Road
Existing Road
Existing Facilities
Alt 1 Proposed Facilities
Alt 2 Proposed Facilities
Alt 1 & 2 Proposed Facility Improvements
100 Year Flood Zone
500 Year Flood Zone
0.25 0 0.25 0.5
Miles
N
Title: Floodplains
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Expansion of the Launch Range at Wallops Flight Facility

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

Because Wallops Island is within Virginia's CMA, NASA activities are subject to the Federal Consistency requirement.

3.1.2.6 Stormwater

Wallops Island has storm drains that divert stormwater flow to several individual discharge locations. The northern portion of Wallops Island drains by overland flow to Bogues Bay and Chincoteague Inlet via Sloop Gut and Ballast Narrows. The central portion of the island drains primarily to the west toward Bogues Bay. Cross-culverts under Island Road drain stormwater collected by culverts and ditches. Flap gates have been installed west of Island Road to convey stormwater to Bogues Bay via Hog Creek. Tidal flaps have been installed on most outfalls west of Island Road to minimize tidal influence on internal drainage ways.

The CWA National Pollutant Discharge Elimination System (NPDES) (33 U.S.C. 1342) requires permits for stormwater discharges associated with industrial activities. VDEQ is authorized to carry out NPDES permitting under the VPDES (9 VAC 25-151). Currently, there are no permitted stormwater outfalls located on Wallops Mainland or Wallops Island; however, NASA maintains a Stormwater Pollution Prevention Plan (SWPPP) to ensure that its operations have minimal impact on stormwater quality.

The Virginia Stormwater Management Program (VSMP) regulations (4 VAC 3-20), administered by DCR, require that construction and land development activities incorporate measures to protect aquatic resources from the effects of increased volume, frequency, and peak rate of stormwater runoff and from increased non-point source pollution carried by stormwater runoff. The VSMP also requires that land-disturbing activities of 0.4 hectare (1 acre) or greater develop a SWPPP and acquire a permit from DCR prior to construction. Construction and demolition activities on Wallops Island are subject to VSMP permitting. As such, NASA and its tenants develop SWPPPs and acquire the necessary permits as part of early project planning.

3.1.2.7 Wastewater

NASA owns and operates a wastewater treatment plant (WWTP) that has the capacity to treat up to 1,135,623 liters per day (300,000 gallons per day). The WWTP currently treats flows of approximately 227,125 liters per day (60,000 gallons per day). Wastewater is pumped through a force main from Wallops Island and Wallops Mainland to the collection system on the Main Base. Treated wastewater from the WWTP is discharged via a single outfall to an unnamed freshwater tributary to Little Mosquito Creek under WFF’s VPDES permit VA0024457. The WFF chemistry laboratory tests the wastewater discharge on a daily basis to ensure discharges do not exceed permitted limits.

3.1.2.8 Groundwater

VDEQ manages groundwater through a program regulating the withdrawals in certain areas, called Groundwater Management Areas, under the Groundwater Management Act of 1992. Wallops Island lies within the Eastern Shore Groundwater Management Area, which includes Accomack and Northampton counties. Any person, business, or community wishing to withdraw 1,135 kiloliters (300,000 gallons) or more per month in a declared management area must obtain a permit from VDEQ.

VDEQ has identified four major aquifers on the Eastern Shore of Virginia: the Columbia aquifer and the three aquifers that comprise the Yorktown-Eastover aquifer system.

The Columbia aquifer is known as the water table aquifer, and primarily consists of Pleistocene (approximately 1.8 million to 10,000 years ago) sediments of the Columbia Group (NASA, 2008a). It is unconfined and typically overlain by wind-deposited beach sands, silts, and gravel. The aquifer occurs between the depths of 1.5 and 18.3 meters (5 and 60 feet) below the ground surface, with the water table ranging between the depths of 0 and 9.1 meters (30 feet) below the ground surface. In general, the Columbia aquifer on the Delmarva Peninsula is recharged by surface waters or infiltration of precipitation. On Wallops Island, groundwater flow is generally west and north toward nearby creeks and the marsh area that separates the island from the mainland.

The Yorktown-Eastover system is a multiaquifer unit consisting of late Miocene and Pliocene (approximately 11 to 1.8 million years ago) deposits and is composed of the sandy layers of the Yorktown and Eastover Formations (NASA, 2008a). The top of the shallowest confined Yorktown-Eastover aquifer in the area of Wallops Island is typically found at a depth of approximately 30.5 meters (100 feet) below the ground surface. It is separated from the overlying Columbia aquifer by a 6.1- to 9.1-meter-thick (20- to 30-foot-thick) confining layer (aquitard) of clay and silt. The Yorktown-Eastover aquifers are classified as the upper, the middle, and the lower Yorktown-Eastover aquifers. Correspondingly, each Yorktown-Eastover aquifer is overlain by the upper, middle, and lower Yorktown-Eastover aquitards. The Yorktown-Eastover aquifers on the Delmarva Peninsula are generally recharged by surface waters or infiltration of precipitation from areas located beyond the immediate vicinity of WFF.

Groundwater Appropriation

Groundwater from the Columbia and Yorktown-Eastover Multiaquifer System is the sole source of potable water for WFF and the surrounding area. No major streams or other fresh surface water supplies are available as alternative sources of water for human consumption. The Columbia and Yorktown-Eastover Multiaquifer System is designated and protected by the U.S. Environmental Protection Agency (EPA) as a sole-source aquifer (EPA, 2007a). A sole-source aquifer is a drinking water supply located in an area with few or no alternative sources to the groundwater resource, and if contamination occurred, using an alternative source would be extremely expensive. The sole-source aquifer designation protects an area's groundwater resource by requiring the EPA to review any proposed projects within the designated area that are receiving Federal financial assistance. All proposed projects receiving Federal funds that would have potential impacts on groundwater quantity or quality are subject to review to ensure they do not endanger the water source. Additionally, the Accomack-Northampton Planning District Commission has established a groundwater management program for the entire Eastern Shore of Virginia. This Commission includes a Groundwater Committee, established in 1990, that monitors usage and ensures that an optimal balance exists between groundwater withdrawals and recharge rates. This balance helps to minimize the problems of water quality due to saltwater intrusion, aquifer de-watering, and well interference in the general area (NASA, 2008a).

Two supply wells located on Wallops Mainland provide potable and fire suppression water to all Wallops Island facilities. These supply wells are several hundred feet deep and withdraw water from the Middle Yorktown-Eastover Aquifer. No supply wells are located on Wallops Island and all water is piped from wells and treatment facilities on Wallops Mainland**.**

The Main Base is permitted by VDEQ to withdraw up to 30,862,000 liters (8,153,000 gallons) per month. Actual Main Base withdrawals averaged 8,911,000 liters (2,354,000 gallons) per month between 2002 and 2007.

Wallops Mainland and Wallops Island are permitted separately from the Main Base, and are permitted by VDEQ to withdraw up to 6,800,000 liters (1,800,000 gallons) per month and up to 50,345,000 liters (13,300,000 gallons) per year. Wallops Island and Mainland have withdrawn an average of approximately 34,574,000 liters (9,133,000 gallons) per year during 2006–2008, with an average monthly withdrawal of 2,881,000 liters (761,100 gallons) per month during 2006–2008 (Bundick, pers. comm.).

Groundwater Quality

WFF's chemical laboratory performs routine analytical sampling of WFF's water systems in accordance with Federal and State requirements and submits the results to the State for review. Recent sampling of the drinking water system found that all parameters are within regulatory limits. Currently, there are no remedial actions underway that could affect the supply wells on Wallops Mainland.

3.1.3 Air Quality

The CAA (P.L. 108-201, 42 U.S.C. 85 et seq.), as amended, requires EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The CAA established two types of NAAQS: primary and secondary standards. Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

The EPA has set NAAQS for six principal pollutants that are called "criteria" pollutants. They are: carbon monoxide (CO), nitrogen oxides (NO_X), ozone (O_3), lead (Pb), particulate matter less than or equal to 10 microns (PM_{10}), particulate matter less than or equal to 2.5 microns ($PM_{2.5}$), and sulfur dioxide (SO_2). Although States have the authority to adopt stricter standards, the Commonwealth of Virginia has accepted the Federal standards and has incorporated them by reference in 9 VAC 5-30 (VDEQ, 2008a; see Table 7).

Table 7: National Ambient Air Quality Standards

Pollutant	Averaging Time	Primary/Secondary NAAQS	NAAQS Violation Determination[a]
O_3	8 hour	0.075 ppm [b]	3-year average of the annual 4th highest daily maximum 8-hour average concentration
CO	8 hour	9.0 ppm	Not to be exceeded more than once per calendar year
	1 hour	35.0 ppm	Not to be exceeded more than once per calendar year
NO_2	Annual arithmetic mean	0.053 ppm	Annual average
SO_2	Annual arithmetic mean	0.03 ppm	Not to be exceeded more than once per calendar year
	24 hour	0.14 ppm	Not to be exceeded more than once per calendar year
	3 hour	0.5 ppm	Not to be exceeded more than once per calendar year
PM_{10}	Annual arithmetic mean	Revoked	Expected number of days per calendar year with a 24-hour average concentration above 150 µg/m^3 cannot be exceeded more than once per year on average over a 3-year period
	24 hours	150 µg/m^3	
$PM_{2.5}$	Annual arithmetic mean	15 µg/m^3	3-year average of annual arithmetic mean
	24 hour	65 µg/m^3	3-year average of 98th percentile of the 24-hour values determined for each year
Pb	Quarterly average	1.5 µg/m^3	Quarterly arithmetic mean

[a]A NAAQS violation results in the re-designation of an area; however, an exceedance of the NAAQS does not always mean a violation has occurred.
[b]New O_3 8-hour standard effective May 30, 2008.
[c]Revoked annual PM_{10} standard December 2006.
µg/m^3 = micrograms per cubic meter
ppm = parts per million
NA = not applicable
NO_2 = nitrogen dioxide

Source: Derived from EPA, 2008

Federal regulations designate Air Quality Control Regions, or airsheds, that cannot attain compliance with the NAAQS as non-attainment areas. Areas meeting the NAAQS are designated as attainment areas. Wallops Island and Mainland are located in Accomack County, an attainment area for all criteria pollutants; therefore, a General Conformity Review (under Section 176(c) of the CAA) does not apply to the facilities prior to implementing a Federal action.

Wallops Island and Wallops Mainland are considered a synthetic minor source, and the two land masses are combined into a facility-wide State operating air permit for stationary emission sources (Permit Number 40909, amended August 3, 2006). A facility is considered a major source in an attainment area if all of its sources together have a potential to emit greater than or equal to 90.7 metric tonnes per year (100 tons per year) of the criteria pollutants, or greater than or equal to 9.1 metric tonnes per year (10 tons per year) of a single Hazardous Air Pollutant (HAP) or 22.7 metric tonnes per year (25 tons per year) of combined HAPs. Table 8 lists the emissions for Wallops Island and Mainland based on the 2007 annual update form, which provides VDEQ with consumption rates.

Table 8: Calendar Year 2007 Air Emissions at Wallops Island

Pollutant	Emissions (metric tonnes per year/tons per year)
CO	0.46 / 0.51
NO_X	1.93 / 2.13
SO_2	2.98 / 3.28
VOC	0.05 / 0.06
PM_{10}	0.20 / 0.22
$PM_{2.5}$	0.18 / 0.20

VOC = volatile organic compound

Source: VDEQ, 2008c

Prevention of Significant Deterioration

Separate pre-construction review procedures have been established for projects that are proposed to be built in attainment areas versus non-attainment areas. The pre-construction review process for new or modified major sources is called New Source Review (NSR) and consists of a Prevention of Significant Deterioration (PSD) review for sources located in an attainment area. This review process is intended to keep new air emission sources from causing existing air quality to deteriorate beyond acceptable levels codified in the Federal regulations. Construction of major new stationary sources in attainment areas must be reviewed in accordance with the PSD regulations. The PSD rule defines a major source as any source with a potential to emit (PTE) of 90.7 metric tonnes per year (100 tons per year) or more of any criteria pollutant for source categories listed in 40 CFR 52.21(b)(1)(i), or 226.8 metric tonnes per year (250 tons per year) or more of any criteria pollutant for source categories that are not listed. If a new source is determined to be a major source for any criteria pollutants, then other remaining criteria pollutants would be subject to PSD review if those pollutants are emitted at rates that exceed the following significant emission thresholds:

- 90.7 metric tonnes per year (100 tons per year) for CO
- 36.3 metric tonnes per year (40 tons per year) for NO_X, VOC, and SO_2 each

- 13.6 metric tonnes per year (15 tons per year) for PM_{10}
- 22.7 metric tonnes per year (25 tons per year) for PM

Major sources that exceed any of the PSD thresholds are subject to PSD review for all criteria pollutants. Wallops Island and Mainland are assumed not to be a major source under the PSD program, nor one of the listed source categories. To continue to protect air quality in designated attainment areas, a PSD applicability analysis must be conducted for each Federal project. NASA ensures that before each project is initiated, PTE is calculated not only to assess whether a permit to construct for applicable sources is needed, but also to document that the entire project does not trigger PSD.

Minor New Source Review

The minor NSR permit program applies to the construction, reconstruction, relocation, or modification of any stationary source that will emit regulated air pollutants above minimum exemption levels. If a permit is required, it must be obtained before any activity on the project can begin. Prior to installing any new stationary emission sources, NASA is responsible for assessing if a permit-to-construct application is necessary, and if so, for preparing and filing the applicable Form 7 permit application forms.

New Source Performance Standards

New Source Performance Standards (NSPS) regulations (40 CFR 60) establish pollutant emission limits and monitoring, reporting, and recordkeeping requirements for various emission sources based on source type and size. These regulations apply to new, modified, or reconstructed sources. According to the State operating permit, and confirmation by NASA environmental personnel, there are no emission sources (i.e., boilers, storage vessels, emergency generators) that are subject to NSPS.

National Emission Standards for Hazardous Air Pollutants

Section 112(a) of the CAA Amendments requires the development of emission standards for listed HAPs from new and modified equipment at stationary major and area sources (i.e., a source that is not a major HAP source). Emission standards promulgated under this subsection require the maximum degree of reduction in emissions of HAPs for specific source categories. The standards are to be established by taking into consideration the cost of achieving such emission reductions, and any non-air quality health and environmental impacts and energy requirements.

National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations, codified at 40 CFR Parts 61 and 63, regulate HAP emissions. Part 61 was promulgated prior to the 1990 CAA Amendments and regulates specific HAPs: asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. The 1990 CAA Amendments established an original list of 189 HAPs to be regulated, which resulted in the promulgation of Part 63, also known as the Maximum Achievable Control Technology (MACT) standards. These MACTs regulate emissions from major HAP sources and specific source categories that emit HAPs.

Wallops Island and Wallops Mainland are currently considered a minor or area HAP source, and are therefore not subject to NESHAP regulations for major sources. The facility would, however, be subject to area source NESHAP regulations when these regulations are promulgated by EPA.

Condition 19 of the March 24, 2008, Stationary Source Permit to Operate establishes a federally enforceable limit of 8.5 metric tonnes per year (9.4 tons per year) of hydrogen chloride (HCl) and 0.91 metric tonne per year (1.0 ton per year) of Pb. These limits are placed on the combustion of solid fuel propellants during static rocket motor test firing events.

3.1.3.1 Regional Meteorology

WFF is located in the climatic region known as the humid continental warm summer climate zone. Large temperature variations during the course of a single year and lesser variations in average monthly temperatures typify the region. The climate is tempered by the proximity of the Atlantic Ocean to the east and the Chesapeake Bay to the west. Also affecting the climate is an oceanic current, know as the Labrador Current, which originates in the polar latitudes and moves southward along the Delmarva coastline. The current creates a wedge between the warm Gulf Stream offshore and the Atlantic coast. The climate of the region is dominated in winter by polar continental air masses and in summer by tropical maritime air masses. Clashes between these two air masses create frontal systems, resulting in thunderstorms, high winds, and precipitation. Precipitation in this climate zone varies seasonally.

Four distinct seasons are discernible in the region. In winter, sustained snowfall events are rare. Spring is wet with increasing temperatures. Summer is hot and humid with precipitation occurring primarily from thunderstorm activity. Autumn is characterized by slightly decreasing temperatures and strong frontal systems with rain and sustained winds.

Climate records are maintained by the WFF Meteorological Office. A summary of local climate data for 2007 is presented in Table 9, along with record high and low temperatures over a 44-year timeframe (NASA, 2008a).

Table 9: Temperature Records at Wallops Flight Facility

Mo	Avg Max Temp °C (°F)[1]	Avg Min Temp °C (°F)[1]	Avg Precip cm (in.)[1]	Avg Hum (%)[1]	Avg Vis km (mi)[1]	Avg Wind Speed kph (mph)[1]	Record Hi °C (°F)/ Year[2]	Record Low °C (°F)/ Year[2]
Jan	6.7 (44)	-2.2 (28)	7.92 (3.12)	66.8	13.1 (8.13)	15.2 (9.42)	26.1 (79)/2002	-20 (-4)/1965
Feb	7.8 (46)	-1.7 (29)	7.67 (3.02)	59.2	12.7 (7.89)	14.8 (9.18)	26.1 (79)/1997	-20 (-4)/1971
Mar	11.7 (53)	2.2 (36)	9.65 (3.80)	61.8	13.3 (8.26)	18.0 (11.16)	30 (86)/1990	-10 (14)/ 1980, 1996
Apr	17.2 (63)	6.7 (44)	7.21 (2.84)	63.3	12.4 (7.73)	16.3 (10.13)	33.9 (93)/1990	-4.4 (24)/1969
May	21.7 (71)	11.7 (53)	7.85 (3.09)	66.7	13.9 (8.61)	15.3 (9.48)	36.1 (97)/1991	1.1 (34)/1974
Jun	26.7 (80)	17.2 (63)	8.61 (3.39)	70.6	12.5 (7.77)	14.0 (8.73)	36.1 (97)/1964	4.4 (40)/1967
Jul	29.4 (85)	20.6 (69)	9.50 (3.74)	68.8	13.6 (8.42)	12.9 (8.00)	38.3 (101)/1993	10.6 (51)/1965
Aug	28.9 (84)	20 (68)	9.73 (3.83)	72.0	12.2 (7.61)	11.8 (7.35)	38.3 (101)/1977	8.3 (47)/1982
Sept	25.6 (78)	16.1 (61)	8.90 (3.50)	70.3	15.1 (9.40)	12.5 (7.77)	35.6 (96)/1983	4.4 (40)/1970
Oct	20 (68)	10 (50)	7.57 (2.98)	72.7	12.7 (7.87)	12.8 (7.97)	32.8 (91)/2007	-3.3 (26)/1976
Nov	15 (59)	4.4 (40)	6.93 (2.73)	68.3	14.7 (9.13)	11.6 (7.23)	28.3 (83)/1974	-7.2 (19)/1967, 1974, 1976
Dec	9.4 (49)	0 (32)	8.33 (3.28)	78.8	12.1 (7.52)	13.0 (8.10)	25 (77)/1998	-15.6 (4)/1989

cm = centimeters km = kilometers kph = kilometers per hour
in. = inches mi = miles mph = miles per hour

[1] Average Maximum Temperature, Minimum Temperature, Precipitation, Humidity, Visibility, and Wind Speed are based on data, by month, from January 1, 2007 through December 31, 2007.

[2] Record High Temperatures and Low Temperatures are based on a 44-year time period from 1963 through 2007.

Source: Wallops Range User's Guide, 2007.

For Wallops Island, prevailing winds in the fall and winter tend to be from the northwest, but stormy nor'easters can occur. These 2- to 3-day storms produce severe conditions offshore, with high winds, cold rain, and steep seas due to the open distance of water over which wind can blow from the northeast. Prevailing winds in the summer are southerly, increasing in mid-morning to typically lower than 20 knots and usually dying down at dusk. Offshore fog is uncommon, but can be produced during the spring when a warm, moist, southerly flow of air passes over the cold ocean water.

Winds at Wallops Island are an important influence on the physical environment, as well as on the success of the NASA and MARS missions. Launch vehicles operate under very narrow wind conditions; therefore wind speed and direction are constantly monitored prior to a launch. Wind speeds are the strongest during the fall and winter months, with winds exceeding 55 kilometers per hour (kph, 30 knots) more than 5 percent of the time from November through February. Wind speeds peak in December, when winds exceed 55 kph (30 knots) more than 6 percent of the time. During these months, the predominant wind direction is from the northwest. During March and April, winds are more southerly but still strong. March winds exceed 55 kph (30 knots) nearly 5 percent of the time.

An inversion is another meteorological aspect that affects NASA and MARS missions, whereby ambient air temperature increases with height for some distance above the ground (as opposed to the normal decrease in temperature with height). This effect traps cold air beneath warm air and does not allow emissions (for example, rocket exhaust) to rise and disperse properly. Table 10 describes the temperature, wind structure, and characteristic mixing rate.

Table 10: Dispersion Characteristics within Selected Atmospheric Layers

Atmospheric Layer Altitude Range	Temperature Structure	Wind Structure	Characteristic Mixing Rate
Below nocturnal inversion 0–500 m	Increase with height	Very light or calm	Very poor
Below subsidence inversion 0–1500 m	Decrease with height to inversion base	Variable	Generally fair to inversion base
Troposphere 0.5–20 km	Decrease with height	Variable; increase with height	Generally very good
Stratosphere 20–67 km	Isothermal or increase with height	Tends to vary seasonally	Poor to fair
Mesosphere-Thermosphere Above 67 km	Decrease with height	Varies seasonally	Good

Source: NASA, 2005

3.1.3.2 Atmosphere

The Earth's atmosphere is best described in terms of four principal layers: the troposphere, the stratosphere, the mesosphere, and the ionosphere. These layers have indistinct boundaries. They are identified by temperature, structure, density, and composition.

The lowest level of the atmosphere, the troposphere, extends upward from the Earth's surface to approximately 10 kilometers (6.2 miles). The Earth's weather evolves within this very turbulent region. This layer contains an estimated 75 percent of the total mass of the atmosphere. Solar radiation penetrates the atmosphere, causing heating at the surface that decreases with height within the lower atmosphere. This variation in temperature makes the troposphere the most dynamic of the four atmospheric layers. The troposphere is composed of 76.9 percent nitrogen and 20.7 percent oxygen by weight. The relative concentrations of these gases are highly uniform throughout the lower atmosphere. Water vapor is the next largest component (1.4 percent average by volume throughout the lower atmosphere), although its concentration is rather variable near the Earth's surface. Trace gases make up the remainder of the lower atmosphere. These gases, in order of decreasing amount, are argon, carbon dioxide, neon, helium, methane, krypton, nitrous oxide, hydrogen, xenon, and ozone.

The stratosphere extends from 10 to 50 kilometers (6.2 to 31 miles) and is identified by both physical stability and maximum ozone concentration. It is characterized by an increase in temperature and a decrease in density with altitude. This is due to the ozone layer, which absorbs ultraviolet solar radiation and reradiates it back at longer wavelengths. The base of the stratosphere is marked by an increase in ozone concentration over levels found in the troposphere. The highest ozone concentrations are found near the middle of the stratosphere, in the center of the ozone layer, at approximately 25 kilometers (15.5 miles).

An ozone molecule contains three atoms of oxygen and is produced by the chemical combination of an oxygen molecule with an atom of oxygen. Atomic oxygen is produced by the breakdown of molecules of oxygen, nitrogen dioxide, or ozone. The ozone distribution in the stratosphere is maintained as the result of a dynamic balance between creation and destruction mechanisms. The distribution fluctuates seasonally by approximately 25 percent and annually by approximately 5 percent. Although it comprises only several parts per million (ppm) in the stratosphere, ozone absorbs virtually all ultraviolet solar radiation of wavelengths less than 295 Angstroms, and much of the radiation in the range of 290 to 320 Angstroms (the ultraviolet-B region). Ozone also contributes to the heat balance of the Earth by absorbing radiation in the infrared, near the 9,600-Angstrom wavelength.

The mesosphere extends from 50 to 80 kilometers (31 to 50 miles) and is a transition layer between the stratosphere and the ionosphere. The base of the mesosphere marks the upper boundary of the ozone layer. This area is warmed by the absorption of solar ultraviolet energy by ozone. Ozone production/destruction also occurs in the lower part of the mesosphere, although these mechanisms are most critical in the stratosphere. The temperature and density of the mesosphere decrease with altitude, reaching a minimum at the top of the mesosphere.

The ionosphere, or thermosphere, which extends from 80 to beyond 1,000 kilometers (50 to 621 miles), is characterized by high ion and electron density. Although this region is significantly less dense compared to the atmosphere at the Earth's surface, it still causes some drag on satellites orbiting within it. The ionosphere's several layers of differing properties are particularly important to low-frequency radio communications. It is also the region where the auroras originate. The ionosphere is influenced by solar radiation, variations in the Earth's magnetic field, and motion of the upper atmosphere. Because of these interactions, the properties of the ionosphere vary greatly with time (daily, seasonally, and over the approximately 11-year solar cycle) and geographical latitude (NASA, 2005).

3.1.3.3 Emissions from Rocket Launches

NASA and MARS routinely launch suborbital and orbital rockets. During a typical flight of a three-stage rocket, several materials are ejected into the atmosphere. As propellant is burned from the first-, second-, and third-stage rockets, exhaust gases and products of combustion mix with the air and are dispersed by the wind. Chemicals, usually gaseous or liquid, may be released from a scientific payload in the higher reaches of the trajectory, mix with the air, and become driven by the wind. The rocket components outgas materials due to low pressure and aerodynamic heating. In guided rockets, attitude control fluids or gases may be released. Rockets with guidance systems are also equipped with destruct systems that rupture the propellant tanks and release all remaining propellants in the event of an in-flight vehicle failure. Under normal launch conditions, all of these emitted compounds are distributed along the rocket trajectory. Burn times per stage vary per rocket. The quantities emitted per unit length of the trajectory are greatest at ground level and decrease continuously as the rocket launches (NASA, 2005). Combustion products emitted from solid rocket propellant are predominantly aluminum oxide (Al_2O_3), CO, HCl, water (H_2O), nitrogen (N_2), carbon dioxide (CO_2), and hydrogen (H_2). The meteorological rockets also emit SO_2 and a small amount of Pb. Liquid-fueled rockets predominately emit PM_{10}, SO_2, nitrogen dioxide (NO_2), CO, and VOCs. The criteria and HAP emissions are regulated by the EPA and the Commonwealth of Virginia under the State-adopted NAAQS. Because rockets are considered mobile emission sources, they are not required to be permitted by the EPA.

3.1.3.4 Prevention of Accidental Releases

Section 112(r) of the CAA Amendments, the Prevention of Accidental Releases, requires owners and operators of stationary sources to identify onsite hazards and describe the appropriate steps used to prevent and minimize the effects of an accidental release involving an extremely hazardous substance (EHS), such as hydrazine. Section 112(r)(7) applies to facilities that have more than a threshold quantity of a toxic (ranges from 225 to 9,000 kg [500 to 20,000 lbs]) or flammable (4,500 kg [10,000 lbs]), and requires preparation of a Risk Management Plan.

Wallops Island has been assessed for its applicability to this rule, and no Risk Management Plan is required. However, Section 112(r)(1) applies to any owner or operator of stationary sources producing, processing, handling, or storing any EHS. There are no chemical quantity threshold levels associated with this section, known as the General Duty Clause (GDC). Although there is no definition of an EHS, there are criteria that can be used to determine if a substance is extremely hazardous. According to a 1989 Senate Report on the CAA there are criteria that EPA may use to determine if a substance is extremely hazardous. The report expressed the intent that an EHS is any agent that may or may not be listed[1] or otherwise be identified by any government agency, which may as the result of short-term exposures associated with releases to the air cause death, injury, or property damage due to its toxicity, reactivity, flammability, volatility, or corrosivity. The GDC is a performance-based provision, which recognizes that owners and operators have primary responsibility in the prevention of onsite chemical accidents. It requires

[1] EHS are not limited to the list of regulated substances listed under Section 112(r), nor the extremely hazardous substances under EPCRA §302 (40 CFR Part 355, Appendices A and B).

the owner/operator to be continuously vigilant about hazards and it is a continuing obligation, rather than a one-time compliance event.

As part of this responsibility, facilities must develop and implement standard operating procedures to manage the risk associated with the storage and handling of chemicals, regardless of their amount. NASA has prepared an Integrated Contingency Plan (ICP), which combines requirements and provides for the implementation of several plans (i.e., Spill Prevention Control and Countermeasures Plan, Hazardous Substance Contingency Plan, Hazardous Waste Operations and Emergency Response, and SWPPP). Its purpose is "to minimize hazards to human health and the environment from fires, explosions, or from any unplanned, sudden, or gradual releases of oil or hazardous substance to the air, soil, surface water, or sanitary sewer system at the facility" (NASA, 2001b). In addition, as described in further detail in Section 4.4.3 (Health and Safety), WFF conducts its operations in accordance with its Range Safety Manual, Hydrazine Contingency Plan, and project-specific Ground Safety Plans. NASA routinely works with onsite and local emergency organizations to ensure these plans can be implemented effectively if needed.

3.1.3.5 Open Burning

On the south end of Wallops Island, NASA operates an Open Burn Area for the treatment of hazardous waste solid fuel rocket motors and igniters. Rocket motors that do not meet launch or test specifications and cannot be reused are thermally treated in this area to render them non-reactive. On average, the Open Burn Area is used 4 days a year. The primary combustion products from the thermal destruction process are the same as those resulting from the launch of rockets containing these motors, which include CO, CO_2, H_2O, N_2, H_2, HCl, Al_2O_3, and Pb.

3.1.3.6 Halon

Bromotrifluoromethane (trade name Halon-1301) is used as a fire suppression and explosion protection agent in the aviation and space flight industry. Halon contains bromine, which is known to destroy the upper ozone in the stratospheric layer. Halon-1301 is used as an effective fire and explosion suppression agent during launch activities. At WFF, 227 kg (500 lb) of Halon 1211 is stored within large fire extinguishers around the Main Base airfield, and 34 kg (75 lb) of Halon 1301 is stored on each aircraft.

This chemical is regulated by the EPA under 40 CFR Part 82 Subpart H, Protection of Stratospheric Ozone. The regulation bans the manufacture of blends of these halons (i.e., blends containing two or more halons) and requires organizations to provide training on halon emissions reduction to any technicians who test, maintain, service, repair, or dispose of halon-containing equipment (40 CFR 82.270(c)). Technicians must receive on-the-job training within 30 days of hiring to satisfy the training requirement. They should be trained regarding control of the process to ensure minimal losses of halon to the atmosphere (EPA, 2001).

The EPA does not establish numeric limits on the quantities of Halon-1301 that can be released to the atmosphere for fire suppression use, but does prohibit the intentional release of it during repair, testing, technician training, and disposal of equipment that contains halon. Halon and halon-containing equipment must be properly disposed of at the end of its useful life; proper disposal is defined as sending such equipment for halon recovery for recycling by an acceptable facility that operates in accordance with National Fire Protection Association Standard 10 and Standard 12A, or destruction using one of several processes identified in the rule (EPA, 2001).

Section 604 of the CAA set phase-out targets of Class I ozone-depleting substances, which include halon; therefore, the production and import of virgin (non-recycled) halons have currently been phased out in the U.S. There are a few exceptions to the import of halon, and the import of halon contained within rockets would qualify as one of the exceptions.

3.1.3.7 Climate Change

There is scientific consensus that the chemical composition of the Earth's atmosphere is being changed by human activities, such as fossil fuel combustion, deforestation, and other land use changes, resulting in the accumulation of trace greenhouse gases (GHGs) in the atmosphere. GHGs, including water vapor, CO_2, CH_4, nitrous oxide (N_2O), O_3, and several hydro and chlorofluorocarbons, absorb the radiative energy from the Sun and Earth. Water vapor occurs naturally and accounts for the largest percentage of GHGs, while CO_2 is the second-most abundant GHG. Some GHGs are directly emitted from human processes (CO_2, chlorofluorocarbons, and water vapor), while other gases (e.g., NO_X and VOCs) emitted from these processes contribute indirectly by forming tropospheric (ground-level) ozone and other reactive species. Those compounds then react photochemically with GHGs and control the amount of radiation penetrating through the troposphere. GHGs may be contributing to an increase in the Earth's average surface temperature, which in turn is expected to affect weather patterns, average sea levels and increased intrusion of seawater into estuaries. Other effects are changes in precipitation rates, an increase in ozone levels due in part to changes in atmospheric photochemistry, and decreased water availability and quality (Jones & Stokes 2007).

There are a multitude of state and regional regulatory programs requiring GHG emissions reductions. Although Virginia has no current GHG legislation, the Governor issued Executive Order 59 in 2007, which established the "Governor's Commission on Climate Change" (Bryant, 2008). Since then, VDEQ has had a Climate Change Steering Committee and Greenhouse Gas Emissions Workgroup who have focused on possible regional reduction targets, among other items. In addition to state programs, there is emerging federal climate change-related legislation. In 2007, the U.S. Supreme Court determined that EPA had the regulatory authority to include GHGs as pollutants under the Clean Air Act. Two years later, EPA issued a draft regulation (Mandatory Reporting Rule) that adds substantial additional requirements, such as measurement, monitoring, and reporting, for many industries.

As GHGs are relatively stable in the atmosphere and are essentially uniformly mixed throughout the troposphere and stratosphere, the climatic impact of GHG emissions does not depend upon the source location. Therefore, regional climate impacts are likely a function of global emissions.

GHG emissions were calculated for WFF to estimate NASA's contribution, referred to as the "baseline" condition for WFF. "Baseline" is defined as emissions resulting from mobile and stationary source operations in calendar year 2007. The baseline does not include rocket launches and static fire testing due to a lack of readily available data.

Table 11 lists the GHG emissions for WFF based on the 2007 annual update forms for both Wallops Island and Main Base, which provides VDEQ with consumption rates from stationary sources. Emissions factors from the U.S. EPA's AP-42 and Environment Canada's National Inventory Report Annex 13 were used in conjunction with the WFF consumption rates to calculate annual GHG emissions for boilers/heating equipment, emergency generators, and mobile sources (i.e., government-owned diesel- and gasoline-powered vehicles). Total baseline

CO_2 emissions for WFF are 10,600 metric tonnes per year (11,700 tons per year). Emissions of the other GHG emissions are negligible.

Table 11: Calendar Year 2007 Greenhouse Gas Air Emissions at WFF

Pollutant	Emissions (metric tonnes per year (tons per year))
CH_4	0.14 (0.16)
CO_2	10,600 (11,680)
N_2O	0.19 (0.21)
Total GHG Emissions	10,600 (11,680)

Tables 12 and 13 show estimates of GHG emissions for Wallops Island and Main Base facilities by source categories. Mobile source emissions were based on 102 sounding rockets that were launched in 2007. Emissions were not quantified for Wallops Island (Table 12) since gasoline and diesel is dispensed from the Main Base gasoline service station for all WFF vehicles.

Table 12: Calendar Year 2007 Greenhouse Gas Emissions at Wallops Island in Metric Tonnes per Year (Tons per Year)

Source	CH_4	CO_2	N_2O
External Combustion Sources	0.022 (0.024)	1,957.10 (2,157.30)	0.038 (0.042)
Internal Combustion Sources	0.0009 (0.001)	20 (22)	0.0027 (0.003)
Mobile Sources	0	70 (77)	0
Total GHG Emissions	0.023 (0.025)	2,050 (2,257)	0.041 (0.045)

Table 13: Calendar Year 2007 Greenhouse Gas Emissions at WFF Main Base in Metric Tonnes per Year (Tons per Year)

Source	CH_4	CO_2	N_2O
External Combustion Sources	0.073 (0.080)	7,478.42 (8,243.46)	0.038 (0.042)
Internal Combustion Sources	0.0009 (0.001)	52.30 (57.65)	0.00027 (0.0003)
Mobile Sources	0.048 (0.053)	1,087.98 (1,199.28)	0.109 (0.120)
Total GHG Emissions	0.121 (0.133)	8,618.71 (9,500.4)	0..145 (0.162)

3.1.4 Noise

The EPA's Noise Control Act of 1972 (42 U.S.C. 4901 to 4918) as amended by the Quiet Communities Act of 1978, states that it is the policy of the United States to promote an environment for all Americans free from noise that jeopardizes their health or welfare.

3.1.4.1 Noise Standards and Criteria

Noise is defined as any loud or undesirable sound. The standard measurement unit of noise is the decibel (dB), generally weighted to the A-scale (dBA), corresponding to the range of human hearing (Table 14). Since sounds in the outdoor environment are usually not continuous, a common unit of measurement is the L_{eq}, which is the time-averaged sound energy level. The L_{10} is the sound level exceeded 10 percent of the time and is typically used to represent peak noise levels. Similarly, the L_{01} and L_{90} are the noise levels exceeded 1 percent and 90 percent of the time, respectively. The 1-hour L_{eq} is the measurement unit used to describe monitored baseline noise levels in the vicinity of WFF. It conforms to the requirements in 23 CFR Part 772 and is a descriptor recommended by the Federal Highway Administration for describing noise levels during peak traffic periods. EPA guidelines, and those of many other Federal agencies, state that outdoor sound levels in excess of 55 dB night level are “normally unacceptable” for noise-sensitive land uses such as residences, schools, or hospitals.

The U.S. Occupational Safety and Health Administration (OSHA) regulates noise impacts to workers. OSHA regulations on noise standards ensure that workers are not exposed to noise levels higher than 115 dBA. Exposure to 115 dBA is limited to 15 minutes or less during an 8-hour work shift. Exposure to impulsive or impact noise (loud, short duration sounds) is not to exceed 140 dB peak sound pressure level.

Table 14: Typical Noise Levels of Familiar Noise Sources and Public Responses

Thresholds/Noise Sources	Sound Level (dBA)	Subjective Evaluation[a]	Possible Effects on Humans[a]
Human threshold of pain	140	Deafening	Continuous exposure to levels above 70 dBA can cause hearing loss in the majority of the population
Siren at 100 feet Loud rock band	130		
Jet takeoff at 200 feet Auto horn at 3 feet	120		
Chain saw Noisy snowmobile	110		
Lawn mower at 3 feet Noisy motorcycle at 50 feet	100	Very Loud	
Heavy truck at 50 feet	90		
Pneumatic drill at 50 feet Busy urban street, daytime	80	Loud	
Normal automobile at 50 mph Vacuum cleaner at 3 feet	70		Speech interference
Air conditioning unit at 20 feet Conversation at 3 feet	60	Moderate	
Quiet residential area Light auto traffic at 100 feet	50		Sleep interference
Library Quiet home	40	Faint	
Soft whisper at 15 feet	30		
Slight rustling of leaves	20	Very Faint	
Broadcasting studio	10		
Threshold of Human Hearing	0		

[a]Both the subjective evaluations and the physiological responses are continuums without true threshold boundaries. Consequently, there are overlaps among categories of response that depend on the sensitivity of the noise receivers.
Source: EPA, 1974

The Accomack County code states that "...any loud, disturbing, or unreasonable noise in the county, which noise is of such character, intensity or duration as to be detrimental to the life, health, or safety of any person, or to disturb the quiet, comfort, or response of any reasonable person" is prohibited (Accomack County, 2001). Table 15 shows the specific noise limitations by land use as regulated by Accomack County.

Table 15: Accomack County Noise Guidelines by Land Use

District/Land Use	Daytime Level (dBA)	Nighttime Level (dBA)
Residential	65	55
Agricultural	65	55
Business	70	60
Industrial	70	60
Barrier Island	65	55

Source: Accomack County, 2001

As a general rule, the above levels should not be exceeded; however, exceptions to the rule exist. According to Article II, Section 38-35 of the Accomack County code, "This article shall not apply to noises generated by commercial or industrial operations except for those noises that emanate from the boundaries of such commercial or industrial site and affect persons who are not working onsite at such commercial or industrial operation." Noise levels from rocket launches attenuate rapidly, are low frequency, and occur infrequently. There are no County-specific regulations regarding unacceptable levels of dBA at noise-sensitive receptors such as schools, hospitals, courts, and churches; although the Accomack County code states that noise would be deemed excessive when it "unreasonably interferes with the workings of such institution or building, provided that conspicuous signs are displayed on or near such building or institution indicating that such is a school, church, hospital, clinic or other public building."

Noise sources associated with activities on Wallops Island include vehicular and air traffic, and target and rocket launches. In general, vehicular traffic on Wallops Island is minimal, and rocket launches are relatively infrequent and of short duration. WFF and Navy air traffic from the Main Base flies over Wallops Mainland and Wallops Island. Wind, wildlife, and wave action are the predominant sources of naturally occurring noise on Wallops Island.

Noise levels and frequencies from rocket launches are basically dependent upon the thrust of the rocket motors. The Conestoga launch vehicle is the largest rocket launched from Wallops Island to date. An overall sound pressure level (OSPL) of approximately 107 dB resulting from the Conestoga could extend as far as 12.07 kilometer (7.5 miles) from the launch site. The towns of Atlantic and Chincoteague, as well as some farms, are located within this 12.07-kilometer (7.5-mile) radius. The OSPL would be maintained for one to two seconds and then rapidly decrease.

Although a maximum of 12 launches per year can occur at WFF, since 2001, NASA has averaged six sounding rocket launches and one orbital launch per year from the launch areas on Wallops Island. The marshland and water surrounding Wallops Island act as a noise buffer zone due to the sound absorption capacity of the vegetation. Noise levels from rocket launches attenuate rapidly, are low frequency, and occur infrequently. According to the WFF Public

Affairs Office, no complaints have been received from the public regarding noise resulting from a rocket launch (Flowers, pers. comm.).

3.1.4.2 Noise Monitoring Program

In 1992, WFF performed a noise monitoring survey and modeling program to determine baseline noise levels around the facility. Of the 13 sites selected for the noise-monitoring program, four were on Wallops Island and one was in the town of Assawoman along the route to Wallops Island.

Noise levels at each site were monitored for periods ranging from 15 minutes to 1 hour, depending on the site and predominant source of noise. A period of 1 hour was used at sites monitored during peak traffic conditions. Shorter periods were used for sites monitored during off-peak traffic conditions and sites in natural environments where noise levels were relatively constant.

Wallops Island was found to contain a wide range of background noise levels. At the northern portion of Wallops Island, natural sounds of wind, trees, and birds are the predominant source of the 53-dBA noise level. At the southern end of the island, as well as along the eastern seawall, the sounds of water and waves generate a noise level of about 64 dBA. In the interior of the island, near roads and buildings, noise levels are about 61 dBA during off-peak traffic periods and 64 to 65 dBA during peak a.m. and p.m. traffic (NASA, 2005).

3.1.4.3 Subsonic and Supersonic Noise (Sonic Booms)

Subsonic noise is defined as the noise caused by a designated medium having a speed less than that of sound (referred to as Mach 1). Aircraft and rocket launches are the primary sources of subsonic noise at WFF, but cannon fire, gun fire, and machinery operation also contribute.

Supersonic noise (a sonic boom) is defined as the noise caused by a designated medium having a speed greater than Mach 1. The energy range of sonic booms is concentrated in the 0.1 to 100 hertz (Hz) frequency range, which is considerably below that of subsonic aircraft, gunfire, and most industrial noise. The largest portion of the total acoustic energy produced by a launch vehicle is usually contained in the low-frequency end of the spectrum (1 to 100 Hz). Launch vehicles also generate sonic booms. A sonic boom differs from other sounds in that it is impulsive and very brief. Because a sonic boom is not generated until the vehicle reaches supersonic speeds, the launch site itself does not experience a sonic boom. The entire boom footprint is typically in the area of 19 kilometers (12 miles) downrange of the launch site and directed skyward along the trajectory of the rocket (Patterson, pers. comm.).

The duration of a sonic boom is brief—less than a second: 100 milliseconds (0.100 second) for most fighter-sized aircraft and 500 milliseconds (0.500 second) for the space shuttle or Concorde jetliner.

Aircraft are prohibited from causing supersonic noise in the airspace over WFF unless a waiver is granted by the Flight Standards Office of the FAA. Supersonic flights over the Atlantic must be coordinated through the Navy’s Virginia Capes Fleet Area Control and Surveillance Facility. Supersonic, low-flying rocket and target launches that cause sonic booms are limited to Wallops Island eastward over the Atlantic Ocean (NASA, 2005).

3.1.5 Orbital and Reentry Debris

Orbital debris is defined as artificial objects, including derelict spacecraft and spent launch vehicle orbital stages, left in orbit and no longer serving a useful purpose. As a result of U.S. and foreign space activities, objects in orbit may reenter the Earth's atmosphere. NASA, on behalf of the U.S., annually presents reentry statistics to the United Nations (UN) Committee on the Peaceful Uses of Outer Space (COPUOS) Scientific and Technical Subcommittee (STSC). In February 2009, NASA reported that 743 man-made objects reentered the atmosphere in 2008. Of these, 730, including 6 spacecraft and 34 launch vehicle stages with a total mass of 80 tonnes (90 tons), reentered in an uncontrolled manner. The annual mass of reentries has varied significantly with changes in the world-wide launch rate and solar activity, reaching a high of 350 tonnes (385 tons) in 1988. The number of reentries is normally driven by satellite fragmentations and solar activity.

Because of the increasing number of objects in space and their potential for reentry, NASA adopted guidelines and assessment procedures to reduce the number of non-operational spacecraft and spent rocket upper stages orbiting the Earth. One method of disposal is to allow reentry of these spacecraft, either from orbital decay (uncontrolled reentry) or with a controlled reentry.

Spacecraft that reenter from either orbital decay or controlled entry usually breakup at altitudes between 84 to 72 kilometers (52 to 45 miles) above Earth. After breakup, individual components or fragments will continue to lose altitude until they either completely burn up or survive to impact the Earth.

NASA's launch project managers must employ design and operation practices that limit the generation of orbital debris, consistent with mission requirements and cost effectiveness. NPR 8715.6A, "NASA Procedural Requirements for Limiting Orbital Debris," requires that each program or project conduct a formal assessment for the potential to generate orbital debris and to analyze the impacts of space structure reentry. NASA also has in place a technical standard (NASA STD 8719.14) and corresponding handbook (NHBK 8719.14) to provide specific guidelines and methods to limit orbital debris generation.

General methods to accomplish this policy include:

- Depleting onboard energy sources after completion of mission
- Limiting orbit lifetime after mission completion to 25 years or maneuvering to a disposal orbit
- Limiting the generation of debris associated with normal space operations
- Limiting the consequences of impact with existing orbital debris or meteoroids
- Limiting the risk from space system components surviving reentry as a result of post-mission disposal
- Limiting the size of debris that survives reentry

Additionally, other Federal agencies (e.g., Department of Defense, Federal Communications Commission, and FAA) employ similar processes when they either sponsor or license the launch or reentry of a spacecraft. Orbital missions originating from WFF comply with the orbital and reentry debris processes described above.

3.1.6 Hazardous Materials and Hazardous Waste

3.1.6.1 Hazardous Materials Management

The WFF ICP, developed to meet the requirements of 40 CFR Part 112 (Oil Pollution Prevention and Response), 40 CFR Part 265 Subparts C and D (Hazardous Waste Contingency Plan), and 9 VAC 25-91-10 (Oil Discharge Contingency Plan), serves as the facility's primary guidance document for the prevention and management of oil, hazardous material, and hazardous waste releases. The ICP includes the following procedures for hazardous materials management at the entire WFF facility, including Wallops Island:

- Each container of hazardous material is labeled in English with the following minimal description: name of chemical and all appropriate hazard warnings.
- Each work area has Material Safety Data Sheets (MSDSs) on file for each hazardous material used onsite. Each MSDS is in English and contains all required information. WFF utilizes an online electronic chemical inventory that contains links to appropriate MSDSs and is accessible to all WFF personnel through the GSFC intranet. Individual WFF support contractor offices train their personnel in the applicable hazardous communication pertinent to the requirements for each employee.
- Spill contingency and response procedures are prepared and implemented.
- The WFF Environmental Office offers annual ICP training to all Wallops and tenant personnel as well as to all visiting project teams.

3.1.6.2 Hazardous Waste Management

The regulations that govern hazardous waste management are the Resource Conservation and Recovery Act (RCRA, 42 U.S.C. 6901 *et seq*.) and Virginia's Hazardous Waste Management Regulations (9 VAC 20-60). A solid waste is any material that is disposed, incinerated, treated, or recycled except those exempted under 40 CFR 261.4. All hazardous wastes are classified as solid wastes. Wallops Main Base is separated from Wallops Island and Wallops Mainland by approximately 11.2 kilometers (7 miles) of public roadway. As they are not contiguous, each has been assigned its own EPA hazardous waste generator number. Shipment of hazardous waste between the two sites is illegal except by a licensed hazardous waste transporter. To facilitate the transportation of rocket motors declared hazardous waste from the Main Base to the Wallops Island, NASA has its own hazardous waste transporter license. NASA uses licensed hazardous waste transporters to transport hazardous waste off site to licensed treatment, storage, and disposal facilities.

Wallops Island and Wallops Mainland are together classified as a Large Quantity Generator because the area has the potential to generate more than 1,000 kg (2,205 lbs) of hazardous waste per month. In calendar year 2007, 4,070 kg (8,972 lbs) of hazardous waste including various expired chemicals, jet fuel mixed with hydraulic fluid, used oil, oily condensate, oily rags, paint cans, and paint thinner were generated on Wallops Island and Wallops Mainland combined (NASA, 2008a). Hazardous wastes generated on Wallops Island are stored on the Mainland at Building U-081, a less-than-90-day accumulation area in which hazardous waste may be stored for up to 90 days from the date of initial accumulation. In addition, Satellite Accumulation Areas are established in individual laboratories, shops, or other facilities designated by the generator for the accumulation of waste, not to exceed 208 liters (55 gallons) of hazardous waste, or 0.95 liter (1 quart) of extremely or acutely hazardous waste.

Wallops Island hazardous waste generators are responsible for the following:

- Properly containerizing waste
- Properly labeling waste containers with information pertaining to the contents and with the words "Hazardous Waste"
- Ensuring that less than 208 liters (55 gallons) of hazardous waste or less than 0.95 liter (1 quart) of acute hazardous waste are accumulated at or near the point of generation
- Properly completing and transferring a disposal inventory sheet to the NASA Environmental Office

3.1.6.3 Petroleum Storage Tank Management

The Wallops Island facilities include 21 above ground storage tanks (ASTs) and 2 underground storage tanks (USTs). Both the ASTs and USTs are used for the storage and dispensing of heating oil. Occasionally, temporary tanks are brought to Wallops Island during construction activities and typically contain diesel fuel and gasoline. All fuel storage tanks must be operated in accordance with Virginia storage tank regulations (9 VAC 25-91 [AST] and 9 VAC 25-580 [UST]), which are overseen by the VDEQ Tidewater Regional Office.

3.1.7 Radiation

Radiation-emitting materials and equipment are used at WFF in space flight research, earth sciences research, atmospheric research, testing, and integration of space flight hardware, and communications. Radiation-emitting materials and equipment are used and stored under a comprehensive radiation protection program. NASA's Safety Office administers the program, and the GSFC Radiation Safety Committee provides oversight.

Radiation-emitting materials and equipment can be classified as either ionizing or non-ionizing radiation. Ionizing radiation is any type of radiation capable of directly or indirectly producing ions as it passes through a medium. In general, ionizing radiation has considerably greater kinetic energy than non-ionizing radiation. Non-ionizing radiation is not strong enough to produce free ions as it passes through media (NASA, 2005).

3.1.7.1 Ionizing Radiation

The Federal Nuclear Regulatory Commission (NRC) licenses the use and storage of ionizing source material, special nuclear material, and byproduct material. Source material is any radioactive material that contains at least 0.05 percent by weight of uranium and/or thorium, excluding special nuclear material. Special nuclear material is plutonium, uranium 233, or uranium enriched in the isotopes 233 or 235. Byproduct material is any radioactive material derived from production or use of special nuclear material.

The NRC has issued license number 19-05748-02 to NASA for NRC-regulated radioactive materials. The NRC license is considered a Broad Type A license, generally issued to large facilities with comprehensive radiological programs. The license requires NASA to have a Radiation Safety Officer and a committee to act in place of the NRC in making day-to-day decisions.

Sources of ionizing radiation include radioactive materials for science instruments and experiments and for instrument calibration. They are used in the laboratory, in the field, and aboard payloads. There is no permanent storage of radioactive sources at WFF except for NASA's two calibration sources for radiation monitoring equipment (NASA, 2005).

3.1.7.2 Non-Ionizing Radiation

Rocket launches and payloads may use or contain equipment that produces non-ionizing radiation including lasers, radars, microwaves, and ultraviolet and high-intensity lamps. The biological effects of lasers are well known, including damage to the eye or skin. The hazards of lasers are also well known, and proper handling techniques have been developed and implemented (NASA, 2005). Per OSHA Directive STD 01-05-001-PUB 8-1.7, *Guidelines for Laser Safety and Hazard Assessment*, and Chapter 6, "Laser Hazards," of Section III, "Health Hazards," of OSHA Technical Manual TED 01-00-015 (TED 1-0.1 5A), all laser operators must be trained in the proper use of the class of lasers they use. All lasers can be classified into one of four categories based on use and light intensity in compliance with ANSI standard 7136.6:

- Class I lasers are considered exempt and are typically enclosed in a protective device. Control measures are not required for the operation of a Class I laser.
- Class II lasers are low-power visible continuous wave and high pulse-rate frequency lasers. These lasers are incapable of producing eye injury within the duration of a blink. If a user stares directly into the laser beam, eye injury can occur.
- Class III lasers are medium-power lasers. These lasers can cause serious eye injury if the user looks directly into the beam.
- Class IV lasers are high-power lasers and are usually only found in controlled research laboratory settings. These lasers can present serious skin and eye hazards and can ignite flammable targets, create hazardous airborne contaminants, and have a potentially lethal, high-current, high-voltage power supply.

Sources of radio-frequency radiation that produce power densities greater than 100 milliwatts per square centimeter are also potentially hazardous. Sources of radio frequency radiation associated with rocket launches at WFF often include radar units, induction heating devices, and radio-frequency generators. Radio frequency radiation is measured by the Safety Office.

The DOD establishes permissible exposure limits for personnel exposed to radiation based on international standards. The DOD Radio Frequency Safety Standard (DOD Instruction 6055.11), which is in agreement with the general industry consensus standard (IEEE C95.1-1999), assumes worst-case conditions in developing the frequency dependent permissible exposure limits used to determine potential Hazards of Electromagnetic Radiation to Personnel (HERP) limits. The NASA Safety Office implements DOD Instruction 6055.11 for WFF and MARS.

Potential Hazards of Electromagnetic Radiation to Ordnance (HERO) are determined by the NASA Safety Office for radio frequency emitting systems at WFF because electro-explosive devices may be accidentally initiated or their performance degraded by exposure to radio frequency environments. Some of the systems on Wallops Island have been qualified as HERO safe or HERO susceptible by U.S. Navy or Air Force testing. Navy criteria for HERO are established in Ordnance Publication 3565, based on average radiated power density over a relatively short time period as opposed to the longer time periods used for HERP analyses (NASA, 2005).

3.1.8 Munitions and Explosives of Concern

Munitions and Explosives of Concern (MEC) are explosive munitions (bombs, shells, grenades, etc.) that did not function as designed and may pose a risk of detonation. According to a map of historic Ordnance and Explosives Impact Areas dated September 2006, there are nine known historic live fire and bombing areas off of Wallops Island; none of these are currently active. On the northernmost portion of the island, there was a target center, active between 1946 and 1959, and the Gunboat Point bombing area, used in 1952, with a firing line that extended approximately 3.2 kilometers (2 miles) southeast into the ocean. Along this firing line, there was also a sea target, utilized in the late 1940s and early 1950s, located approximately 1.6 kilometers (1 mile) out to sea. A machine gun and rocket firing area, used in the 1950s, was located on the northern portion of the island with a line of fire that extends approximately 8 kilometers (5 miles) southeast into the ocean. An explosive ammunition test facility was located on the central portion of the island shoreline with a firing line that extends approximately 8 kilometers (5 miles) east-southeast into the ocean. A strafing target, used to test aircraft machine guns, was located on land on the northeastern tip of Wallops Island.

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 Vegetation

Wallops Island is a barrier island that contains various ecological succession stages, including beaches, dunes, swales, maritime forests, and marsh (Figure 20). These natural vegetative zones form a series of finger-like stands that merge or grow into each other. The northern and southern dune vegetation on Wallops Island directly borders saltmarshes.

The dune system from east to west includes the sub-tidal zone, inter-tidal zone, and upper beach zone. The inter-dune swale zone includes the area located between the westernmost portion of the dune zone and the maritime zone. The dune and swale zone is an extremely harsh environment. Biotic resources in this zone must be very adaptable to contend with high temperatures, high winds, salt, sandblasting, drought, and low nutrient levels in the sandy soil medium (NASA, 2008a). Dominant species within the dune system include seabeach orach (*Atriplex arenaria*), common saltwort (*Salsola kali*), sea rocket (*Cakile edentula*), American beachgrass (*Ammonphila breviligulata*), seaside goldenrod (*Solidago sempervirens*), and common reed (*Phragmites australis*).

The sub-tidal zone on the eastern side of Wallops Island extends from the lower limit of low tide to the seaward-most limit of wave action. Because of the dynamics of wave action, few plants exist in the sub-tidal zone. Phytoplankton are prevalent, as well as macroalgae, and algae attached to substructure.

The inter-tidal zone is a transition zone exposed during low tide and totally submerged at high tide. The inter-tidal zone is an extremely dynamic area. Plant species are virtually nonexistent in the inter-tidal zone located on the eastern portion of Wallops Island because of the deleterious effects of wave action on the stability of the zone. Microscopic plants and animals exist in the minute spaces between individual sand grains in the eastern inter-tidal zone.

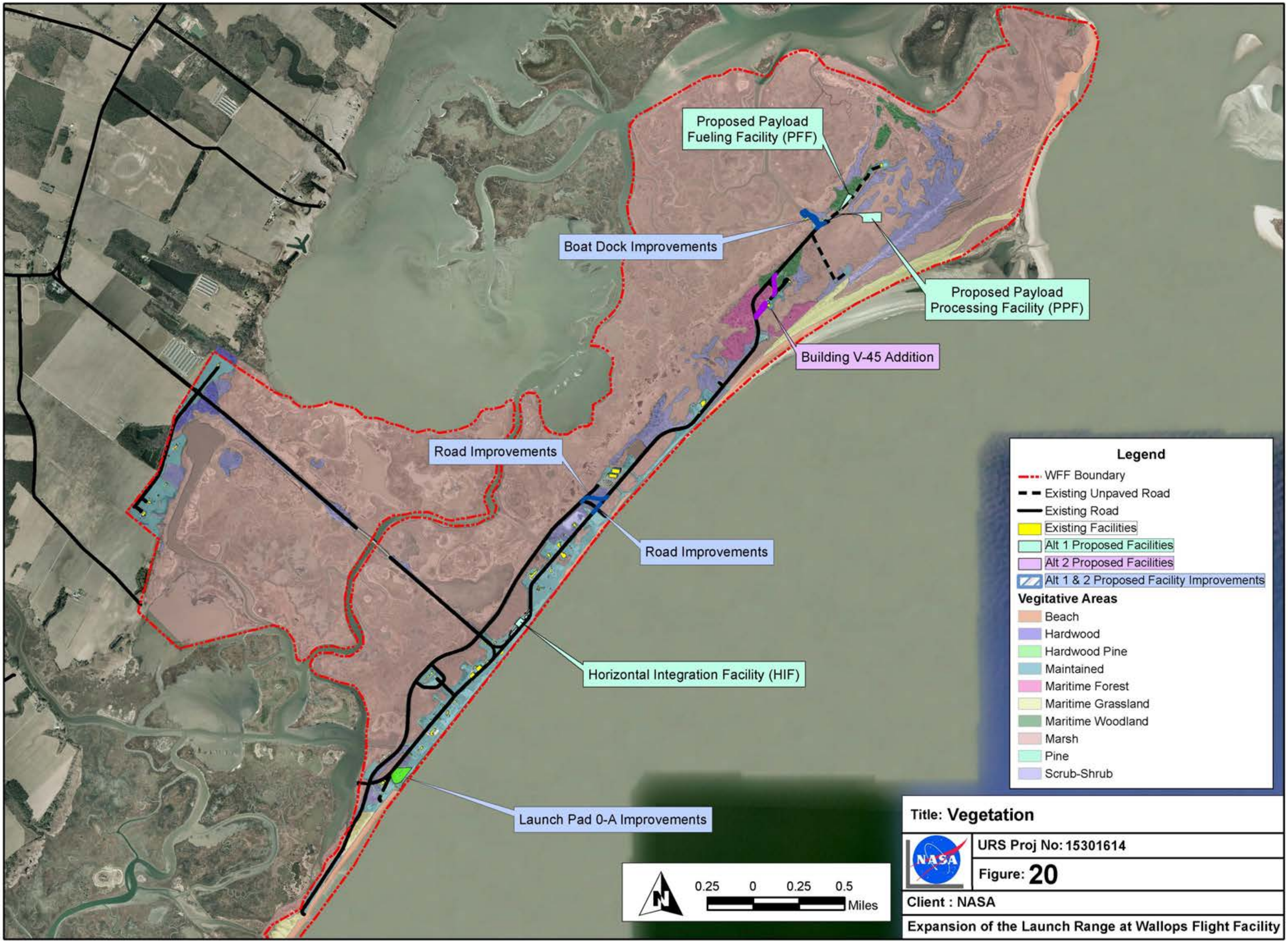
The upper beach zone extends from the high tide mark to the crest of the easternmost dune. On Wallops Island this zone is found on the northern and extreme southern sections of the island. The remaining eastern section of the island is a developed, operational area that is protected by an extensive seawall built where the upper beach zone would normally exist. Vascular plant life maintains a tenuous foothold in this area. Plants such as sea rocket and beach grass are scattered on the northern part of the island.

On the southern part of Wallops Island, the dune and swale zone extends to the tidal marsh on the western side of Wallops Island with no maritime forest present. In the central and northern areas, the dune and swale zone extends to the maritime zone that starts where the secondary dune line once existed. The northern part of Wallops Island within the dune and swale zone is in an almost natural state, and is dominated by northern bayberry (*Morella pensylvanica*), wax myrtle (*Morella cerifera*), groundsel-tree (*Baccharis halimifolia*), and American beachgrass.

The central portion of Wallops Island is dominated by common reed and maintained lawn areas. Common reed is invasive and has the ability to grow in areas with very low habitat value; it is considered by many to be an undesirable plant. Due to its successful competition with many other plant species, the common reed has virtually taken over much of the area in the center of Wallops Island.

A small area of maritime forest zone exists on the central portion of the island, with an expansive thicket zone on the northern part. The thicket zone is dominated by extensive clusters of northern bayberry, wax myrtle, and groundsel-tree. The thicket zone in some areas is virtually impenetrable due to dense stands of poison ivy (*Toxicodendron radicans*) and greenbriar (*Smilax* spp.), which is also pervasive on other areas of Wallops Island. The northern maritime forest zone is dominated by loblolly pine (*Pinus taeda*) and cherry trees (*Prunus* spp.), with an understory of northern bayberry, wax myrtle, and groundsel-tree.

Between Wallops Island and Mainland extends 461 hectares (1,140 acres) of tidal marsh. A tidal marsh is an area of low-lying wetlands that is influenced by the tides. The marsh is interlaced with small streams known locally as "guts." The marsh itself can be divided into the low marsh and the high marsh—each a distinctive community. The low marsh, which is inundated at high tide, is dominated by saltmarsh cordgrass (*Spartina alterniflora*). The high marsh, which is flooded by approximately 50 percent of the high tides, is dominated by salt meadow cordgrass (*S. patens*). As the marshes provide suitable habitat for both feeding and reproduction, these areas are of tremendous importance to marine life and to the terrestrial and avian species that depend on the marshes for their existence (NASA, 2008a).



Proposed Payload Fueling Facility (PFF)
Boat Dock Improvements
Proposed Payload Processing Facility (PPF)
Building V-45 Addition
Road Improvements
Road Improvements
Horizontal Integration Facility (HIF)
Launch Pad 0-A Improvements
Legend
WFF Boundary
Existing Unpaved Road
Existing Road
Existing Facilities
Alt 1 Proposed Facilities
Alt 2 Proposed Facilities
Alt 1 & 2 Proposed Facility Improvements
Vegitative Areas
Beach
Hardwood
Hardwood Pine
Maintained
Maritime Forest
Maritime Grassland
Maritime Woodland
Marsh
Pine
Scrub-Shrub
0.25 0 0.25 0.5
Miles
Title: Vegetation
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Expansion of the Launch Range at Wallops Flight Facility

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3.2.2 Terrestrial Wildlife and Migratory Birds

Wallops Island hosts both terrestrial and aquatic forms of fauna that comprise its biotic communities. Terrestrial and aquatic species are particularly concentrated in the tidal marsh areas, which provide abundant habitat.

The Migratory Bird Treaty Act (MBTA, 16 U.S.C. 703-712) was enacted to ensure the protection of shared migratory bird resources. The MBTA prohibits the take and possession of any migratory bird, their eggs, or nests, except as authorized by a valid permit or license. The statutory definition of "take" is "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill." A migratory bird is any species that lives, reproduces, or migrates within or across international borders at some point during its annual life cycle.

The Atlantic Flyway route is of great importance to migratory waterfowl and other birds during the spring and fall. The coastal route of the Atlantic Flyway, which in general follows the eastern seaboard, is a regular avenue of travel for migrating land and water birds that winter on the waters and marshes south of Delaware Bay. Ducks, geese, shorebirds, songbirds, and raptors pass through the Atlantic Flyway. Some species use Wallops Island as a stopover point, while others use the island and surrounding habitats as an overwintering area.

3.2.2.1 Invertebrates

Wallops Island, particularly the tidal marsh area, has an extensive variety of invertebrates. Saltmarsh cordgrass marshes have herbivorous (plant eating) insects such as the saltmarsh grasshopper (*Orchelium fidicinium*) and the tiny plant hopper (*Megamelus* spp.). Plant hopper eggs are in turn preyed upon by a variety of arthropods, the group of animals that includes insects, spiders, and crustaceans. The tidal marshes are inhabited by a number of parasitic flies, wasps, spiders, and mites. The spiders prey mostly on herbivorous insects, and mites prey primarily on microarthropods (small invertebrates) found in dead smooth cordgrass. Saltmarsh mosquitoes (*Ochlerotatus sollicitans*) and greenhead flies (*Tabanus nigrovittatus*) are prevalent insects on Wallops Island.

Particular species inhabit different areas of the marsh depending on their ability to adapt to the fluctuating tides. Many insects and arachnids (e.g., spiders and ticks) can tolerate lengthy submersions. Insects that cannot sustain long submersions tend to move up the marsh vegetation during high tide. For example, periwinkle snails (*Littorina irrorata*) and mud snails (*Ilyanassa obsoleta*) can withstand lengthy submersions and are found mainly on the marsh surface, while the majority of the predatory spiders, which are unable to withstand submersions, live within the vegetation above the mean high water level.

3.2.2.2 Amphibians and Reptiles

Amphibians and reptiles use the dune and swale zones of Wallops Island for foraging. Fowler's toad (*Bufo woodhoussei*) can be found under stands of bayberry. The green tree frog (*Hyla cinerea*) can be found in the wetter areas in the northern portion of Wallops Island. Some species of reptiles such as the black rat snake (*Elapha obsoleta*), hognose snake (*Heterodon platyrhinos*), snapping turtle (*Chelydra serpentina*), box turtle (*Terrapene carolina*), and northern fence lizard (*Sceloporus undulatus*) can be found in low-lying shrubby areas. Diamondback terrapin (*Malaclemys terrapin*) can be found in saltmarsh estuaries, tidal flats, and lagoons.

3.2.2.3 Mammals

Mammals such as white-tailed deer (*Odocoileus virginianus*), opossum (*Didelphis marsupialis*), raccoon (*Procyon lotor*), and gray squirrel (*Sciurus carolinensis*) are plentiful on Wallops Island. Raccoon and red fox (*Vulpes vulpes*) are occasionally found in the upper beach zone and the inter-tidal zone. The gray squirrel and opossum make their homes in the maritime forest along with other mammals that use other sections of the island for forage and shelter.

Mammals such as raccoon, red fox, white-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), rice rat (*Oryzomys palustris*), white-tailed deer, and Eastern cottontail rabbit (*Sylvilagus floridanus*) are found in the dune and swale zone.

3.2.2.4 Birds

During spring and fall migrations, approximately 15 species of shorebirds feed on microscopic plants and animals in the inter-tidal zone. Abundant among these are the sanderling (*Calidris alba*), semi-palmated plover (*Charadrius semipalmatus*), red knot (*Calidris canutus*), short-billed dowitcher (*Limnodromus griseus*), and dunlin (*Calidris alpina*). The willet (*Catoptrophorus semipalmutus*) is very common during the breeding season. Royal tern (*Sterna maxima*), common tern (*S. antillarum*), and least tern (*S. hirundo*) can be observed during the summer months. In addition, the piping plover (*Charadrius melodus*) and Wilson's plover (*Charadrius wilsonia)* sometimes nest on the northern and southern ends of Wallops Island.

Laughing gulls (*Larus atricilla*), herring gulls (*L. argentatus*), and great black-backed gulls (*L. marinus*) commonly forage in the upper beach zone and the intertidal zone. Forster's terns (*S. foresteri*) are common in the marshes and on occasion may winter on Wallops Island. Birds that use the shrub zones include various species of sparrows, red-winged blackbirds (*Agelaius phoeniceus*), boat-tailed grackles (*Quiscalus major*), and fish crows (*Corvus ossifragus*). Birds common in the shrub zone include the song sparrow (*Melopiza melodia*), gray catbird (*Dumetella carolinensis*), yellowthroat (*Geothlypis trichas*), and mourning dove (*Zenaida macroura*). Resident Canada geese (*Branta canadensis*) are found year-round in open upland portions of the property.

Raptors, including State endangered peregrine falcons (*Falco peregrinus*), northern harriers (*Circus cyaneus*), and osprey (*Pandion haliaetus*), inhabit the marsh areas west of Wallops Island. Great horned owls (*Bubo virginianus*) can be found in the maritime forest, and bald eagles (*Haliaeetus leucocephalus*) can often be seen flying over the facility although they do not nest on Wallops Island. There is an active bald eagle nest just north of the WFF Main Base; this nest is located more than 12.8 kilometers (8 miles) away from Wallops Island.

3.2.3 Threatened and Endangered Species

Under Section 7 of the Federal Endangered Species Act (ESA), as amended, (U.S.C. 1531-1544) Federal agencies, in consultation with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), are required to evaluate the effects of their actions on special status species of fish, wildlife, and plants, and their habitats, and to take steps to conserve and protect these species. Special status species are defined as plants or animals that are candidates for, proposed as, or listed as sensitive, threatened, or endangered by USFWS.

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

Table 16 shows the State and federally listed threatened or endangered species that may occur on and near Wallops Island. The descriptions below contain a brief overview of protected species occurring within the vicinity of Wallops Island. Additional details on federally listed species can be found in the Biological Assessment (BA) prepared in August 2009 for this project (Appendix C).

Table 16: Threatened and Endangered Species in the WFF Area

Scientific Name	Common Name	Expected Seasonal Presence*	Status
Amaranthus pumilus	Seabeach amaranth	All	Federally Threatened
Megaptera novaeangliae	Humpback Whale	All	Federally Endangered, State Endangered
Balaeanoptera physalus	Fin Whale	Spring, Summer	Federally Endangered, State Endangered
Eubalaena glacialis	Right Whale	Summer	Federally Endangered, State Endangered
Physeter macrocephalus	Sperm Whale	All	Federally Endangered, State Endangered
Balaenoptera borealis	Sei Whale	All	Federally Endangered, State Endangered
Balaenoptera musculus	Blue Whale	All	Federally Endangered, State Endangered
Trichechus manatus latirostrus	Florida Manatee	Summer	Federally Endangered, State Endangered
Sciurus niger cinereus	Delmarva Peninsula Fox Squirrel	All	Federally Endangered, State Endangered
Dermochelys coriaces	Leatherback Sea Turtle	Summer	Federally Endangered, State Endangered
Eretmochelys imbricate	Hawksbill Sea Turtle	Unknown	Federally Endangered, State Endangered
Lepidechelys kempi	Kemp's Ridley Sea Turtle	All	Federally Endangered, State Endangered
Caretta caretta	Loggerhead Sea Turtle	All	Federally Threatened, State Threatened
Chelonia mydas	Atlantic Green Sea Turtle	Unknown	Federally Threatened, State Threatened
Charadrius wilsonia	Wilson's Plover	All	State Endangered
Falco peregrinus	Peregrine Falcon	Fall	State Endangered
Bartramia longicauda	Upland Sandpiper	Spring, Fall Migration	State Threatened
Sterna nilotica	Gull-billed Tern	Spring, Fall Migration	State Threatened
Haliaeetus leucocephalus	Bald Eagle	All	State Threatened
Calidris canutus rufa	Red Knot	Spring, Fall Migration	Federal Candidate Species
Charadrius melodus	Piping Plover	All	Federally Threatened, State Threatened
Cicendela dorsalis dorsalis	Northeastern Beach Tiger Beetle	All	Federally Threatened State Threatened

Source: NASA, 2008a
*Source: Department of the Navy, 2002

Figure 21 shows the known locations of federally protected species in the vicinity of Wallops Island. The ESA also regulates the critical habitat of threatened and endangered species. Critical habitat is defined as the geographical area essential to the survival and recovery of a species. Biologists from the WFF USDA Wildlife Service Office aid with predator control and the management of all protected species.

Vegetation

Seabeach amaranth habitat is restricted to sandy ocean beaches and consists of the sparsely vegetated zone between the high tide line and the toe of the primary dune. There have been no known or recorded occurrences of seabeach amaranth on Wallops Island to date. A single plant was identified on the southern end of Assateague Island in 2004 (USFWS, 2008a).

Marine Mammals

Each winter, from December through March, whales follow a migration route which brings them to the coastal waters near the shores of Virginia. The two most commonly seen species off the coast of Virginia are the Humpback and Fin whales.

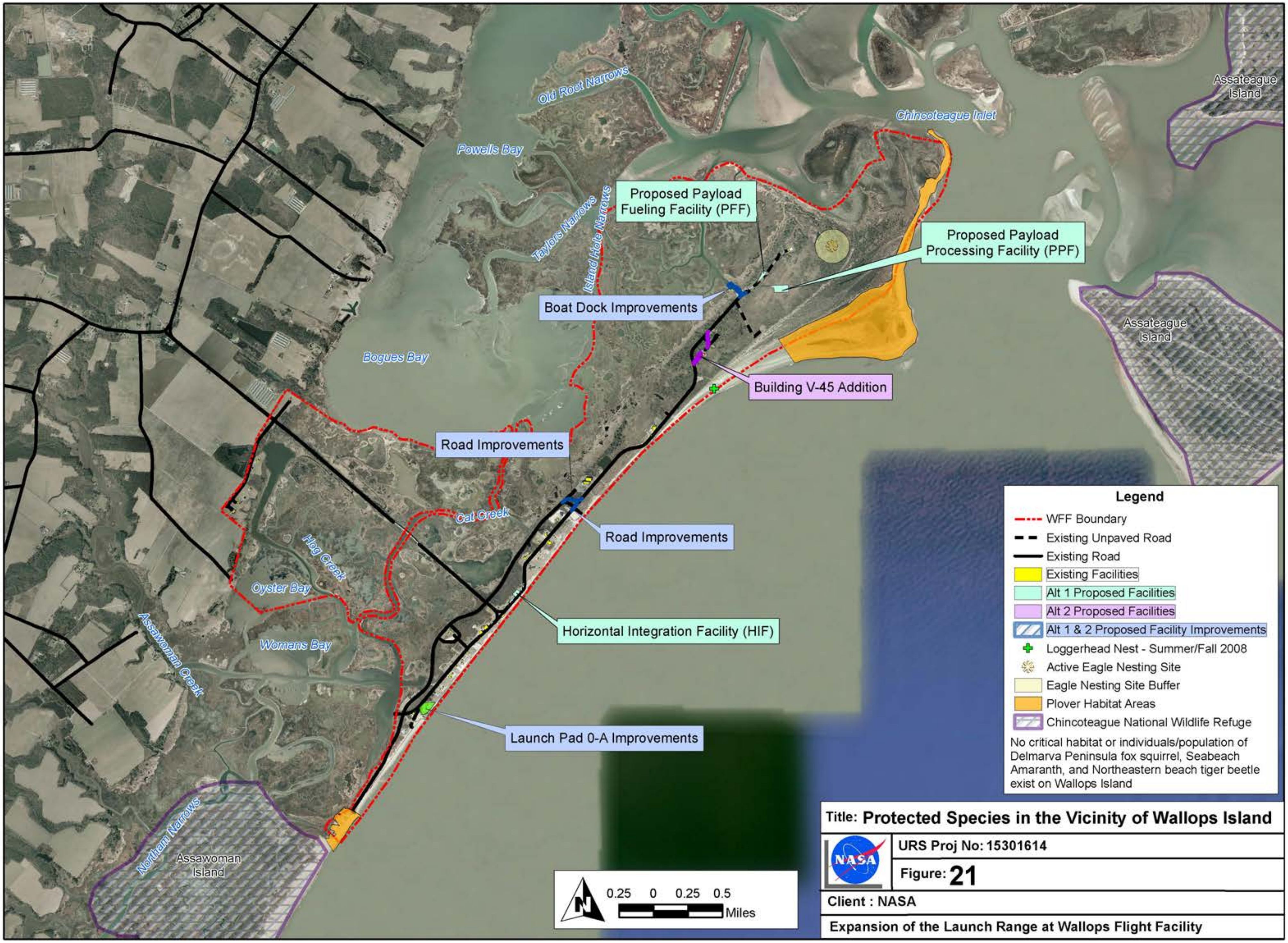
Manatees need warm water, typically above 20 degrees Celsius (68 degrees Fahrenheit) to survive. In the winter, usually November though March, the manatee population is concentrated primarily in Florida. Manatees travel through freshwater, brackish and saltwater environments, reaching as far west as Louisiana and as far north as Maryland during summer. The Florida manatee uses the waters off Wallops Island during migration.

Terrestrial Mammals

The Delmarva Peninsula Fox Squirrel lives in mature forests of mixed hardwoods and pines with a closed canopy and open understory on the Delmarva Peninsula. The Chincoteague National Wildlife Refuge (CNWR), located approximately 3.2 kilometers (2 miles) east of Wallops Island, is home to a large population of these squirrels. Accomack County, including Wallops Island is not included in the USFWS' areas where the squirrel is likely to occur (USFWS, 2008).

Sea Turtles

The leatherback, hawksbill, Kemp's Ridley, loggerhead, and Atlantic green sea turtles are known to migrate along east coast beaches. One loggerhead sea turtle nest was discovered on north Wallops Island in summer 2008 (Figure 21), although none of the eggs hatched. Other than this nest, sea turtle crawl tracks, a sign of potential nesting activity, have seldom been found on Wallops Island beaches. NASA coordinates with CNWR and USDA personnel in monitoring the Wallops Island beaches for sea turtle activity.



Old Root Narrows
Powells Bay
Chincoteague Inlet
Assateague Island
Taylors Narrows
Island Hole Narrows
Proposed Payload Fueling Facility (PFF)
Proposed Payload Processing Facility (PPF)
Boat Dock Improvements
Assateague Island
Bogues Bay
Building V-45 Addition
Road Improvements
Cat Creek
Road Improvements
Hog Creek
Oyster Bay
Horizontal Integration Facility (HIF)
Assawoman Creek
Womans Bay
Launch Pad 0-A Improvements
Northam Narrows
Assawoman Island
0.25 0 0.25 0.5
Miles
Legend
WFF Boundary
Existing Unpaved Road
Existing Road
Existing Facilities
Alt 1 Proposed Facilities
Alt 2 Proposed Facilities
Alt 1 & 2 Proposed Facility Improvements
Loggerhead Nest - Summer/Fall 2008
Active Eagle Nesting Site
Eagle Nesting Site Buffer
Plover Habitat Areas
Chincoteague National Wildlife Refuge
No critical habitat or individuals/population of Delmarva Peninsula fox squirrel, Seabeach Amaranth, and Northeastern beach tiger beetle exist on Wallops Island
Title: Protected Species in the Vicinity of Wallops Island
URS Proj No: 15301614
Figure: 21
Client : NASA
Expansion of the Launch Range at Wallops Flight Facility

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Birds

Gull-billed terns can be found nesting on the beaches or mud flats on Wallops Island. A resident pair of peregrine falcons nests on a hacking tower on the northwest side of Wallops Island; migrating peregrine falcons occur along the Wallops Island beach during fall migration.

Upland sandpipers migrate through the WFF area, with fall migration typically lasting from mid-July through September and spring migration from March through May. Upland Sandpipers typically feed in shortgrass areas, but require taller grass for nesting. These birds are almost never found on mudflats or in wetland environments where other shorebirds are found. Upland sandpipers are birds of open country and are typically found in large fallow fields, pastures, and grassy areas.

Bald eagles can often be seen flying over WFF. An active nest was documented in 2009 on the north end of Wallops Island. In addition, there is an active bald eagle nest just north of the WFF Main Base.

The red knot is a medium-sized shorebird that undertakes an annual 30,000 kilometer (20,000 mile) hemispheric migration from breeding grounds in the Arctic to wintering grounds in South America. During migration, the Virginia barrier islands, including Wallops Island, provide an important stopover area for the red knot.

Piping plover nesting habitat has been delineated on the beaches and dunes at the northern and southern ends of Wallops Island (Figure 21). Wilson’s plovers tend to nest with piping plovers. Although Wallops Island is not designated as critical habitat, the piping plover is known to breed on Wallops Island; therefore, portions of the island are managed as protected areas by NASA. The northern and southern beaches have been closed to vehicle and human traffic during the plover’s nesting season (March 15 through September 1) since 1986. Biologists from the USFWS, CNWR, and VDGIF monitor piping plover nesting activities and provide advice to NASA on protection and management of the species. There has been an increasing trend in the number of nesting pairs of piping plovers at all CNWR units (including Assateague, Assawoman, and Metompkin Islands). As south Wallops Island has experienced substantial erosion, suitable habitat is becoming less abundant. No nesting plovers have been observed on south Wallops Island since 2000. North Wallops Island has been accreting, thus presenting additional potential for plover nesting.

Insects

Northeastern beach tiger beetles inhabit wide, sandy, ocean beaches from the intertidal zone to the upper beach. Eggs are deposited in the mid- to above-high tide drift zone. Larval beetles occur in a relatively narrow band of the upper intertidal to high drift zone, where they can be regularly inundated by high tides. Eight protected populations exist within the Eastern Shore of Chesapeake Bay, Virginia geographic recovery area; however, there are no protected populations on Wallops Island. The closest documented population is approximately 30 kilometers (20 miles) southwest of Wallops Island (USFWS, 2009).

3.2.3.1 Former USFWS Consultation

On April 22, 1997, NASA initiated formal Section 7 consultation with USFWS for potential impacts to the piping plover from the expansion of range operations at WFF and MARS Launch Pad 0-B. On July 14, 1997, the USFWS issued a biological opinion on the effects of the range expansion on the piping plover (Appendix D). In summary, the USFWS stated that depending on the time of year, time of day, and proximity to the launch site, piping plovers may temporarily abandon the area during migration or the breeding season during a rocket launch. However, the USFWS did not anticipate that the range expansion and operations would result in the incidental take of any piping plovers because of the short duration of the disturbance, the long distance between the disturbance and the area used by plovers, the limited number of launches during the nesting season, and the lack of other disturbances (e.g., recreation) to the plovers on Wallops Island. As part of this consultation, NASA agreed to monitor piping plovers.

3.2.4 Marine Mammals

The Marine Mammal Protection Act of 1972 (MMPA, 16 U.S.C. 1361 et seq.) prohibits the taking of marine mammals on the high seas. Section 101(a)(5) of the MMPA directs the Secretary of the Department of Commerce to allow, upon request, the incidental (but not intentional) take of marine mammals. There are 23 marine mammal species within the area offshore of Wallops Island (NASA, 2008a). This includes cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals). See Table 17 for a list of the most common marine mammals found offshore of Wallops Island.

As documented in a Memorandum for the Record dated April 3, 2003, the NASA Environmental Office consulted Mr. Ken Hollingshead of the NMFS Office of Protected Resources on March 26, 2003; Mr. Hollingshead stated "WFF is not required to submit an application for the incidental take of marine mammals [as] the level of impact from WFF activities does not warrant a Letter of Authorization."

Table 17: Common Marine Mammals Offshore of Wallops Island

Common Name	Scientific Name	Common Name	Scientific Name
Pygmy Sperm Whale	*Kogia breviceps*	Atlantic White-Sided Dolphin	*Lagenodelphis acutus*
Dwarf Sperm Whale	*Kogia simus*	Risso's Dolphin	*Grampus griseus*
True's Beaked Whale	*Mesoplodon mirus*	Striped Dolphin	*Stenella coeruleoalba*
Blainville's Beaked Whale	*Mesoplodon densirstris*	Spinner Dolphin	*Stenella longirostris*
Sowerby's Beaked Whale	*Mesoplodon bidens*	Clymene Dolphin	*Stenella clymene*
Cuvier's-Beaked Whale	*Ziphius cavirostris*	Melon-Headed Whale	*Peponocephala crassidens*
Northern Bottlenose Whale	*Hyperoodon ampullantus*	Short-Finned Pilot Whale	*Globicephala macrorhynchus*
Rough-Toothed Dolphin	*Steno bredanensis*	Long-Finned Pilot Whale	*Globicephala melas*
Bottlenose Dolphin	*Tursiops truncates*	Harbor Porpoise	*Phocoena phocoena*
Atlantic Spotted Dolphin	*Stenella frontalis*	Harbor Seal	*Phoca vitulina*
Pantropical Spotted Dolphin	*Stenella attenuata*	Gray Seal	*Halichoerus grypus*
Common Dolphin	*Delphinus* spp.		

Source: NASA, 2003a

3.2.5 Fish

Common fish in the waters near Wallops Island include the Atlantic croaker (*Micropogonias undulatus*), sand shark (*Carcharias taurus*), smooth dogfish (*Mustelus canis*), smooth butterfly ray (*Gymnura micrura*), bluefish (*Pomatomidae saltatrix*), spot (*Leiostomus xanthurus*), and summer flounder (*Paralichthys dentatus*) (NASA, 2008a). Salinity and water depths play a major role in determining if a coastal fish species is present in the bays and inlets near the island.

3.2.5.1 Essential Fish Habitat

The tidal marsh areas of Wallops Island act as nursery grounds for a variety of fish species due to the protection the marsh grasses provide and the abundance of food (NASA, 2008a). Eelgrass, for example, provides protection to the spot, the northern pipefish (*Syngnathus fuscus*), the dusky pipefish (*Syngnathus floridae*), and the bay anchovy (*Anchoa mitchilli*).

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 (Magnuson-Stevens Act, 16 U.S.C. 1801 et seq.), as amended, gives the U.S. exclusive management authority over fisheries, except for highly migratory species of tuna, within a fishery conservation zone of 5 to 322 kilometers (3 to 200 miles) offshore. The Mid-Atlantic Fisheries Management Council is responsible for managing fisheries in Federal waters off the Atlantic Coast, including the project area fisheries, in accordance with the Magnuson-Stevens Act. To promote the long-term health and stability of managed fisheries, the Mid-Atlantic Fisheries Management Council utilizes Fishery Management Plans for the following species or species complexes: mackerel, squid and butterfish, bluefish, dogfish, surf clam and ocean quahog, summer flounder, scup, sea bass, and tilefish. The Magnuson-Stevens Act also mandates the identification of Essential Fish Habitat (EFH) for managed species. EFH is defined as the waters or substrate necessary for fish to spawn, breed, feed, or grow to maturity.

EFH is designated for areas of the Atlantic Ocean within which WFF performs its missions. Ocean waters east of Wallops Island also feature intermittent floating *Sargassum* habitat, which is considered EFH. Live/hard EFH communities are not known to occur naturally offshore of Wallops Island, except for those that exist on manmade structures such as shipwrecks and artificial reefs.

3.3 SOCIAL AND ECONOMIC ENVIRONMENT

3.3.1 Population

In 2006, the U.S. Census Bureau reported that the population of the Commonwealth of Virginia was about 7.6 million, and Accomack County’s population was 39,345, with a population density of 218 people per square kilometer (84.2 people per square mile) (U.S. Census Bureau, 2000). The population growth rate in Accomack County between 2000 and 2006 was approximately 2.7 percent (U.S. Census Bureau, 2008a).

The village of Assawoman, approximately 8 kilometers (5 miles) to the southwest, is the closest residential community to Wallops Island. The towns of Wattsville and Atlantic are the closest incorporated communities to Wallops Island and are located approximately 13 kilometers (8 miles) and 8 kilometers (5 miles) northwest of Wallops Island, respectively. There is no specific census data available for Wattsville because it is an unincorporated residential area.

Chincoteague Island, Virginia, is approximately 13 kilometers (8 miles) northeast of Wallops Island. The Town of Chincoteague is the most densely populated area in Accomack County, with a resident population of 4,317 people. Area populations fluctuate seasonally. During the summer months the population increases due to tourism and vacationers who visit the nature reserve and beaches of Assateague Island. Daily populations often reach up to 15,000 in the summer months. Special events, such as the annual pony swim and roundup/auction, sponsored by the Chincoteague Volunteer Fire Department in July, draw crowds of up to 40,000. Table 18 lists the 2000 U.S. Census population of nearby towns in Accomack County (U.S. Census Bureau, 2008a).

Table 18: Town Population and Housing Units in Accomack County

Location	Population	No. of Housing Units
Accomac Town	547	234
Atlantic Town	539	272
Belle Haven Town	480	257
Bloxom Town	395	180
Chincoteague Town	4,317	3,970
Hallwood Town	290	120
Keller Town	173	87
Melfa Town	450	210
Onancock Town	1,525	725
Onley Town	496	273
Painter Town	246	114
Parksley Town	837	404
Saxis Town	337	194
Tangier Town	604	272
Wachapreague Town	236	229

Source: U.S. Census Bureau, 2008a

3.3.2 Recreation

WFF is located on Virginia's Eastern Shore, a popular tourist destination. Many tourists and vacationers visit Accomack County throughout the late spring, summer, and early fall. Regional attractions include the Assateague Island National Seashore and CNWR. Winter hunting season draws people to hunt local game including dove, quail, deer, fox, and many types of geese and ducks.

Accomack County also offers an assortment of recreational opportunities. Three county park facilities support a variety of activities, including basketball, football, golf, soccer, softball, and volleyball. Tennis courts, public beaches, and indoor movie theaters also provide sources of recreation and entertainment throughout the area.

Many other activities and facilities are offered to WFF and tenant employees and their families through the Wallops Employee Morale Association. There are also numerous WFF clubs (e.g., Eco Club, Fitness Club, and Music Club) and recreational facilities.

3.3.3 Employment and Income

This section provides general background information on employment and income data for the WFF region. This includes 2000 U.S. Census data on the employment, unemployment, income, and poverty characteristics of the region complied by the Virginia Employment Commission

(VEC) and by Virginia Polytechnic Institute (Eastern Shore Chamber of Commerce, 2007). The section also includes employment statistics for WFF itself.

The unemployment rate in Virginia was 3.0 percent in 2007 (VEC, 2009). In 2007, Accomack County was approximately average in the Delmarva region in terms of unemployment rates. The total labor force of Accomack County is 19,091 people, 18,309 of whom are employed, resulting in an unemployment rate of 4.1 percent (VEC, 2009). Employment fluctuates seasonally in Accomack County and the Town of Chincoteague, with decreased unemployment occurring from June through October (VEC, 2009). Overall, the unemployment rates in Virginia and Accomack County have been declining since 2000.

Table 19 lists the distribution by broad occupational categories for Virginia, Accomack County, and Chincoteague, as reported by the U.S. Census Bureau.

Table 19: Occupational Distribution (percent)

Category	Virginia	Accomack County	Chincoteague
Management, professional, and related occupations	38	24	26
Sales and office occupations	26	22	26
Production, transportation, and material moving occupations	13	20	9
Service occupations	14	17	17
Construction, extraction, and maintenance occupations	10	11	15
Farming, fishing, and forestry occupations	1	6	7

Source: U.S. Census Bureau, 2000

Table 20 shows the income and poverty rates of the Commonwealth of Virginia, Accomack County, and Chincoteague. Accomack County and Chincoteague both have a higher percentage of families below the poverty level and a lower per capita income than Virginia as a whole; however, Accomack County and Chincoteague do not include major urban centers.

Table 20: Income and Poverty

Region	Median Household Income (2007)	Per Capita Income (2007)	Percent of Families Below Poverty Level (2007)
Virginia	$53,066	$28,255	9.9
Accomack County	$35,048	$18,468	18.0
Chincoteague	$36,566	$24,549	13.4

Source: U.S. Census Bureau, 2008b

In 2008, WFF employed a total of 1,485 people; 1,027 of those supported NASA (including 238 civil servants and 789 contractors), MARS employed 3 full-time people, and the remainder worked for either NOAA or the U.S. Navy (NASA, 2008a). The VEC reported that in 2007

NASA was the fourth largest employer in Accomack County; other large employers on the Eastern Shore are Perdue Farms (1,900 employees) and Tyson Foods (950 employees) (VEC, 2008).

Employment categories at WFF consist largely of managerial, professional, and technical disciplines with higher than regional average salaries. The mean salary of NASA employees for fiscal year 2008 was $88,047, while the median salary is in the $80,000-$90,000 range (NASA, 2008a). The median family income for Accomack County in 2008 was $41,845. Due to the wide gap between salaries of WFF employees and most area residents, the facility contributes considerably to the local economy (NASA, 2008a).

3.3.4 Environmental Justice

The goal of environmental justice from a Federal perspective is to ensure fair treatment of people of all races, cultures, and economic situations with regard to the implementation and enforcement of environmental laws and regulations, and Federal policies and programs. EO 12898, *Federal Action to Address Environmental Justice in Minority Populations and Low Income Populations*, (and the February 11, 1994, Presidential Memorandum providing additional guidance for this EO) requires Federal agencies to develop strategies for protecting minority and low-income populations from disproportionate and adverse effects of Federal programs and activities. The EO is “intended to promote non-discrimination in Federal programs substantially affecting human health and the environment.”

Accomack County is on the lower end of income measures in the region, with a 2005 median family income of $32,837. As a result, the county is also on the higher end of poverty levels in the region based on U.S. Census Bureau data reports. The per capita income in Accomack County in 2007 was reported to be $18,468, with an estimated 18.0 percent of people below the poverty level (U.S. Census Bureau, 2008b). The per capita income in the Commonwealth of Virginia in 2007 was reported to be $28,255, with an estimated 9.9 percent of people below the poverty level statewide (U.S. Census Bureau, 2008b).

NASA has prepared an Environmental Justice Implementation Plan (EJIP) to comply with EO 12898 (NASA, 1996). The EPA’s Environmental Justice Coordinators Council has defined minority communities as exceeding a 50 percent minority population. Table 21 provides a review of Accomack County Census data used to determine the baseline for the facility’s EJIP.

Table 21: Environmental Justice Concerns – by Census Tract, Accomack County, VA

Tract	Location	Percent Minority 2000	Percent Low Income 2000	Percent Poverty 2000
9901	MD/VA line south including Fisher's Point	1.97	51.53	12.80
9902	MD/VA line south including Wallops Island to Assawoman Inlet	41.75	49.96	16.38
9903	West of 9902 and 9904, MD/VA line south to Ann's Cove Road	24.66	55.94	19.28
9904	East of Mears Station Road, South of 9902 south to Horseshoe Lead	59.14	51.61	27.14

Source: NASA, 2008a

Chincoteague Island, at approximately 13 kilometers (8 miles) northeast of Wallops Island, is the closest populated area to the seaward side of Wallops Island. No minority or low-income communities exist on the portion of Chincoteague Island that lies within a 4-kilometer (2.5-mile) radius of Wallops Island.

EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks,* encourages Federal agencies to consider the potential effects of Federal policies, programs, and activities on children. The closest day care centers, schools, camps, nursing homes, and hospitals are addressed within the EJIP.

No nursing homes, hospitals, or schools are located near WFF. The closest hospital, McCready Memorial Hospital in Crisfield, Maryland, is located approximately 32 kilometers (20 miles) northwest of Wallops Island. One public campground, Trail's End, is located approximately 13 kilometers (8 miles) northwest of the Launch Complex 0. One day care center, Emma's World Daycare & Preschool, is located approximately 10 kilometers (6 miles) northwest of Launch Complex 0. The closest schools are: Arcadia High School, located approximately 11 kilometers (7 miles) northwest of Launch Complex 0, and Kegotank Elementary School, located 7 kilometers (4.4 miles) west of Launch Complex 0. None of these facilities would be in the planned flight path of the ELV and all are beyond the safety zone around Pad 0-A.

3.3.5 Health and Safety

Three local emergency health services are located in the vicinity of Wallops Island. WFF has its own health unit with a full-time nursing staff and a full-time physician to provide first aid and immediate assistance to patients in emergency situations. The Health Unit operates from 8:00 a.m. to 4:30 p.m. After-hours emergency medical care is provided by the Emergency Medical Services staff of the WFF Fire Department. The Chincoteague Community Health Center on Chincoteague Island and the Atlantic Community Health Center in Oak Hall, Virginia, also provide emergency assistance, and both are located within 8 kilometers (5 miles) of WFF. Four hospitals are also located in the region, all within 64 kilometers (40 miles) of WFF. These hospitals include:

- Atlantic General Hospital in Berlin, Maryland
- McCready Memorial Hospital in Crisfield, Maryland
- Peninsula Regional Medical Center in Salisbury, Maryland
- Shore Memorial Hospital in Nassawadox, Virginia

The Peninsula Regional Medical Center in Salisbury serves as the regional trauma center for the Delmarva Peninsula. If additional trauma care is needed, Sentara Norfolk General Hospital is 19 minutes away (by helicopter) from the Shore Memorial Hospital in Nassawadox, Virginia. Accomack and Northampton County Health Departments offer clinical services. Five nursing homes on Virginia's Eastern Shore and eight nursing homes on Maryland's Lower Eastern Shore are available to the surrounding communities.

To protect the public and personnel at WFF during pre-launch preparations, no one other than approved and essential personnel are allowed within a specified distance of the launch pad, referred to as the pre-launch danger area (PLDA). During the launch countdown, a larger launch hazard area (LHA) is established in case a mishap occurs during the launch and flight.

3.3.5.1 Fire and Police Protection

The WFF Fire Department provides emergency services to the neighboring community and has a Mutual Aid Agreement with the Accomack-Northampton Fireman's Association for any outside assistance needed at WFF (NASA, 2008a). There are 21 existing Fire and Rescue stations in Accomack County. The local fire companies closest to Wallops are in the towns of Atlantic, Chincoteague, and New Church, Virginia.

Fire company personnel are housed in two buildings on the facility, one on Wallops Island and one on Wallops Main Base (NASA, 2008a). There are 24-hour fire and protection services, and personnel are also trained as first responders for hazardous materials, waste, and oil spills. The fire fighting personnel maintain three shifts of nine employees: two officers and seven fire fighters. All are Emergency Medical Technicians and two employees per shift are Advanced Life Support certified. Rescue vehicles include three structural engines, four aircraft firefighting vehicles, two ambulances, a hazmat truck and trailer, a technical rescue trailer, two utility pickup trucks, one tracked all-terrain vehicle, and one wheeled all-terrain vehicle (NASA, 2008a).

WFF maintains a security force that is responsible for the internal security of the base. The force provides 24-hour-per-day protection services for 2,428 hectares (6,000 acres) of real estate, 513 buildings and structures, and approximately 1,485 employees and tenants, with an average of 34,000 visitors per year (NASA, 2008a). On the Main Base, one entrance gate to WFF, one to NOAA, and one to the U.S. Navy are used to control and monitor daily employee and visitor traffic. One entrance gate serves as the control and monitoring point for Wallops Mainland and Wallops Island, combined. Other services provided by the security force include security patrols, employee and visitor identification, mail delivery, after-hours security checks, and police services.

Police protection for the surrounding areas is supplied by town, county, and State personnel. The Commonwealth of Virginia's police force employs 23 officers in the area, while the Accomack County Sheriff's Office has approximately 34 officers. Several towns also have their own police forces, including: Bloxom, Cape Charles, Chincoteague, Exmore, Ocean City, Onancock, Onley, Parksley, Pocomoke, Salisbury, Saxis, and Tangier (Eastern Shore Chamber of Commerce, 2007). The USCG and the Virginia Marine Police Officers of the VMRC provide law enforcement and investigation, search and rescue, and harbor and open seas patrol in the back bays around Wallops Island and on the Atlantic Ocean.

3.3.6 Cultural Resources

The National Historic Preservation Act (NHPA) of 1966, (P.L. 89-665; 16 U.S.C. 470 *et seq.*) as amended, outlines Federal policy to protect historic sites and values in cooperation with other nations, Tribal Governments, States, and local governments. Subsequent amendments designated the State Historic Preservation Officer as the individual responsible for administering State-level programs. The NHPA also created the Advisory Council on Historic Preservation, the Federal agency responsible for providing commentary on Federal activities, programs, and policies that affect historic resources.

Section 106 and Section 110 of the NHPA and its implementing regulations (36 CFR 800) outline the procedures to be followed in the documentation, evaluation, and mitigation of impacts for cultural resources. The Section 106 process applies to any Federal undertaking that has the potential to affect cultural resources. This process includes identifying significant historic properties and districts that may be affected by an action and mitigating adverse effects to properties listed, or eligible for listing, in the National Register of Historic Places (NRHP) (30 CFR 60.4). Section 110 of the NHPA outlines the obligations Federal agencies have in regard to historic resources under their ownership.

In November 2003, NASA prepared a *Cultural Resources Assessment of Wallops Flight Facility, Accomack County, Virginia* (CRA) that examined each of the three land areas of the facility within WFF's property boundaries: Wallops Main Base, Wallops Mainland, and Wallops Island (NASA, 2003c). The study was completed to assist NASA in meeting its obligations under Sections 106 and 110 of the NHPA. According to the NRHP, the age criterion for consideration of a historic property is 50 years. For planning purposes, this study evaluated properties constructed prior to 1955, using 1955–2005 as the youngest applicable 50-year period. Additionally, the CRA established a predictive model for understanding the archaeological potential over the entire WFF property.

The CRA determined that among cultural resources at WFF are six archaeological sites, two of which are historic sites on Wallops Island (Figures 22 and 23), and a total of 166 structures that are at least 55 years old, 25 of which are located on Wallops Island. Comments from the Virginia Department of Historic Resources (VDHR) were received in a letter dated December 4, 2003 (NASA, 2003b). The letter concurred with the findings of the CRA. VDHR accepted the predictive model for archaeology at WFF, noting that many of the areas with moderate to high archaeological potential are unlikely to be disturbed by future construction or site use (NASA, 2003b).

Following the initial 2003 reconnaissance survey task, an intensive-level historic resource survey and historic research were conducted to develop a historic context for WFF. This context provided the necessary information with which to make NRHP eligibility determinations for the surveyed buildings and structures constructed prior to 1956. The findings were presented in the *Historic Resources Survey and Eligibility Report for Wallops Flight Facility* (NASA, 2004). The historic context developed for the report, in conjunction with field observations, served as the basis of evaluation for the buildings and structures determined to be (or soon to be) 50 years or older at Wallops. Of the 124 buildings assessed that pre-date 1956, 25 still exist on Wallops Island.

Two resources—the Wallops Coast Guard Lifesaving Station (VDHR #001-0027-0100; WFF# V-065) and its associated Coast Guard Observation Tower (001-0027-0101; WFF# V-070)—were determined to be eligible for listing in the NRHP and Virginia Landmarks Register (NASA, 2004). The other surveyed resources were determined not to be NRHP eligible because they lacked the historical significance or integrity necessary to convey significance.

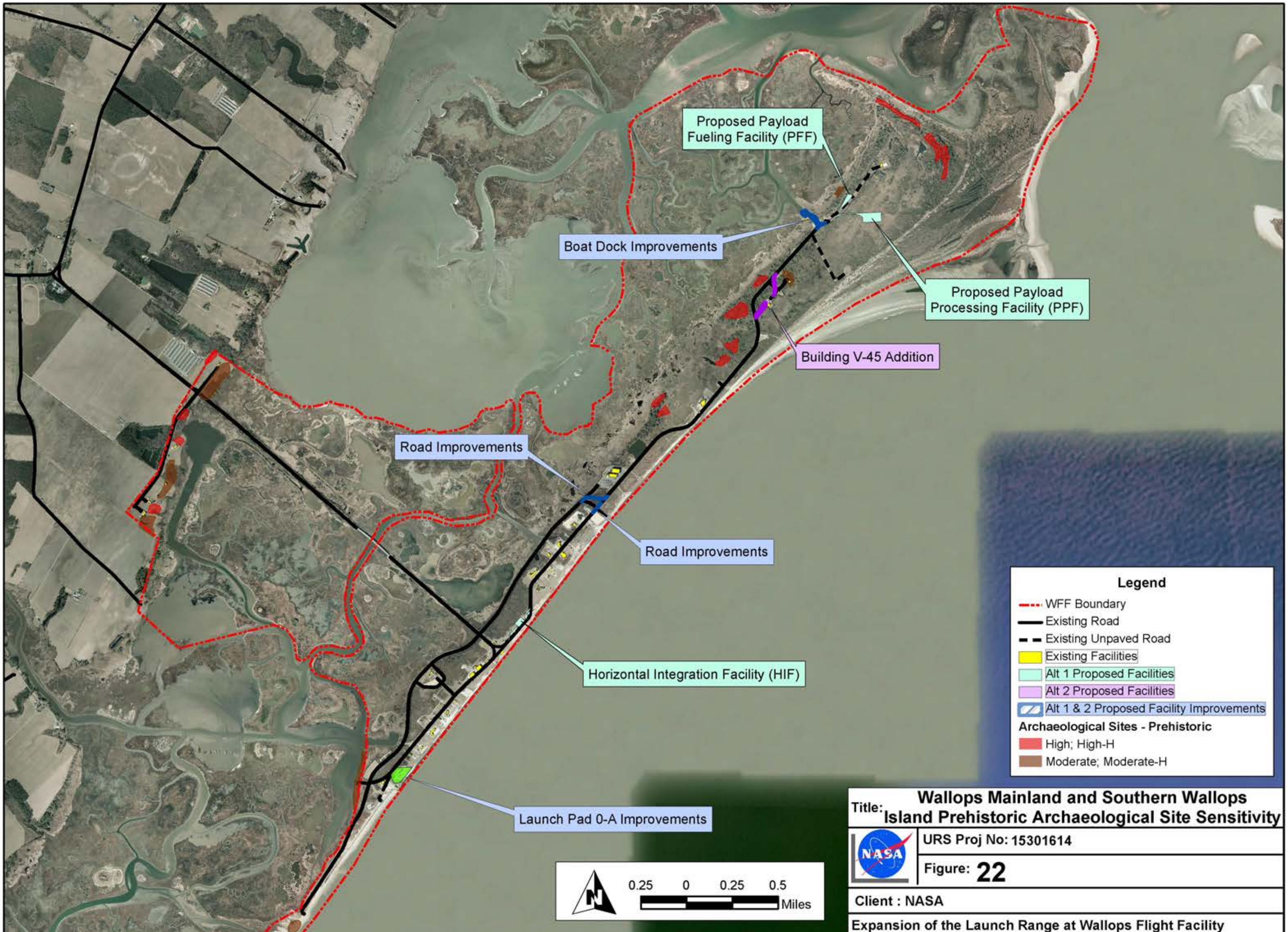
In a letter dated November 4, 2004, the VDHR concurred with the findings and determinations in the *Historic Resources Survey and Eligibility Report*, confirming that the Wallops Coast Guard Lifesaving Station is eligible for listing in the NRHP, with the Observation Tower as a contributing structure to the historic property (NASA, 2004). NASA has determined that the Wallops Coast Guard Lifesaving Station is located inside the explosive hazard arc of a nearby rocket motor storage facility and as a result, is planning the demolition or removal of the Lifesaving Station and Observation Tower. In compliance with Section 106 of the NHPA, NASA and VDHR are currently negotiating a Memorandum of Agreement to resolve the effects of demolition or removal.

Since the 2004 report, no additional large-scale identification and evaluation of above-ground historic properties has been conducted at WFF. Accordingly, survey updates at WFF may reveal above-ground historic properties not identified in the 2004 report, including properties that have achieved 50 years of age since 2004 and properties that are less than 50 years of age.

3.3.7 Transportation

The Eastern Shore of Virginia is connected to the rest of the State by the Chesapeake Bay Bridge-Tunnel. The primary north-south route that spans the Delmarva Peninsula is U.S. Route 13, a four-lane divided highway. Local traffic travels by arteries branching off U.S. Route 13. Activities at Wallops Island and Wallops Mainland generate traffic along Route 803. Primary access to WFF is provided by Route 175, a two-lane secondary road. Traffic in the region varies with the seasons—during the winter and early spring, traffic is minimal; during the summer and early fall, traffic increases due to the number of tourists in the area.

Wallops Main Base and Wallops Mainland are connected by approximately 10 kilometers (6 miles) of the paved, two-lane Route 679. A NASA-owned road, bridge, and causeway link Wallops Mainland to Wallops Island. Hard surface roads provide access to most buildings at WFF and are maintained by NASA and its tenants. Most organizations at WFF own and maintain a variety of vehicles ranging from sedans and vans to trucks. There is no public transportation on the facility. Many WFF employees carpool to and from the facility.



Title: Wallops Mainland and Southern Wallops Island Prehistoric Archaeological Site Sensitivity

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Figure: 22

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Expansion of the Launch Range at Wallops Flight Facility

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Title: Wallops Mainland and Southern Wallops Island Historic Archaeological Site Sensitivity

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Figure: 23

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Expansion of the Launch Range at Wallops Flight Facility

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Commercial air service to the area is provided through the Norfolk International Airport, about 145 kilometers (90 miles) to the south, and the Salisbury Regional Airport, about 64 kilometers (40 miles) to the north. Air service is also available approximately 40 kilometers (25 miles) south of WFF through the Accomack County Airport in Melfa, which normally provides flights during daylight hours. Surface transportation from the airports to WFF is by private rental vehicles, government vehicles, and commercial bus or taxi. In addition, ground transportation to the Salisbury Airport is occasionally provided by a WFF Shuttle Bus for WFF employees. Chartered and private aircraft that have the appropriate clearance may land at the WFF Airport for business purposes. Air-freight services are available from the Salisbury Regional Airport.

Rail freight service is provided to the Delmarva Peninsula by Bay Coast Railroad, although no rail freight service is available directly to WFF. No rail passenger service is available to WFF. Eleven motor freight carriers that serve the eastern United States are authorized to provide service to the Accomack-Northampton District, and therefore, WFF.

Ocean cargo shipments are typically offloaded at the Port of Baltimore, Maryland, or Cape Charles, Virginia, and transferred to commercial trucks or rail for transport to WFF. A sea-based option also exists utilizing Chincoteague Inlet and offloading cargo at the boat docks at WFF (one on Wallops Main Base and one on the north end of Wallops Island). Numerous small harbors are located throughout Accomack and Northampton Counties, which are used primarily for commercial or recreational fishing and boating.

3.3.8 Department of Transportation Section 4(f) Lands

The DOT Act of 1966 (49 USC, Subtitle I, Section 303(c)), as amended, includes a special provision—Section 4(f)—that stipulates that DOT agencies cannot approve the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites unless the following conditions apply:

- There is no feasible and prudent alternative to the use of such land
- The project includes all possible planning to minimize harm to the land resulting from such use

Because the FAA Office of Commercial Space Transportation is a DOT agency with jurisdiction over the Proposed Action, this EA includes an evaluation of DOT Section 4(f) lands.

Section 4(f) includes guidelines for assessing the significance of an impact or the level of impairment that would occur when a proposed action involves either:

- More than a minimal physical use of a section 4(f) property; or
- Deemed a “constructive use” substantially impairing the 4(f) property, and mitigation measures do not eliminate or reduce the effects of the use below the threshold of significance.

According to Section 4(f), substantial impairment would occur when impacts are sufficiently serious that the value of the site in terms of its prior significance and enjoyment are substantially reduced or lost.

3.3.8.1 National Historic Preservation Act of 1966, Section 106

Where historic sites are determined to be eligible for inclusion in the NRHP, NASA, MARS, and FAA are required to comply with all requirements of the NHPA prior to disturbance of a structure or site. Refer to the cultural resources discussion in Section 3.3.6 of this EA for further discussion regarding NHPA.

3.3.8.2 Public Lands and Refuges

Section 4(f) prohibits park and recreation lands, and wildlife and waterfowl refuges from being converted to non-recreational use on Federal lands or other public land holdings (e.g., State forests) unless approval is received from the Secretary of the DOT. Although public land holdings surround WFF, Wallops Island is not a public land holding.

Several wildlife refuges that are Section 4(f) lands are located within the vicinity of Wallops Island. Assawoman Island, which lies immediately south of Wallops Island, and the northern portion of Metompkin Island, which lies immediately south of Assawoman Island, are owned by the USFWS. Assawoman Island is closed year round except for seasonal boat and fishing access on the southern tip. The northern part of Metompkin Island is owned by the USFWS and the southern half is owned by the Nature Conservancy; both portions are open to the public for low-impact, recreational daytime activities, such as hiking, bird watching, fishing, and photography.

3.3.8.3 Land and Water Conservation Act, Section 6(f)

Section 6(f) of the Land and Water Conservation Act (LWCA) also applies to Section 4(f) lands. Section 6(f) prohibits recreational facilities funded under the LWCA from being converted to non-recreational use unless approval is received from the director of the National Park Service. No facilities on Wallops Island are funded under the LWCA.

SECTION FOUR ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

Section 4 presents the potential impacts on existing resources at WFF described in Section 3 that may result from the alternatives described in Section 2. This section contains discussions on potential impacts on resources under the three main categories of Physical Environment, Biological Environment, and Social and Economic Environment. Land Use and Recreation will not be discussed further because no impacts to these resources are anticipated.

Analysis of potential impacts will focus on Taurus II and the ES as bounding cases. Discussions of potential impacts from other ELVs (e.g., Falcon family) or spacecraft (e.g., Cygnus and Dragon) will be limited to resource areas where impacts differ enough to warrant further assessment.

The Launch Range Operations Expansion EA (NASA, 1997) for the expansion of MARS addressed specific actions including construction of Launch Pad 0-B, minor modifications to Launch Pad 0-A, minor modifications to utility infrastructure, expansion of capabilities to accommodate both solid- and liquid-fueled rockets, and increasing launch frequency to 12 orbital-class launches per year. This document describes environmental consequences of the current No Action Alternative.

4.1.1 Definitions of Impacts

A major focus of Section 4 is to determine if any of the project-related environmental impacts could be classified as significant. The assessment of potential impacts and the determination of their significance are based on the requirements in 40 CFR 1508.27. Three levels of impact can be identified:

- No Impact – No impact is predicted
- No Significant Impact – An impact is predicted, but the impact does not meet the intensity/context significance criteria for the specified resource
- Significant Impact – An impact is predicted that meets the intensity/context significance criteria for the specified resource

Impacts that are not significant may still have an effect on the environment, and can be described in a variety of ways, such as:

- Type (beneficial or adverse)
- Context (site-specific, local, or regional)
- Intensity (negligible, minor, moderate, or substantial)
- Duration (short- or long-term)

The levels of these impacts and their specific definitions vary based on the resource that is being evaluated. For example, the scale at which an impact may occur (local, regional, etc.) would be different for wetland impacts as compared to economic resources.

Under NEPA (42 U.S.C. 4321 et seq.), significant impacts are those that have the potential to significantly affect the quality of the human environment. Human environment is a comprehensive phrase that includes the natural and physical environments and the relationship of people to those environments (40 CFR Section 1508.14). Whether an alternative significantly affects the quality of the human environment is determined by considering the context in which it would occur, along with the intensity of the action (40 CFR Section 1508.27).

During the discussion of impacts on each resource area, the type, context, intensity, and duration of the impact are presented in this EA. Additionally, mitigation measures that would reduce the potential for an impact are identified.

4.2 PHYSICAL ENVIRONMENT

4.2.1 Land Resources

4.2.1.1 Topography

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to topography.

Alternative One

Site Improvements

Under Alternative One, land grading, excavation, and construction activities for the construction of the PPF, PFF, HIF, roads, Pad 0-A, and a LFF would cause land disturbances. Construction of these facilities would also result in increased impervious surfaces on Wallops Island. Because Wallops Island is essentially flat, the site improvement activities would not substantially alter topography. Although approximately 8.5 hectares (21 acres) of land would be disturbed and permanently altered by site improvement activities under Alternative One, impacts would not be substantial.

Transportation, Handling, and Storage of Materials

The transportation and handling of materials, launch vehicles, and the ES would not result in impacts on topography.

Launch Activities

Launch activities would not result in impacts on topography.

Alternative Two

Under Alternative Two, transportation, handling, and storage of materials and launch activities would not result in impacts to topography. Approximately 4.5 hectares (11 acres) of land would be disturbed by site improvement activities; however, because Wallops Island is essentially flat, the site improvement activities would not substantially alter topography.

4.2.1.2 Geology and Soils

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to geology and soils.

Alternative One

Site Improvements

Under Alternative One, construction activities, including grading, clearing, filling, and excavation, would result in disturbance of the ground surface and would have the potential to cause soil erosion. NASA and MARS would minimize adverse impacts to soils by acquiring VSMP permits as necessary, and developing and implementing site-specific SWPPPs and Erosion and Sediment Control Plans prior to ground disturbing activities. NASA and MARS would revegetate bare soils and incorporate landscaping measures in areas to be left as pervious surfaces (not paved) when construction is complete.

Construction of the pile foundation to support the Pad 0-A infrastructure would require driving precast concrete piles to depths of approximately 27 meters (90 feet) below ground surface. The piles are expected to penetrate the surficial coastal deposits and terminate in the Yorktown Formation. Although the driven piles would create long-term changes to the subsurface geology immediately around the driven piles, the changes would be limited in extent and are considered negligible. Therefore, construction of the pile foundation is not anticipated to result in an adverse impact on geologic resources.

Transportation, Handling, and Storage of Materials

Other potential impacts to soils include spills or leaks of pollutants from vehicles or equipment during construction activities and transportation of materials. NASA and MARS would minimize adverse impacts to soils by acquiring VSMP permits as necessary, and developing and implementing site-specific SWPPPs that would include best management practices for vehicle and equipment fueling and maintenance, and spill prevention and control measures to reduce potential impacts to soils during construction. The *Hazardous Materials and Hazardous Waste Management* discussion in Section 4.2.6 of this EA describes the procedures for transportation and handling of hazardous materials.

There is the potential for an accidental release of contaminants into soils resulting from ASTs, or during transportation of the ELV components and the ELV. Any accidental release of contaminants or liquid fuels would be addressed in accordance with the WFF ICP. All petroleum storage tanks would include spill containment measures such as impermeable berms that hold at least 110 percent of the tank's maximum capacity. The impacts of an accidental release would be adverse, although the likelihood of an accidental release would be low due to spill prevention and containment measures.

Launch Activities

Launch activities are not expected to impact soils because they would take place over the impervious surface at Pad 0-A.

Alternative Two

Under Alternative Two, the types of impacts to soils and geology would be the same as those described for Alternative One. However, due to approximately 50 percent less site disturbance, fewer impacts would occur. There would less potential for a spill under Alternative Two because fewer ELVs would be launched.

4.2.2 Water Resources

4.2.2.1 Surface Water Including Wetlands

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to surface water including wetlands.

Alternative One

Site Improvements

Under Alternative One, construction activities including grading, clearing, filling, and excavation would result in disturbance of the ground surface and would have the potential to cause soil erosion and the subsequent transport of sediment into waterways via stormwater.

To quantify the potential wetland impacts under Alternative One, NASA and MARS performed wetland delineations at the Wallops Island Boat Dock, mid-Island road, HIF, and Pad 0-A. The total area of potential impacts to wetlands under Alternative One would be approximately 1.7 hectares (4.1 acres). Up to 1.6 hectares (3.9 acres) of nontidal scrub-shrub and emergent wetlands dominated by *Phragmites* would be filled by construction of the PPF and its access road. In addition, approximately 28 square meters (305 square feet) of tidal emergent wetlands would be affected by construction at the boat basin and 0.1 hectare (0.2 acre) of nontidal scrub-shrub and emergent wetlands would be filled for improvements to mid-island roads. No wetlands would be affected by construction of the PFF, LFF, HIF, Pad 0-A infrastructure, or other roads. Due to siting constraints including available land, hazard arcs surrounding existing facilities on Wallops Island, and road design requirements for oversized launch support equipment and the ELV, NASA has determined that there are no practicable alternatives for the location of the site improvements.

Prior to construction, NASA and MARS would conduct additional wetland delineations, if necessary, in accordance with the USACE 1987 Wetland Delineation Manual (USACE, 1987) and regional guidelines to determine the precise location and size of the wetland area that would be adversely affected. NASA and MARS would notify the public and coordinate with applicable agencies including USACE, the VDEQ, VMRC, and the Accomack County Wetlands Board; these agencies would be notified of potential impacts to wetlands by VMRC through the JPA process. NASA and MARS would obtain a jurisdictional determination and necessary permits including Section 404 and/or Section 10 permits. NASA and MARS would implement wetland mitigation measures agreed upon through the JPA consultation process to offset the impacts and to ensure no net loss of wetlands.

Because the Proposed Action under Alternative One would involve federally funded and authorized impacts on jurisdictional wetlands, this EA serves as NASA's means for facilitating public review as required by EO 11990.

Transportation, Handling, and Storage of Materials

Other potential impacts to surface waters include contamination from spills or leaks of pollutants from vehicles or equipment during construction activities and transportation of materials. NASA and MARS would implement site-specific construction and industrial SWPPPs that would include best management practices for vehicle and equipment fueling and maintenance, and spill prevention and control measures to reduce potential impacts to surface water during construction. The *Hazardous Materials and Hazardous Waste Management* discussion in Section 4.2.6 of this EA describes the procedures for transportation and handling of hazardous materials.

There is the potential for an accidental release of contaminants into surface water resulting from ASTs, or during transportation of the ELV, ES, and components. Any accidental release of contaminants or liquid fuels would be addressed in accordance with the existing WFF ICP.

Launch Activities

Launch of a Taurus II rocket would result in the emission of CO and CO_2 at Pad 0-A. When CO and CO_2 combine with water vapor in the air, carbonic acid may form, which could result in the deposition of carbonic acid on the ground surface in the area surrounding the launch pad. The effects of carbonic acid deposition on the adjacent tidal wetland area would be minimal as carbonic acid is a weak acid normally found in rainwater; the natural buffering capacity of the nearby surface waters and wetlands would resist substantial changes in pH. Additionally, stormwater within the Pad 0-A complex would be retained in basins designed to facilitate infiltration and evaporation. No direct discharges to surface waters including wetlands are anticipated.

Deluge water discharged to the lined retention basin would be allowed to cool and then tested for potential release to an unlined infiltration and evaporation basin. NASA would coordinate with VDEQ regarding specific water quality requirements and treatment of the deluge water prior to discharge, and NASA would modify its existing VPDES permit if necessary. If required, the deluge water would be treated (i.e., pH adjustment) before release, or removed for disposal if it does not meet the standards for discharge to surface water as permitted by VDEQ. The release may occur over a period of several days due to the large quantity of water to be discharged.

Launch failures could result in impacts on surface waters due to contamination from rocket propellant. In the unlikely occurrence of a launch failure, spilled RP-1 (a maximum of 79,000 liters [21,000 gallons] for Taurus II) could enter the tidal wetlands close to the launch pad. Because some propellant would likely be burned prior to failure, it is unlikely that the maximum amount of RP-1 held in the tanks would be spilled. NASA and MARS would follow the emergency response and cleanup procedures outlined in the WFF ICP. Procedures may include containing the spill using disposable containment materials such as absorbent pigs and berms, fences, trenches, sandbags, and cleaning the area with absorbents or other material to reduce the magnitude and duration of any impacts. If the spill is greater than 95 liters (25 gallons) of petroleum or of any size that affects or threatens to affect surface waters (i.e., one that creates a sheen, emulsion, or sludge), it would be reported within 2 hours to the National Response Center and the Tidewater Regional Office of the VDEQ during business hours or the Virginia Department of Emergency Management during non-business hours.

A release of unspent RP-1 from the ELV may create a thin film of petroleum on the water surface near the impact area. Due to the volume of this release into the nearby tidal wetlands, temporary impacts on water quality in the tidal wetlands may be adverse; however, because mitigation and cleanup measures would be implemented, the potential long-term impacts on tidal wetlands would not be substantial.

If leaked into the ocean, the amount of water in comparison to the amount of propellant would allow the propellant to dilute so that impacts would be temporary and extremely localized. Dissipation into the ocean waters would occur within hours due to a combination of wave moment, oxygen exposure, and sunlight (USAF, 2007). Due to the small volume of this release into the open ocean, impacts on water quality in the ocean would be negligible.

Alternative Two

Under Alternative Two, transportation, handling, and storage of materials and launch activities would result in the same types of impacts as for Alternative One. Fewer ELV launches under Alternative Two would result in less potential for a spill. Site improvement activities would result in different impacts than Alternative One and are described below.

Site Improvements

Under Alternative Two, construction activities including grading, clearing, filling, and excavation would result in disturbance of the ground surface and would have the potential to cause soil erosion and the subsequent transport of sediment into waterways via stormwater.

In addition to the wetland delineations described under Alternative One, NASA also performed a delineation of the area adjacent to the proposed building V-45 high bay and access road. The total area of potential impacts to wetlands under Alternative Two would be approximately 0.3 hectare (0.8 acre). Up to 0.2 hectare (0.6 acre) of nontidal forested and emergent wetlands would be filled by construction of the Building V-45 high bay and a new access road from the south. Approximately 28 square meters (305 square feet) of tidal emergent wetlands would be affected by construction at the boat basin, and 0.1 hectare (0.2 acre) of nontidal scrub-shrub and emergent wetlands would be filled for improvements to mid-island roads. No wetlands would be affected for construction of the Pad 0-A infrastructure or other site improvements. Due to siting constraints including available land, hazard arcs surrounding existing facilities on Wallops Island, and road design requirements for oversized launch support equipment and the ELV, NASA has determined that there are no practicable alternatives for the location of the site improvements.

Prior to construction, NASA and MARS would conduct additional wetland delineations, if necessary, in accordance with the USACE 1987 Wetland Delineation Manual (USACE, 1987) and regional guidelines to determine the precise location and size of the wetland area that would be adversely affected. NASA and MARS would notify the public and coordinate with applicable agencies including USACE, the VDEQ, VMRC, and the Accomack County Wetlands Board; these agencies would be notified of potential impacts to wetlands by VMRC through the JPA process. NASA and MARS would obtain a jurisdictional determination and necessary permits including Section 404 and/or Section 10 permits. NASA and MARS would implement wetland mitigation measures agreed upon through the JPA consultation process to offset the impacts and to ensure no net loss of wetlands.

Because Alternative Two would involve federally funded and authorized impacts on jurisdictional wetlands, this EA serves as NASA’s means for facilitating public review as required by EO 11990.

4.2.2.2 Marine Waters

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to marine waters.

Alternative One

Site Improvements

Localized temporary adverse impacts on marine waters in the area immediately surrounding the Wallops Island boat basin would occur during improvements to the dock, including installation of pilings and other in-water activities. NASA would use best management practices such as installation of a silt curtain during pile driving at the boat basin, to minimize impacts on marine water quality. No impacts on other marine waters are anticipated from implementation of Alternative One site improvements.

Transportation, Handling, and Storage of Materials

The ELV would be transported to Wallops Island unfueled; therefore, no impacts from ELV fuels would occur during barge transport. Marine waters would be affected if a barge or vessel were to spill its fuels or other substances that could contaminate the open ocean or estuary environment. Toxic concentrations would be localized and temporary due to the mixing and dilution associated with wave movement and the vastness of the ocean environment. A spill within Chincoteague Inlet or the approach channel to the boat dock would likely result in short-term adverse impacts on the marine environment. Personnel would implement USCG-approved safety response plans or procedures outlined in WFF's ICP to prevent and minimize any impacts associated with a spill.

Launch Activities

The rockets launched from Pad 0-A would be multi-stage vehicles, so spent ELV stages would fall into the ocean during every launch event. Spent ELV stages falling into the ocean are a potential source of pollution to marine environments. Approximately 1,700 liters (450 gallons) of LOX and 760 liters (200 gallons) of RP-1 would remain in the fuel tanks at the time of the splashdown of Taurus II Stage 1 (anticipated to land in the ocean approximately 2,100 kilometers [1,300 miles] southeast of Wallops Island at a water depth of approximately 6 kilometers [3.7 miles]). The tank would be expected to sink to the bottom of the ocean, and its contents would be released as extreme ocean pressures rupture the tanks or valves.. Six launches under Alternative One would result in approximately 10,000 liters (2,700 gallons) of LOX and 4,600 liters (1,200 gallons) of RP-1 entering the ocean annually. Short-term impacts may result, but long-term impacts would be negligible due to the buffering capacity of the ocean. LOX would dissolve in marine water. However, liquid fuels such as RP-1 that are relatively insoluble in water pose a slight risk to the marine environment until evaporation occurs. When the propellant surfaces, it would form a thin film that would be broken up by wave action, sunlight, and oxygen. All traces of propellant would quickly dissipate within 1 to 2 days.

Both the Falcon 1 and Falcon 9 flight vehicles allow recovery of the spent first stage by use of a parachute attached to the front end of the first stage. The location of the stage's ocean impact would vary with each mission. The first stage would be recovered returned to land. Residual kerosene would remain on-board until the vehicle arrives at the refurbishment facility. Residual

LOX would generally boil-off before recovery operations begin, vaporizing before arriving on land. The Falcon 9 second stage could be recovered if so designed. In this event, recovery of the second stage would be similar to recovery of the first stage.

Corrosion of hardware into toxic concentrations of metal ions would be localized and temporary because corrosion rates are slow in comparison to the mixing and dilution rates associated with marine environments (Detachment 12/RP, 2006; NASA, 2002b). The presence of miscellaneous materials such as battery electrolytes and hydraulic fluids are in such small quantities that only temporary effects would be expected.

Although potential reentry of the ES would result in debris entering the ocean, impacts to marine waters would be localized and temporary due to the mixing and dilution associated with wave movement and the vastness of the ocean environment.

If a launch failure were to occur, debris and unspent fuel would be removed from the near-shore ocean environment as practicable and disposed of in accordance with Federal, State, and local regulations. Short-term impacts on the near-shore environment may result, but long-term impacts would be negligible due to the buffering capacity of the Atlantic Ocean.

Alternative Two

Under Alternative Two, impacts to marine waters from site improvements would be the same as those described for Alternative One. Impacts from transportation, handling, and storage of materials and launch activities would result in the same types of impacts as for Alternative One; however, fewer ELV launches under Alternative Two would result in less pollutants entering the ocean.

4.2.2.3 Floodplains

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to floodplains.

Alternative One

Site Improvements

Wallops Island is located entirely within the floodplain; therefore, all facility construction and infrastructure improvements would take place within the 100-year and 500-year floodplains. Because Wallops Island is the location for WFF's core launch range functions, no practicable alternatives to development in the floodplain exist. NASA would ensure that its actions comply with EO 11988, *Floodplain Management*, and 14 CFR 1216.2 (NASA Regulations on Floodplain and Wetland Management) to the maximum extent possible. Since the Proposed Action would involve federally funded and authorized construction in the 100-year floodplain, this EA also serves as NASA's means for facilitating public review as required by EO 11988.

Access to Wallops Island is controlled and only authorized personnel are allowed on the facility, public education regarding flood hazards (e.g., marking flood heights on buildings) is not applicable. However, flood elevations are marked on some Wallops Island facilities to inform NASA, Navy, MARS, and visiting personnel. Other flood control measures that would be implemented include locating water-sensitive equipment, supplies, chemicals, etc. above the flood level (approximately 3.4 meters [11 feet] amsl), and moving hazardous waste outside of the floodplain when substantial storms are imminent. The functionality of the floodplain on Wallops Island, provided both by the wetlands on the island and the area of the island itself, is not substantially reduced due to the presence of existing or proposed facilities because the footprint of the facilities does not cover a substantial area of the island.

Transportation, Handling, and Storage of Materials

Flood control measures for handling and storage of hazardous wastes and materials includes location of the substances above the flood level (approximately 3.4 meters [11 feet] amsl), and moving hazardous wastes and materials outside of the floodplain when substantial storms are imminent.

Launch Activities

There would be no impacts on the floodplain as a result of launch activities.

Alternative Two

Under Alternative Two, the types of impacts to floodplains would be the same as those described for Alternative One; however, fewer site improvements would result in lesser impacts to the floodplain.

4.2.2.4 Coastal Zone Management

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to the coastal zone.

Alternative One

All activities under Alternative One occur within Virginia's CMA as designated by Virginia's CZM Program. As the lead Federal agency for this project, NASA has determined that expansion of launch support facilities under Alternative One is consistent with the enforceable policies of the CZM Program. In a letter dated June 18, 2009, VDEQ concurred that the project is consistent with Virginia's CZM Program.

Alternative Two

Due to the lower level of activities under Alternative Two, this alternative would also be consistent with Virginia's CZM Program.

4.2.2.5 Stormwater

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to stormwater.

Alternative One

Site Improvements

Under Alternative One, construction activities would result in changes to stormwater conveyance due to minor disruptions of the natural drainage. NASA and MARS would obtain VSMP construction site stormwater permits and implement site-specific SWPPPs to minimize impacts to stormwater conveyance and stormwater quality during construction.

Up to approximately 4 hectares (10 acres) of new impervious area would be added to the existing 174.5 hectares (431.1 acres) of impervious surfaces on Wallops Island due to construction of buildings, roads, and expansion of the launch complex. These improvements would represent approximately a 2 percent increase from existing conditions.

To mitigate effects on stormwater runoff due to increased impervious surfaces, permanent stormwater control measures including retention basins, vegetated swales, and buffer strips would be constructed in compliance with the VSMP regulations to provide adequate drainage for the new building sites, and to mitigate the effects of increased runoff from impervious surfaces. Wetlands would not be used for primary stormwater retention or treatment. VSMP regulations require the incorporation of measures to protect aquatic resources from the effects of increased volume, frequency, and peak rate of stormwater runoff, and from increased nonpoint source pollution carried by stormwater runoff.

NASA would modify its existing VPDES industrial stormwater permit and update its SWPPP to include all activities under Alternative One that would generate regulated discharges. The SWPPP would identify all stormwater discharges at each facility, actual and potential sources of stormwater contamination, and would require the implementation of both structural and nonstructural best management practices to reduce the impact of stormwater runoff on the receiving stream to the maximum extent practicable, and to meet water quality standards.

With adherence to VSMP construction and industrial stormwater permit regulations and implementation of best management practices (BMPs), only minor impacts on stormwater would be expected.

Transportation and Handling of Materials

Other potential impacts to stormwater include accidental spills or leaks of pollutants that could be carried from vehicles or equipment via stormwater runoff during construction activities and transportation of materials. NASA and MARS would implement site-specific SWPPPs that would include best management practices for vehicle and equipment fueling and maintenance, and spill prevention and control measures to reduce potential impacts to surface waters during construction. The *Hazardous Materials and Hazardous Waste Management* discussion in Section 4.2.6 of this EA describes the procedures for transportation and handling of hazardous materials.

There is potential for an accidental release of contaminants (from ASTs or during transportation of the ELV, ES, and ELV components) that could be carried into surface waters via stormwater runoff. Any accidental release of contaminants or liquid fuels would be addressed in accordance with the WFF ICP.

Launch Activities

ELV exhaust products could interact with stormwater to form carbonic acid, a weak acid commonly found in rain water. Stormwater could transport the carbonic acid into nearby surface waters including the tidal wetlands, approximately 125 meters (400 feet) west of Pad 0-A. Due to the natural buffering capacity of wetlands, effects from carbonic acid would be negligible. Also, the proposed launch complex stormwater control structures would contain nearly all pad runoff.

Alternative Two

Under Alternative Two, transportation, handling, and storage of materials would result in the same types of impacts as under Alternative One, but with less potential for a spill because fewer ELVs would be launched. Site improvement activities would result in different impacts than Alternative One and are described below.

Site Improvements

Under Alternative Two, construction activities would result in permanent changes to stormwater conveyance due to disruptions of the natural drainage. NASA and MARS would obtain VSMP construction site stormwater permits and implement site-specific SWPPPs to minimize impacts to stormwater conveyance and stormwater quality during construction.

Up to approximately 2.5 hectares (6 acres) of new impervious area would be added to the existing 174.5 hectares (431.1 acres) of impervious surfaces on Wallops Island due to construction of buildings, roads, and expansion of the launch complex. These improvements would represent a 1.5 percent increase from existing conditions.

NASA would modify its existing VPDES industrial stormwater permit and update its SWPPP to include all activities under Alternative Two that would generate regulated discharges. The mitigation and control measures described under Alternative One would also be implemented under Alternative Two. With adherence to VSMP construction and industrial stormwater permit regulations and implementation of BMPs, only temporary minor impacts on stormwater would be expected during construction.

4.2.2.6 Wastewater

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to wastewater.

Alternative One

Site Improvements

Wastewater generated by newly constructed facilities would discharge to existing WFF wastewater collection lines and would be sent to the WFF WWTP for treatment. The estimated volume of domestic wastewater that would be discharged to the WWTP from Alternative One is 10,000 liters (2,700 gallons) per day. The permitted maximum capacity of the wastewater facility is 1,135,625 liters (300,000 gallons) per day. The amount of wastewater that is currently treated is approximately 227,125 liters (60,000 gallons) per day (Bundick, pers. comm.); therefore, the WWTP has the capacity to treat the approximately 4.5 percent increase in wastewater from the new facilities, and Alternative One would not result in an adverse impact to the WWTP or wastewater.

To protect delicate electronic systems, the new facilities may use fire suppression foam instead of water to put out fires. The fire suppression foam could include chemicals that are harmful to aquatic systems and must be diluted prior to being discharged into the wastewater collection lines. Each building that uses a foam fire suppression system would be equipped with an adequate containment area to hold the foam prior to dilution and release to the WWTP.

Transportation, Handling, and Storage of Materials

No impacts to wastewater are anticipated due to transportation, handling, and storage of materials.

Launch Activities

No impacts to wastewater are anticipated due to launch activities.

Alternative Two

Under Alternative Two, transportation, handling, and storage of materials and launch activities would result in the same impacts as under Alternative One. Site improvement activities would result in different impacts than Alternative One and are described below.

Site Improvements

Wastewater generated under Alternative Two would discharge to existing WFF wastewater collection lines and be sent to the WFF WWTP for treatment. The estimated volume of domestic wastewater that would be discharged to the WWTP from Alternative Two is 7,570 liters (2,000 gallons) per day. The amount of wastewater that is currently treated is approximately 227,125 liters (60,000 gallons) per day (Bundick, pers. comm.); therefore, the WWTP has the capacity to treat the approximately 3 percent increase in wastewater from the facility improvements, and Alternative Two would not result in an adverse impact to the WWTP or wastewater.

Impacts and mitigation for fire suppression foam would be the same as those described under Alternative One.

4.2.2.7 Groundwater

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to groundwater.

Alternative One

Site Improvements

Under Alternative One, NASA would provide potable water to the PPF, PFF and HIF for drinking water supply and industrial water use. Using an estimated water usage rate of 95 liters (25 gallons) per person per day within the proposed facilities, and an estimated 125 additional people in those facilities, the estimated potable water demand of Alternative One facilities combined is approximately 367,000 liters (97,000 gallons) per month. The HIF cooling tower would use 1,892,700 liters (500,000 gallons) annually; because the cooling tower would only be in use six months of the year, usage per month would be approximately 315,300 liters (83,300 gallons). In addition to foam fire suppression, the PPF, PFF, and HIF would include water-based fire suppression systems. These systems would require periodic flow testing that would use up to approximately 38,000 liters (10,000 gallons) per testing period. Because the flow testing would be conducted within a one-month period, this quantity would be a maximum monthly withdrawal that would occur only once a year.

To minimize potable water consumption, NASA would encourage water use conservation practices in facility design and operation, such as the use of low-consumption water fixtures, the use of native plants in landscaping that are adapted to the local precipitation levels, and educating employees about water conservation methods.

Transportation, Handling, and Storage of Materials

Transportation, handling, and storage of hazardous materials could result in adverse impacts to groundwater if a spill were to occur that would contaminate groundwater. The RP-1 tank would be located within secondary containment designed to hold at least 110 percent of the tank's maximum volume. To further minimize the potential for groundwater contamination, NASA and MARS would ensure that proper spill prevention, response, cleanup, and training procedures contained in the WFF ICP are implemented. Emergency response and cleanup procedures contained in the ICP would reduce the magnitude and duration of any impacts.

Launch Activities

RP-1 fueling activities would be expected to last no more than 1 hour. If an accidental release of RP-1 during ELV fueling at Pad 0-A were to occur, the impact would likely be minor and localized as the majority of the launch complex would be concrete and personnel performing fueling would be trained in the emergency response and cleanup procedures specified in the WFF ICP. Spill response equipment would be stored nearby for immediate access during an accidental release.

ELV testing and launches would require the use of deluge water (sound and vibration suppression water spray) that would be injected into the rocket exhaust plume and flame trench and sprayed on the pad deck. NASA's existing potable water system would provide water for the 946,350-liter (250,000-gallon) elevated storage tank proposed at Pad 0-A. The amount of water used during each of the six proposed launches would be 662,500 (175,000 gallons), equaling a total water usage of 3,974,700 liters (1,050,000 gallons) per year.

Each static fire test would utilize the entire deluge water tank capacity, as well as up to an additional 378,500 liters (100,000 gallons) for a maximum water usage of 1,325,000 liters (350,000 gallons) during a static fire test. No more than one static fire test would occur in a one-month period. Prior to the test, temporary water tanks would be placed adjacent to Pad 0-A. During the test, water from the temporary tanks would be pumped into the rocket exhaust plume and flame trench. Any deluge water not vaporized by the ELV-generated heat would be collected in the retention basin and may be recirculated until completion of the launch or test.

Adding the groundwater usage for the deluge system during six launches and two static fire tests would result in 6,624,500 liters (1,750,000 gallons) of water use annually. Because static fire testing requires more water use than a launch, and given that only one static fire or one launch could occur in any calendar month, a monthly maximum water usage of 1,325,000 liters (350,000 gallons) at Pad 0-A is anticipated.

Combined Groundwater Withdrawal

NASA's groundwater withdrawal permit, issued by VDEQ for Wallops Island and Wallops Mainland, allows WFF to withdraw up to 6,813,741 liters (1,800,000 gallons) per month and 50,345,980 liters (13,300,000 gallons) per year from its wells in the middle Yorktown-Eastover aquifer. WFF has withdrawn an average of approximately 34,573,680 liters (9,133,400 gallons) per year during calendar years 2006–2008, with a monthly withdrawal of 2,881,000 liters (761,100 gallons) during this same time (Bundick, pers. comm.). Table 22 below shows the combined water demand of the existing WFF uses at Wallops Island and Wallops Mainland for Alternative One. Although the implementation of Alternative One would increase the system's annual water use, it would not result in a substantial impact on groundwater resources because withdrawal amounts would be within limits set by NASA's existing VDEQ-issued groundwater withdrawal permit.

Table 22: Groundwater Withdrawal Rates under Alternative One

Activity	Usage Rate per Month Liters (Gallons)	Usage Rate per Year Liters (Gallons)
Potable Use in Facilities	682,500 (180,300)	6,298,900 (1,664,000)
Fire Flow Testing	37,900 (10,000)	37,900 (10,000)
Static Fire Testing	1,325,000 (350,000)	2,649,800 (700,000)
Launch	0[1]	3,974,700 (1,050,000)
Alternative One Total	**2,045,400 (540,300)**	**12,961,300 (3,4924,000)**
Existing Wallops Island and Wallops Mainland Combined Usage	2,881,000 (761,100)	34,573,680 (9,133,400)
Alternative One Added to Existing Usage	4,926,400 (1,301,400)	47,534,980 (12,557,400)
Existing Permit Limits[2]	6,813,740 (1,800,000)	50,345,980 (13,300,000)

[1]Because a launch and a static fire test would not both take place within the same month, the higher of the two water use volumes (static fire test) was used to calculate a monthly total.
[2]Wallops Island and Wallops Mainland VDEQ Permit.

Alternative Two

Under Alternative Two, transportation, handling, and storage of materials and launch activities would result in the same impacts as under Alternative One. Site improvement and launch activities would result in different impacts than Alternative One and are described below.

Site Improvements

Under Alternative Two, NASA would provide potable water to the Building V-45 addition for drinking water supply and industrial water use, and water use at existing facilities would increase as a result of additional launch support staff and increased industrial use. Using an estimated water usage rate of 95 liters (25 gallons) per person q1`` per day within the proposed facilities, and an estimated 80 additional people in those facilities, the estimated potable water demand of Alternative Two facilities combined is approximately 237,000 liters (62,500 gallons) per month. In addition to foam fire suppression, the high bay addition to Building V-45 would include water-based fire suppression systems. These systems would require periodic flow testing that would use up to approximately 38,000 liters (10,000 gallons) per testing period. Because the flow testing would be conducted within a one-month period, this quantity would be a maximum monthly withdrawal that would occur only once a year.

To minimize potable water consumption, NASA would encourage water use conservation practices in facility design and operation, such as installing low-consumption water fixtures, planting native plants in landscaping that are adapted to the local precipitation levels, and educating employees about water conservation methods.

Launch Activities

Launch activities could potentially affect groundwater if fuels leach into the aquifer after an accidental release of RP-1 during ELV fueling at Pad 0-A. The impact would likely be minor and localized because the majority of the launch complex would be concrete, and personnel performing fueling would be trained in the emergency response and cleanup procedures specified in the WFF ICP.

The static fire test water usage described under Alternative One would be the same under Alternative Two. Adding the groundwater usage during three launches and two static fire tests would result in 4,637,129 liters (1,225,000 gallons) of water use annually. Because static fire testing requires more water use than a launch, and given that only one static fire or one launch could occur in any calendar month, a monthly maximum water usage of 1,325,000 liters (350,000 gallons) at Pad 0-A is anticipated.

Combined Groundwater Withdrawal

NASA's groundwater withdrawal permit, issued by VDEQ for Wallops Island and Wallops Mainland, allows WFF to withdraw up to 6,813,741 liters (1,800,000 gallons) per month and 50,345,980 liters (13,300,000 gallons) per year from the Yorktown-Eastover Multiaquifer System. WFF has withdrawn an average of approximately 34,573,680 liters (9,133,400 gallons) per year during calendar years 2006–2008, with an average monthly withdrawal of 2,881,077 liters (761,100 gallons) during this same time (Bundick, pers. comm.). Table 23 below shows the combined water demand of the existing WFF uses at Wallops Island and Wallops Mainland for Alternative Two. Although the implementation of Alternative Two would increase the system's annual water use, it would not result in a substantial impact on groundwater resources because withdrawal amounts would be within limits set by NASA's existing VDEQ-issued groundwater withdrawal permit.

Table 23: Groundwater Withdrawal Rates under Alternative Two

Activity	Usage Rate per Month Liters (Gallons)	Usage Rate per Year Liters (Gallons)
Potable Use in Facilities	236,600 (62,500)	2,839,100 (750,000)
Fire Flow Testing	37,900 (10,000)	37,900 (10,000)
Static Fire Testing	1,325,000 (350,000)	2,649,800 (700,000)
Launch	0[1]	1,987,300 (525,000)
Alternative Two	**3,113,500 (422,500)**	**7,514,100 (1,985,000)**
Existing Wallops Island and Wallops Mainland Combined Usage	2,881,100 (761,100)	34,573,700 (9,133,400)
Alternative Two Added to Existing Usage	5,994,600(1,583,600)	42,087,800 (11,118,400)
Existing Permit Limits[2]	6,813,740 (1,800,000)	50,345,980 (13,300,000)

[1]Because a launch and a static fire test would not both take place within the same month, the higher of the two water use volumes (static fire test) was used to calculate a monthly total.
[2]Wallops Island and Wallops Mainland VDEQ Permit.

4.2.3 Air Quality

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to air quality.

Alternative One

Site Improvements

Construction activities would generate fugitive dust from clearing, trenching, backfilling, grading, and traffic on paved and unpaved areas, as well as combustion emissions from construction equipment. The internal combustion engines powering most of the construction equipment and vehicles would burn diesel fuel and the remaining vehicles would burn gasoline. Equipment that would be used for the construction activities is anticipated to include earthmoving equipment, pickup trucks, and compressors. To minimize impacts during construction, site-specific dust suppression methods would be implemented to minimize windblown and vehicular-borne fugitive dust generated from the construction site areas (e.g., daily watering of disturbed surfaces and soil stockpiles, covering stockpiles, implementing track-out controls). Construction-related impacts are expected to be short-term and limited to the duration and area of the construction activities.

The criteria pollutant emissions from the construction phase were estimated using the modeling tool developed for the U.S. Air Force, called Air Conformity Applicability Model (ACAM), version 4.3.3 (Air Force Center for Environmental Excellence, 2005). The emissions summary is annotated in Table 24 and raw data with assumptions are provided in Appendix E.

Table 24: Emissions from Proposed Construction Activities in Metric Tonnes per Year (Tons per Year)

Year	CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$
2009	1.67 (1.84)	4.19 (4.62)	0.51 (0.58)	0.45 (0.50)	18.00 (19.85)	0.00 (0.00)
2010	22.56 (24.87)	5.17 (5.70)	0.64 (0.70)	0.58 (0.64)	0.42 (0.46)	0.00 (0.00)
2011[1]	0.049 (0.054)	0.085 (0.094)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
2012	2.4 (2.64)	5.75 (6.34)	0.70 (0.77)	0.52 (0.58)	4.76 (5.25)	0.00 (0.00)
TOTAL (2009–2012)	26.68 (29.41)	15.2 (16.78)	1.85 (2.05)	1.56 1.73)	23.18 (25.56)	0.00 (0.00)

[1] No construction is planned in 2011

Stationary Source Operational Phase Activities

Stationary sources that may be installed and used during the operational phase of Alternative One to support launches are the following:

- Two diesel fuel-fired internal combustion engines used as emergency generators
- Two Number 2 oil-fired external combustion units (e.g., domestic hot water heaters, space heaters, boilers)

- One propane-fired boiler

Criteria emissions for the stationary sources' first year of operation were calculated using emission factors from EPA's AP-42, as well as estimating the annual throughput for the boilers and annual operating hours for the generators. The emissions summary is annotated in Table 25 and raw data with assumptions are provided in Appendix E.

Table 25: Emissions from Stationary Source Operational Activities in Metric Tonnes per Year (Tons per Year)

Year	Source	CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$
2013[1]	Boilers	0.17 (0.19)	0.58 (0.64)	0.020 (0.022)	0.017 (0.019)	0.07 (0.08)	0.012 (0.013)
2013	Emergency Generators	0.82 (0.90)	3.70 (4.08)	0.006 (0.007)	0.10 (0.11)	0.01 (0.02)	0.0045 (0.005)
2013 Total		0.99 (0.109)	4.28 (4.72)	0.026 (0.029)	0.117 (0.129)	0.08 (0.09)	0.017 (0.018)

[1]Years 2009 through 2012 were not included in the stationary source emissions because the facilities would not be operational until 2013.

The emissions estimated from the construction activities and proposed stationary sources are small, therefore impacts to the environment would not be substantial.

Transportation, Handling, and Storage of Materials

Under Alternative One, during the loading operation, all propellant liquid and vapors would be contained; any propellant vapors left in the loading system would be routed to air emission scrubbers. Liquid propellant left in the loading system would be drained back to supply tanks or into dedicated waste tanks for treatment prior to disposal.

Based on current operations for other launches at WFF, emissions of VOCs would result from pre-launch activities in preparation of the launch vehicle and payloads. Although specific consumption rates and processing materials have not yet been identified specific to the Taurus II, information does exist for the Atlas V 500 launch vehicle. Material consumption data for the Atlas V 500 were used to derive consumption rates based on the surface area of the spacecraft and the payload. The surface area of the Atlas V 500 complete with the Centaur upper stage and payload fairing is approximately 3,530 square meters (38,000 square feet). The surface area of the Taurus II with payload fairing is approximately 3,620 square meters (38,960 square feet). Therefore, for the purpose of this analysis, the surface area of the two vehicles is essentially equivalent. Emissions of VOCs resulting from pre-launch preparation of the Taurus II would be similar to the Atlas V 500. Emissions from pre-launch activities are presented in Table 26.

Based on a launch schedule of six launches per year, approximately 6.4 metric tonnes (7 tons) of VOCs would be emitted. Although no information is currently available as to the HAP content of the various materials likely to be used, HAP emissions are expected to be low since many products have been reformulated to eliminate or reduce the HAP content. NASA and MARS personnel would utilize good operating practices to reduce evaporative losses of VOCs and HAPs during pre-launch preparation. Therefore minimal impact to the environment is anticipated.

Table 26: Quantification of VOCs from a Typical Taurus II Launch Preparation

Materials[1,2]	Usage per Launch	Density (lbs per gallon)	VOC Content (percent by weight)	Percent Emitted	VOC Emissions per Launch (kg [lbs])
Petroleum, Oils, Lubricants (POL)					
POL	2,177 kg (4,800 lbs)	Varies	Negligible	0.00%	0.00
Coatings					
VOC-based primers, topcoats, coatings	145 kg (320 lbs)	10.00	56.00%	100.00%	81.3 (179.20)
Non-VOC-based primers, topcoats, coatings	86 kg (190 lbs)	10.00	13.00%	100.00%	11.2 (24.70)
Solvents, Cleaners					
VOC-based solvents, cleaners	623 kg (1,382 lbs)	N/A	100.00%	100.00%	626.9 (1,382.0)
Non-VOC-based solvents, cleaners	432 kg (952 lbs)	N/A	0.00%	100.00%	0.00
Corrosives					
Corrosives	2,495 kg (5,500 lbs)	N/A	0.00%	100.00%	0.00
Adhesives, Sealants					
Adhesives, Sealants	1,036 kg (2,284 lbs)	N/A	25.00%	100.00%	259.0 (571.00)
Other					
Silicone RTV-88[3]	45.5 liters (12 gallons)	0.00	0.00%	100.00%	0.00
Electric insulating enamel	0.01 kg (0.22 lbs)	N/A	50.00%	100.00%	0.05 (0.11)
Acrylic primer	6 gallons	6.60	N/A	100.00%	18.0 (39.60)
Conductive paint	22. liters (12 gallons)	5.60	N/A	100.00%	30.5 (67.20)
Chemical conversion coating	0.30 kg (0.66 lbs)	N/A	50.00%	100.00%	0.15 (0.33)
Cork-filled potting compound	5.7 liters (1.5 gallons)	4.40	N/A	100.00%	3.0 (6.60)
Epoxy adhesive	5.7 liters (1.5 gallons)	4.40	N/A	100.00%	3.0 (6.60)
TOTAL		-	-		**1,035.20 (2,282.23)**
TOTAL Metric tonnes (tons) per year					**1.03 (1.14)**

Sources:

[1]Material quantities associated with an Atlas V 500 using five SRMs.

[2]All product data from FAA, 2001 (except where otherwise noted).

[3]Product VOC content based on MSDS (General Electric Corporation, 2001).

Launch Activities

Under Alternative One, WFF proposes to conduct up to two static firing test per year and up to six launches of suborbital and orbital class ELVs from Pad 0-A. Two scenarios, which include static test firing and launch, were evaluated to determine the impact of emissions on ambient air quality.

Rocket Exhaust Effluent Dispersion Model Results

The Rocket Exhaust Effluent Dispersion Model (REEDM) Version 7.13 was used to determine the ambient air impacts from static test firing and launching of Taurus II from Pad 0-A (USAF, 1999). A brief introduction on REEDM is provided in Appendix F. REEDM modeling analyses for 6,432 meteorological cases between 2000 and 2008 were conducted based on actual WFF weather balloon measurements.

The impacts of Stage I firing were considered to assess the impact resulting from launch activities; by the time Stages II and III are ignited, the altitude at which the exhaust from those stages is emitted (approximately 185 kilometers [115 miles]) is well above the Earth's atmosphere.

In the REEDM normal launch scenario, a fully configured launch vehicle with payload is ignited on the launch pad. The vehicle is held on the pad for approximately 2 seconds as the first stage engines build thrust. The hold-downs are then released, allowing the vehicle to begin its ascent to orbit. During ascent the vehicle velocity steadily increases, resulting in a time and altitude varying exhaust product emission rate. Initially the rocket engine exhaust is largely directed into and through the flame duct. As the vehicle lifts off from the pad and clears the launch tower, a portion of the exhaust plume impinges on the pad structure and is directed radially around the launch pad stand. The portion of the rocket plume that interacts with the launch pad and flame trench is referred to as the "ground cloud." As the vehicle climbs to an altitude several hundred feet above the pad, the rocket plume reaches a point where the gases no longer interact with the ground surface. The exhaust plume at that point is referred to as the "contrail cloud." Similar to static test firing, CO, CO_2, and H_2O are the primary exhaust products emitted during the Stage I flight. Emissions of CO from the proposed six Taurus II launches are approximately 374 metric tonnes per year (412 tons per year) (Nyman, pers. comm.). Only about 20 percent (74 tonnes per year [82 tons per year]) of these emissions would be released in the lower atmosphere (below 3,048 meters [10,000 feet]) (Nyman, pers. comm.).

As shown in Table 27 below, the maximum peak concentration for CO for a day or nighttime meteorology was 7.9 ppm at 7,000 meters (23,000 feet) from Pad 0-A. Similarly, the maximum 1-hour Time Weighted Average (TWA) concentration predicted by REEDM for a day or nighttime meteorology was 0.60 ppm at 7,000 meters (23,000 feet) from Pad 0-A. These are low concentrations that would have minimal or no impact on the population outside WFF property boundaries. The values predicted by the model are significantly below acute exposure guideline levels (AEGL-2 levels) and would occur for a very short duration. Appendix G contains detailed modeling results.

Table 27: Taurus II Normal Launch Predicted CO Ceiling and TWA Concentration Summary

Month	Daytime or Nighttime Meteorology	Peak Ceiling Concentration [ppm]	Distance to Peak Ceiling Concentration [meters (feet)]	Peak TWA Concentration [ppm]	Distance to Peak TWA Concentration [meters (feet)]
May	Daytime	7.9	7,000 (23,000)	--	--
May	Daytime	--	--	0.34	11,000 (36,000)
April	Nighttime	6.3	9,000 (30,000)	--	--
September	Nighttime	--	--	0.30	12,000 (40,000)

Source: NASA, 2009

Static Fire Testing

Static fire testing of the Taurus II first stage would be conducted while the ELV is held stationary on the launch pad. In this scenario the two first stage engines are both ignited and are run through a 52-second thrust profile that ramps the engines up to full performance (112.9 percent) and back down. Exhaust from the rocket engine nozzles is directed downward into a flame trench and deflected through the flame duct so that the exhaust gases are diverted away from the launch vehicle and near by facilities. The exhaust plume exits the flame duct at supersonic velocity and its flow is approximately parallel to the ground and slightly above the ground.

Taurus II Stage I propellants consist of RP-1 and LOX as the oxidizer. The major constituents of combustion products resulting from static test firing of RP-1 and LOX are CO, CO_2, and H_2O. CO is the primary pollutant of concern as elevated concentrations can have serious health effects and it is regulated under the CAA. Emissions of CO from a single static fire test event per year would be approximately 14.4 tonnes (15.9 tons) (Nyman, 2009), and emissions if two tests were conducted would be 28.8 tonnes (31.8 tons).

As shown in Table 28 below, the maximum peak concentration for CO for a day or nighttime meteorology would be 18.9 ppm at 6,000 meters (20,000 feet) from Pad 0-A. Similarly, the maximum 1-hour TWA concentration predicted by REEDM for a day or nighttime meteorology is 0.30 ppm at 12,000 meters (40,000 feet) from Pad 0-A. These are low concentrations and would have minimal or no impact on the population outside WFF property boundaries. AEGL-2 concentration for a 1-hour exposure is 83 ppm for CO. This means that anyone who breathes CO at 83 ppm or above may experience irreversible or long-term damage. The values predicted by the model are significantly below AEGL-2 levels and would last for a very small duration. The AEGL-1 concentration for CO has not been determined and the AEGL-3 concentration for a 1-hour exposure is 330 ppm for CO. See Appendix G for a detailed explanation on AEGLs and detailed report on model runs.

Table 28: Taurus II Static Fire Testing Predicted CO Ceiling and TWA Concentration Summary

Month	Daytime or Nighttime Meteorology	Peak Ceiling Concentration [ppm]	Distance to Peak Ceiling Concentration [meters (feet)]	Peak TWA Concentration [ppm]	Distance to Peak TWA Concentration [meters (feet)]
February	Daytime	--	--	0.27	8,000 (26,000)
March	Daytime	18.9	6,000 (20,000)	--	--
April	Nighttime	13.7	5,000 (16,000)	--	--
September	Nighttime	--	--	0.30	12,000 (40,000)

Source: NASA, 2009

According to the final report summarizing the REEDM analysis for this EA, the far field CO concentration levels predicted for launching and static test firing the Taurus II ELV would be well below the published emergency exposure guidelines for humans and are considered to be benign to people, flora, and fauna (NASA, 2009). Near-field CO concentrations (in the vicinity of Pad 0-A) may reach hazardous levels that exceed the AEGL-3 10-minute exposure threshold or the Immediately Dangerous to Life and Heath exposure threshold. Given the proximity of the near-field exposed region to the exhaust plume, other hazards, such as radiant heat transfer or direct exposure to the high temperature exhaust gas mixture, may be more severe than the hazard from CO exposure.

Alternative Two

Because the analysis of launch activities was conducted for a single launch event and a single static fire test event, the modeling and emissions data are the same as described for Alternative One. Under Alternative Two, site improvements and transportation, handling, and storage of materials would result in different impacts than Alternative One and are described below.

Site Improvements

Construction activities would generate fugitive dust from clearing, trenching, backfilling, grading, and traffic on paved and unpaved areas, as well as combustion emissions from construction equipment. The internal combustion engines powering most of the construction equipment and vehicles would burn diesel fuel, and the remaining vehicles would burn gasoline. Equipment that would be used for the construction activities is anticipated to include earthmoving equipment, pickup trucks, and compressors. To minimize impacts during construction, site-specific dust suppression methods would be implemented to minimize windblown and vehicular-borne fugitive dust generated from the construction site areas (e.g., daily watering of disturbed surfaces and soil stockpiles, covering stockpiles, and implementing track-out controls). Construction-related impacts are expected to be short-term and limited to the duration and area of the construction activities.

The criteria pollutant emissions were estimated using the ACAM model with the No Action Alternative as the baseline for comparison of air quality impacts. The emissions summary for Alternative Two is shown in Table 29.

Table 29: Emissions from Proposed Construction Activities in Metric Tonnes per Year (Tons per Year)

Year	CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$
2009	0.47 (0.52)	1.29 (1.42)	0.15 (0.17)	0.15 (0.16)	13.73 (15.14)	0.00 (0.00)
2010	1.58 (1.74)	3.86 (4.25)	0.46 (0.51)	0.46 (0.51)	0.30 (0.33)	0.00 (0.00)
2011[1]	0.11 (0.12)	0.62 (0.68)	0.02 (0.02)	0.01 (0.01)	0.02 (0.02)	0.01 (0.01)
TOTAL (2009–2011)	2.17 (2.39)	5.82 (6.42)	0.63 (0.70)	0.62 (0.68)	14.05 (15.49)	0.00 (0.00)

[1] No construction is planned for 2011

Stationary Source Operational Phase Activities

Stationary sources that may be installed and used during the operational phase of Alternative Two to support launches are the following:

- One diesel fuel-fired internal combustion engine used as an emergency generator
- One Number 2 oil-fired external combustion unit (e.g., domestic hot water heater, space heater, or boiler)

Emissions from the Building V-45 addition were calculated for the stationary sources' first year of operation and are shown in Table 30. Raw data with assumptions are provided in Appendix E.

Table 30: Emissions from Stationary Source Operational Activities in Metric Tonnes per Year (Tons per Year)

Year	Source	CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$
2011[1]	Boilers	0.08 (0.09)	0.34 (0.38)	0.02 (0.02)	0.0027 (0.003)	0.03 (0.04)	0.00 (0.00)
	Emergency Generators	0.32 (0.35)	1.52 (1.60)	<0.001 (<0.001)	0.04 (0.04)	0.05 (0.05)	0.00 (0.00)
2011 Total		0.40 (0.44)	1.86 (2.06)	0.02 (0.02)	0.043 (0.043)	0.08 (0.09)	0.00 (0.00)

[1]Years 2009 and 2010 were not included in the stationary source emissions because the facilities would not be operational until 2011.

The emissions estimated from the construction activities and proposed stationary sources are small, therefore impacts to the environment would not be substantial.

Transportation, Handling, and Storage of Materials

During the loading operation, all propellant liquid and vapors would be contained; any propellant vapors left in the loading system would be routed to air emission scrubbers. Liquid propellant left in the loading system would be drained back to supply tanks or into dedicated waste tanks for treatment prior to disposal.

Based on current operations for other launches at WFF, emissions of VOCs would result from pre-launch activities in preparation of the launch vehicle and payloads. Although specific consumption rates and processing materials have not yet been identified specific to the Taurus II, information does exist for the Atlas V 500 launch vehicle. Material consumption data for the Atlas V 500 were used to derive consumption rates based on the surface area of the spacecraft and the payload. The surface area of the Atlas V 500 complete with the Centaur upper stage and payload fairing is approximately 3,530 square meters (38,000 square feet). The surface area of the Taurus II with payload fairing is approximately 3,620 square meters (38,960 square feet). Therefore, for the purpose of this analysis, the surface area of the two vehicles is essentially equivalent. Emissions of VOCs resulting from pre-launch preparation of the Taurus II would be similar to the Atlas V 500. Emissions from pre-launch activities are presented in Table 26.

Based on a launch schedule of three launches per year, approximately 3.2 metric tonnes (3.5 tons) of VOCs would be emitted. Although no information is currently available as to the HAP content of the various materials likely to be used, HAP emissions are expected to be low since many products have been reformulated to eliminate or reduce HAP content. NASA and MARS personnel would utilize good operating practices to reduce evaporative losses of VOCs and HAPs during pre-launch preparation. Therefore minimal impact to the environment is anticipated.

Launch Activities

Based on the REEDM model results for a single launch, emissions of CO from three Taurus II launches are approximately 187 metric tonnes per year (206 tons per year) (Nyman, pers. comm.). Only about 20 percent (37 tonnes per year [41 tons per year]) of these emissions would be released in the lower atmosphere (below 3,000 meters [10,000 feet]) (Nyman, pers. comm.). Emissions for static fire testing would be the same as Alternative One.

4.2.3.1 Halon

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no impacts from halon.

Alternative One

Site Improvements

Halon would not be used during site improvements.

Transportation, Handling, and Storage of Materials

Halon would arrive at WFF enclosed within the Stage I of the Taurus II ELV; therefore, direct transportation, handling, and storage of halon would not occur. However, per the EPA regulation (40 CFR 82.270[c]) that requires trained technicians who test, maintain, service, repair, or dispose of halon-containing equipment, MARS would ensure that such technicians are trained and familiar with halon to ensure minimal loss of halon to the atmosphere. The ELV manufacturer would limit the supply of halon to recycled (non-virgin) sources only. MARS would ensure that any recovered halon is disposed of properly and all appropriate records would be maintained for a minimum of 3 years. With implementation of training and adherence to the EPA regulations regarding the transportation, handling, storage, and disposal of halon, the use of Halon-1301 under Alternative One would not result in substantial impacts on human health or the atmosphere.

Launch Activities

Approximately 20 kg (40 lbs) of Halon-1301 would be onboard the Taurus II within Stage 1 for use as a fire suppressant, all of which would be vented to the atmosphere in the aft bay of the ELV during a brief period beginning a few seconds immediately before main engine ignition. The maximum amount of Halon-1301 that would be released to the atmosphere by six Taurus II launches at Wallops Island would be approximately 120 kg (265 lbs) annually. Many studies have been conducted on the cumulative environmental effects of launches worldwide. The American Institute for Aeronautics and Astronautics (AIAA) convened a workshop (AIAA, 1991) to identify and quantify the key environmental issues that relate to the effects on the atmosphere from launches. The conclusion of the workshop, based on evaluation of scientific studies performed in the United States, Europe, and Russia, was that the effects of launch vehicle propulsion exhaust emissions on stratospheric ozone depletion, acid rain, toxicity, air quality, and global warming were extremely small compared to other human activities (such as the burning of coal, oil, and natural gas, as well as deforestation and various agricultural and industrial practices) (AIAA, 1991; FAA, 2001).

Alternative Two

Under Alternative Two, the types of impacts from site improvements and transportation, handling, and storage of materials would be the same as under Alternative One; however, there would be less handling and storage of Halon 1301 due to fewer launches than Alternative One. Impacts from launch activities would be different from Alternative One and are discussed below.

Launch Activities

Approximately 20 kg (40 lbs) of Halon-1301 would be onboard the Taurus II within Stage 1 for use as a fire suppressant, all of which would be vented to the atmosphere in the aft bay of the ELV during a brief period beginning a few seconds immediately before main engine ignition. The maximum amount of Halon-1301 that would be released to the atmosphere by three Taurus II launches at Wallops Island would be approximately 60 kg (132.5 lbs) annually.

4.2.3.2 Climate Change

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no increase in GHG emissions.

Alternative One

Site Improvements

Emissions associated with construction equipment and commuting by construction workers using privately-owned vehicles would be transient and short-term; therefore, they were not quantified.

Stationary Source Operational Phase Activities

GHG emissions were calculated based on the same stationary sources that are anticipated to be installed and operated during the operational phase of Alternative One. CO_2 emissions from this alternative represent a 4 percent increase from the baseline CO_2 emissions from stationary sources. Emissions are summarized in Table 31 and raw data with assumptions are provided in Appendix E.

Table 31: Alternative One Greenhouse Gas Emissions for Stationary Source Operational Activities in Metric Tonnes per Year (Tons per Year)

Source	CH_4	CO_2	N_2O
External Combustion Sources	0.0036 (0.004)	362.84 (399.96)	0.0018 (0.002)
Internal Combustion Sources	0.0036 (0.004)	78.11 (86.10)	0.0116 (0.0128)
Total GHG Emissions	0.0072 (0.008)	440.95 (486.06)	0.0134 (0.0148)

Transportation, Handling, and Storage of Materials

Emissions associated with the transportation and handling of materials would be transient and short-term; therefore, they were not quantified. The storage of materials does not produce or emit GHGs directly; however, trace amounts of GHG may potentially be emitted as a result of the type of storage needed (i.e., refrigeration).

Launch Activities

The CO_2 emissions estimated below are based on the Lewis Combustion Model results calculated for the static fire test and for the Stage 1 motor of a normal launch. Supporting documentation is provided in Appendix E.

Table 32 shows the GHG emissions for two static fire tests and six ELV launches. Each static fire test would emit 25 metric tonnes (28 tons) of CO_2. Each normal launch would emit 108 metric tonnes (120 tons) of CO_2. Therefore, six ELV launches will result in 650 metric tonnes (716 tons) of CO_2.

Table 32: Alternative One Greenhouse Gas Emissions for Launch Activities in Metric Tonnes per Year (Tons per Year)

Source	CH_4	CO_2	N_2O
Two Static Fire Tests	0	50 (56)	0
Six ELV Launches	0	650 (716)	0
Total GHG Emissions	0	700 (772)	0

Alternative Two

Site Improvements

Emissions associated with construction equipment and commuting by construction workers using privately-owned vehicles would be transient and short-term; therefore, they were not quantified.

Stationary Source Operational Phase Activities

GHG emissions were calculated based on the same stationary sources that are anticipated to be installed and operated during the operational phase of Alternative Two. CO_2 emissions from this alternative represent a 2 percent increase from the baseline CO_2 emissions from stationary sources. Emissions are summarized in Table 33 and raw data with assumptions are provided in Appendix E.

Table 33: Alternative Two Greenhouse Gas Emissions for Stationary Source Operational Activities in Metric Tonnes per Year (Tons per Year)

Source	CH_4	CO_2	N_2O
External Combustion Sources	0.0017 (0.0019)	181.42 (199.98)	0.0009 (0.001)
Internal Combustion Sources	0.0013 (0.0014)	26.04 (28.70)	0.0036 (0.004)
Total GHG Emissions	0.0030 (0.0033)	207.46 (228.68)	0.0045 (0.005)

Transportation, Handling, and Storage of Materials

Emissions associated with the transportation and handling of materials would be transient and short-term; therefore, they were not quantified. The storage of materials does not produce or emit GHGs directly; however, trace amounts of GHG may potentially be emitted as a result of the type of storage needed (i.e., refrigeration).

Launch Activities

Table 34 shows the GHG emissions for two static fire tests and three ELV launches. Supporting documentation is provided in Appendix E. Each static fire test would emit 25 metric tonnes (28 tons) of CO_2. Each normal launch would emit 108 metric tonnes (120 tons) of CO_2.

Table 34: Alternative Two Greenhouse Gas Emissions for Launch Activities in Metric Tonnes per Year (Tons per Year)

Source	CH_4	CO_2	N_2O
Two Static Fire Tests	0	50 (56)	0
Three ELV Launches	0	325 (358)	0
Total GHG Emissions	0	375 (414)	0

4.2.3.3 Regulatory Analysis

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no changes to regulatory requirements.

Alternative One

The following regulatory requirements were reviewed for applicability to Alternative One:

- NSR/PSD (9 VAC 5-80-1605)
- Minor NSR (9 VAC 5-80-1100)
- Title V Operating Permits (9 VAC 5-80-50)
- NSPS (40 CFR 60)
- NESHAP (40 CFR 61 and 40 CFR 63)

Prevention of Significant Deterioration

Under the NSR regulations, the activities associated with Alternative One would not be subject to the PSD requirements of 9 VAC 5-80-1605. WFF is not defined as a major source under the PSD program and the potential emissions from the proposed stationary sources would be less than the applicable major modification threshold for all criteria pollutants (see Table 35).

Table 35: Potential Emissions for Proposed Stationary Sources (Metric Tonnes per Year [Tons per Year])

Pollutant	Boiler Emissions	Generator Emissions	Kerosene Storage Tank Emissions	Pre-Launch Preparation Emissions	Static Rocket Motor Testing/ Normal Launches[1]	Total Project Stationary Source Emissions[2]	PSD Significant Modificati on Threshold
CO	0.54 (0.60)	1.91 (2.10)	0.00	0.00	88.8 (97.9)	16.87 (18.60)	90.72 (100.00)
NO_X	2. 17 (2.39)	13.15 (14.50)	0.00	0.00	0.00	15.32 (16.89)	36.29 (40.00))
SO_2	0.23 (0.25)	0.18 (0.20)	0.00	0.00	0.00	0.41 (0.45)	36.29 (40.00)
VOC	0.04 (0.04)	0.24 (0.26)	Negligible	12.43 (13.70)	0.00	6.49 (7.15)	36.29 (40.00)
PM_{10}	0.12 (0.13)	0.16 (0.18)	0.00	0.00	0.00	0.28 (0.31)	13.61 (15.00)
$PM_{2.5}$	0.09 (0.10)	0.16 (0.18)	0.00	0.00	0.00	0.25 (0.28)	9.07 (10.00)

[1]14.4 metric tonnes (15.9 tons) for one static fire test and 74 metric tonnes (82.0 tons) from a total of six launches within 10,000 feet of the ground
[2]Emissions do not include mobile sources (i.e., launches) when comparing total emissions to PSD modification thresholds

Minor New Source Review

Prior to installing the proposed diesel-fired emergency generators at the PPF and PFF, NASA and MARS would prepare the necessary permit-to-construct applications with VDEQ. The aggregate kilowatt (kW) rating of the proposed emergency generators is anticipated to exceed the regulatory threshold of 1,125 kW (per 9 VAC 5-80-1320B).

To ensure the new stationary sources associated with Alternative One are accounted for on a facility-wide basis, NASA would modify its State operating permit, which would likely include adjusting its current permit limits for various sources. A modification is any change to the facility or process, including hours of operation, which increases the potential to emit an air pollutant or causes a pollutant to be emitted that was not previously emitted. The emergency generators and boilers, pre-launch activities, and static fire testing would all be included. This permit application modification would be submitted to VDEQ well in advance to enable receipt of the modified permit prior to the implementation of Alternative One. VDEQ is currently reviewing NASA's application under the New Source Review permit process; NASA has not received a determination to date.

Title V Operating Permit

Activities under Alternative One would not require NASA or MARS to be subject to the Title V Operating Permit program, as per 9 VAC 5-80-50, as the emissions from the proposed stationary sources would not increase facility-wide emissions significantly to trigger a Title V permit. The proposed sources can be incorporated into the existing limits for criteria and hazardous air pollutants and the facility could remain a synthetic minor source; however, a modification of the existing limits would be necessary.

New Source Performance Standards

Based on maximum heat input and storage capacity, respectively, none of the external combustion sources or storage vessels would be subject to NSPS. However, the facility would be subject to Subpart IIII of 40 CFR 60 (Standards of Performance for Stationary Compression Ignition Internal Combustion Engines). This standard applies to diesel-fueled stationary compression ignition internal combustion engines of any size that are constructed, modified, or reconstructed after July 11, 2005. The rule requires manufacturers of these engines to meet emission standards based on engine size, model year, and end use. It also requires owners and operators to configure, operate, and maintain the engines according to specifications and instructions provided by the engine manufacturer. The facility would also be subject to the applicable recordkeeping and reporting requirements.

National Emission Standards for Hazardous Air Pollutants

The EPA has issued one NESHAP applicable to stationary internal combustion engines (40 CFR 63, Subpart ZZZZ – Reciprocating Internal Combustion Engines). This subpart became effective on March 18, 2008, and includes requirements to regulate emissions from new and reconstructed stationary reciprocating internal combustion engines (RICE) less than or equal to 370 kW (500 horsepower) at major sources of HAPs and all new and reconstructed stationary RICE at area sources (it does not address existing RICE). Owners and operators of compression ignition stationary engines less than or equal to 370 kW (500 horsepower) at HAP major and area sources that demonstrate compliance with the requirements of the NSPS Subpart III would be considered to be in compliance with Subpart ZZZZ. Owners/operators of these engines at HAP major and area sources can demonstrate compliance with the NESHAP recordkeeping and reporting requirements by meeting those requirements of the appropriate NSPS (Subpart IIII).

Alternative Two

Potential stationary source emissions for the three launches proposed under Alternative Two would be half the amount of emissions for the six launches proposed under Alternative One and would be less than the applicable major modification threshold for all criteria pollutants (see Table 31).Therefore, the regulatory analysis and results for Alternative Two would be the same as for Alternative One.

4.2.4 Noise

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to noise levels.

Alternative One

Site Improvements

Under Alternative One, construction activities have the potential to generate temporary increases in noise levels from heavy equipment operations. Special precautions (such as noise suppression systems for heavy equipment) may be required when construction occurs near occupied facilities at Wallops Island. Noise impacts from the operation of construction equipment are usually limited to a distance of 305 meters (1,000 feet)—no residential areas or other noise-sensitive receptors occur close enough to Wallops Island to be affected by construction-related noise. NASA and MARS would comply with local noise ordinances and State and Federal standards and guidelines for potential impacts to humans caused by construction activities in order to mitigate potential impacts on NASA and MARS personnel.

OSHA limits noise exposure for workers to 115 dB for a period of no longer than 15 minutes in an 8-hour work shift, and to 90 dB for an entire 8-hour shift. Workers near activities producing unsafe noise levels, both during construction and after facilities are operational, would be required to wear hearing protection equipment. Therefore, impacts to the occupational health of construction workers as a result of construction noise are not expected.

Transportation, Handling, and Storage of Materials

Noise sources from transportation of materials include vehicles, airplanes (deliveries to the airport), and barges arriving at the Wallops Island boat dock.

According to a study done at WFF, the highest noise level for traffic near the Main Base during both peak and off-peak periods was 67 dB (NASA, 2003b). Transportation of materials for Alternative One activities is not anticipated to be outside the range of existing noise levels from vehicles, airplanes, and barges at WFF; therefore, no noise-related adverse effects to human health and safety or the environment from transportation of materials are anticipated under Alternative One.

Launch Activities

Taurus II would create loud instantaneous noise that may be heard for several miles from WFF. Impacts from engine noise and sonic booms are discussed below. Launch Pad 0-A is located approximately 4 kilometers (2.5 miles) from the Mainland. The marshland and water surrounding Wallops Island act as a buffer zone for noise generated during rocket launches. The noise levels generated during launches depend principally upon the thrust level of the rocket motors. Rocket noise has been part of the ambient noise levels at WFF for over 50 years.

Engine Noise

Noise levels were predicted by a formula that equates noise to rocket motor thrust (NASA, 1973). The method is commonly used by the WFF Range Safety Office and is conservative as it assumes noise levels to be distributed radially about the source. Calculations were made to estimate noise levels during static fires and launches of the Taurus II at specific distances away from Pad 0-A.

Figure 24 shows the noise levels potentially generated by Taurus II in relation to noise receptors within the area. Ground level noise at various receptors during the launch of Taurus II is listed below:

- 124 dBA at the northern boundary of the piping plover habitat on south Wallops Island, approximately 1.46 kilometers (0.9 mile) from Pad 0-A
- 117 dBA in the community of Assawoman, approximately 3.2 kilometers (2.0 miles) from Pad 0-A
- 107 dBA in the town of Chincoteague, approximately 10.57 kilometers (6.57 miles) from Pad 0-A
- 106 dBA at the Main Base, approximately 12.28 kilometers (7.63 miles) from Pad 0-A

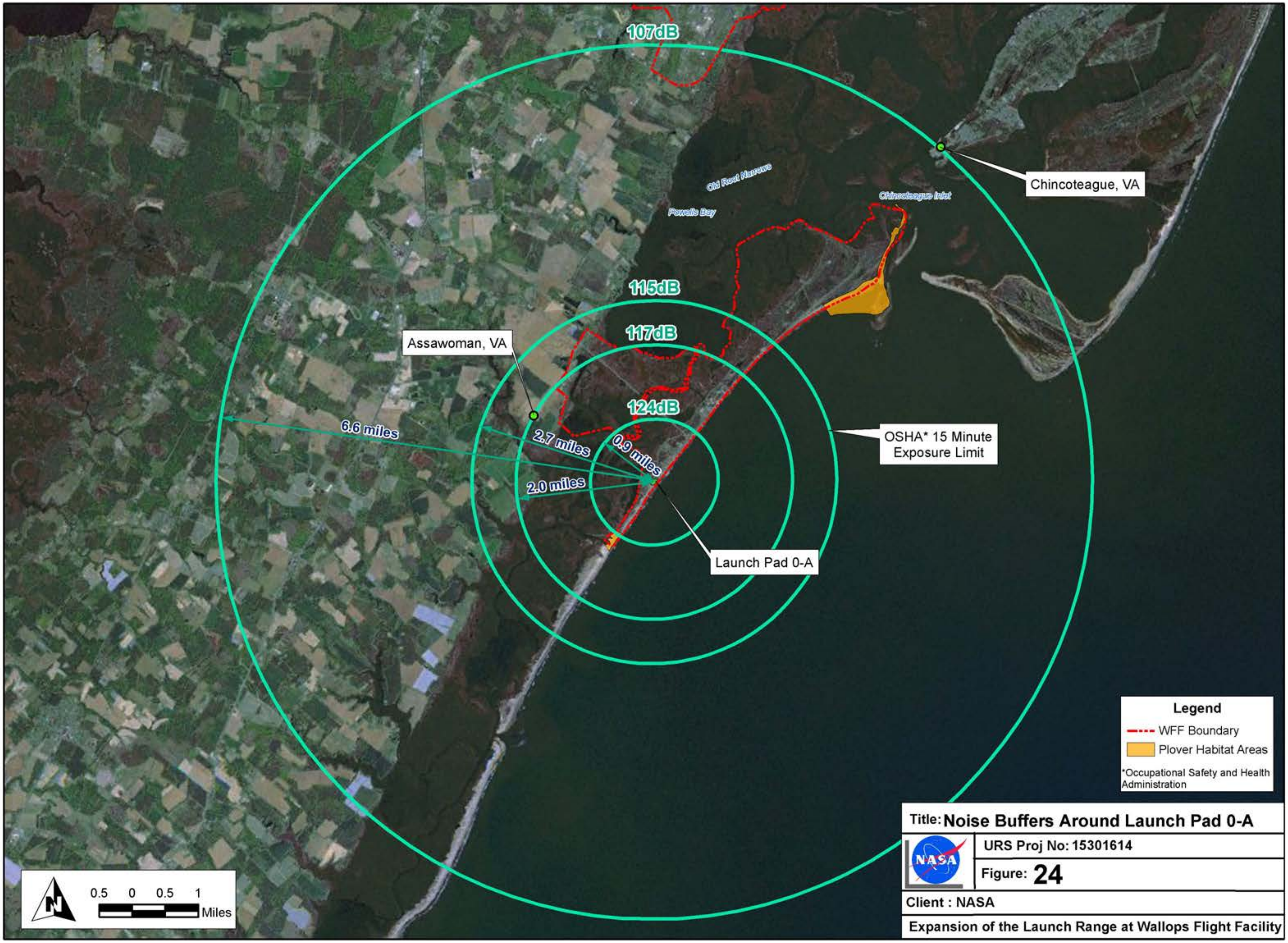
The OSHA level of exposure for worker safety is 115 dBA for 15 minutes and not to exceed 140 dBA peak sound pressure level for impulsive or impact noise (loud, short duration sounds). Noise levels immediately adjacent to the launch pad may reach over 140 dBA for a few seconds. MARS and WFF would be responsible for occupational safety of their personnel, and for determining the need for personal hearing protection for people working near the launch site. Exposure to noise would be minimized by personnel remaining inside a blast-proof building, called a blockhouse, or through the use of personal hearing protection (NASA, 2005). Personnel outside the hazard area may be restricted to their buildings depending on the size of the hazard area.

A noise level of 115 dBA would occur within an approximately 4.3-kilometer (2.7-mile) radius of Pad 0-A during the launch of a Taurus II (Figure 24). The town of Assawoman and some residences and businesses lie within the radius of the 115 dBA noise level. The towns of Atlantic and Chincoteague and the Main Base are outside of this 115 dBA radius, but people in those areas would be able to hear the launch. People within and outside of the 115 dBA radius would not be exposed to noise levels or durations that would exceed OSHA exposure standards during static fire testing or launches because noise at the 115 dBA level would not last for more than a few seconds. Noise levels would exceed the Accomack County regulations for exposure to noise for a few seconds; however, while some observers may find the noise from a static fire or launch to be an annoyance, the noise would be maintained for only 30 to 60 seconds during launches and for up to 52 seconds during static fire testing and would attenuate after 1 to 2 seconds, would be of low frequency, and would occur no more than seven times per year (six launches and two static fire tests). NASA and MARS personnel and the public would be notified in advance of launch dates and times.

The water deluge system at Pad 0-A would reduce the decibel levels of the engine noise during launches by blocking the sound pressure waves. The deluge system would therefore mitigate the sound levels during launches. Based on the above information, Alternative One is not expected to have noise impacts on the surrounding areas in excess of applicable thresholds of significance.

<u>Sonic Booms</u>

Because a sonic boom is not generated until an ELV reaches supersonic speeds some time after launch, the launch site itself would not experience a sonic boom. Therefore, with respect to human health and safety or structural damage, noise impacts due to sonic booms are not expected. Noise impacts on wildlife are discussed in Section 4.3.2.



Title: Noise Buffers Around Launch Pad 0-A

URS Proj No: 15301614

Figure: 24

Client : NASA

Expansion of the Launch Range at Wallops Flight Facility

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Alternative Two

Under Alternative Two, the types of impacts from site improvements and transportation, handling, and storage of materials, would be the same as Alternative One; however, because fewer site improvements would occur compared to Alternative One, less noise would be generated under Alternative Two. Because the noise analysis was conducted for a single launch or static fire event, the noise levels and impacts for Alternative Two are the same as Alternative One. However, there would be less noise from rocket engines due to fewer launches.

4.2.5 Orbital and Reentry Debris

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no change in orbital and reentry debris levels.

Alternative One

Under Alternative One, up to six spacecraft (e.g., ES, Cygnus, or Dragon) would be placed into orbit each year. The stage one motor of the Taurus II would burn out and fall into the open ocean approximately 965 kilometers (600 miles) east of Wallops Island and would not be subject to orbital debris and reentry requirements. Upper stage motors that achieve LEO would be subject to orbital debris and reentry requirements. Upper stages reaching higher orbits would not be subject to reentry, and would contribute to orbital debris.

After being placed into orbit by the rocket’s uppermost stage, the spacecraft would perform their design functions until the end of their respective missions. After inserting the spacecraft into orbit and at the missions’ end, the upper stages and spacecraft, respectively, would be required to follow one of three disposal options discussed below to mitigate the accumulation of orbital debris:

1. Atmospheric Reentry – the spacecraft and/or upper stage would either leave its orbit by uncontrolled reentry caused by natural orbital decay or by a controlled deorbit trajectory. Upper stages would likely reenter by orbital decay as they typically do not contain propulsion systems necessary to execute a controlled reentry.
2. Storage Orbit – the spacecraft and/or upper stage would maneuver to an orbital altitude that would minimize its potential for impacting current or future orbiting spacecraft or missions. As discussed above under atmospheric reentry, upper stages typically do not contain on-board propulsion systems needed to raise their altitude to an appropriate storage orbit, which would be at least 2,000 km (1,240 mi) above the Earth’s surface. As such, this option would only be executed by space structures with a capable on-board propulsion system.
3. Direct Retrieval – the spacecraft and/or upper stage would be collected by another on-orbit mission and disposed of as part of that mission in accordance with applicable orbital debris and reentry requirements. Although not currently exercised by NASA, this option may become available in the future.

During atmospheric reentry, the extreme heat generated while descending through the Earth’s atmosphere would cause the majority of the reentry vehicle to burn up, however in some instances reentry vehicle parts could survive to impact. During a controlled reentry, such debris would land in a predetermined ocean area no closer than 370 kilometers (230 miles) from foreign land masses, 46 kilometers (29 miles) from U.S. territories and the Continental United States, and 46 kilometers (29 miles) from the permanent ice pack of Antarctica.

Both the Cygnus and Dragon spacecraft would enact controlled reentries. After completion of its mission to deliver cargo to the ISS, the Cygnus would return to Earth. The capsule may contain down-cargo from the ISS for return to Earth, and may also carry trash for disposal. The returning Cygnus would reenter the atmosphere on a pre-planned trajectory with most of its contents burning up during the controlled, destructive reentry. Any surviving components would be expected to land in the ocean. After completion of its mission to deliver cargo to the ISS, the Dragon would also reenter the atmosphere on a pre-planned trajectory and land in the ocean but would be recovered by a recovery vessel. The returning capsule would likely contain similar cargo to the Cygnus. The Dragon may or may not be refurbished and re-used.

Uncontrolled reentries are those that cannot be guaranteed to avoid impacting a landmass, and during such an event debris could fall onto land. Such reentries would be subject to additional design considerations (such as limiting the number and size of debris) to adequately ensure public safety. Per NASA policy, under either a controlled or uncontrolled reentry scenario, the potential for human casualty is limited to 1 in 10,000. This casualty threshold was established by NASA in 1995 to limit the risk of world-wide human casualty from a single, uncontrolled reentering space structure. In 1997 and 2001 this risk threshold was endorsed by the U.S. space community by its inclusion in the U.S. Government Orbital Debris Mitigation Standard Practices.

From 1957 through the end of 2008, a total of over 20,500 man-made objects officially cataloged by the U.S. reentered to Earth in either controlled (a small minority) or uncontrolled reentries. In February 2009, NASA reported to the UN COPUOS STSC that 743 man-made objects reentered the atmosphere in 2008. Of these, 730, including 6 spacecraft and 34 launch vehicle stages with a total mass of 80 tonnes (90 tons), reentered in an uncontrolled manner. The annual mass of reentries has varied significantly with changes in the world-wide launch rate and solar activity, reaching a high of 350 tonnes (385 tons) in 1988.

The environmental impact of objects falling into the ocean would depend on the physical properties of the materials (e.g., size, composition, quantity, and solubility) and the marine environment of the impact region. Based on past analyses of other space components, it is expected that the environmental impact of reentry from orbital debris would be negligible (NASA 1996, USAF 1998, NASA 2005b, NASA 2006d). There is a remote possibility that surviving pieces of debris could impact marine life or vessels on or near the ocean surface. Once the pieces travel a few feet below the ocean surface, their velocity would be slowed to the point that the potential for direct impact on sea life would be low (NASA, 2008c). It is anticipated that most components would sink and slowly corrode on the ocean floor. Toxic concentrations of metals would be unlikely because of slow corrosion rates and the large volume of ocean water available for dilution (USAF 1996, NASA 2006d). The potential for long-term environmental impact from the debris on the ocean floor is small (NASA, 2008c). The spacecraft would be constructed mostly of carbon-based composites and aluminum. Propellant in the spacecraft would be expected to vent fully prior to debris impact but trace amounts could remain.

To mitigate potential safety and environmental impacts from orbital debris generation and space structure reentry, all NASA orbital missions originating from WFF would comply with the processes outlined in NPR 8715.6 and NASA-STD 8719.14, both of which establish requirements for (1) limiting the generation of orbital debris, (2) assessing the risk of collision with existing space debris, (3) assessing the potential of space structures to impact the surface of the Earth, and (4) assessing and limiting the risk associated with the end of mission of a space object. This requirement applies to both full spacecraft and jettisoned components, including launch vehicle orbital stages.

Each NASA program and project would be required to submit a debris assessment to the NASA Office of Safety and Mission Assurance. The following categories must be addressed in the debris assessment:

- Debris released during normal operations;
- Debris generated by explosions and intentional breakups;
- Debris generated by on-orbit collisions during mission operations;
- Reliable disposal of spacecraft and launch vehicle orbital stages after mission completion;
- Structural components impacting the Earth following post-mission disposal by atmospheric reentry;
- Disposal of spacecraft and launch vehicle stages in orbits about the Moon; and
- Debris generated by on-orbit collisions with a tether system.

If an orbital debris requirement cannot be met because of an overriding conflict with mission requirements, technical capabilities, or prohibitive cost impact, then a waiver can be requested through the NASA Program Manager per NPR 8715.3, "NASA General Safety Program Requirements," with the orbital debris assessment report containing the appropriate rationale and justification. Waivers to such requirements are highly mission dependent and would be considered on a case-by-case basis

Additionally, orbital missions sponsored or licensed by other Federal agencies (Department of Defense, FCC, and FAA) could be launched from WFF and MARS; such missions would be required to conform to the responsible agency's orbital debris and reentry policies, as appropriate.

Alternative Two

The types of impacts from orbital and reentry debris under Alternative Two would be the same as described under Alternative One; however impacts would be less due to fewer launches.

4.2.6 Hazardous Materials and Hazardous Waste Management

No Action Alternative

Under the No Action Alternative, activities would remain at present levels. Over an extended period of time, with no expansion of operations, WFF may experience a reduction in hazardous waste generation.

Alternative One

The principal hazardous materials used under Alternative One would be liquid propellants (primarily LOX and RP-1), hypergolic propellants, pressurized gases, and various solvents and compounds used to process the ELV and spacecraft.

Site Improvements

Under Alternative One, construction activities would include the use of hazardous materials and hazardous waste generation (i.e., solvents, hydraulic fluid, oil, and antifreeze). With implementation of safety measures and proper procedures for the handling, storage, and disposal of hazardous materials and wastes during construction activities, no adverse impacts are anticipated during construction. In addition, NASA and MARS would develop a site-specific SWPPP to be developed prior to the start of construction activities for each facility. SWPPPs would contain best management practices related to spill prevention and cleanup procedures for hazardous materials and wastes.

All new petroleum facilities, tanks, and storage areas would be subject to VDEQ Storage Tank Program regulations. NASA must be notified of all portable ASTs brought into WFF. Spills or releases from temporary or permanent USTs or ASTs would be immediately reported to the WFF Fire Department, which would contact the WFF Environmental Office. The WFF Environmental Office would properly characterize the spill or release, notify VDEQ if necessary, arrange for remediation, and dispose of contaminated soils and groundwater.

In addition, during existing building modifications NASA would comply with Federal and State regulations for asbestos containing materials and lead based paint, including Virginia Solid Waste Management Regulations (9 VAC 20-80-640), OSHA, and Virginia Lead Based Paint Activities Rules and Regulations. During construction, NASA and MARS would coordinate with the WFF Manager of Environmental Restoration for information concerning any Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) obligations at or near areas adjacent to WFF CERCLA sites or Formerly Used Defense Sites.

Transportation, Handling, and Storage of Materials

Implementation of Alternative One would result in the generation of domestic, industrial, and hazardous wastes. Fueling and payload processing operations would be the primary sources of hazardous waste and materials. Fueling of ELVs with LOX and RP-1, and pressurized gases would take place at the LFF adjacent to Pad 0-A. Loading of hypergolic propellants onto the ES would take place in the PFF. Hypergolic propellants would arrive at the PFF within DOT-approved shipping containers. Solid rocket propellants would arrive at WFF within the rocket motor casing—no loading of solid propellants would occur at WFF; however, solid propellants contained within the ELVs and ES would be temporarily located within each processing facility.

Liquid hypergolic propellants make up the largest proportion of hazardous materials used in processing the ES. Maximum quantities of propellants for the ES are listed in Table 5 of Section 2. An additional quantity of each propellant could be present at the processing facility. The PFF and PPF would be configured to manage hypergolic propellants and waste products. All propellants would be stored and used in compliance with Federal regulations for handling of solid propellants (14 CFR 420.65) and for storage or handling of solid propellants (14 CFR 420.67).

Spacecraft Processing

Payload processing may require limited use of chemicals considered toxic under CERCLA (NASA, 1997); materials that may be used during processing of the ES, including toxic and hazardous substances, are listed in Table 36. A chemical inventory list would be provided to NASA's Safety and Environmental Offices prior to the arrival of such substances. The greatest risks associated with these substances are accidental leaks or spills. Mission-specific safety and environmental plans, as well as the WFF ICP would be in place to prevent and minimize any impacts associated with accidents involving toxic and or hazardous substances. Any materials remaining after completion of processing would be properly stored for future use or disposed of in accordance with all applicable regulations.

Table 36: Payload Processing Materials of ES

Material	Purpose
Isopropyl Alcohol	Wash
Denatured Alcohol	Wash
Ink, White	Marking
Ink, Black	Marking
Epoxy adhesive	Part bonding
Epoxy, Resin	Repairs
Acetone	Epoxy cleanup
Paint, Enamel	Repair & marking
Paint, Lacquer	Repair & marking
Mineral Spirits	Enamel thinner
Lacquer Thinner	Thinning lacquer
Lubricant, Synthetic	Mechanism lube
Flux, Solder, MA	Electronics
Flux, Solder, RA	Electronics
Hypergolic propellants (MMH, N_2H_4, NTO)	Fuel
Chromate conversion coating	Metal Passivation

Source: NASA, 2007b

The hazardous materials used to process the ES could potentially generate hazardous waste. NASA and MARS would be responsible for identifying, containing, labeling, and accumulating the hazardous wastes in accordance with all applicable Federal, State, and local regulations. Liquid wastes would be generated almost exclusively from fuel and oxidizer transfer operations. Transfer equipment and lines would be flushed, first with potable water and then with an isopropyl alcohol (IPA) and demineralized water mixture. After hypergolic propellant has been loaded, equipment and lines used to transfer it would also undergo potable water flushes followed by an IPA/demineralized water flush. Similarly, potable water would be used to flush oxidizer transfer equipment and lines after the hypergolic oxidizer has been transferred to the satellite. The rinses resulting from the first three flushes of potable water for the propellant lines and equipment would be considered hazardous waste. Approximately 23 liters (6 gallons) of sodium hydroxide solution used for soaking small oxidizer transfer equipment parts (e.g., seals and fittings) would be added to the oxidizer rinse water. All five rinse-water waste streams would be collected in separate DOT-approved containers.

The fuel and oxidizer rinse-water wastes may or may not be hazardous depending on how the waste was generated and the characteristics of the wastes. Waste from each drum would be sampled and characterized based on laboratory analysis and the generation process. Based on the results of the waste characterization, drums would be labeled as hazardous or non-hazardous and disposed of according to applicable regulations.

The sodium hydroxide solution that could be used in the oxidizer scrubber would be changed about once every 5 to 10 years. NASA or MARS would pump the spent solution into approved containers, and then dispose of the waste according to its tested characteristics. The citric acid solution that could be used in the fuel scrubber would be collected and disposed of by NASA or MARS as non-hazardous waste.

During gaseous nitrogen purging of equipment and lines used to transfer anhydrous hydrazine and MMH to the satellite, a liquid separator would collect liquid droplets remaining in the equipment as the air streams pass through the hypergolic vent scrubber system. Prior to loading with NTO, approximately 23 liters (6 gallons) of a mixture of hydrazine and MMH would be transferred from the liquid separator to an approved container.

Solid hazardous wastes would also be generated almost exclusively from fuel and oxidizer transfer operations. Solids such as rags coming into contact with a fuel or oxidizer would be double-bagged and placed in a DOT-approved container. A separate container would be used for each fuel or oxidizer. Because solids contaminated with MMH and NTO are acutely toxic hazardous waste, these containers would be moved to a less-than-90-day waste accumulation facility within 72 hours if the amount exceeds 0.95 liter (1 quart).

The greatest potential impact to the environment due to the release of hazardous materials would result from an accident (e.g., leak, fire, or explosion) at a storage location or, to a lesser degree, from an accidental release during fueling, payload processing, or launch activities (e.g., spills or human exposure). The short- and long-term effects of an accident on the environment would vary greatly depending upon the type of accident and the substances involved. NASA has implemented various controls to prevent or minimize the effects of an accident involving hazardous materials on NASA property, including the following:

- Preparation of an ICP
- Preparation of emergency plans and procedures designed to minimize the effect an accident has on the environment
- Maintenance of an online database (MSDSPro) of hazardous materials and the associated buildings where they are stored or used, which would be updated to include the new facilities
- Annual training for all users of hazardous materials

Sources of hazardous wastes have the potential to adversely affect the environment and would be stored in accumulation areas for less than 90 days. NASA uses licensed contractors to transport and dispose of hazardous waste at permitted offsite facilities. NASA and MARS would implement the following list of controls for actions occurring on NASA property:

- Storing wastes in closed containers, and only using accumulation areas that have the capability of containing a leak or spill
- Inspecting containers for leaks on a scheduled basis
- Providing (and attending) training for all personnel who handle, or supervise those who handle, hazardous waste as part of their job
- Using the communication/alarm system that is in place to provide immediate emergency instructions to facility personnel in the event of an accident
- Employing fire extinguishers and fire control equipment available on site
- Following the ICP to control and mitigate the release of hazardous waste

Potential toxic corridors (transportation routes for toxic or hazardous substances) are defined in mission-specific Operations and Safety Directives. These hazard zones are designed to protect personnel, the environment, and the public. Fully fueled spacecraft or any other potentially hazardous material to be transported would be appropriately placarded and transported following Federal and State transportation regulations.

Hazardous materials would be managed according to standard safety procedures that include proper containment, separation of incompatible and reactive chemicals, worker warning and protection systems, and handling procedures to ensure safe operations. All personnel who transport, fuel, or otherwise work with ELVs (including launch or preparation activities such as payload processing) would receive training in hazardous waste management.

Launch Activities

The operation of ELVs would result in the use of hazardous materials and generation of hazardous wastes. Hazardous materials in use as part of flight operations include, but are not limited to, solvents, hydraulic fluid, oil, antifreeze, and paint. In addition, hazardous materials could exist within a payload or spacecraft for scientific research.

Hazardous wastes are unavoidable aspects of launch operations. Limited amounts of hazardous wastes, such as chemical solvents and some waste fuel and oxidizer, are necessarily associated with the preparation of launch vehicles. The small amount of waste generated would not substantially increase existing hazardous waste volumes, and would be segregated and handled through proper disposal. WFF is registered with EPA as a “large quantity generator” of hazardous waste. Mature programs for addressing hazardous waste and hazardous materials already exist. The incremental increase in hazardous waste requirements associated with Alternative One is well within the capabilities of the existing infrastructure for handling hazardous waste at WFF. In addition, WFF would continue to monitor existing and proposed activities and programs to ensure compliance with the pollution prevention program objectives.

Launch deluge wastewater generated by Alternative One would likely be categorized as industrial wastewater; however, this wastewater would be tested to ensure that it would not be considered a hazardous waste. If so, it would be properly handled and disposed of, typically by pumping it into a wastewater removal truck from the deluge water holding area onsite, and either transporting it to the WWTP on the Main Base or off-base to the appropriate hazardous waste treatment disposal site.

Because all applicable rules and regulations regarding hazardous waste (RCRA and non-RCRA) storage, treatment, disposal, and associated reporting requirements would be adhered to, less than substantial impacts on hazardous waste management would occur under Alternative One. In addition, the hazardous waste streams likely to be generated by activities under Alternative One are not anticipated to substantially increase the amount of hazardous waste currently generated by WFF.

A launch failure could result in a payload ground impact resulting in propellant tank rupture and spillage. The *Health and Safety* discussion in Section 4.4.3 of this EA addresses the potential impacts of spills during launch activities. It should be noted that during each launch, NASA coordinates with the local police and emergency personnel in anticipation of the need for evacuation of areas surrounding the launch site, up to the appropriate radius distance established by the WFF Range Safety Office at the time of launch.

Alternative Two

The types of hazardous materials and hazardous waste management impacts, minimization and mitigation measures, and regulations for Alternative Two are the same types as those described under Alternative One. However, there would be less generation of hazardous wastes, and less transportation, handling and storage of hazardous materials and hazardous waste due to fewer launches and less site improvement activities.

4.2.7 Radiation

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts from radiation.

Alternative One

Site Improvements

Construction activities are not anticipated to result in a potential source of radiation. Approximately 0.45 hectare (1.1 acres) of trees would be removed for the construction of new facilities on Wallops Island. Tree removal would not result in impacts to NOAA radar or radio frequency (RF) systems because of the 7.6 kilometer (4.7 mile) distance of the closest tree removal from the NOAA facility at the Main Base. Currently, NASA is unaware of any new or expanded RF systems that would be installed or operated as a result of Alternative One. However, if new RF systems or modifications to existing RF systems, such as increasing RF power output or changing location or pointing direction, are planned in the future, NASA would coordinate with its tenants via the Wallops Frequency Utilization Management Working Group.

No radiation impacts to human health, the environment, or existing NOAA systems are expected to occur during or as a result of construction or site improvement activities under Alternative One.

Transportation, Handling, and Storage of Materials

Radioactive Materials

Operation of the PPF/PFF and handling of the ES could result in a potential source of radiation. Spacecraft may carry small quantities of encapsulated radioactive materials for instrument calibration or similar purposes. The amount and type of radioactive material that can be carried on NASA or MARS missions is strictly limited by the approval authority level delegated to the NASA NFSAM (NASA, 2005). As part of the approval process, the spacecraft program manager must prepare a Radioactive Materials Report that describes all of the radioactive materials to be used on the spacecraft. The NFSAM would certify that preparation and launching of a payload that carries small quantities of radioactive materials would not present a substantial risk to public health or safety.

The amount of radioactive materials used on payloads would be limited to small quantities, typically a few millicuries, and the materials would be encapsulated and installed into the payload instruments prior to arrival at the launch site. Therefore, the use of radioactive materials in payloads would not present any substantial impact or risk to the public or to the environment during normal or abnormal launch conditions (NASA, 2002a).

Lasers

Alternative One involves the use of lasers for science instrumentation on the ES. Lasers could also be used during launch vehicle or payload processing for miscellaneous tasks such as component alignment and calibration. Admissible safety analysis techniques are well established based on ANSI Z136.1-2007 and ANSI Z136.6-2005. The ANSI safety analysis applies to any laser that might be operationally or accidentally pointed toward people or wildlife on Earth or in an aircraft. To be covered within this EA, laser systems must be evaluated and found to be within ANSI standards for safe operations if they can be operated in an Earth-pointing mode.

According to ANSI standard Z136.6-2000, the maximum permissible exposure values are below known injury levels; therefore, use of lasers at WFF would be required to meet the safety standards set forth by ANSI, which would mitigate potential impacts to human health. Since the energy threshold for skin damage exceeds that for eye injury, any system found to be eye-safe would not present a substantial hazard to skin, structures, or plants.

Gases and particles in the atmosphere can absorb the energy from laser systems and cause changes in atmospheric chemistry by initiating various chemical reactions. However, for a typical laser system utilized by Earth-orbiting spacecraft, the mean beam power and, therefore, the maximum available atmospheric energy deposition rate is not substantial when compared to the mean solar energy deposition rate, so substantial atmospheric impacts are not expected.

Radio Frequency Electromagnetic Fields

Most of the proposed spacecraft would be equipped with radar, telemetry, and tracking system transmitters. The ES is limited to a power of 10 kW for radar; a radar instrument of this size on a nadir-viewing satellite can provide useful information with no risk to people on the Earth or in aircraft above the Earth. A 2 kW radar (94 gigahertz with a 1.95-meter [6.4-foot] antenna) drops to safe levels in less than 2.5 kilometers (1.6 miles) from the satellite. Considering that LEO altitudes range from 200 to 800 kilometers (124 to 497 miles) above Earth, such a system presents no radiation hazard to populated regions of Earth or its atmosphere.

Launch Activities

Launch activities are not anticipated to result in a potential source of radiation; therefore, no impacts to human health or the environment from radiation are expected to occur during launches.

Alternative Two

The impacts from transportation, handling, and storage of materials and from launch activities for Alternative Two are the same as described under Alternative One. Impacts from site improvements are discussed below.

Site Improvements

Construction activities are not anticipated to result in a potential source of radiation. Approximately 0.45 hectare (1.1 acres) of trees would be removed for the construction of the Building V-45 addition, parking lot, and access roads on Wallops Island. Tree removal would not result in impacts to NOAA radar or RF systems because of the 7.6-kilometer (4.7-mile) distance of the closest tree removal from the NOAA facility at the Main Base. Currently, NASA is unaware of any new or expanded RF systems that would be installed or operated as a result of Alternative Two. However, if new RF systems or modifications to existing RF systems, such increasing RF power output or changing location or pointing direction, are planned in the future, NASA would coordinate with its tenants via the Wallops Frequency Utilization Management Working Group.

No radiation impacts to human health, the environment, or existing NOAA systems are expected to occur during or as a result of construction or site improvement activities under Alternative Two.

4.2.8 Munitions and Explosives of Concern

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no change in MEC levels.

Alternative One

Site Improvements

Ground disturbances such as excavations and clearing may have the potential to encounter MECs on Wallops Island during construction. The 2005 Archive Search Report and other studies at WFF found potential MEC sites on Wallops Island (NASA, 2008a). A qualified MEC expert would evaluate the area proposed for ground disturbance and conduct a survey of the area if necessary prior to construction activities. WFF would continue to implement its MEC Safety Awareness Program to mitigate immediate risks to employees and the public at or around these sites (NASA, 2008a).

Transportation, Handling, and Storage of Materials

No impacts on MEC are anticipated from transportation, handling, and storage of materials.

Launch Activities

No impacts on MEC are anticipated from launch activities.

Alternative Two

The impacts and mitigation measures for Alternative Two are the same as those described under Alternative One.

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Vegetation

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to vegetation.

Alternative One

Site Improvements

Under Alternative One, construction activities including grading, clearing, filling, and excavation would result in disturbance of the ground surface and adverse impacts on vegetation. NASA and MARS would minimize adverse impacts to vegetation during construction by acquiring VSMP permits as necessary, and developing and implementing site-specific SWPPPs and Erosion and Sediment Control Plans prior to ground-disturbing activities. NASA and MARS would revegetate bare soils and incorporate landscaping measures in areas to be left as pervious surfaces (not paved) when construction is complete.

Approximately 0.45 hectare (1.1 acres) of trees would be removed for the construction of the PFF and road improvements (with approximately 0.4 hectare [1 acre] attributed to the PFF) and approximately 1.7 hectares (4.1 acres) of wetland vegetation would be removed; the wetland would be filled under Alternative One (Figure 25). Impacts to vegetation would be long-term and adverse; however, these impacts would be localized and would not present a substantial adverse effect.

Transportation, Handling, and Storage of Materials

Vegetation could be adversely affected if a spill or leak were to occur where contaminants were released on the ground or into the terrestrial environment or surface waters. NASA and MARS would implement site-specific SWPPPs that would include best management practices for vehicle and equipment fueling and maintenance, and spill prevention and control measures to reduce potential impacts to vegetation during construction. The *Hazardous Materials and Hazardous Waste Management* discussion in Section 4.2.6 of this EA describes the procedures for transportation and handling of hazardous materials. Any accidental release of contaminants or liquid fuels would be addressed in accordance with the WFF ICP and other mission-specific response plans. All petroleum storage tanks would include spill containment measures such as berms that contain at least 110 percent of the tank's maximum capacity.

Launch Activities

NASA has conducted annual monitoring of the vegetation surrounding Pad 0-B since 2003 and observations were made directly after a launch in the spring of 2007. The monitoring results are mostly inconclusive as to the long-term effects on vegetation due to variation in perennial cover year to year; however, observers after the spring 2007 launch did note singeing and charring of vegetation immediately around the pad as a result of several small fires caused by the launch (Mitchell, pers. comm.). Heat and emissions from rocket exhaust under Alternative One may result in localized foliar scorching and spotting within the area immediately surrounding the launch pad.

Launch Pad 0-A would include a flame duct to direct heat and combustion products and the initial sound blast toward the ocean. The majority of the area in the combustion path of the flame duct is beach with little to no vegetation. In addition, the vegetation immediately around the launch pad is regularly mowed to minimize the risk of grass fires. Therefore, minor adverse effects on vegetation from launches would occur, and would be limited to a localized area around Pad 0-A.

Alternative Two

The types of impacts from transportation, handling, and storage of materials and from launch activities would be the same as those described under Alternative One; however, there would be less impacts due to fewer launches. Impacts from site improvements are discussed below.

Site Improvements

Under Alternative Two, construction activities including grading, clearing, filling, and excavation would result in disturbance of the ground surface and adverse impacts on vegetation. NASA and MARS would minimize adverse impacts to vegetation during construction by acquiring VSMP permits as necessary, and developing and implementing site-specific SWPPPs and Erosion and Sediment Control Plans prior to ground-disturbing activities. NASA and MARS would revegetate bare soils and incorporate landscaping measures in areas to be left as pervious surfaces (not paved) when construction is complete.

Approximately 0.45 hectare (1.1 acres) of trees would be removed for the construction of the addition to Building V-45 and road improvements and approximately 0.21 hectare (0.73 acre) of wetland vegetation would be removed under Alternative Two (Figure 25). Impacts to vegetation would be long-term and adverse; however, these impacts would be localized and would not present a substantial adverse effect.

4.3.2 Terrestrial Wildlife and Migratory Birds

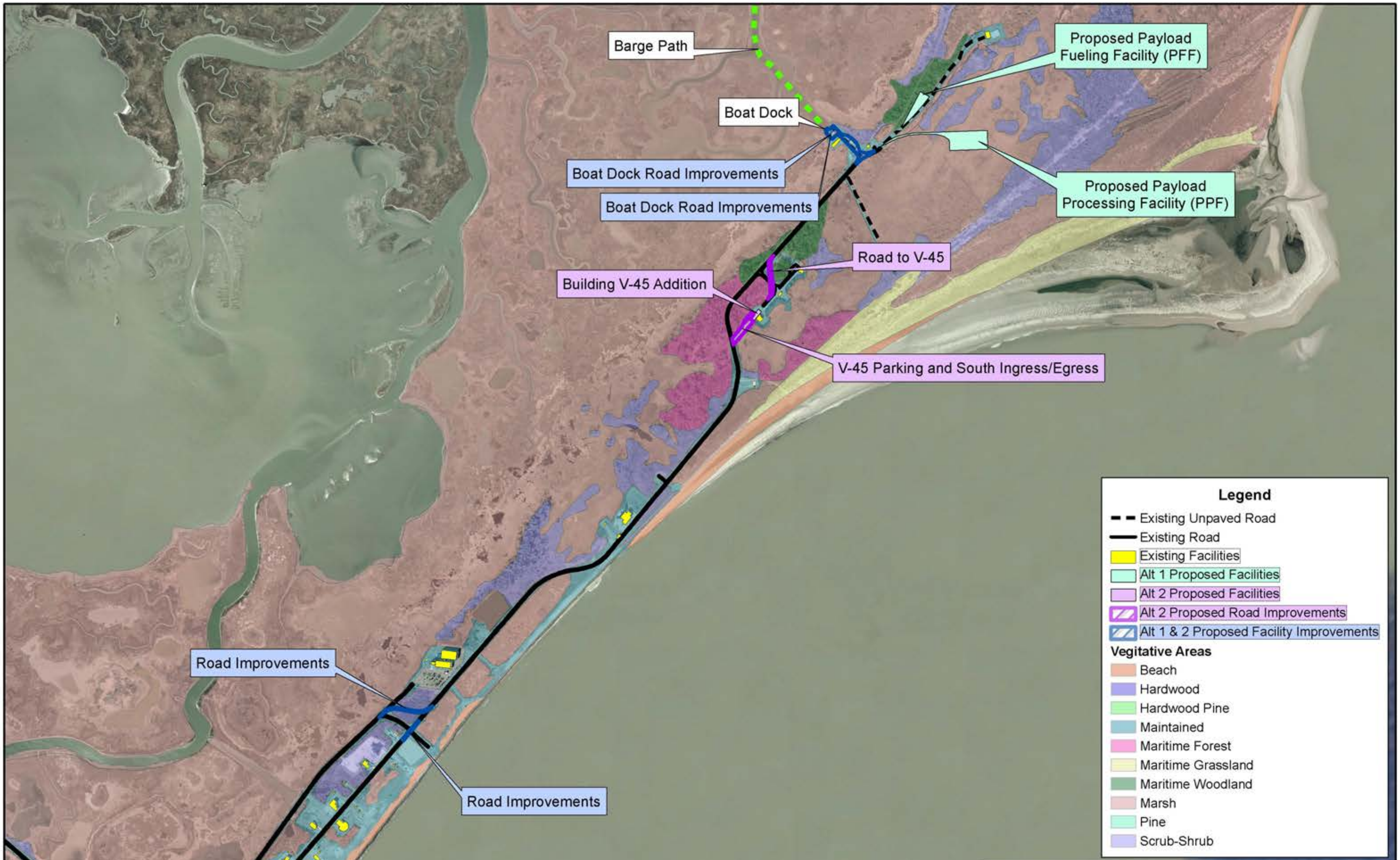
No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to terrestrial wildlife and migratory birds.

Alternative One

Site Improvements

Short-term adverse impacts to wildlife and migratory birds may be anticipated during construction activities due to temporary noise disturbances, especially during spring and fall migrations; however, noise disturbances would be similar to existing noise from daily operations at the Main Base and Wallops Island. The areas surrounding Pad 0-A, the PPF, and the PFF are currently affected by human-related noise. The launching of ELVs from Pad 0-A would cause short duration and infrequent noise disruptions similar to what already exists at WFF for existing flight and launch operations.



Title: Affected Vegetation

URS Proj No: 15301614

Figure: 25

Client : NASA

Expansion of the Launch Range at Wallops Flight Facility

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Long-term impacts to terrestrial wildlife or migratory birds may be anticipated due to the conversion of habitat to developed land. The impacts would be greatest on migratory birds during spring and fall migrations. Alternative One would result in the removal of approximately 1.7 hectares (4.1 acres) of wetlands that would permanently displace terrestrial wildlife and prevent migratory birds from utilizing those areas. Implementation of mitigation measures as agreed upon through the JPA consultation process, such as restoration of wetlands on Wallops Island, would minimize the impacts from loss of habitat at the PPF and Pad 0-A.

The removal of up to 0.45 hectare (1.1 acres) of trees to construct the PFF, PPF, and access roads would adversely affect wildlife due to the loss of habitat. No trees would be removed for construction of the Pad 0-A improvements.

Transportation, Handling, and Storage of Materials

Terrestrial wildlife could be adversely affected if a spill or leak were to occur where contaminants were released on the ground or into the terrestrial environment. NASA and MARS would implement site-specific SWPPPs that would include best management practices for vehicle and equipment fueling and maintenance and spill prevention and control measures. Section 4.2.6 describes the mitigation measures for transportation and handling of hazardous materials. Any accidental release of contaminants or liquid fuels would be addressed in accordance with WFF emergency management and response plans. All petroleum storage tanks would include spill containment measures such as berms that contain at least 110 percent of the tank's maximum capacity.

Launch Activities

Noise generated from rocket launches is generally low-frequency and of short duration (see Section 4.2.4 for more information on noise impacts); noise from static fire activities would be of longer duration, but infrequent (not more than two per year). Birds in the immediate area would be startled by rocket motor noise and are likely to temporarily leave the immediate area, which could disrupt foraging and nesting activities. Due to the short duration of the noise disturbances, impacts to birds are considered minimal (NASA, 1997). The continued presence of migratory, sea, and shore birds at WFF suggests that rocket launches over the past few decades have not significantly disturbed birds on the island.

During launch events, a bird strike could occur, although there would be an extremely low probability of such an event. Rockets launched from Pad 0-B have not resulted in a documented bird strike. In the unlikely event of a migratory or special status bird strike, the USFWS would be consulted.

Terrestrial mammals near a launch might suffer startle responses; however, the launches are infrequent and would have a minor adverse effect on wildlife.

Currently, all launches from Pad 0-B require closure of the southern end of Assateague Island. NASA has an established agreement with CNWR for such closures and coordinates with CNWR personnel during mission planning to ensure that closures do not adversely affect CNWR activities. The value of CNWR in terms of its significance and enjoyment is not substantially reduced or lost due to launch activities at WFF. CNWR has instead become a popular observation location for viewing NASA and MARS launches from the northern end of Assateague Island..

To mitigate the effects from CNWR personnel not being able to monitor birds during launch operations, WFF would continue to make its range schedule available online, and the Security Office would provide relevant information to CNWR staff upon request so they can plan their activities accordingly. Such coordination with WFF could facilitate CNWR staff using alternate means for accessing Assawoman Island (e.g., boats), provided that all such activities would occur outside of the established PLDA (381 meters [1,250 feet]) and LHA (3.04 kilometers [1.89 miles]) surrounding Pad 0-A.

Alternative Two

The types of impacts from transportation, handling, and storage of materials and from launch activities would be the same as those described under Alternative One; however, there would be less impacts due to fewer launches. Impacts from site improvements are discussed below.

Site Improvements

Short-term adverse impacts to wildlife and migratory birds may be anticipated during construction activities due to temporary noise disturbances, especially during spring and fall migrations; however, noise disturbances would be similar to existing noise from daily operations at the Main Base and Wallops Island. The areas surrounding Pad 0-A, the boat dock, and Buildings V-45, V-50, and V-55 are currently affected by human-related noise. The launching of ELVs from Pad 0-A would cause short-duration and infrequent noise disruptions similar to what already exists at WFF for existing flight and launch operations.

Long-term impacts to terrestrial wildlife or migratory birds may be anticipated due to the conversion of habitat to developed land. The impacts would be greatest on migratory birds during spring and fall migrations. Approximately 0.29 hectare (0.73 acre) of wetlands would be removed, permanently displacing terrestrial wildlife and preventing migratory birds from utilizing those areas. Implementation of mitigation measures as agreed upon through the JPA consultation process, such as restoration of wetlands on Wallops Island, would minimize the impacts from loss of habitat at the PPF and Pad 0-A.

Up to 0.45 hectare (1.1 acres) of trees would be removed to construct the Building V-45 addition, parking lot, and access roads and would adversely affect wildlife due to the loss of habitat. No trees would be removed for construction of the Pad 0-A improvements.

4.3.3 Threatened and Endangered Species

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to threatened and endangered species.

Alternative One

Site Improvements

Vegetation

All site improvement activities would be located outside of the beach habitat within which the seabeach amaranth might be found; therefore Alternative One site improvements would not affect seabeach amaranth.

Marine Mammals

All site improvement activities would be located outside of the ocean environment; therefore no impacts on marine mammals from site improvements are anticipated.

Terrestrial Mammals

Because the Delmarva Peninsula Fox Squirrel habitat is located outside of the proposed action area, therefore Alternative One site improvements would have no effect on the species.

Sea Turtles

Under Alternative One, interior and exterior facility lighting would be necessary to maintain required visibility for safety, security, and launch preparation requirements. The proposed PPF, which would be located approximately 650 meters (2,130 feet) from the north Wallops Island beach, and the proposed launch complex at existing Pad 0-A, which would be located approximately 200 meters (650 feet) from the south Wallops Island beach, would emit sources of artificial light during times when sea turtles may be nesting. Artificial light can prevent adult turtles from nesting and disorient hatchlings trying to reach the ocean. To mitigate the effects of lighting from the proposed facilities, NASA and MARS would install “turtle friendly” exterior lighting on all new facilities. Low-pressure sodium lights, which are monochromatic and emit only yellow wavelengths, would be installed where feasible, and shielding measures would be used to reduce lighting effects on turtles.

Illumination of these facilities would be kept at a minimum until operations or pre-launch preparations dictated their necessity. Launch vehicle uplighting would be used at Pad 0-A; however, it would only be in use when the ELV is physically sitting on the launch pad, which would typically be no more than 24 to 48 hours prior to launch. Similar lighting management measures employed at Cape Canaveral Air Force Station successfully reduced estimated turtle hatchling disorientation from over 4 percent in 1989 to less than 0.01 percent in 1999 (USFWS, 2000a).

NASA would continue to coordinate with CNWR and USDA personnel in monitoring the Wallops Island beaches for sea turtle activity. Any nests discovered would be appropriately marked with a Global Positioning System (GPS) unit, identified with signage, and closed to employee access by cordoning off the path between the nest and the surf zone to ensure that ruts from off-road vehicles do not preclude hatchlings from safely reaching the ocean.

Sediment suspension and acoustic vibration associated with pile driving at the boat dock could affect the navigation and behavior of sea turtles. To mitigate any adverse effects, each day during pile driving, or prior to resuming pile driving after a greater than 30-minute pause, a trained observer would perform a visual “sweep” of the waterways adjacent to the boat dock; the observation area is shown on Figure 26. If a listed sea turtle is found within 460 meters (1,500 feet) of the work area, pile driving would be stopped until the turtle has moved outside of the observation area. NASA would direct the construction contractor to install pilings by vibratory techniques rather than hammer methods in an effort to reduce the noise and vibration of the pile driving installation.

Due to the low number of sea turtles in the vicinity of Wallops Island, and with the above mitigation measures, Alternative One site improvements would not result in substantial impacts on federally protected sea turtles.

Birds

Short-term adverse impacts to gull-billed terns, peregrine falcons, upland sandpipers, and bald eagles may be anticipated during construction activities due to temporary noise disturbances near areas these species use, especially during spring and fall migrations; however, this would be similar to disruptions from daily operations at the Main Base and Wallops Island. Because effects on these birds would likely be confined to temporary startle effects, the proposed action would not result in substantial adverse effects to gull-billed terns, peregrine falcons, upland sandpipers, and bald eagles.

Red Knot

All construction activities would be located outside of the beach and lagoon environments within which these birds typically would stopover or feed. Therefore, Alternative One site improvements would not result in substantial impacts on the red knot.

Piping Plover

Construction activities are not anticipated to produce noise levels that would result in adverse impacts on the piping plover because of the distance of the closest construction (1.5 kilometers [0.9 mile]) to their protected habitat on Wallops Island (see Figure 21). Because construction activities are planned outside of the piping plover habitat and would not occur on the beach or in the near-shore environment, no direct impacts on piping plover are anticipated as a result of construction.

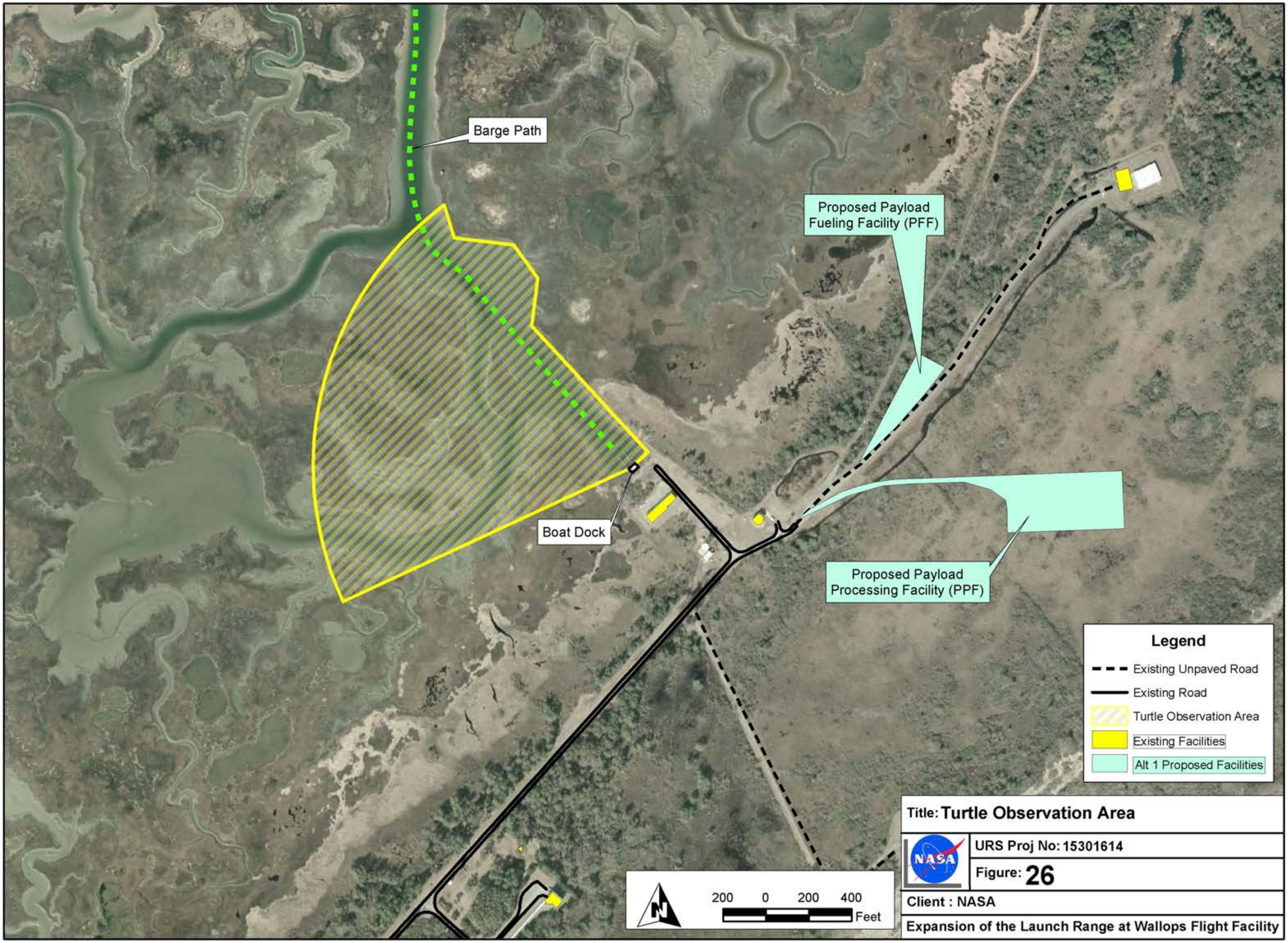
Insects

Because the Northeastern beach tiger beetle habitat is located outside of the proposed action area, there would be no effect on this species under Alternative One.

Transportation, Handling, and Storage of Materials

An accidental release of hazardous materials during transportation via barge, rail, or road could occur. If a spill were to occur in the ocean, the vessel would notify the USCG and implement its approved spill response plan. Quantities of petroleum products transported over water would be no greater than are typically needed to fuel the vessel; any pollutants released would be cleaned up immediately; any remaining products would be diluted with sea water beyond a substantial impact.

The piping plover habitat located at the northern end of Wallops Island is approximately 900 meters (2,950 feet) away from the proposed PPF, and the piping plover habitat at the southern end of Wallops Island is approximately 400 meters (1,300 feet) away from Pad 0-A. Therefore, the piping plover habitat is a sufficient distance from where a spill could occur, so it is not likely that piping plovers would be affected.



Barge Path
Proposed Payload Fueling Facility (PFF)
Boat Dock
Proposed Payload Processing Facility (PPF)
Legend
Existing Unpaved Road
Existing Road
Turtle Observation Area
Existing Facilities
Alt 1 Proposed Facilities
200 0 200 400
Feet
N
Title: Turtle Observation Area
URS Proj No: 15301614
Figure: 26
Client : NASA
Expansion of the Launch Range at Wallops Flight Facility

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Launch Activities

Vegetation

During launch activities, areas that could provide habitat for seabeach amaranth could be susceptible to scorching from hot rocket exhaust; however, as the nearest suitable habitat (beach above normal high tide line) is currently 1,500 meters (5,000 feet) south of Launch Pad 0-A, adverse effects to this habitat would be unlikely. Potential indirect adverse effects on seabeach amaranth include trampling or crushing of unprotected plants by pedestrian or vehicular traffic (e.g., roving security patrols) on the beach.

Seabeach amaranth would be expected to grow in areas suitable for both piping plover and sea turtle nesting. As such, NASA would continue to coordinate with CNWR and USDA staff during their plover and sea turtle monitoring efforts along the Wallops Island beach. If discovered, plants would be marked with a GPS unit and fenced to provide a minimum 3-meter (10-foot) buffer zone around individual plants or groups of plants.

Based on very low species density in the area, and with the implementation of mitigation measures such as regular surveys, employee education, and exclusionary fencing if identified, launch activities under Alternative One would not result in substantial impacts on seabeach amaranth.

Marine Mammals

Launches and static fire tests could initiate a startle response to marine mammals in the immediate vicinity of Wallops Island. Effects would be temporary due to the short duration of the noise event; therefore, launch activities under Alternative One would not result in substantial impacts on federally listed marine mammal species.

Terrestrial Mammals

Because the Delmarva Peninsula Fox Squirrel habitat is located outside of the proposed action area, there would be no effect on this species under Alternative One.

Sea Turtles

One loggerhead sea turtle nest has been discovered in recent years on Wallops Island, approximately 5.1 kilometers (3.2 miles) north of Pad 0-A (Figure 21). There is no available beach for 4.2 kilometers (2.6 miles) along the Wallops Island Shoreline; the beach areas immediately adjacent to Pad 0-A are regularly inundated by the tides and wave energy, making these areas unsuitable for sea turtle nesting.

Nesting turtles could be directly affected by rocket exhaust immediately adjacent to Launch Pad 0-A. Effects could include burns, auditory effect (deafening), and potential asphyxiation from elevated levels of carbon monoxide in the exhaust plume. However, these effects are unlikely because noise and lighting from pre-test and launch operations would likely deter the female turtle from nesting nearby. Additionally, as estimated from the rocket exhaust modeling performed for the Taurus II ELV, toxic plumes at ground level would only be expected within approximately the first 100 meters (328 feet) of the launch pad. The nearest beach is approximately 200 meters (656 feet) south of Pad 0-A, and the closest beach suitable for turtle nesting (i.e., contains sand above the high tide line) is more than 1,000 meters (41,980 feet) away from Pad 0-A.

The low-frequency vibrations caused by a static fire test or rocket launch could affect the success of nearby sea turtle nests. As with the potential effects of the exhaust, the potential for vibration effects is low because the closest suitable nesting beach is more than 1,000 meters (41,980 feet) south of Launch P0-A. Additionally, recent experience at Cape Canaveral Air Force Station indicates that the three space shuttle launches that have taken place during the 2009 turtle nesting season have not produced substantial adverse effects; over 900 nests were present, with the closest nests approximately 500 meters (1,640 feet) from Launch Complex 39 (Shaffer, pers. comm., 2009).

Indirect effects to nesting turtles and hatchlings may occur from security patrols prior to launch. Vehicles can crush eggs, kill hatchlings, and disturb nesting adults; tire ruts can trap hatchlings attempting the reach the ocean.

Due to the low number of sea turtles in the vicinity of Wallops Island, and with the above mitigation measures, launch related activities under Alternative One would not result in substantial impacts on federally protected sea turtles.

Birds

Launches and static fire tests could initiate a startle response to birds in the vicinity of Wallops Island. Effects would likely be temporary, with the birds leaving the area due to the high intensity, short duration noise event. The potential for acute adverse effects including scorching, inhalation of toxic rocket exhaust gases, and deafening exists; however, it is unlikely because unnatural noise and lighting from pre-test and launch operations would likely deter the birds from inhabiting the areas within the immediate vicinity of the launch pad prior to and during launch operations. As the effects on birds would likely be confined to temporary startle effects, the proposed action would not result in substantial adverse effects to gull-billed terns, peregrine falcons, upland sandpipers, and bald eagles.

Red Knot

Launch activities, including pre-launch preparations, static fire tests, and launches, could initiate a startle response in individuals foraging along the nearby beaches or in the lagoon environment to the west. Effects would likely be temporary, with the birds leaving the area due to the high intensity, short duration noise event. The potential for acute adverse effects including scorching, inhalation of toxic rocket exhaust gases, and deafening exists; however, these effects are unlikely because unnatural noise and lighting from pre-test and launch operations would likely deter the birds from inhabiting the areas within the immediate vicinity of the launch pad prior to and during launch operations. Indirect effects on the species could be expected from roving security patrols that could startle birds foraging or resting on the nearby beach.

Red knots would be expected to be present in areas suitable for both piping plover and sea turtle nesting during similar times of year. As such, NASA would continue to coordinate with CNWR and USDA staff during their monitoring efforts along the Wallops Island beach. As the effects on the red knot would likely be confined to temporary startle effects that may disrupt feeding, launch activities under Alternative One would not result in substantial impacts on the red knot.

Piping Plover

Temporary interruption of foraging and nesting activities for piping plover may occur as a result of launch and static fire testing activities. The nesting area designated on the northern end of Wallops Island is approximately 6.7 kilometers (4 miles) from Pad 0-A, and is not expected to be affected by emissions or noise. The northernmost point of the designated plover habitat on the southern end of the island is approximately 1.46 kilometers (0.9 miles) from Pad 0-A. Noise generated from rocket launches is generally low-frequency, of short duration, and occurs infrequently, and naturally occurring background noises in the nesting area, such as wave action and thunderstorms, are more frequent and of longer duration than noise from a rocket launch.

The 1997 USFWS guidance for managing fireworks near piping plover habitats recommends that a minimum 1.2-kilometer (0.75-mile) distance be established between the piping plover nests and the fireworks launch site. These same guidelines were referenced by USFWS in its July 14, 1997, Biological Opinion for construction of Pad 0-B. Fireworks noise outputs are comparable to the noise intensity at Pad 0-A during a Taurus II launch or static fire test and would likely last for a considerably longer period of time (USFWS, 1997). As launches and static fire tests under Alternative One would occur at a greater distance and be of shorter duration than those discussed in the 1997 USFWS guidance, no adverse effect on plover is anticipated.

Air quality modeling conducted for the launch of Taurus II at WFF (REEDM modeling described in Section 4.2.3 *Air Quality* discussion) showed that the limit of the near-field exhaust cloud ("near field" is defined as the region near the launch pad where the rocket exhaust cloud is formed) would extend approximately 200 meters (656 feet) away from Pad 0-A during static fire and approximately 100 meters (328 feet) away from Pad 0-A during launch, then begin to rise into the atmosphere where it would reach a "ceiling" due to an inversion, and then drift back down to the ground (NASA, 2009). Because of wind and atmospheric mixing, the exhaust cloud is predicted to move a minimum of approximately 5,000 meters (3.1 miles) downwind from Pad 0-A before "touching down." By the time the exhaust cloud has moved downwind and resettled, the constituents from the rocket exhaust would be significantly dispersed and their concentrations substantially lowered.

The 1997 Launch Range Expansion EA assessed the peak concentrations of HCl, CO, and Al_2O_3 from a solid rocket motor (the Athena-3) at a distance of 1,400 meters (0.87 mile); this distance was selected because it is the boundary to the nearest sensitive receptor from Launch Pad 0-B, piping plover habitat. A comparison of the estimated peak concentrations of CO at a distance of 1,400 meters (0.87 mile) to the OSHA Threshold Limit Values (TLV)-TWA for Chemical Substances demonstrated that the levels of CO were well below exposure standards established to protect human worker health. TLV-TWA values were chosen for comparison purposes because these limits are more conservative than the TLV-Short Term Exposure Level exposure indices.

Human health exposure standards have been established well below levels shown to affect laboratory animals (NASA, 1997). Based on these comparisons, NASA determined that the launch of the Athena 3, a rocket utilizing solid propellants in its first stage and emitting higher launch concentrations of CO (0.9 to 1.1 ppm at 1,400 meters [0.87 mile] [NASA 1997]) than either Taurus II launch or static test firing CO concentrations (less than 0.04 ppm for far field 1-hour TWA concentrations to less than 1.0 ppm for far field instantaneous concentrations [NASA, 2009]), would not have a substantial effect on humans or wildlife outside of the established hazard arc.

Open burning of rocket motors occurs approximately 400 meters (0.25 mile) north of the piping plover habitat on the southern end of Wallops Island. In a letter dated February 27, 1998, from NASA to USFWS, NASA summarized a telephone conference between USFWS, VDGIF, and

NASA (Appendix D). The telephone conference discussed the 1997 USFWS Biological Opinion on impacts to the piping plover and the agreement that NASA could conduct year-round open burning of rocket motors at the open burning site located north of the southern piping plover habitat. Therefore, NASA has determined that the static fire testing under Alternative One also would not result in adverse impacts on the piping plover or its habitat.

Pad 0-A is 400 meters (1,312 feet) further away from the piping plover habitat on the southern end of Wallops Island than Pad 0-B. Also, the Taurus II-class rockets that would be tested and launched from Pad 0-A would be smaller and cleaner burning than the previously assessed Athena-3 launching from Pad 0-B. Finally, the burning of waste solid rocket fuel that takes place on south Wallops Island has not been documented to impact the piping plovers.

NASA would continue to coordinate with CNWR and USDA personnel in monitoring the Wallops Island beach for piping plover activity. These personnel routinely monitor Assateague, Wallops, Assawoman, and Metompkin Island beaches for piping plovers during nesting season. Any nests discovered would be appropriately marked with a GPS unit, identified with signage, and closed to employee access.

As the effects from the proposed and ongoing actions would likely be limited to startle effects, and because NASA will continue to monitor for plovers and implement mitigation measures, launch related activities under Alternative One would not result in substantial impacts on the piping plover.

Insects

Because the Northeastern beach tiger beetle habitat is located outside of the proposed action area, there would be no effect on this species under Alternative One.

Alternative Two

Under Alternative Two, the types of impacts to threatened and endangered species would be the same as those described for Alternative One; however, there would be less impacts because ELVs would be launched.

4.3.3.1 ESA Consultation

Determination of Effects to Federally Protected Species

Table 37 includes NASA's determination of effects to federally protected species under the ESA.

Table 37: Determination of Effects to Federally Protected Species

Species	NASA's Determination
Seabeach amaranth	May affect, but not likely to adversely affect
Whales	May affect, but not likely to adversely affect
Delmarva Peninsula fox squirrel	No effect
Hawksbill, Kemp's Ridley Sea Turtles	Not likely to adversely affect
Loggerhead, Atlantic Green, Leatherback Sea Turtles	May affect and likely to adversely affect
Red knot	May affect, but not likely to adversely affect
Piping plover	May affect, and likely to adversely affect
Northeastern Beach Tiger Beetle	No effect

NMFS Consultation

NASA informally consulted with NMFS regarding potential effects to species listed under NMFS jurisdiction as a result of the proposed action. In a letter dated July 8, 2009, NMFS concurred with NASA's determination that the proposed action "is not likely to adversely affect" any listed species under NMFS jurisdiction (Appendix D). If, in the future, sea turtle activity increases on Wallops Island or adjacent properties, this determination will be revisited in consultation with the NMFS and the USFWS.

USFWS Consultation

In 1997, NASA formally consulted with USFWS regarding potential impacts to listed species from the construction and operation of the MARS Launch Pad 0-B; USFWS issued its Biological Opinion on July 14, 1997. In April 2009, NASA began informal consultation with USFWS regarding the proposed action. During this informal consultation, USFWS indicated that the 1997 consultation should be re-initiated to include both ongoing and proposed launch activities, and to include the most current information regarding the piping plover and potential effects to listed sea turtles, seabeach amaranth, and the red knot. The informal consultation process led to initiation of formal Section 7 consultation with USFWS.

NASA prepared a BA for potential effects to seabeach amaranth, listed sea turtles, the red knot, and the piping plover (Appendix C). NASA has determined that there would be no adverse effects to listed species from site improvements; adverse effects would only result from facility operation and launch activities. A summary of NASA's determination of effects is shown in Table 37. The conclusion of the Section 7 process is pending. NASA and MARS would not begin operation of facilities until Section 7 consultation is completed and a Biological Opinion is issued by USFWS. NASA would adhere to all avoidance and mitigation measures issued by USFWS.

4.3.4 Marine Mammals and Essential Fish Habitat

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to marine mammals and essential fish habitat.

Alternative One

Site Improvements

Construction of facilities under Alternative One would occur in the estuary for modifications to the boat dock on the north end of Wallops Island. Temporary adverse impacts may occur to fish and EFH in the immediate area of construction due to suspension of sediment into the water column. The impacts from maintenance dredging that would occur are described in an existing REC (NASA, 2008b) and are currently permitted by the USACE.

NASA consulted with NMFS regarding impacts to EFH from the proposed action, including the boat dock improvements. On August 11, 2009, NMFS responded that "the proposed bulkhead construction will not result in substantial adverse effects to EFH, managed species or their prey species."

No marine mammals have been documented or are known to inhabit the approach channel and boat dock area at Wallops Island; therefore, no impacts on marine mammals are anticipated.

Transportation, Handling, and Storage of Materials

An accidental release of onboard fuels (e.g., diesel, gasoline, etc.) during transportation via barge or boat could occur. If a spill were to occur, the vessel would notify the USCG and implement its approved spill response plan. Quantities of petroleum products transported over water would be no greater than are typically needed to fuel the vessel; any pollutants released would be cleaned up immediately; any remaining products would be diluted with sea water. If a spill were to occur within Chincoteague Inlet or the estuaries surrounding Wallops Island, adverse impacts on marine mammals and fish habitat might occur; however, due to the low probability of a large spill, the ability of marine mammals and fish to swim away, and the dilution of the pollutant with sea water, adverse impacts on marine mammals and fish are not anticipated.

Launch Activities

Spent stages would fall into the ocean many miles offshore. While a salvage boat may be used to recover the first stages of an ELV, the recovery efforts are likely to occur over 300 kilometers (500 nautical miles) from the coast. Stages that would not be recovered would sink to the ocean bottom. Due to the vastness of the ocean and the low density of marine mammals, it is extremely unlikely that a spent stage would strike a marine mammal or fish. Spent stages would not include propellants, and ES would not fall into the ocean under successful launches; therefore, no adverse effects on marine species are anticipated as a result of spent stages falling into the ocean.

In the unlikely event of a failure during launch, or an early termination of flight, the launch vehicle would most likely fall into the ocean, along with some scattered debris. Propellants and other chemicals could be released, although they would be quickly diluted within the ocean. Because the probability of an early flight termination is low, it is unlikely that a terminated launch vehicle or debris would strike a marine mammal, turtle, or fish; therefore, no substantial adverse effects on marine species from Alternative One are expected from launch vehicle failure or early flight termination.

In the event of a launch failure, the ELV or ES may survive to strike the water essentially intact, presenting some potential for habitat impact. This potential arises from the fact that some stages of the ELV and the ES may carry hypergolic propellants, which are toxic to marine organisms. A lesser hazard may exist from small amounts of battery electrolyte (battery acid) carried aboard all spacecraft vehicles, but risk from the electrolyte is far smaller due to lesser quantities, lower toxicity, and more rugged containment.

Although it is unlikely that a fully fueled ELV or ES would fall in the ocean, several scenarios are possible if such an event did occur:

1. The entire spacecraft, with onboard propellants, is consumed in a destruct action.
2. The spacecraft is largely consumed in the destruct action, but residual propellant escapes and vaporizes into an airborne cloud.
3. The spacecraft survives to strike the water essentially intact, whereupon the propellant tanks rupture, releasing liquid propellants into surface waters.
4. The spacecraft survives water impact without tank rupture and sinks to the bottom, but leaks propellant into the water over time.

The probability of any one of these scenarios is unknown, but only the last two would potentially impact marine life or habitat.

The toxicology of hydrazine, MMH, and NTO with marine life is not well known. NTO almost immediately breaks down to nitric and nitrous acid on contact with water, and would be very quickly diluted and buffered by seawater; hence, it would offer negligible potential for harm to marine life. Hydrazine fuels are highly reactive substances that quickly oxidize to form amines and amino acids, which are beneficial nutrients to small marine organisms. Prior to oxidation, there is some potential for exposure of marine life to toxic levels, but for a very limited area and time. A half-life of 14 days for hydrazine in water is suggested based on the unacclimated aqueous biodegradation half-life (NASA, 2007b).

In summary, a mishap occurring downrange over the open ocean is improbable, and this event would not likely jeopardize any wildlife, given the relatively low density of species within the surface waters of these open ocean areas (NASA, 2007b). Debris from launch failures has a small potential to adversely affect managed fish species and their habitats in the vicinity of the project area.

Sonic booms created by launches from WFF could occur away from the Wallops Island shoreline over the open Atlantic Ocean. The effects of a sonic boom on whales or other open ocean species are not known. Because sonic booms are infrequent, and the marine species in the ocean’s surface waters are present in low densities (although spring and fall migration would see periodic groups of migrating whales that follow the coastline), the sonic booms from launches are not expected to adversely affect the survival of any marine species (NASA, 2007b).

Alternative Two

Under Alternative Two, the same types of impacts to marine mammals and fish would occur as described for Alternative One; however, impacts would be less due to fewer launches.

4.4 SOCIAL AND ECONOMIC ENVIRONMENT

4.4.1 Population, Employment, and Income

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to population, employment, and income.

Alternative One

Site Improvements

Construction activities would result in a temporary increase in the number of workers at WFF; however, because local contractors would primarily be utilized, no long-term increase in population is anticipated due to construction activities. Some non-local construction workers are anticipated to require lodging in local motels and hotels. Construction activities would result in a benefit to the local economy due to employment opportunities for local construction workers and increased numbers of people in Accomack County during business hours resulting in a potential increase in the use of local stores and businesses for purchases.

Transportation, Handling, and Storage of Materials

Existing employees at WFF and MARS would assist in the transportation, handling, and storage of materials in support of launch activities. In addition, new employees specializing in the management of the materials, launch vehicles, and ES would be hired.

Launch Activities

Under Alternative One, the projected increase in newly hired permanent employees at MARS and WFF is approximately 125 people. Employment opportunities would be created in various areas of expertise (including the transportation, handling, and storage of materials along with those more directly involved with launch activities). In addition, private industries utilizing MARS Pad 0-A for a launch campaign may temporarily relocate a staff of approximately 15–20 personnel for periods of roughly 30 days, during which time food, lodging, and material goods would be needed. Taxes generated by this influx of personnel would directly benefit the local communities. The Virginia Economic Development Partnership estimated the net tax revenue from the 125 new jobs as $7,140,000 over 5 years ($1,430,000 annually), $13,200,000 over 10 years, and $23,500,000 over 20 years (VEDP, 2008).

Per launch event, the local economy typically benefits approximately $1,000,000 from the launch team alone (e.g., hotel, per diem rates for meals and incidentals, rental car), $2,000,000 for services and commodities support, and $3,000,000 to $5,000,000 from tourism (Reed, pers. comm.).

The U.S. Census 2000 estimates there are 3.04 people per household in Virginia and 3.12 people per household in Maryland (U.S. Census Bureau, 2000). Using these estimates, the 125 jobs created by expanded launch activities would bring approximately 385 people to the Lower Delmarva Peninsula. Employment opportunities within WFF would result in NASA continuing to be among the top five largest employers in Accomack County. The increase in population within the county would also result in increased tax revenues, thereby providing further growth for the local economy (NASA, 1997). The number of people moving to Accomack County under Alternative One would comprise less than 1 percent of the county's population of 39,345 in 2006.

The average salaries of new employees at WFF and MARS would likely be similar to the 2008 average NASA WFF civil servant salary of $83,462 (NASA, 2008a). Although Accomack County would likely continue to maintain lower income rates as compared with the Commonwealth of Virginia, the average income of people employed by WFF tenants and partners is expected to be well above the 2008 average county per capita income of $18,657 and median household income of $44,845 (NASA, 2008a). Due to greater average salaries of WFF employees, Alternative One would contribute positively to the local economy.

Alternative Two

Site Improvements

Construction activities would result in a temporary increase in the number of workers at WFF; however, because most contractors would be local, no long-term increase in population is anticipated due to construction activities. Some non-local construction workers are anticipated to require lodging in local motels and hotels. Construction activities would result in a benefit to the local economy due to employment opportunities for local construction workers and increased numbers of people in Accomack County during business hours, resulting in a potential increase in the use of local stores and businesses.

Transportation, Handling, and Storage of Materials

Existing employees at WFF and MARS would assist in the transportation, handling, and storage of materials in support of launch activities. In addition, new employees specializing in the management of the materials, launch vehicles, and ES would be hired.

Launch Activities

Under Alternative Two, the projected increase in newly hired permanent employees at MARS and WFF is approximately 80 people. Employment opportunities would be created in various areas of expertise (including the transportation, handling, and storage of materials along with those more directly involved with launch activities). In addition, private industries utilizing MARS Pad 0-A for a launch campaign may temporarily relocate a staff of approximately 15–20 personnel for periods of roughly 30 days, during which time food, lodging, and material goods would be needed. Taxes generated by this influx of personnel would directly benefit the local communities. The net tax revenue determined by the Virginia Economic Development Partnership (VEDP, 2008) for 125 new jobs was used to calculate estimated net tax revenue for 80 jobs, which is $4,570,000 over 5 years, $8,448,000 over 10 years, and $15,040,000 over 20 years.

Per launch event, the local economy typically benefits approximately $1,000,000 from the launch team alone, $2,000,000 for services and commodities support, and $3,000,000 to $5,000,000 from tourism (Reed, pers. comm.).

The U.S. Census 2000 estimates there are 3.04 people per household in Virginia and 3.12 people per household in Maryland (U.S. Census Bureau, 2000). Using these estimates, the 80 jobs created by expanded launch activities t would bring approximately 245 people to the Lower Delmarva Peninsula. Employment opportunities within WFF would result in NASA continuing to be among the top five largest employers in Accomack County. The increase in population within the county would also result in increased tax revenues, thereby providing further growth for the local economy (NASA, 1997). The number of people moving to Accomack County under Alternative Two would comprise less than 1 percent of the county's population of 39,345 in 2006.

The discussions of average salaries and educational systems under Alternative One would be the same under Alternative Two.

Summary of Jobs and Economic Growth

Both alternatives would result in an increase in jobs and economic growth in the form of tax revenue and direct and indirect economic benefits. Table 38 shows a summary and comparison between of the proposed action alternatives.

Table 38: Summary of Jobs and Economic Growth

	Alternative One	Alternative Two
Number of new jobs	125	80
Annual tax revenue increase	$1,430,000	$915,000
Local annual economic benefit[1]	$36,000,000	$18,000,000
Total annual economic growth	**$37,430,000**	**$18,915,000**

[1]For Alternative One, $6,000,000 per launch times six launches; for Alternative Two, $6,000,000 times three launches.

4.4.2 Environmental Justice

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to low-income or minority populations.

Alternative One

NASA complies with EO 12898 by incorporating Environmental Justice into their mission. WFF has prepared a site-specific EJIP that identifies programs and Federal actions that may disproportionately and adversely affect minority and low-income populations around WFF. The EJIP concluded that Federal actions conducted at or by WFF do not disproportionately or adversely affect low-income or minority populations.

There are minority and low-income communities within Accomack County, but disproportionately high or adverse impacts to low-income or minority populations are not anticipated to occur under Alternative One because no displacement of residences or businesses would occur as a result of the implementation of Alternative One. In addition, Alternative One would include similar activities as those conducted at WFF, and the EJIP found that current WFF actions do not disproportionately affect low-income or minority populations (NASA, 1996).

Alternative Two

Under Alternative Two, impacts to environmental justice would be the same as those described for Alternative One.

4.4.3 Health and Safety

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to health and safety.

Alternative One

The establishment of ground and flight safety guidelines is the responsibility of NASA. WFF's Range Safety Branch is responsible for implementing these safety guidelines. The *Range Safety Manual for Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF)* (RSM-2002) outlines the Ground and Flight Safety Requirements, the Range User and Tenant Responsibilities, and the Safety Data Requirements to which all range users must conform.

To ensure the safety of personnel, property, and the public, WFF requires all range users to submit formal documentation pertaining to their proposed operations for safety review. Mission-specific safety plans will be prepared by WFF's Ground and Flight Safety Groups. These plans address all potential ground and flight hazards related to a given mission, in accordance with the Range Safety Manual. The Range Safety Branch is responsible for coordinating review of the proposed operations with all applicable organizations. Risks to human health and safety will be completely addressed and managed by these plans.

As a tenant, MARS and its clients would be required to comply with all of WFF's existing safety regulations. In addition, FAA licensing procedures require the Commercial Operator to prepare a Spaceport Explosives Site Plan, a Spaceport Safety Plan, and tailor Spaceport Operations for compliance with the WFF Range Safety Manual.

Site Improvements

Construction activities at the WFF site could result in short-term impacts to human health and safety and the increased usage of local fire, police, and medical services. Construction safety procedures and appropriate training would be implemented at WFF to ensure that events having the potential to adversely affect human health and safety are minimized.

Transportation and Handling of Materials

Transportation Routes

Public transportation routes would be utilized for the conveyance of a variety of materials to WFF. Transportation of all materials would be conducted in compliance with DOT regulations.

NASA and MARS would implement a Ground Safety Plan that outlines operational management procedures for minimizing risks to human health and the environment. These procedures are in addition to the Occupational Safety and Health Guidelines outlined in 29 CFR 1910. Guidelines that specifically pertain to Federal employees are outlined in 29 CFR 1960. Ground safety focuses on potential hazards associated with activities such as fueling, handling, assembly, and checkout for all pre-launch activities. System designs and safety controls are established to minimize the potential hazards associated with the operations of a launch range. The Ground Safety Plan addresses the following areas:

- Hazardous Materials Handling
- Explosive Safety
- Personal Protective Equipment
- Health and Safety Monitoring
- Training
- Operational Security, Controls, and Procedures

The majority of issues covered by the Ground Safety Plan deal with worker protection—to ensure the safety of personnel, property, and the public, the use of hazard quantity distances and other protective engineering controls would continue when dealing with explosives or other hazardous materials.

Handling of Liquid Propellants RP-1 and LOX

Along with the other issues addressed by ground safety, the handling of liquid fuels represents a potential environmental impact. Fueling launch vehicles with LOX and RP-1 would take place at Pad 0-A (Figures 8 and 9). Refilling LOX and RP-1 tanks would occur onsite by tank trucks. LOX and other cryogenic liquids, if spilled, could cause localized environmental damage such as grass kill due to the extreme cold associated with the liquid. LOX may explode if improperly mixed with combustible materials such as liquid hydrogen, and the gaseous oxygen evaporating from a liquid spill would intensify any existing fires. Long-term environmental impacts have not been reported due to spills of LOX (NASA, 1997). The cryogenic risk associated with the use of liquid hydrogen is similar to LOX.

The greatest risks associated with the use of RP-1 are attributable to spills or leaks. The procedures outlined in the ICP would be followed while fueling with RP-1 at Pad 0-A.

Handling of Hypergolic Propellants

Inadvertent releases of hypergolic propellants are possible from accidents during payload processing, transportation, and launches—hypergolic propellants would not be permanently stored at WFF. However, safeguarding the public, property, and the environment would be integrated at every step of the process, from design to construction to launch activities associated with this Proposed Action.

The proposed facilities would be designed and constructed specifically to meet several criteria to minimize the potential for accidents, as well as to minimize the potential impacts in the rare event an accident should occur. Facility designs would incorporate and meet criteria from the Uniform Building Code and Uniform Fire Code. Safety distance requirements would be implemented as part of the design process for storage and handling of propellants to protect personnel, other facilities, and the public. Integration of these safety criteria would also satisfy GDC requirements under the CAA. The proposed PFF and PPF would provide a completely controlled environment for critical operations.

Loading of hypergolic propellants would be performed either in the PFF or Building V-55. Each loading operation would be independent, sequential, and conducted using a closed-loop system. During the operation, all propellant liquid and vapors would be contained. If small leaks occur during propellant loading, immediate steps would be taken to stop loading, correct the leakage, and clean up leaked propellant with approved methods before continuing work. Personnel would wear protective clothing (Self-Contained Atmosphere Protective Ensemble suits) and would be closely monitored from a remote location during hazardous propellant operations. Leakage would be absorbed in an inert material for later disposal as hazardous waste, or aspirated into a neutralizer solution. Propellant vapors left in the loading system would be routed to air emission scrubbers, which are designed to remove more than 99 percent of propellant vapors. Liquid propellant left in the loading system would be either drained back to the supply containers or into waste drums for disposal as hazardous waste.

Prior to launch operations, only personnel with the appropriate clearance would be allowed access to various buildings. All other personnel are restricted from access by a security fence. Personnel are not present in the immediate vicinity of the ELV when fueling occurs. As with other launch vehicles, the fueling of Taurus II has been designed to preclude the release of fuels during normal operations.

WFF's Range Safety Manual states that bi-propellant systems shall be designed so that mixing cannot result if either the fuel or oxidizer subsystems malfunction. In general, liquid propellant systems shall be designed to prevent inadvertent mixing, especially where chemical reactions could lead to catastrophic consequences.

The likelihood of a hypergolic propellant release would be greatest during fueling operations. Under Alternative One, fueling would take place in the PFF or occasionally at Building V-55. During hypergolic fueling operations at WFF, the NASA Safety Office would employ weather data and computer models to predict the effects of an unintentional release. Based on the results of the analyses, access-controlled hazard areas would be established and maintained to ensure that public safety is not affected in the event of a mishap.

Spill response planning procedures are already in place to minimize spill size and duration, as well as any possible exposures to harmful air contaminants. In the event of an accident, the largest releases would result from the spillage of the entire quantity of liquid propellants. WFF's Hydrazine Contingency Plan would be followed in the event of an emergency or release. Lesser releases would result from fires or explosions that would consume significant fractions of the propellants. The magnitude of air releases from payload accidents would be relatively small compared to possible releases from accidents involving DOT shipping containers or launch vehicles. Therefore, payload accidents would have no substantial impact on the ambient air quality. Any impacts to public safety are anticipated to be minor and mitigatable as a result of integrating safety in the facility designs and siting of facilities, as well as maintaining a current preparedness and response plan.

Areal Locations of Hazardous Atmospheres Model (ALOHA) Results

The NASA Range Safety Office performed modeling using ALOHA, Version 5.3.1, to determine the extent of the area that could be affected during an accidental release of hypergolic propellants from ES. ALOHA is considered a very conservative model as it assumes complete evaporation of the propellant, no chemical degradation in the air, and no emergency response measures such as dilution. Background information on ALOHA is included in Appendix F.

Liquid propellant loads of 504.7 kg (1,110.3 lbs) of hydrazine, 357.95 kg (787.5 lbs) of MMH, 321.7 kg (707.7 lbs) of NTO, and 268.8 kg (591.4 lbs) of MON-3 were the basis for the analysis. These quantities are based on the propellant loads that would be required for a three-stage Taurus II (with ORK motor as third stage) carrying the Cygnus spacecraft (Moskios, pers. comm.). Two spill scenarios were established by the WFF Range Safety Office to illustrate worst-case hazard distances. The first scenario was run for a small spill of 19 liters (5 gallons). The second scenario involved releasing the entire amount of liquid propellant that could be contained in the ELV and ES. A total of 36 runs were made for each propellant for small and large leaks during the day, afternoon and night time scenarios, as well as including/excluding low-level (305 meter [1,000 feet]) atmospheric inversions. According to the WFF Weather Office, morning and evening inversion levels typically occur at approximately 915 meters (3,000 feet); however, employing a lower altitude in the model presents a more conservative analysis as the inversion would trap the released propellant vapors closer to the ground surface. Detailed information regarding conditions used for each test case is located in Appendix F.

Threat zones, which radiate outward from a release site and are considered as areas where potential threats to human health may occur, were predicted using ALOHA. A threat zone's radius and area of influence changes along with changes in wind direction, which dictate the actual direction and distance that a substance would travel. The following concentrations were used to determine the maximum threat zone for each propellant:

- Hydrazine (0.12 ppm 1-hour average)
- MMH (0.26 ppm 1-hour average)
- NTO (1.0 ppm 1-hour average)
- MON- 3 (1.0 ppm, 1-hour average)

Table 39 presents the maximum threat zones for each of the propellants based on the levels of concern (LOCs) presented below and various meteorological conditions. The maximum threat zones for each propellant based on the LOCs are for individual propellant spill scenarios. The large spill scenarios are based on the maximum amount of propellant that would be within the payload. ALOHA does not predict maximum threat zone distance based on the release of the combination of propellants. In the case of a spillage involving more than one propellant at the same time, the larger of the maximum threat zone distances would apply.

Spillage of the entire propellant load, while unlikely, could occur during the actual launch operation. A launch failure could result in a payload ground impact resulting in propellant tank rupture and spillage. The cases modeled by ALOHA are worst case since they assume that the spills are unconfined and evaporate to completion without dilution or other mitigating actions.

Table 39: Maximum Threat Zone Distances Predicted by ALOHA for Various Meteorological Conditions (Wind Speeds Constant at 4 meters/second)

Spill Size (small or large)	Spill Quantity L[1] (gallons) or kg[2] (lbs)	Atmospheric Inversion Yes or No (Y/N)	Maximum Threat Distance in kilometer (km) (mile [mi])			ALOHA Model Type Gaussian or Heavy Gas
			Morning	Afternoon	Night	
Hydrazine (0.12 ppm)						
Small	18.93 L (5.00 gallons)	Y	0.49 (0.30)	-	-	heavy gas
Small	18.93 L (5.00 gallons)	N	0.38 (0.24)	-	-	heavy gas
Small	18.93 L (5.00 gallons)	Y	-	NA[3]	-	NA
Small	18.93 L (5.00 gallons)	N	-	0.41 (0.26)	-	heavy gas
Small	18.93 L (5.00 gallons)	Y	-	-	0.70 (0.43)	Gaussian
Small	18.93 L (5.00 gallons)	N	-	-	0.53 (0.33)	heavy gas
Large	504.7 kg (1,112 lbs)	Y	4.5 (2.8)	-	-	Gaussian
Large	504.7 kg (1,112 lbs)	N	2.6 (1.6)	-	-	Gaussian
Large	504.7 kg (1,112 lbs)	Y	-	NA	-	NA
Large	504.7 kg (1,112 lbs)	N	-	2.7 (1.7)	-	Gaussian
Large	504.7 kg (1,112 lbs)	Y	-	-	4.5 (2.8)	Gaussian
Large	504.7 kg (1,112 lbs)	N	-	-	2.6 (1.6)	Gaussian

Spill Size (small or large)	Spill Quantity L[1] (gallons) or kg[2] (lbs)	Atmospheric Inversion Yes or No (Y/N)	Maximum Threat Distance in kilometer (km) (mile [mi])			ALOHA Model Type Gaussian or Heavy Gas
			Morning	Afternoon	Night	
MMH (0.26 ppm)						
Small	18.93 L (5.00 gallons)	Y	0.80 (0.50)	-	-	Gaussian
Small	18.93 L (5.00 gallons)	N	0.61(0.38)	-	-	heavy gas
Small	18.93 L (5.00 gallons)	Y	-	NA	-	NA
Small	18.93 L (5.00 gallons)	N	-	0.64 (0.38)	-	heavy gas
Small	18.93 L (5.00 gallons)	Y	-	-	0.80 (0.50)	Gaussian
Small	18.93 L (5.00 gallons)	N	-	-	0.61 (0.38)	heavy gas
Large	357.95 kg (789.15 lbs)	Y	5.1 (3.2)	-	-	Gaussian
Large	357.95 kg (789.15 lbs)	N	2.7 (1.7)	-	-	heavy gas
Large	357.95 kg (789.15 lbs)	Y	-	NA	-	NA
Large	357.95 kg (789.15 lbs)	N	-	2.9 (1.8)	-	heavy gas
Large	357.95 kg (789.15 lbs)	Y	-	-	5.1 (3.2)	Gaussian
Large	357.95 kg (789.15 lbs)	N	-	-	2.7 (1.7)	heavy gas
NTO (1 ppm)						
Small	18.93 L (5.00 gallons)	Y	1.28 (0.80)	-	-	Gaussian
Small	18.93 L (5.00 gallons)	N	1.03 (0.64)	-	-	heavy gas
Small	18.93 L (5.00 gallons)	Y	-	NA	-	NA
Small	18.93 L (5.00 gallons)	N	-	1.04 (0.65)	-	heavy gas
Small	18.93 L (5.00 gallons)	Y	-	-	1.28 (0.80)	Gaussian
Small	18.93 L (5.00 gallons)	N	-	-	1.03 (0.64)	heavy gas
Large	321.7 kg (709.2 lbs)	Y	4.7 (2.9)	-	-	Gaussian
Large	321.7 kg (709.2 lbs)	N	3.1 (1.9)	-	-	Gaussian

Spill Size (small or large)	Spill Quantity L[1] (gallons) or kg[2] (lbs)	Atmospheric Inversion Yes or No (Y/N)	Maximum Threat Distance in kilometer (km) (mile [mi])			ALOHA Model Type Gaussian or Heavy Gas
			Morning	Afternoon	Night	
Large	321.7 kg (709.2 lbs)	Y	-	NA	-	NA
Large	321.7 kg (709.2 lbs)	N	-	3.1 (1.9)	-	Gaussian
Large	321.7 kg (709.2 lbs)	Y	-	-	4.7 (2.9)	Gaussian
Large	321.7 kg (709.2 lbs)	N	-	-	3.1 (1.9)	Gaussian
MON-3 (1 ppm)						
Small	18.93 L (5.00 gallons)	Y	1.29 (0.80)	-	-	heavy gas
Small	18.93 L (5.00 gallons)	N	1.23 (0.76)	-	-	heavy gas
Small	18.93 L (5.00 gallons)	Y	-	NA	-	NA
Small	18.93 L (5.00 gallons)	N	-	1.24 (0.77)	-	heavy gas
Small	18.93 L (5.00 gallons)	Y	-	-	1.47 (0.91)	Gaussian
Small	18.93 L (5.00 gallons)	N	-	-	1.23 (0.76)	heavy gas
Large	321.7 kg (709.2 lbs)	Y	2.9 (1.8)	-	-	Gaussian
Large	321.7 kg (709.2 lbs)	N	2.1 (1.3)	-	-	heavy gas
Large	321.7 kg (709.2 lbs)	Y	-	NA	-	NA
Large	321.7 kg (709.2 lbs)	N	-	2.1 (1.3)	-	heavy gas
Large	321.7 kg (709.2 lbs)	Y	-	-	2.9 (1.8)	Gaussian
Large	321.7 kg (709.2 lbs)	N	-	-	2.1 (1.3)	heavy gas

[1] L = liters
[2] kg = kg
[3] NA = data not available

The maximum threat distance for any of the propellants based on the small spill would be less than 1,473 meters (4,833 feet); this is well within WFF's property boundaries and would not impact offsite human population or properties outside WFF. The maximum threat distances for large spills range from 2 to 5 kilometers (1.3 to 3.2 miles). This would be the maximum downwind distance that would require evacuation and control by the NASA Range Safety Office in case of an accidental release. To reduce the risk to public safety and to ensure that evacuations could be executed if needed, NASA would coordinate with local emergency response agencies during mission planning to establish roadblocks and safety corridors. Also, this type of release would be highly unlikely to occur because trained personnel perform fueling operations, and emergency response measures (dilution, absorption, etc.) would be employed immediately following a release.

Launch Activities

Medical, Fire and Police Protection

Under Alternative One, the estimated number of people moving to the Lower Delmarva Peninsula as a result of the Proposed Action is approximately 385. According to current distributions of WFF employee households among the five counties of the Lower Delmarva Peninsula, the 385 people anticipated to move to the Lower Delmarva Peninsula would be distributed as follows: 220 in Accomack County, 7 in Northampton County, 56 in Wicomico County, 20 in Somerset County, and 82 in Worcester County. The current capability of local medical, fire, and police services is sufficient to handle the additional people in the area

Range Safety

Requirements for the Flight Safety Plan, found within WFF's Range Safety Manual, include flight management procedures for minimizing risks to human health and the environment. Flight safety focuses on the flight of the launch vehicle and ensures that safety criteria are met at all times. NASA coordinates all operations with the FAA, U.S. Navy, USCG, and other organizations as required in order to clear the potential hazard areas. Notices to mariners (called NOTMARS) and airmen (called NOTAMS) listing restricted or hazardous areas shall be made available at least 24 hours prior to launch. All launch limitations are published in the Flight Safety Plan.

WFF Range Safety Office uses models to predict launch hazards to the public and onsite personnel prior to every launch. These models calculate the risk of injury resulting from toxic gases, debris, and blast overpressure from both normal launches and launch failures. Launches are postponed if the predicted risk of injury exceeds acceptable limits. Current estimates for the Taurus II and similar ELVs indicate that a typical mission PLDA would be a 380-meter (1,250-foot) radius around Pad 0-A and the LHA would be a 3.04-kilometer (1.89-mile) radius around the launch pad.

A flight trajectory analysis is completed prior to each launch. As part of this analysis, flight termination boundaries are designated to ensure that vehicle destruction occurs within a predetermined safety zone. This safety zone is established for the protection of human safety. If an ELV approaches the edge of the safety zone, the flight would be terminated by WFF Range Safety personnel. ELVs are equipped with a Flight Termination System that allows personnel to remotely trigger an explosive charge on the ELV. Once triggered, the explosive charge would penetrate the motor causing the ELV to rapidly decelerate. This ensures that spent stages or debris would only strike approved ocean areas cleared of shipping or air traffic. In rare cases, over-flight of land areas might be permitted if all Range Safety requirements are met. In addition, while failures have occurred in the past, the history of WFF offers no evidence of acute or cumulative environmental impacts as a result of launch failures.

With implementation of safety procedures, appropriate training, and oversight of activities under Alternative One by WFF's Range Safety Branch, events that have the potential to adversely affect human health and safety would be minimized or eliminated; therefore, no adverse impacts on health or safety are expected.

Probability of Launch Failure

When an ELV is launched, four outcomes can occur: successful launch, abort (abandoning the mission prior to takeoff), failure, and partial failures (defined as failures for which the payload is left by the launch vehicle in an incorrect orbit and lifespan is reduced because the payload expends fuel to reach its final orbit).

Rockets launched from MARS would be equipped with radio receivers and ordnance for in-flight destruction if the flight is determined to be erratic. The system is designed to terminate rocket motor thrust upon activation; however, it is possible that a portion of the ELV may fall into the ocean or in the Pad 0-A area. Toxic concentrations of contaminants would be quickly dissipated by the ocean currents.

A Programmatic EA completed by DOT in 1986 (USDOT, 1986) discusses the accidental release of an entire load of kerosene from an Atlas V rocket into the ocean. The Atlas is a liquid-fueled main stage rocket with a fuel capacity larger than the Taurus II. The thin film of liquid propellant released from an Atlas rocket evaporates quickly. While evaluating the accidental release from an Atlas, DOT determined that “due to the relatively small area involved and fleeting nature of the phenomena, no substantial environmental effect is expected.” The 1986 DOT Programmatic EA also addresses the near-shore (shallow water) accidental releases from Titan and Delta rockets, which both utilize liquid propellants, and concludes that although release of liquid propellant into the environment might be regarded as a substantial impact, such an extreme event is not considered likely. The 1986 DOT Programmatic EA determined that the probability of a launch failure is estimated at 1 percent.

For this EA, the FAA characterized the amount of orbital-class launch failures between 1989 and 2009, as shown in Table 40.

Table 40: Orbital Launch Attempt Failures 1989–2009*

	Failures and Total Orbital Attempts	**Percent of launches that have failed**
Department of Defense	9 of 164	5.5
NASA	2 of 173	<1.2
U.S. Government	11 of 337	3.3
Commercial**	11 of 147	7.5

Source: FAA, 2009a and FAA, 2009b

*Data does not include Sea Launch built by Ukraine and Russia (licensed by FAA) and does not include suborbital launches. Non-commercial launches were divided between the Department of Defense and NASA based on payload mission, not by the organization responsible for conducting the launch. The data does not include the 4 commercial and 10 non-commercial partial failures.

**Commercial launch is defined as a U.S. launch that is licensed by FAA.

Additionally, the Taurus II is designed to achieve 98 percent or greater launch capability (Orbital, 2008). NASA evaluated the probability of launch failure for the Athena-3, which is a larger ELV than the Taurus II, in the 1997 Launch Range Expansion EA and concluded that "such an event [launch failure] should not pose a substantial environmental impact" (NASA, 1997). Therefore, impacts from launch failure events are not considered a substantial adverse environmental impact.

If a launch failure were to cause rocket debris to land in the ocean, NASA would implement its emergency cleanup procedures as discussed in the EA. NASA would also report the incident to the VDEQ Pollution Response Program, and if there is contamination of natural resources, NASA would report the incident to the National Response Center and the Virginia Emergency Operations Center.

Alternative Two

Under Alternative Two, the types of impacts to health, safety and prevention and mitigation measures would be the same as those described for Alternative One. However, because fewer launches would occur under Alternative Two, fewer people would be moving to the lower Delmarva Peninsula, and less transportation, handling, and storage of hazardous materials including propellants would occur, there would be less impacts than for Alternative One.

4.4.4 Cultural Resources

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to cultural resources.

Alternative One

Section 106 of the NHPA requires Federal agencies take into consideration the effects of their undertakings on historic properties and to allow the Advisory Council on Historic Preservation (ACHP) the opportunity to comment on such undertakings. As defined in the Act, "historic properties" are one of five resource types—buildings, structures, object, sites, or districts—that are listed in or eligible for listing in the NRHP. Although buildings and archaeological sites are most readily recognizable as historic properties, a diverse range of resources are listed in the NRHP including roads, landscapes, and vehicles. As noted above, resources less than 50 years of age are not generally eligible for listing in the NRHP, but may be if they are of exceptional importance. Accordingly, to be in compliance with Section 106 of the NHPA, NASA must consider the effects of the proposed undertaking on all properties that are listed in or eligible for listing in the NRHP—both those owned by NASA within the boundaries of WFF, as well as those located outside of WFF that may be affected.

The geographical area within which an undertaking may affect historic properties is the Area of Potential Effects (APE). As stipulated in Section 106, Federal agencies must identify historic properties within the APE and consider the effects of the undertaking on these properties. The *Historic Resources Survey and Eligibility Report for Wallops Flight Facility* (NASA, 2004) referenced earlier in this report serves as the baseline for the identification of the above-ground historic properties at WFF, while the archaeological sensitivity model presented in the *Cultural Resources Assessment, NASA Wallops Flight Facility* (NASA, 2003c) serves as the baseline for identifying potential archaeological resources. Together these studies, addressed in the Cultural

Resources Management Plan for WFF, likely account for many of the historic properties that are present at WFF and as such allow for a general assessment of the potential for an undertaking to affect historic properties.

The information contained within the cultural resources studies suggests that Alternative One would have a low potential to adversely affect either above-ground or archaeological historic properties. Alternative One would not have a direct effect on identified historic properties either within or outside of WFF. Alternative One may have indirect visual and auditory effects on identified historic properties in the APE, including the Wallops Coast Guard Lifesaving Station and Observation Tower, but these effects would not likely be adverse.

Site Improvements

Modifications to Boat Dock

In 2008, NASA carried out Section 106 consultation with VDHR on a project to make extensive alterations and improvements to the North Island Boat Basin and access road to accommodate the transport of the Max Launch Abort System (MLAS) vehicle, an undertaking that included components similar to those proposed for the MARS project. In documentation submitted to VDHR, NASA determined that the North Island Boat Basin no longer retained integrity necessary for listing in the NRHP, and that the undertaking would have no effect on above-ground and archaeological historic properties. In their response letter dated April 22, 2008, VDHR concurred with NASA's findings. As the scope of actions under Alternative One is analogous to the MLAS undertaking, it is unlikely that historic properties would be affected.

Payload Fueling Facility

Above-Ground Resources: The proposed PFF is new construction in an area at the north end of Wallops Island where there are few existing structures. However, the PFF would be located approximately 0.8 kilometer (0.5 mile) northeast of the NRHP-eligible Wallops Coast Guard Lifesaving Station and Observation Tower. The exact specifications of the PFF are not yet determined, but it is estimated that the building would occupy approximately 450 square meters (5,000 square feet) and be a maximum of 30.5 meter (100 feet) tall in the high bay. As such, the PFF would likely be visible from the Wallops Coast Guard Lifesaving Station and Observation Tower. However, the distance of the PFF, and the presence of other utilitarian built resources related to the NASA presence on the island suggest that the construction of the PFF would have no adverse effect on the historic property. NASA is currently negotiating a Memorandum of Agreement (MOA) with VDHR for the demolition of this resource pursuant to an undertaking unrelated to the MARS project. As the Station and Tower are located within the existing hazard arc of the rocket motor storage facility, the resources can no longer be occupied and NASA has determined that the Station and Tower will be demolished. The MOA stipulates that NASA will seek to donate the Station to a party that will remove the building from WFF prior to demolition.

The community of Chincoteague is located approximately 3.5 kilometers (2.2 miles) northeast of the proposed PFF location, and Assateague Island is located approximately 5 kilometers (3.2 miles) northeast. Although the PFF may be visible from these sites, visibility at that distance is expected to be minimal.

Archaeological Resources: The proposed PFF is located on the northern portion of Wallops Island in an area that is not designated as having either high or moderate potential for prehistoric or historic archaeological resources. Therefore, NASA has determined that the proposed construction would have no effect on archaeological resources eligible for listing in the NRHP, and that no further archaeological investigations are warranted.

<u>Payload Processing Facility</u>

Above-Ground Resources: The PPF would be located approximately 0.6 kilometer (0.4 miles) northeast of the NRHP-eligible Wallops Coast Guard Lifesaving Station and Observation Tower, and 380 meters (1,250 feet) west of the PFF. The exact specifications of the PPF are not yet determined, but it is estimated that the building would be a maximum of 23 meters (75 feet) tall (high bay). As such, the PPF would be visible from the Wallops Coast Guard Lifesaving Station and Observation Tower. However, the distance of the PPF, and the presence of other utilitarian built resources related to the NASA presence on the island, suggest that the construction of the PPF would have no adverse effect on the historic property.

The community of Chincoteague is located approximately 3.9 kilometers (2.4 miles) northeast of the proposed PPF location, and Assateague Island is located approximately 5.5 kilometers (3.4 miles) northeast. Although the PPF may be visible from these sites, visibility at that distance is expected to be minimal. In a letter dated July 2, 2009, the NPS concurred with NASA's determination that the PPF would have no adverse effect on the cultural landscape and vistas associated with the Assateague Beach Coast Guard Station, located on Assateague Island.

Archaeological Resources: The proposed PPF is located on the northern portion of Wallops Island in an area that is not designated as having either high or moderate potential for prehistoric and historic archaeological resources. Therefore, NASA has determined that the proposed construction would have no effect on archaeological resources eligible for listing in the NRHP, and that no further archaeological investigations are warranted.

<u>Horizontal Integration Facility</u>

Above-Ground Resources: The HIF would be located approximately 4.3 kilometer (2.7 miles) southwest of the NRHP-eligible Wallops Coast Guard Lifesaving Station and Observation Tower. The exact specifications of the HIF are not yet determined, but it is estimated that the building would be 21 meters (70 feet) tall. As such, the HIF would be minimally visible from the Wallops Lifesaving Station and Observation Tower, suggesting that the construction of the HIF would have no adverse effect on the historic property.

The construction of the HIF may result in indirect visual effects to resources in close proximity. Extant building and structures located in the vicinity of the proposed HIF location include W-65 (Rocket Build-up/Payload Process/Assembly Shop #3, 1962), W-96 (Assy. & Ckout/Mobile Shelter, 1964), X-75 (Island Terminal, 1960), X-80 (MET Tower, circa 2008), X-85 (Special Projects, 1963), and X-140 (Electrical Storage Building/POMB Material Storage, 1970). None of these resources have been evaluated for their eligibility for listing in the NRHP, so it is unknown whether or not they are historic properties. However, because these properties are NASA-built, utilitarian resources constructed for the purpose of rocket development and testing, it is not expected that the HIF would detract from the physical context of historic properties, if present, and therefore is not likely to have an adverse effect on these properties.

The HIF, while tall, would be located a considerable distance (approximately 3.2 kilometers [2 miles]) from historic properties on the mainland, if present, resulting in minimal visibility on the landscape. Additionally, the presence of numerous other tall buildings and structures at WFF, such as X-80 (MET Tower, circa 2008), suggests that the HIF would not have an adverse effect on historic properties outside of WFF, if present.

Archaeological Resources: The proposed HIF is located in the middle of Wallops Island in an area that is not designated as having either high or moderate potential for prehistoric or historic archaeological resources. Therefore, NASA has determined that the proposed construction would have no effect on archaeological resources eligible for listing in the NRHP, and that no further archaeological investigations are warranted.

Transportation Infrastructure

Above-Ground Resources: New road construction and improvements to existing roads between the North Island Boat Dock, PFF, PPF, and HIF, are not expected to affect extant built resources and are, therefore, not likely to result in adverse effects to above-ground historic properties should they be present.

Archaeological Resources: The locations and specifications for existing road improvements, for the roads from the PFF or PPF to the HIF, would consist of either new construction or widening or straightening existing roads, resulting in up to 0.2 hectares (0.5 acres) of pavement. The exact locations and specifications have not yet been determined, but existing roads and proposed roads between the PFF, PPF, and HIF do not cross areas designated as having either high or moderate potential for prehistoric or historic archaeological resources. Therefore, NASA has determined that the proposed construction would have no effect on archaeological resources eligible for listing in the NRHP, and that no that further archaeological investigations are warranted.

Pad 0-A Improvements

Aboveground Resources: Constructed in 1994 by the Virginia Commercial Space Flight Authority to support Commercial Experiment Transporter (COMET) launches, Launch Pad 0-A was not included in the 2004 *Historic Resources Survey and Eligibility Report for Wallops Flight Facility*. The structure was utilized for the launch of the Conestoga rocket on October 23, 1995. This was the only test conducted at Launch Pad 0-A and the facility has not been used since the Conestoga/COMET launch. Proposed work includes new construction of a pad access ramp and launch mount, liquid fuel storage tanks and piping, as well as a security fence and camera towers. A deluge system would be constructed, including an above-ground water tank not to exceed 38 meters (125 feet) in height. Additionally, four lightning protection towers, not to exceed 60 meters (200 feet) in height, would be constructed adjacent to the launch pad. Several resources in the vicinity of Launch Pad 0-A were included in the 2004 survey and were determined not eligible for listing in the NRHP, including Z-035 (Tracking Camera Turret, 1951), Z-065 (Blockhouse #1, 1952), and Z-70 (Launch Area 1, 1952). Properties outside of WFF on the mainland are located more than 2.4 kilometers (1.5 miles) from Pad 0-A, suggesting that the water tank and antenna towers would be minimally visible. The existence of other towers and water tanks within the WFF facility on Wallops Island further suggests that the new water tank would have no adverse effect on historic properties on the mainland should they be present.

Archaeological Resources: The proposed ramp and deluge system at Launch Pad 0-A are located outside of areas designated as having a moderate or high potential for archaeological resources and no archaeological survey is warranted.

Transportation, Handling, and Storage of Materials

Transportation, handling, and storage of materials are not anticipated to have an adverse effect on historic properties.

Launch Activities

Because the launches would increase from 12 to 18 a year, the indirect auditory effects to historic properties in the APE are expected to be negligible; therefore, launch activities are not expected to have an adverse effect on historic properties.

Agency Consultation

NASA initiated Section 106 consultation with VDHR in May 2009 for the proposed actions under Alternative One as originally submitted in the Draft EA. In a letter dated July 15, 2009, VDHR responded stating that it concurred with NASA's determination that the project alternatives [No Action and Alternative One] as presented in the Draft EA (without the HIF and associated infrastructure) would have no adverse effect on historic properties.

NASA initiated Section 106 consultation with the NPS in June 2009 for the proposed actions under Alternative One as originally submitted in the Draft EA. In a letter dated July 2, 2009, the NPS concurred with NASA's determination that the project alternatives [No Action and Alternative One] as presented in the Draft EA (without the HIF and associated infrastructure) would have no adverse effect on the cultural landscape and vistas associated with the Assateague Beach Coast Guard Station, located on Assateague Island. In a subsequent letter to the SHPO dated August 13, 2009, NASA determined that the addition of the HIF to Alternative One would have no adverse effect on historic properties. In a reply letter dated August 24, 2009, VDHR responded stating that it concurred with NASA's determination that the project alternatives, including the HIF and associated infrastructure, would not adversely affect any historic properties.

Alternative Two

Impacts from transportation, handling, and storage of materials and launch activities would be the same as those described for Alternative One. Impacts from site improvements would be different from Alternative One and are described below.

Site Improvements

Modifications to Boat Dock

Modifications to the boat dock are the same as under Alternative One; therefore, impacts to cultural resources would be the same under Alternative Two as described under Alternative One.

Building V-45 High Bay

Aboveground Resources: Building V-45 (Horizontal Dynamics and Static Balancing Facility, 1963) is located approximately 0.8 kilometer (0.5 mile) southwest of the NRHP-eligible Wallops Coast Guard Lifesaving Station and Observation Tower. The exact specifications of the addition are not yet determined, but it is estimated that the addition would not exceed 23 meters (75 feet) tall (high bay). NASA has determined that V-45 is not eligible for listing in the NRHP and is not a historic property. Accordingly, NASA has determined that the construction of the addition would have no direct adverse effect on historic properties.

The addition may be visible from the Wallops Lifesaving Station and Observation Tower. However, the distance of V-45, and the presence of other utilitarian built resources related to the NASA presence on the island, suggest that the construction of an addition to V-45 would have no adverse effect on the historic property.

The community of Chincoteague is located approximately 5.1 kilometers (3.2 miles) northeast of V-45, and Assateague Island is located approximately 6.4 kilometers (4.0 miles) northeast. Although the addition to V-45 may be visible from these sites, visibility at that distance is expected to be minimal.

Archaeological Resources: The proposed Building V-45 addition is located on the northern portion of Wallops Island in an area that is not designated as having either high or moderate potential for prehistoric and historic archaeological resources. Therefore, NASA has determined that the proposed construction would have no effect on archaeological resources eligible for listing in the NRHP, and that no further archaeological investigations are warranted.

<u>Modifications to Buildings V-50 and V-55</u>

Aboveground Resources: The nature of modifications to buildings V-50 (Dynamic Control Building, 1963) and V-55 (Vertical Dynamic and Static Balancing Facility, 1963) has not yet been defined, but they would be contained within the existing building footprints are would be largely confined to the interiors. NASA has determined that these buildings, and V-45 located immediately to the southwest, are not eligible for listing in the NRHP and are not historic properties. Accordingly, NASA has determined that the proposed modifications would have no adverse effect on above-ground historic properties.

Archaeological Resources: The proposed modifications to buildings V-50 and V-55 would be contained within the existing building footprints, and would require no ground disturbance. Therefore, NASA has determined that the proposed modifications would have no effect on archaeological resources eligible for listing in the NRHP, and that no further archaeological investigations are warranted.

<u>Transportation Infrastructure</u>

Aboveground Resources: New road construction and improvements to existing roads between the North Island Boat Dock and Building V-45 are not expected to affect extant built resources and are, therefore, not likely to result in adverse effects to aboveground historic properties should they be present.

Archaeological Resources: The locations and specifications for existing road improvements for the roads from the North Island Boat Dock to Building V-45 and the southern ingress/egress to Building V-45 (see Figure 10) would consist of either new construction, widening, or straightening existing roads, resulting in up to 0.2 hectare (0.5 acre) of pavement. The existing roads and proposed roads do not cross areas designated as having either high or moderate potential for prehistoric or historic archaeological resources. Therefore, NASA has determined that the proposed construction would have no effect on archaeological resources, and that no further archaeological investigations are warranted.

<u>Pad 0-A Improvements</u>

Modifications to Pad 0-A are the same as under Alternative One; therefore, impacts to cultural resources would be the same under Alternative Two as described under Alternative One.

Agency Consultation

In a letter to the SHPO dated August 13, 2009, NASA determined that Buildings V-45, V-50, and V-55 were not eligible for listing in the NRHP, and that Alternative Two would have no adverse effect on historic properties. In a letter dated August 24, 2009, VDHR responded stating that it concurred with NASA's determination that the project alternatives would not adversely affect any historic properties.

4.4.5 Transportation

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to transportation.

Alternative One

Site Improvements

Temporary impacts to traffic flow would occur during construction activities due to an increase in the volume of construction-related traffic at roads in the immediate vicinity of Wallops Island. Traffic lanes may be temporarily closed or rerouted during construction, and construction equipment and staging could interfere with typical vehicle flow. NASA and MARS would coordinate all transportation activities, including closures, traffic control, safety issues, etc. with Accomack County and the Virginia DOT Accomack Residency Office. To mitigate potential delays, NASA and MARS would:

- Provide adequate advance notification of upcoming activities for all areas that would be affected by construction-related traffic, temporary closures, or re-routing
- Coordinate any traffic lane or pedestrian corridor closures with all appropriate officials
- Place construction equipment and vehicle staging so as to not hinder traffic and pedestrian flow
- Minimize the use of construction vehicles in residential areas

Transportation, Handling, and Storage of Materials

When payload processing is completed, the rocket (ELV and ES) would be encapsulated and transported to Pad 0-A. Accidents during transport would be extremely unlikely because movement of the rocket would be carefully controlled in convoys with security escorts. Several factors would minimize the consequences of an accident should one occur. The forces imparted to the encapsulated spacecraft during an accident would be small because of the low speeds involved during transport and the spacecraft would be protected from damage by the capsule and a protective blanket. Should the spacecraft be damaged, it would be unlikely that the propellant tanks would be damaged. In the unlikely event of a propellant leak, transport and security personnel would be protected by following emergency procedures developed in the project's ground safety plan and wearing appropriate protective clothing.

Transportation routes that may be utilized for the conveyance of ELVs, ELV components, payloads, fuels, and other materials necessary to support the Proposed Action include public roads, airplane delivery of materials to the airport at the Main Base, and barge deliveries that would either navigate from the boat basin at the Main Base or through Chincoteague Inlet and arrive at the boat dock on Wallops Island. Transportation of all materials would be in compliance with DOT regulations. Potential toxic corridors (transportation routes for toxic or hazardous substances) are defined in mission-specific Operations and Safety Directives. These hazard zones are designed to protect personnel, the environment, and the public. Fully fueled spacecraft or any other potentially hazardous material to be transported would be appropriately placarded and transported following Federal and State transportation regulations.

The largest load transported to Wallops Island under Alternative One would be the stage one core arriving by barge from the port of Newport News, Virginia, and would never be transported over a public road. All other components would consist of legal DOT loads, although approximately 30 loads arriving via truck would be characterized as oversize and would require a permit from the Virginia Department of Motor Vehicles for transportation. In 2008, 104,175 oversized load permits were issued by the Virginia Department of Motor Vehicles; the loads arriving at WFF would be a negligible amount compared to the total travelling on State roads.

The truck traffic arriving at WFF under Alternative One can be broken into two categories: recurring traffic that would be necessary for each launch event and non-recurring traffic that would be related to a one-time event. The lists below include an example of the types of loads that would be delivered via truck for Taurus II over public roads under Alternative One; other deliveries may also occur.

Recurring traffic:

- Stage 2 of ELV (Trucked from Promontory, Utah), Hazardous
- Main engines (Trucked from Stennis, Mississippi)
- Main engine Thrust Frame (Trucked from Dulles, Virginia), Oversized
- Interstage/motor cone (Trucked from Chandler, Arizona)
- Avionics shelf (Trucked from Chandler, Arizona)
- Fairing aft cylinder (Trucked from Chandler, Arizona), Oversized
- Fairing halves (Trucked from Chandler, Arizona), Oversized (two trucks)
- Payload service module (Trucked from Dulles, Virginia)
- Miscellaneous United Parcel Service, U.S. Postal Service, and Federal Express deliveries
- Cargo delivery (Trucked from various U.S. locations and arriving by aircraft)
- Cranes to support static fire test (up to twice per year)

Non-recurring traffic:

- Construction traffic
- Pad 0-A components (strongback and erector mechanism) (Trucked from California), Oversized
- Miscellaneous heavy mechanical ground support equipment deliveries, Oversized (some)

Oversize items that are trucked in to the Main Base via Route 175 may require temporary closure of that roadway. NASA would coordinate with the local electric company to shut down the electricity in the overhead power lines along the transportation route, as necessary. The closure and power shut down would likely last a maximum of 2 hours and would occur in the middle of the night for minimal impact on electricity users and traffic. NASA and MARS would coordinate the closure with Accomack County, the Virginia State Police, and the Virginia DOT Accomack Residency Office.

Launch Activities

Temporary traffic closures would occur on Wallops Island roads, the causeway going from Wallops Island to the Mainland, and potentially other public roads in the Wallops Island vicinity prior to and immediately after launches. NASA and MARS would coordinate all transportation activities including closures, traffic control, and safety issues with Accomack County, the Virginia State Police, and the Virginia DOT Accomack Residency Office. NASA and MARS would alert personnel and contractors of temporary closures.

NASA and MARS would coordinate all launch operations with the FAA, USCG, Virginia Capes Operating Area, the Fleet Area Control and Surveillance Facility, and other organizations as required in order to clear any areas of air and maritime traffic (including commercial and recreational boats); NOTMARS and NOTAMS listing restricted or hazardous areas shall be made available at least 24 hours prior to launch. All launch limitations would be established in the project's safety plans and would be conveyed to the public prior to the launch to minimize transportation interruptions.

Alternative Two

Transportation impacts under Alternative Two would be the same as those described under Alternative One, but there would be less traffic (barge and truck) travelling to and within WFF because there would be fewer launches.

4.5 CUMULATIVE EFFECTS

The CEQ defines cumulative effects as the "impact on the environment which results from the incremental impact of the action(s) when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1500). NASA has determined that the Proposed Action alternatives, in conjunction with the impacts of other WFF projects and operations, could result in cumulative impacts on some resources.

4.5.1 Past, Present, and Reasonably Foreseeable Projects

4.5.1.1 Wallops Research Park

The Wallops Research Park (WRP) project will create an integrated business park for aerospace research and development programs, scientific research, commercial space industries, and educational centers. Development of the WRP will take place adjacent to the Main Base at WFF over a 20-year period; some development has occurred, but the majority of the Proposed Action has not been constructed. WRP will consist of a multi-use development created for non-retail commercial, government space, science research, educational facilities, and public recreation areas. An EA was prepared for the construction of WRP, which resulted in a FONSI (NASA, 2008f).

4.5.1.2 North Unmanned Aerial Vehicle Airstrip

NASA is currently considering the construction of an unmanned aerial vehicle (UAV) airstrip on north Wallops Island. The purpose of the North UAV Airstrip would be to provide a venue and infrastructure to support launch and recovery operations for UAVs. UAVs are small aircraft that serve as platforms for small science instruments. They are controlled remotely by a pilot on the ground and are powered by batteries or small model aircraft gasoline engines. The east-west orientation of this airstrip would provide an alternative to the north-south positioning of the current UAV airstrip on south Wallops Island. The airstrip is currently planned for late 2009 or early 2010; an EA is currently being prepared.

4.5.1.3 Shoreline Restoration and Infrastructure Protection Program

A Shoreline Restoration and Infrastructure Protection Program (SRIPP) is currently being planned at WFF to help reduce the risk of damage to existing NASA, U.S. Navy, and MARS assets on Wallops Island that are at risk due to extensive shoreline retreat. The proposed program may include: 1) dredging of approximately 3 million cubic yards of sand from a borrow site located in Federal waters, and subsequent sand placement on the Wallops Island shoreline with maintenance dredging to be performed every 5 years for the duration of the project's 50-year design life; 2) construction of a sand retention structure at the south end of Wallops Island; and 3) extension of the existing seawall a maximum of approximately 1,400 meters (4,500 feet) south. Implementation of this program is planned for 2010. An EIS is currently being prepared for the SRIPP.

4.5.1.4 Alternative Energy Project

The purpose of WFF's Alternative Energy Project is to generate clean, renewable energy from a technologically proven source that will be used by WFF in order to meet Federal renewable energy requirements. WFF plans to implement the use of wind turbines and solar panels in order to reduce the fossil fuels needed to create electricity while also reducing WFF's annual operation costs. NASA is currently preparing an EA for the project; implementation of this project is planned for 2010.

4.5.1.5 WFF Launch Range Activities

NASA can currently launch up to approximately 102 rockets a year from the launch areas on Wallops Island. These include a maximum of 60 from the Sounding Rocket Program, 12 from orbital rocket missions at Pad 0-B, and 30 from Navy missiles and drones (NASA, 2005).

Orbital Rockets

The Lockheed Martin Athena-3 class vehicle is the largest vehicle expected to be launched from WFF in terms of solid propellant weight for the first stage (approximately 133,120 kg [293,479 lbs]). The 1997 WFF Launch Range Expansion EA analyzed 12 annual launches of the Athena-3 class vehicle as an upper bound for environmental effects (NASA, 1997).

Sounding Rockets

Sounding rockets at WFF, managed under the NASA Sounding Rockets Program, carry research payloads with scientific instruments to altitudes up to 1,600 kilometers (994 miles). Scientific data are collected and returned to Earth by telemetry links. The NASA Sounding Rockets Program primarily operates for NASA, but serves other government agencies, universities, industry, and foreign countries as well. Several launch vehicles could be used to support the Sounding Rocket Program. The largest sounding rocket launched to date in terms of propellant weight is the Black Brant XII (approximately 3,350 kg [7,385 lbs]).

Since 2001, NASA has averaged six sounding rocket launches and one orbital launch per year from the launch areas on Wallops Island (NASA, 2008a).

Drones and Missiles

Drone targets are used at WFF as part of missile training exercises conducted by the U.S. Navy and supported by NASA. Targets are used to test the performance of shipboard combat systems, as well as to provide simulated real-world targets for ship defense training exercises. Drone targets are either launched from the WFF Range or air-launched from military aircraft in controlled airspace.

4.5.2 Potential Cumulative Effects by Resource

Resources that may experience cumulative impacts are discussed below.

4.5.2.1 Surface Waters Including Wetlands

The Proposed Action would have a minor and temporary impact on the water resources of the affected region; the incremental contribution to cumulative water resource impacts from the Proposed Action would not be substantial.

The area surrounding MARS Launch Complex 0 has historically seen many rocket launches and local water resources have been exposed to launch impacts by many past actions. Impacts on water resources from other launches at WFF may result from incidental spills and release of propellants from on-pad accidents or emergencies, launch anomalies, or rocket stages falling in the ocean. Such spills or releases may affect surface water, including wetlands. Emergency response and cleanup procedures similar to those discussed under the Proposed Action would be employed to address on-pad accidents and emergency releases, and solid waste recovery and treatment would reduce the severity of launch anomalies. Table 41 shows the amount of wetland impacts for current and proposed projects at WFF. The type of impact for all current projects including the WRP would be permanent fill, except for the UAV airstrip.

Table 41: Amount of Wetlands Affected for Current and Proposed Projects on Wallops Island

Project	Amount of Wetlands Affected hectares (acres)
Wallops Research Park	0.4 (1)
UAV Airstrip	0.4 (1) filled 0.8 (2) converted
Alternative Energy Project	0.4 (1)
SRIPP	0
Expansion of WFF Launch Range – Alternative One[1]	1.7 (4.1)
Total	**3.7 (9.1)**

[1]Because Alternative One would result in a larger amount of wetlands impacts than Alternative Two, it was used for the cumulative effects analysis.

In addition, past projects have resulted in wetlands impacts. Table 42 provides detailed information on Wallops Island wetland impacts including the amount of area impacted, compensation that was completed as mitigation, and the net change in wetland area as a result.

Table 42: Amount of Wetlands Affected from Past Projects on Wallops Island

Date	Project	Area Impacted hectares (acres)	Impact Type	Compensation hectares (acres)	Net Change hectares (acres)
Oct. 1997	Pad 0-A	0.13 (0.32)	Permanent Fill	0.71 (1.76)	0.55 (1.44)
Feb. 2002	Navy MFR	0.0085 (0.021)	Temporary Fill	0.0085 (0.02)	0 (0)
Nov. 2004	Navy DDG	0.85 (2.1)	Permanent Fill	0.76 (4.35)	0.91 (2.25)
Apr. 2008	Boat Dock	0.014 (0.033)	Permanent Fill, Shading	0.026 (0.064)	0.0125 (0.031)
	Total	**1.0 (2.47)**		**2.5 (6.2)**	**1.5 (3.7)**

The current and proposed projects on Wallops Island would have a combined impact of 3.7 hectares (9.1 acres). Previous compensation resulted in 1.5 hectares (3.7 acres) of wetlands gained. Therefore, the cumulative impact of past, current, and proposed projects on Wallops Island would result in a net loss of 1.2 hectares (5.4 acres) of wetlands which would require compensatory mitigation.

NASA would obtain necessary permits including Section 404 and Section 10 permits for all proposed projects that would affect wetlands. Additionally, NASA is currently preparing a Wetlands Inventory and Management Plan for WFF. The goal of this effort is to provide strategic regulatory, environmental, and land use analysis of all wetlands on the Main Base, Wallops Mainland, and Wallops Island in order to develop a comprehensive long-term wetland management plan for the facility.

Because NASA would implement compensatory wetland mitigation measures (agreed upon through the JPA consultation process) to offset any impacts and ensure no net loss of wetlands, no substantial cumulative adverse impacts to wetlands are anticipated.

4.5.2.2 Groundwater

The UAV Airstrip, SRIPP, and Alternative Energy projects are not expected to increase potable water demand at WFF. The estimated total potable water demand for the WRP (4,156,000 liters [1,098,000 gallons] per month) would be permitted under the Main Base VDEQ groundwater withdrawal permit; therefore, water demands from WRP would not affect or be included in the water usage of Wallops Mainland and Wallops Island.

Alternative One is anticipated to result in the withdrawal of approximately 2,045,400 liters (540,300 gallons) per month (Table 43). The combined water demand of existing Wallops Island and Wallops Mainland added to Alternative One would result in approximately 4,926,400 liters (1,301,400 gallons) of water withdrawn per month and 47,534,980 liters (12,557,400 gallons) per year, which are below the VDEQ groundwater withdrawal permit of 6,813,740 liters (1,800,000 gallons) per month and 50,345,980 liters (13,300,000 gallons) per year respectively. Therefore, Alternative One, when combined with other WFF projects and existing usage, is not anticipated to contribute to substantial adverse cumulative impacts to the sole source aquifer. WFF would monitor groundwater withdrawal rates to ensure continued compliance with WFF's VDEQ groundwater withdrawal permit.

Table 43: Cumulative Analysis of Groundwater Withdrawal Rates

Activity	Usage Rate Per Month Liters (Gallons)	Usage Rate Per Year Liters (Gallons)
Alternative One[1] Total	2,045,400 (540,300)	12,961,300 (3,4924,000)
Existing Wallops Island and Wallops Mainland Combined Usage	2,881,000 (761,100)	34,573,680 (9,133,400)
Alternative One Added to Existing Usage	4,926,400 (1,301,400)	47,534,980 (12,557,400)
Existing Permit Limits[2]	6,813,740 (1,800,000)	50,345,980 (13,300,000)

[1]Because Alternative One would result in a larger volume of water usage than Alternative Two, it was used for the cumulative effects analysis.
[2]Wallops Island and Wallops Mainland VDEQ Permit.

4.5.2.3 Air Quality

Construction-related activities under the Proposed Action and the other projects planned at WFF would occur at different locations and at different times over a period of several years. Such activities would result in fugitive particulate emissions (PM_{10} and $PM_{2.5}$) from site preparation (earth moving/soil disturbance) and wind erosion. The amount of fugitive dust would depend on numerous factors including: degree of vehicular traffic; amount of exposed soil; soil moisture content; and wind speed. The extent and duration of these projects would vary; however, best management practices (e.g., dust suppression and establishment of lower speed limits in construction areas) would be implemented on each project to minimize and mitigate those emissions.

Construction activities would also create combustion product (tailpipe) emissions (mostly PM, NO_X, and CO) from contractor personal vehicles, delivery trucks, heavy construction equipment, and temporary non-road equipment powered by internal combustion engines. Emissions from the mobile sources associated with these projects occurring at WFF would be short-term, negligible, and localized.

Cumulative emissions from these construction projects are unlikely to lead to a violation of the NAAQS as regional concentrations are already in attainment, with no indication that a re-designation for any criteria pollutant is imminent. Therefore, minimal and short-term cumulative impacts from construction-related activities are anticipated; there would not be a substantial effect on local or regional air quality, or violation of NAAQS.

Launches in general would have only a localized impact on air quality. Long-term effects are not expected because the Taurus II launches would occur as independent events. Therefore, as the resulting emissions from all launch activities at WFF would be rapidly dispersed and diluted by winds, regional air quality would not be affected and the NAAQS are not expected to be exceeded by launches of the Taurus II launch vehicle when added to the air emissions from existing WFF activities. Since each launch is an independent event, no substantial cumulative impacts to air quality are expected. In addition, the installation of two wind turbines planned on Wallops Island under the Alternative Energy Project would offset over 5,230 metric tonnes (5,760 tons) of CO_2 emissions per year.

Climate Change

In 2004, emissions of CO_2 from fossil fuel combustion totaled 29 gigatonnes (31,967,030,000 tons) per year globally out of a total 49 gigatonnes (54,013,250,000 tons) of global emissions from all sources (IPCC, 2007).

As discussed in Section 4.2.3.2, the proposed action alternatives would emit small amounts of GHGs compared to global emissions. In Virginia, the three largest GHG emission sources are transportation, non-utility uses of fuel in commercial, industrial, and residential facilities, and electricity generation (Bryant, 2008). According to some agencies, the effects of launch vehicle propulsion exhaust emissions on stratospheric ozone depletion, acid rain, toxicity, air quality, and global warming are extremely small compared to other human activities (AIAA, 1991; FAA, 2001). However, to help reduce GHG from its facilities and activities, WFF would comply with the federally mandated EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*. EO 13423 instructs Federal agencies to conduct their environmental, transportation, and energy-related activities in an environmentally, economically, and fiscally sound efficient and sustainable manner. It also directs Federal agencies to implement sustainable practices for energy efficiency, reductions in GHG emissions, and use of renewable energy. The Federal Energy Policy Act requires Federal agencies to increase the usage of renewable fuel sources by 3 percent between 2007 and 2009, 5 percent between 2010 and 2012, and by 7.5 percent for 2013 and beyond.

The principal source of GHG emissions associated with both proposed action alternatives would be from energy use due to construction, transportation of materials/cargo, electricity for buildings, and pre-launch activities). NASA consumes energy primarily across four end-use sectors for all agency use: 1) standard buildings; 2) industrial, laboratory, and other energy-intensive facilities; 3) exempt facilities; and 4) vehicles and equipment, including aircraft operations. From fiscal year 1990 through fiscal year 2005, NASA reduced its total annual primary energy consumption by approximately 16 percent (DOE, 2006).

There are several measures currently in place at WFF, as well as initiatives to be implemented in the near future, that would reduce energy consumption and therefore reduce GHG emissions. For instance, NASA has replaced almost 50 percent of its entire light-duty government-owned fleet (30 out of 70 vehicles) with newer, more fuel efficient vehicles. WFF has switched to biodiesel for equipment and mobile generators. WFF is also in the process of decentralizing the Central Boiler Plant/steam system with individual propane boilers, an estimated emissions reduction of 4,400 metric tonnes per year (4,900 tons per year) of CO_2 compared to the 2007 baseline.

Under the proposed Alternative Energy project, WFF would install two wind turbines on Wallops Island, or solar panels with an equivalent amount of energy generated by two turbines, that would utilize wind and/or solar energy to reduce GHG emissions by reducing the use of fossil fuels to generate electricity. Although the proposed action alternatives would result in minor additional energy demands at WFF compared to baseline operations, the Alternative Energy Project would offset over 4,500 metric tonnes (5,000 tons) of CO_2 emissions per year.

To help mitigate beach erosion and sea level changes that may occur as a result of climate change, WFF has installed temporary geotextile tubes in areas where there is no sea wall to protect portions of eroded beach from further damage. The SRIPP is planned for implementation in the next decade, which would permanently replace the geotextile tubes and mitigate beach erosion that may be worsened by sea level rise. Additionally, WFF would elevate the first floor of new buildings above the base flood elevation, or ensure that equipment and materials that may be damaged by flooding or cause pollution of flood waters would be stored above the base flood elevation.

WFF is committed to complying with Federal policies that address climate change, and would implement measures to reduce or mitigate GHG emissions and promote sustainable energy and resource use practices. Therefore, substantial cumulative impacts to the global climate from the Proposed Action, when added to other known and foreseeable regional actions, are not anticipated.

4.5.2.4 Terrestrial Wildlife and Migratory Birds

Construction and launch noise could temporarily affect wildlife in the area (e.g., short-term disruption of daily/seasonal behavior). Some vegetative damage may occur from heat from the launch and acid deposition in the near-field areas. Potential cumulative impacts to terrestrial wildlife and migratory birds could result from habitat alteration and disturbance under the Proposed Action and other projects planned at WFF; however, since vast areas of habitat will remain on Wallops Island and the surrounding area, no substantial cumulative impacts on wildlife or migratory birds are anticipated.

4.5.2.5 Marine Mammals and Essential Fish Habitat

For marine species, the potential exists for direct contact or exposure to underwater shock/sound waves from the splashdown of spent rocket motors and spacecraft. The likelihood for protected marine mammals or sea turtles to be located in close proximity to the impact points is extremely low, as launches from both Pad 0-A and Pad 0-B would occur only a few times per year, and impacts from each flight would not likely occur at the same locations.

The WRP, Alternative Energy Project, and UAV Airstrip do not involve work in marine waters; therefore, there would be no effects to marine mammals. However both the Alternative Energy Project and UAV Airstrip could affect tidal wetlands and therefore impact EFH. EFH assessments will be included in the EAs for these projects and NASA will consult with NMFS Habitat Conservation Division to develop appropriate mitigation measures, if needed. NASA is currently consulting with NMFS regarding potential effects to both marine species and EFH for the proposed SRIPP. NASA will continue to consult with NMFS to develop appropriate mitigation measures, prior to implementing the program.

As such, NASA does not anticipate substantial cumulative effects to marine mammals or EFH from current and proposed projects.

4.5.2.6 Threatened and Endangered Species

The WRP, Alternative Energy Project, and UAV Airstrip do not involve work in marine waters and therefore would not affect threatened or endangered marine species. As part of the EIS process, NASA is currently consulting with NMFS and USFWS regarding potential effects to threatened and endangered marine species from the proposed SRIPP. NASA will continue to consult with NMFS and USFWS to develop appropriate mitigation measures, prior to implementing the program.

NASA has completed informal consultation with USFWS on the WRP, concluding that the project would have no effect on federally listed species. Currently, NASA is consulting informally with USFWS regarding potential effects to federally listed species from proposed projects including the Alternative Energy Project, SRIPP, and UAV Airstrip.

NASA has determined that although the proposed and current launch activities may adversely affect both piping plover and federally protected sea turtles, the effect on either is not likely to be substantial. NASA prepared a BA for potential effects to listed sea turtles, seabeach amaranth, piping plover and the red knot (Appendix C); the conclusion of the Section 7 process is pending. NASA and MARS would not begin any facility operations or launch activities until Section 7 consultation is completed and a BO is issued by USFWS.

As all future projects at WFF would be subject to Section 7 review and consultation, NASA would adhere to all avoidance and mitigation measures issued by USFWS. Therefore, the current range of operations on Wallops Island, when combined with the Proposed Action and other WFF projects, is not anticipated to result in substantial adverse cumulative effects to federally listed species.

4.5.2.7 Population

The Alternative Energy Project, the UAV Airstrip, and the SRIPP do not require the addition of permanent employees.

The estimated number of people moving to the Lower Delmarva Peninsula as a result of the WRP is approximately 2,430; however, this would occur over a 20-year period due to gradual build-up of the WRP over 20 years. An EA done for the WRP concluded that impacts to population are not likely to occur due to the long lead time. Additionally, the population growth attributed to the WRP over a 10-year period (1.5 percent) compared to the “background” population growth in Accomack County over a 10 year period (between 1990 and 2000) does not indicate that the population growth from WRP would result in a substantial impact on population within Accomack County. The WRP EA also stated that even if Accomack County schools do not increase student capacity, the WRP would not result in adverse impacts to public and private schools, and that in addition, the increase in taxes generated by the additional WRP-employed families would add to the county’s ability to implement upgrades to schools.

The number of people moving to the lower Delmarva Peninsula under the Proposed Action would comprise less than 1 percent of the Accomack County’s projected population of 37,350 in 2010 (VEC, 2008). The combination of additional population due to the Proposed Action and the WRP would not result in a substantial increase in the population of Accomack County or the Lower Delmarva Peninsula due to the reasons described in the WRP EA (stated above).

4.5.2.8 Economic Growth

New jobs and economic benefits to the local economy, including tax revenue, would occur under all projects at WFF. However, quantified information for jobs and tax revenue is only available for the WRP and this Proposed Action; this information is shown in Table 44. Because other jobs and economic benefits would occur as a result from other projects, the numbers in Table 43 are conservative for the cumulative effects of all WFF projects.

Table 44: Jobs and Economic Growth Summary for WRP and Proposed Action

	Number of New Jobs	Tax Revenue Increase Over 20-Year Period
Expansion of WFF Launch Range - Alternative One[1]	125	$23,000,000
Wallops Research Park	708	$133,000,000
Total	**833**	**$156,000,000**

[1]Because Alternative One would result in a larger amount of jobs and tax revenue than Alternative Two, it was used for the cumulative effects analysis.

Source: VEDP, 2008

Educational systems in the surrounding areas, such as CNWR, benefit from WFF's expertise. WFF offers educational tours for schools and other organizations, as well as WFF personnel lecturing at schools and judging school science fairs. The expansion of launch range operations is anticipated to introduce additional educational and recreational experiences for both local residents and tourists.

4.5.2.9 Health and Safety

At this stage of their respective NEPA analyses, the Alternative Energy Project, the UAV Airstrip, and the SRIPP are not anticipated to adversely impact public or WFF employee health or safety.

Due to an increase on the demand for medical, fire, and police services from development of the WRP (WRP would result in approximately 2,430 additional people in the Lower Delmarva Peninsula over a 20-year period) along with the Proposed Action, adverse cumulative impacts to human health and safety could occur if existing capacity of medial, fire, and police services are exceeded. However, the increase in taxes generated by the additional residents would add to the counties' ability to implement upgrades to emergency services. Also, safety procedures and appropriate training would be implemented to ensure that events that have the potential to adversely impact human health and safety are minimized. All operations at WFF must comply with applicable standards, policies, and procedures for health and safety. All rocket launches and other hazardous operations are closely reviewed and analyzed to ensure that there are no unacceptable risks to the public, WFF personnel including tenants (USCG, U.S. Navy, MARS), or contractors. Because implementation of the Proposed Action would also comply with these same requirements, no substantial cumulative impacts to health and safety are expected to occur.

4.5.2.10 Department of Transportation Section 4(f) lands

This EA includes an investigation of impacts due to the Proposed Action upon parks, recreation areas, and wildlife refuges and historic structures that are on, or are eligible for inclusion on, the NRHP. The Proposed Action would not be considered a constructive or physical use of 4(f) properties; therefore, it would not result in impairment of 4(f) properties.

At this stage of their respective NEPA analyses, the Alternative Energy Project, the UAV Airstrip, and the SRIPP are not anticipated to adversely impact Section 4(f) lands.

Closures of the southern end of Assateague Island including a portion of CNWR may occur for launches from Pad 0-A or 0-B. Combining the current 12 ELV launches from Pad 0-B and the proposed 6 additional launches from Pad 0-A, could result in up to 18 closures of the southern end of the CNWR per year. NASA has an established agreement with CNWR for such closures and coordinates with CNWR personnel during mission planning to ensure that closures do not adversely affect CNWR activities. The value of CNWR in terms of its significance and enjoyment is not substantially reduced or lost due to launch activities at WFF. Instead, the northern area of CNWR has become a popular observation location for viewing NASA and MARS launches.

4.6 PERMITS, LICENSES, AND APPROVALS

The following list of potential permits, licenses, and approvals are likely to be required for the Proposed Action. The agency responsible for each is included after the identified permit, license, or required consultation. Any required permits, licenses, or approvals would be obtained prior to construction.

- CWA Section 404 Dredge and Fill Permit, USACE
- Rivers and Harbors Act Section 10 Permit, USACE
- CWA Section 401 Water Quality Certification/Virginia Water Protection Permit, VDEQ
- Virginia Stormwater Management Program Permits, Virginia DCR
- VPDES Industrial Stormwater Permit Modification, VDEQ
- Virginia Marine Resources Commission Permits, VMRC
- MEC Avoidance Plan and Health and Safety Plan, WFF
- Biological Opinion, USFWS
- Modification of State Operating Permit, VDEQ
- Air Quality Permit to construct proposed emission sources, VDEQ

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SECTION SEVEN PUBLIC PARTICIPATION

NASA is the lead Federal agency for conducting the NEPA compliance process for this EA at Wallops Flight Facility. The lead agency's goal is to expedite the preparation and review of NEPA documents while meeting the intent of NEPA and complying with all NEPA provisions including NHPA, EO 12114, EO 11988, EO 11990, CAA, CWA, and the Resource Conservation and Recovery Act.

The Draft EA was available for public review between April 24, 2009, and May 11, 2009, at the following locations:

NASA WFF Technical Library
Building E-105
Wallops Island, VA 23337
(757) 824-1065
Hours: Mon–Fri: 8 a.m. to 4:30 p.m.

Eastern Shore Main Public Library
23610 Front Street
P.O. Box 360
Accomac, VA 23301
Phone: (757) 787-3400
Monday, Tuesday, Wednesday, Friday:
9 a.m. to 6 p.m.
Thursday: 9 a.m. to 9 p.m.
Saturday: 9 a.m. to 1 p.m.

Island Library
4077 Main Street
Chincoteague, VA 23336
(757) 336-3460
Hours: Mon: 10 a.m. to 2 p.m.
Tues: 10 a.m. to 5 p.m.
Wed, Fri, Sat: 1 p.m. to 5 p.m.

NASA solicited public and agency review and comment on the environmental impacts of the proposed action through:

1. A notice of availability of the Draft EA published in the Eastern Shore News on April 25, 2009 and the Chincoteague Beacon on April 30, 2009 (Appendix H).
2. Publication of the Draft EA on the WFF Environmental Office Web site.
3. Consultations with local, State, and Federal agencies.
4. Direct mailing of the Draft EA to interested parties.

Public comments on the Draft EA and NASA's responses are shown in Appendix I. The Final EA can be viewed on the WFF Environmental Office Web site:
http://sites.wff.nasa.gov/code250/docs/EWLR_FEA.pdf

A limited number of copies of the Final EA are available by contacting:

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Appendix A

ELV Specifications and Descriptions

SPECIFICATIONS AND DESCRIPTION OF EXPENDABLE LAUNCH VEHICLES (ELVS)

TAURUS II LAUNCH VEHICLE

Orbital Sciences Corporation is currently developing the Taurus II, which is designed to carry medium-class payloads into a variety of orbits (See Figure A-1). More information on Taurus II is provided below.

Taurus II is a two-stage launch vehicle designed to transport medium-class payloads weighing up to 5,750 kg (12,676 lbs) (Orbital, 2008). An optional third stage can be added. Taurus II incorporates both liquid and solid stages; the first stage uses liquid oxygen (LOX) and rocket propellant-1 (RP-1) as the propellant, the second stage is a solid motor propelled by hydroxyl-terminated polybutadiene (HTPB), and the optional third stage called Orbit Raising Kit (ORK) uses bipropellant hypergolics (nitrogen tetroxide [NTO] and monomethyl hydrazine [MMH]). For high-energy orbits, a Star 48V solid propellant kick motor could be used as a third stage.

Taurus II will stand roughly 40 meters (131 feet) tall, assuming a 9- to 10-meter- (30- to 33-foot-) long payload fairing. The 2.36-meter- (7.74-foot-) diameter Castor 30 second stage would fit within a 3.9-meter- (12.8-foot-) diameter, 4 to 5-meter- (13 to 16 foot-) tall “interstage” section.

Stage 1 will carry approximately 177,436 kg (391,179 lbs) of LOX and 65,000 kg (142,339 lbs) of RP-1 propellant, weigh 18,751 kg (41,253 lbs) empty, and stand 27 meters (88 feet) tall. The first stage structure features two AJ26-62 (Americanized Ukrainian NK33) engines.

The first option for Stage 2 would use a new Castor 30 motor fueled by a solid composite propellant with AP, aluminum, and HTPB. Propellant weight for the Castor 30 is 12,815 kg (28,252 lbs). A second option for Stage 2 would utilize a liquid-propelled motor that will carry approximately 13,250 liters (3,500 gallons) of LOX and 10,600 liters (2,800 gallons) of liquid methane (CH_4).

The optional third stage consists of a 3-engine bipropellant hypergolic pressure-fed propulsion system called an ORK. After completion of the second stage burn, the Castor 30 motor would be jettisoned from the ORK, allowing the third stage to provide the final precision orbit insertion burn and/or orbit raising maneuvers. The ORK will contain up to 322 kg (710 lbs) of NTO as oxidizer and 358 kg (789 lbs) of MMH as fuel. For higher energy missions, the Taurus II third stage could be a Star 48V solid propellant kick motor that would utilize 2,010 kg (4,431 lbs) of composite (AP, ammonium, and HTPB) propellant.

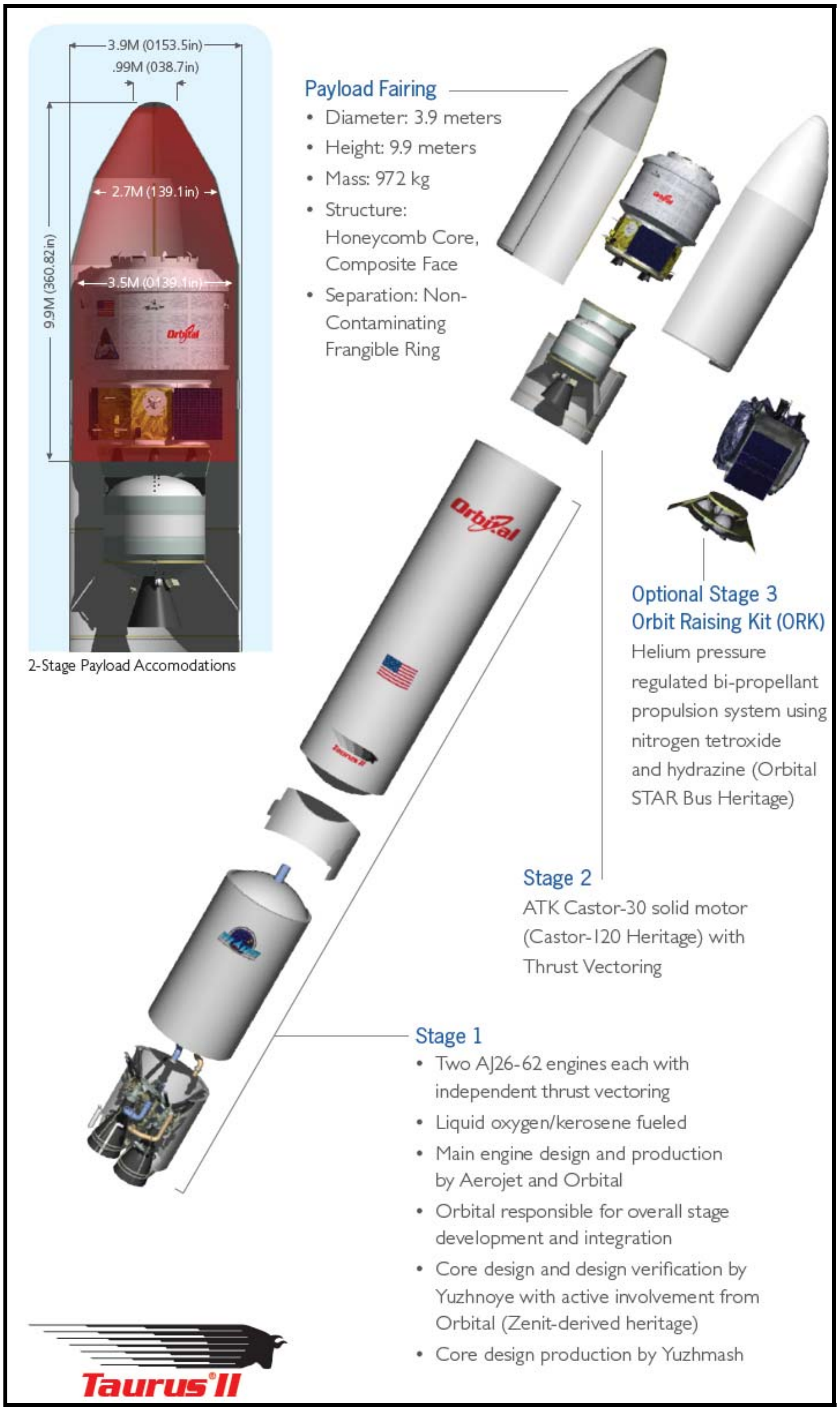

Figure A-1. Taurus II Rocket Configuration (*Source: Orbital Taurus II Fact Sheet, 2008)*

FALCON FAMILY OF LAUNCH VEHICLES

The Falcon family of launch vehicles utilizes a partially reusable launch system designed and manufactured by SpaceX. The two-stage-to-orbit rockets use LOX/RP-1 for both stages.

Falcon 1 and 1e

The Falcon 1 is a small, unmanned, light-lift, two-stage, liquid-fueled vehicle with a gross lift-off weight of approximately 27,273 kg (60,000 lbs) that can carry payloads between 125 kg (275 lbs) and 454 kg (1000 lbs) depending on the orbit. The Falcon 1 measures 21 meters (70 feet) in length with a diameter of 167 centimeters (66 inches), tapering to 152 centimeters (60 inches) on the second stage.

The Falcon 1e is based on the Falcon 1; however, it has an extended first stage tank. The Falcon 1e is also rated as a light-class launch vehicle with a gross lift-off weight of approximately 35,000 kg (77,000 lbs) and an overall length of approximately 27.4 meters (90 feet).

Both the first and second stages of the Falcon 1 and Falcon 1e use only liquid propellants (LOX and RP-1). The first stage uses a turbo pump to feed the propellant, while the second stage is pressure-fed using gaseous helium stored in high pressure, composite over-wrapped cylinders to pressurize the propellant tanks. Quantities of helium required for Falcon 1 processing are 16.5 kg (36.9 lbs) for first stage pressurization, engine spin start, and purging, and 9.8 kg (21.7 lbs) for second stage pressurization. The helium flow is controlled through solenoid valves. Propellant use and specifications for each stage are as follows.

<u>First and Second Stages</u>

The first stage uses a turbo pump to feed the propellant, while the second stage is pressure-fed using gaseous helium stored in high-pressure, composite over-wrapped cylinders to pressurize the propellant tanks.

The first stage consists of aluminum LOX and RP-1 tanks with a common bulkhead powered by a 40,823 kg (90,000 lbs) thrust Merlin LOX/RP-1 engine with Pintle Injector, a pump-fed gas generator cycle, turbine exhaust roll control, and hydraulic thrust vector control. The propellant tanks hold 15,586 kg (34,362 lbs) of LOX and 7,159 kg (15,782 lbs) of RP-1. The second stage consists of aluminum-lithium LOX and RP-1 tanks with a common bulkhead, and uses helium as a pressurant. The engine is a 3,402 kg (7,500 lbs) thrust Kestrel engine with Pintle injector, hot helium attitude control, and an electromagnetic actuator for thrust vector control. The propellant tanks hold 5,941 kg (5,941 lbs) of LOX and 1,142 kg (2,517 lbs) of RP-1. Please refer to Table 4 of this EA for amounts of LOX and RP-1 and engine specifications for Falcon 1e.

Falcon 9

The Falcon 9 is a medium class launch vehicle with a gross lift-off weight of approximately 315,000 kg (693,000 lbs) and an overall length of 54 meters (178 feet). The Falcon 9 uses LOX and RP-1 to carry payloads into orbit and is basically a scaled-up version of the Falcon 1 vehicle.

<u>First and Second Stages</u>

The first stage of the Falcon 9 is approximately 3.6 meters (12 feet) by 30.5 meters (100 feet), and includes 9 Merlin engines, the same engine used on the first stage of the Falcon 1. The second stage is approximately 3.6 meters (12 feet) by 12.5 meters (41 feet), not including the fairing and payload, and uses one or two Merlin engines. The fairing is 5.2 meters (17 feet) by 15.2 meters (50 feet), and a smaller version may also be used. The first stage consists of LOX and kerosene tanks that hold 146,000 liters (38,672 gallons) of LOX and 94,000 liters (24,840 gallons) of kerosene. The second stage consists of 27,600 liters (7300 gallons) of LOX and 17,400 liters (4600 gallons) of kerosene in tanks with a common bulkhead.

Figure A-2. Falcon 9 sitting on launch pad (*Source: SpaceX, 2008)*

Appendix B

Payload Checklist

For a payload to be covered under this EA, it must meet specific limiting criteria, which are determined by evaluating a series of questions that serve as a payload checklist (checklist). The checklist should be evaluated following the format below as soon as the proposed payload and spacecraft subsystems are sufficiently defined (i.e., the end of Phase A/beginning of Phase B – during the Formulation Phase).

If responses to all checklist questions are negative (i.e., the condition is not present), the candidate mission would be considered covered by this EA. If answers to any of the checklist questions are positive, further NEPA analysis and documentation or clarification would be required. The nature and scope of the any incremental environmental review process, analysis, and documentation required would be determined in consultation with NASA Headquarters.

1. Would the candidate mission return a sample from an extraterrestrial body? (A1)

   Spacecraft that would return air, soil, or other materials from any extraterrestrial body or from interplanetary space are not covered by this EA. This includes spacecraft that would return a sample to the Earth's surface and spacecraft that would return a sample only to Earth orbit.

2. Would the candidate spacecraft carry radioactive sources such that launch could not be approved by the NASA Office of Safety and Mission Assurance (OSMA) Nuclear Flight Safety Assurance Manager (NFSAM) per NASA Procedural Requirement (NPR) 8715.3B (NASA Safety Manual)? (B1, B2)

   Spacecraft carrying any radioactive material for power, heat sources, instrument calibration, structural members, or any other purpose must be analyzed and reviewed for launch approval with the level of analysis and approval determined by the quantity of radioactive material. The NASA NFSAM may approve launch for small quantities of radioactive material that have been shown to present no substantial public hazard. Spacecraft that would carry radioactive sources requiring launch approval at the OSMA Associate Administrator level or above are not covered by this EA and would require further NEPA analysis per Table 6.1 of NASA's NPR 8715.3B Chapter 6, the type of radioactive material relates to its activity (A_1 and A_2)[2] (see Table 1 of Appendix D in NPR 8715.3B), and the amount of radioactive material determines the A_1 and A_2 multipliers. For the radioactive instrument calibration and measurement sources NPR payloads would launch, the sum of all of the A_2 values onboard the spacecraft contributes to a value known as the "A_2 mission multiple." For the purposes of this EA, the upper limit of the NFSAM's signature authority is less than 10 times the A_2 mission multiple.

3. Would the candidate spacecraft be launched on a vehicle and launch site combination other than those listed in this EA? (C1)

   The group of launch vehicles selected for routine payload spacecraft has been approved for launch from the launch sites listed. The environmental impacts of these vehicles have been reported in previous NEPA documentation.

[2] The A_2 multiplier for each radioactive source is based on the International Atomic Energy Agency (IAEA), Safety Series Number 6, Regulations for the Safe Transport of Radioactive Material, 1985 edition as amended in 1990, Section III, paragraphs 301 through 306, and summed to determine the A_2 mission multiple.

4. Would the proposed mission launch(es) cause the launch rate (per year) for a particular launch vehicle or total launches to exceed the launch rate previously approved and permitted at the proposed launch site? (C2)

   NEPA documentation for each launch vehicle has been approved assuming a particular number of annual launches from WFF. If adding the launch(es) required by the proposed spacecraft to the existing launch manifest would cause the number of launches to exceed the approved annual number for any year, further NEPA analysis would be required.

5. Would the candidate mission require the construction of any new facilities or substantial modification of existing facilities beyond the scope of this EA? (D1)

   Payload spacecraft would use only existing launch site facilities including roads, utilities, payload and launch vehicle processing facilities, and launch complexes. Minor modifications to existing facilities required for launch of the proposed spacecraft would be covered by this EA only if the associated activities remain within the scope of permitted operations at all proposed launch sites. Any non-covered modification or new construction would require further NEPA analysis.

6. Would the candidate spacecraft utilize any hazardous propellants, batteries, ordnance, radio frequency transmitter power, or other subsystem components in quantities or levels exceeding the ES in Table 5 of this EA? (E1)

   The routine payload Envelope Spacecraft defines the upper limits of quantities and levels of commonly used materials and systems that routine payload spacecraft may carry. These values are presented in Table 5 of this EA.

7. Would the candidate spacecraft utilize any potentially hazardous material as part of a flight system whose type or amount precludes acquisition of the necessary permits prior to its use or is not included within definition of the ES? (E2)

   Routine payload spacecraft may carry small quantities of hazardous materials that are not included as part of the ES description. If so, the required local permit(s) must be identified (if currently in force) or obtained (if new or renewed) before the material is used at the launch site.

8. Would the candidate spacecraft release material other than propulsion system exhaust or inert gases into the atmosphere? (E3)

   Routine payload spacecraft do not release or vent any material into the atmosphere that could present a hazard or substantial environmental impact either during launch preparations or launch.

9. Would launch of the candidate spacecraft suggest the potential for any substantial impact on public health and safety not covered by Chapter 4 of this EA? (E4)

   The environmental impact of routine payload spacecraft is bounded by the potential impact of preparation and launch of Envelope Spacecraft as presented in Chapter 4 of this EA. Changes in preparation, launch, or operation from standard practices described in this EA would require review to determine if the changes or associated environmental impacts are substantial enough to require further NEPA review.

10. Would the candidate spacecraft utilize an Earth-pointing laser system that does not meet the requirements for safe operations according to the analysis techniques in ANSI Z136.1-2000 and ANSI Z136.6-2005? (E5)

    Routine payload spacecraft may carry Earth-pointing laser systems as part of scientific instrumentation. Routine payload laser systems must meet performance criteria that eliminate the potential for the laser energy to present a health hazard for persons on the ground or in aircraft. Laser systems that would operate only in interplanetary space or in orbit around other planets are not required to meet the eye-safe requirement if they have systems that would prevent use when pointing toward the Earth. This EA documents not only the laser safety standards but also the required notifications and permits that must be obtained prior to use of Earth-pointing laser systems.

11. Would the candidate spacecraft contain pathogenic microorganisms (including bacteria, protozoa, and viruses) that could produce disease or toxins hazardous to human health? (E6)

    Spacecraft that would carry live or inactive disease-causing biological agents as part of an experiment package are not covered by this EA.

12. Would the candidate spacecraft have the potential for substantial effects on the environment outside the United States or on the global commons? (F1)

    If the launch or operation of the candidate spacecraft in the course of normal or anomalous operations might cause substantial effects outside of the United States, further analysis must be performed in accordance with Executive Order 12114, Environmental Effects Abroad of Major Federal Actions*, and NASA regulations (14 U.S.C. § 1216.321).*

13. Would launch and operation of the candidate spacecraft have the potential to create substantial public controversy related to environmental issues? (F2)

    Based on prior NASA experience and associated review, routine payload spacecraft are considered routine in that they would not present any environmental impacts that are new or unusual and would not raise or be likely to create substantial public controversy related to environmental concerns.

Appendix C

Biological Assessment for Proposed and Ongoing Orbital Launch Operations at Wallops Flight Facility

FINAL Biological Assessment for Proposed and Ongoing Orbital Launch Operations at Wallops Flight Facility

National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337

August 2009

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1. Introduction

1.1. Purpose of Document

Section 7(c) of the Endangered Species Act (ESA) of 1973 requires that a Biological Assessment (BA) be prepared for all federal actions that may affect federally listed or proposed endangered or threatened species. The federal action considered in this BA is the funding and authorization of proposed and ongoing orbital launch operations at the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center's Wallops Flight Facility (WFF) in Wallops Island, Virginia.

NASA has prepared this BA to consider the potential impacts to listed species under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS) that may occur within the proposed project area. Listed species that may occur within the action area include the threatened piping plover (*Charadrius melodus*), the threatened loggerhead sea turtle (*Caretta caretta*), endangered green (*Chelonia mydas*) and leatherback (*Dermochelys coriacea*) sea turtles, the federally threatened seabeach amaranth (*Amaranthus pumilus*), and the federal candidate red knot (*Calidris canutus rufa*). In previous discussions regarding the proposed project, NASA and USFWS have concluded that Kemp's ridley and hawksbill sea turtles are unlikely to occur within the action area. Two other protected species are known to occur on the Delmarva Peninsula; the federally endangered Delmarva Peninsula Fox Squirrel (*Sciurus niger cinereus*) and the federally threatened Northeast Beach Tiger Beetle (*Cincinela dorsalis dorsalis*). Though it occurs on nearby Assateague Island, the Delmarva Peninsula Fox Squirrel does not occur on those parts of the island (Overwash and Hook) deemed to be part of the action area (Buffa, pers. comm., 2009). The Northeast Beach Tiger Beetle does not inhabit those portions of the Delmarva Peninsula fronting the Atlantic Ocean including the action area. It is found on Chesapeake Bay beaches (Dean, 2009).

1.2. Previous ESA Consultations

During construction and operation of the Mid-Atlantic Spaceport's (MARS) launch pad 0-B, NASA formally consulted with USFWS regarding potential impacts to listed species; USFWS issued its Biological Opinion (BO) on July 14, 1997. The BO considered the impacts of the proposal on the piping plover; no incidental take was authorized. The following year, a series of discussions between NASA and USFWS in February, 1998 led to the agreement that NASA could operate its Open Burn area for the destruction of rocket motors year-round. The Open Burn Area is located approximately 400 meters (1,310 feet) north of the Assawoman Island division of the Chincoteague National Wildlife Refuge and its piping plover nesting area. In 2003, after informal consultation, USFWS issued guidelines for the operation of Uninhabited Aerial Vehicles (UAVs) from the improved road on the southern end of Wallops Island. These guidelines were designed to avoid the impacts of UAV operations on nesting piping plovers. Recent discussions with USFWS indicate that the referenced 1997 formal consultation should be reconsidered to include more current information regarding the piping plover and to include potential effects to listed sea turtles, seabeach amaranth, and the candidate red knot. This BA is intended to provide the requisite information to enable USFWS to prepare a single BO addressing the ongoing actions considered in the 1997 BO and those actions currently proposed at WFF that would enable greater orbital launch capabilities at the MARS on Wallops Island.

In April 2009, NASA informally consulted with the National Marine Fisheries Service (NMFS) regarding potential effects to listed marine mammals and sea turtles under its jurisdiction. In a July 8, 2009 letter, NMFS determined that the effect of proposed and ongoing launch operations at WFF on listed species under NMFS jurisdiction were" insignificant or discountable" and concluded that the proposed project is not likely to adversely affect those species (NMFS, 2009). As such, when addressing potential effects to listed sea turtles, this document will focus on nesting sea turtles.

2. Description of the Actions

2.1. Proposed Action

NASA and MARS are proposing to expand infrastructure on Wallops Island to support the transportation, processing, and launching of up to an additional six medium-class Expendable Launch Vehicles (ELVs) and spacecraft from Pad 0-A on south Wallops Island (Figures 1 and 2).

Figure 1 – Proposed Facility Construction on North Wallops Island

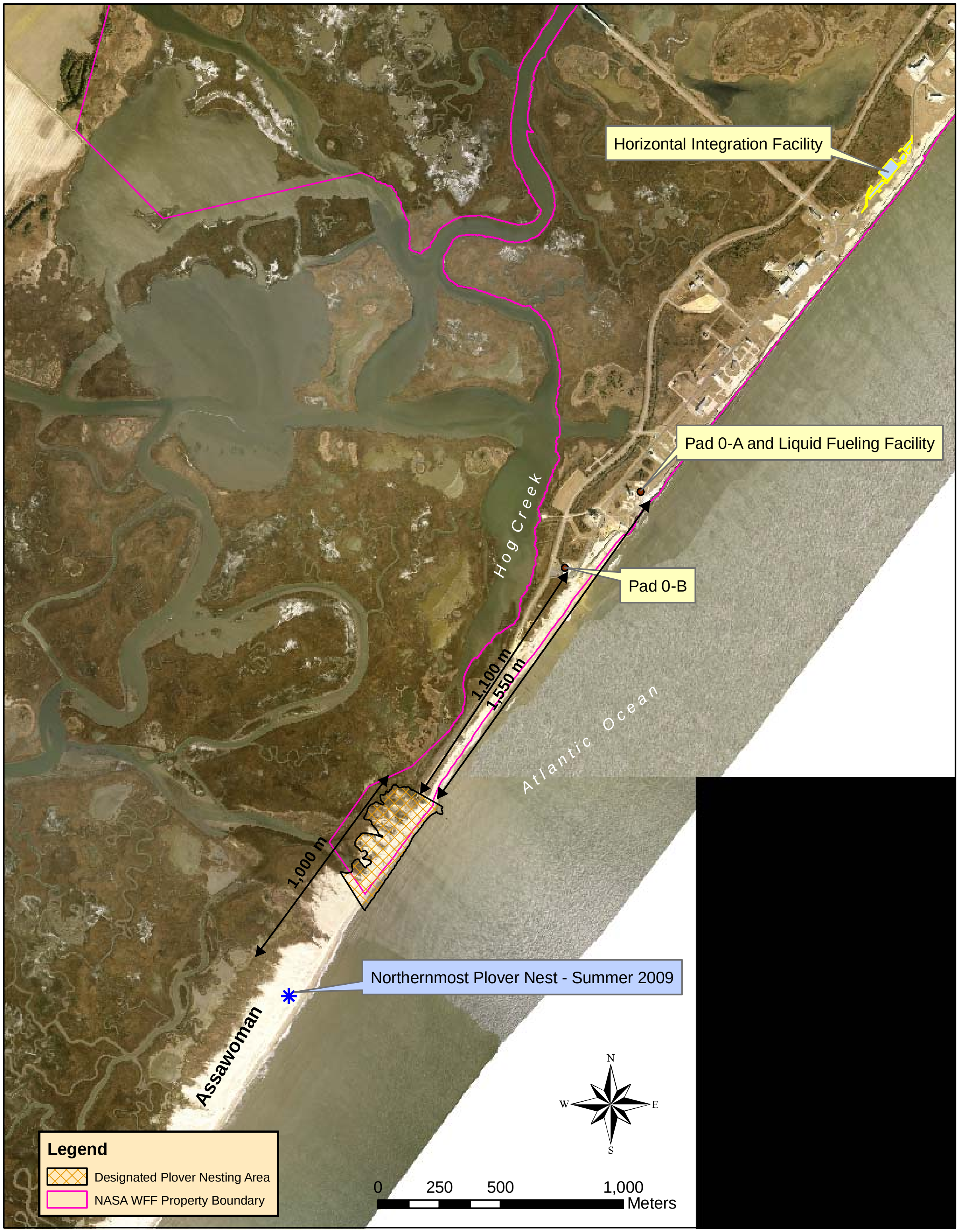

Figure 2 – Proposed Facility Construction and Ongoing Operations on South Wallops Island

Under the proposed action, NASA would:

- Install additional sheet piling at the north Wallops Island boat dock;
- Construct a Payload Fueling Facility on north Wallops Island;
- Construct a Payload Processing Facility on north Wallops Island;
- Construct a Horizontal Integration Facility in the middle of Wallops Island;
- Make improvements to existing roads; and
- Perform minor interior modifications to several existing buildings.

MARS would construct and operate a liquid fueling facility and larger launch complex in approximately the same location as existing Pad 0-A. A variety of ELVs and spacecraft would be processed at WFF and launched from Pad 0-A; however none would be larger than Orbital Sciences Corporation's Taurus II. A more detailed description of the proposed action is provided in NASA's April 2009 *Draft Environmental Assessment for the Expansion of the Wallops Flight Facility Launch Range*.

2.2. Ongoing Action

NASA and MARS would continue transporting, processing, and launching up to twelve orbital-class ELVs from existing Pad 0-B, which is located approximately 450 meters (m) (1,475 feet [ft]) south of the proposed larger Pad 0-A. A variety of ELVs would be launched, with the largest being the equivalent of the solid-fueled Lockheed Martin Launch Vehicle-3 with 8 Castor IV solid rocket motor strap-ons (LMLV-3 [8]). A more detailed description of Pad 0-B and its operations is included in the April 2009 Draft EA and the *Final Environmental Assessment for Range Operations Expansion at the National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility, Wallops Island Virginia 23337* (NASA, 1997).

2.3. Action Area

The action area is defined as a 12.6 kilometer (km) (7.8 mile [mi]) radius around the launch pad 0-B (Figure 3). This radius was chosen as the distance it would take to attenuate the launch noise from the largest vehicle that could launch from that pad to 108 decibels (dB). Noise of that sound level has been demonstrated to disturb shorebirds (Burger, 1981). Noise levels were predicted by a formula that equates noise to rocket motor thrust (NASA, 1973). The method is commonly used by the WFF Range Safety Office and is very conservative as it assumes noise levels to be distributed radially about the source.

This radius is also large enough to include noise effects from static test firing and launching the smaller Taurus II from Pad 0-A (108 dB at 9.6 km [6 mi]), lighting effects from launch support infrastructure on Wallops and nearby beaches, and NASA security patrols along the Wallops beach. The area encompasses the areas known as the Overwash and Hook on south Assateague Island, all of Wallops Island and the marsh areas to its west, all of Assawoman Island, and north Metompkin Island. Although estimated to be subject to the same sound intensities as all areas within the action area radius, the mainland area to the west of Wallops Island will not be discussed further as it is either residentially developed or farmland. This habitat would not be suitable for any of the listed species discussed in this BA with the possible exception of the Delmarva Peninsula Fox Squirrel. However, according to a USFWS fact sheet on this species it is unlikely to occur in Accomack County except on Assateague Island (USFWS, 2008c). The ocean to the east of Wallops Island was considered under the previously cited 2009 informal consultation with NMFS and also will not be further discussed.

Other direct and indirect impacts would be expected to occur within the boundaries of the action area. These include lighting associated with launch infrastructure as well as emissions and vibrations from launch events and engine tests. The impacts of vehicular security patrols along the Wallops Island beach would also be within the defined action area.

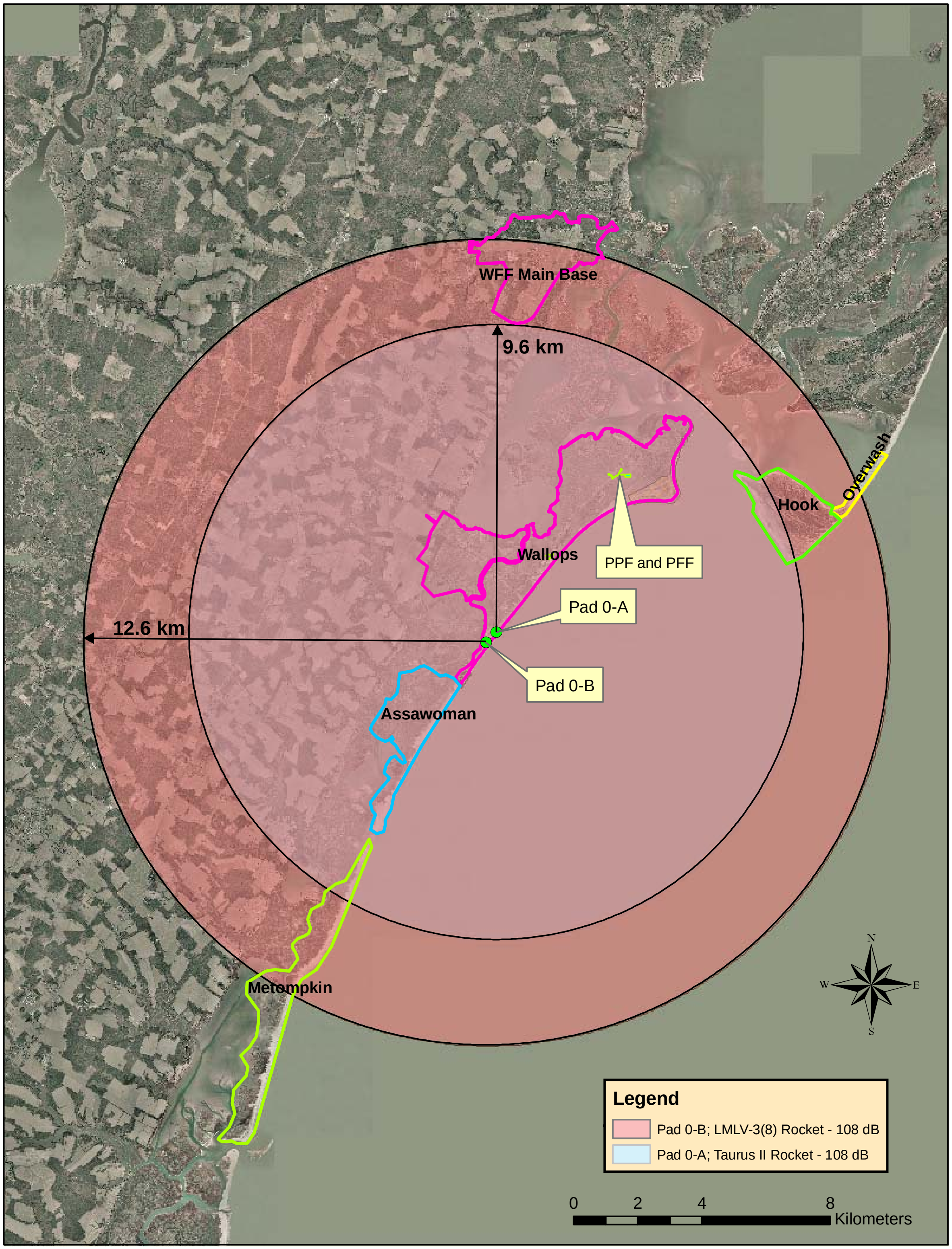

Figure 3 – Action Area

2.3.1. Assateague Island

Assateague Island is a 60 km (37 mi) long barrier island located off the eastern coast of Maryland and Virginia. The portion of the Island within the action area is managed by the USFWS as part of the Chincoteague National Wildlife Refuge (CNWR).

The two principal areas on Assateague potentially affected by the proposed action include those referred to as the Hook and the Overwash. The Hook is the southernmost portion of Assateague Island. The area begins south of the Assateague Beach Coast Guard Station and extends for 5.5 km (3.4 mi). The Hook consists of tidal flats and pools, small-vegetated dunes, wide beach areas, and shrub-scrub habitat. The Overwash is the area between the southernmost public beach parking lot and the Assateague Beach Coast Guard Station. The Overwash is 2.6 km (1.6 mi) in length. The area consists of small dunes and low-lying shell flats.

2.3.2. Wallops Island

Wallops Island is an 11 km (6.8 mi) long barrier island located southwest of Assateague Island; Chincoteague Inlet separates the two islands. The island has been utilized by NASA since WFF's establishment in 1945.

The island is generally classified into three portions. The northern portion is largely undeveloped. It consists of a rapidly accreting beach, backed by an Atlantic maritime forest residing on an ancient dune and swale system which gradually descends to an estuarine salt marsh to the west. Large stands of the invasive species of common reed (*Phragmites australis*) are found in this area.

The center of the Wallops Island is highly developed, with numerous facilities, mown grass areas, scattered areas of scrub shrub species, and large areas of *Phragmites.* Poison ivy (*Toxicodendron radicans)* and greenbriar (*Smilax rotunidifolia*) are present as well. There is no beach in the central portion of Wallops Island. The eastern side of the Island is fronted by a riprap seawall built in the 1990s to protect Wallops infrastructure from the erosion endemic to Atlantic barrier islands. The beach in front of the seawall has washed away. The saltmarsh is to the west and dominated by saltmeadow cordgrass (*Spartina patens*) in the high marsh areas, and saltmarsh cordgrass (*Spartina alterniflora*) in the lower areas.

The southern portion of Wallops Island consists of several rocket launch pads, an Unmanned Aerial Vehicle (UAV) Runway, and an Open Burn area for the destruction of off-specification rocket motors. The southern portion of the Island is subject to severe erosion. In 2006, storms devastated the beach to the east of the UAV runway and presented immediate danger to the runway itself. Geotextile tube structures have been placed along the ocean-land interface as an emergency measure until a more permanent method of protecting the shoreline can be implemented. Wallops Island is narrow at this point, with a thin ribbon of beach seaward of the geotextile tubes, mowed areas and common reed west of the geotextile tubes, and scrub-shrub species such as bayberry, wax myrtle (*Morella spp.)* and groundsel (*Bacchris halmifolia)* fringing the salt marsh to the west.

2.3.3. Assawoman and Metompkin Islands

Assawoman Island is 4.3 km (2.7 mi) long and is immediately south of Wallops Island. Metompkin Island is just south of Assawoman Island; these two islands are separated by Gargatha (Gargathy) Inlet. Assawoman and Metompkin Islands are both undeveloped. Assawoman is owned wholly by the USFWS and is managed as part of the CNWR; USFWS also manages the northern 79 hectares (195 acres) of Metompkin Island. The remainder of Metompkin is owned by The Nature Conservancy. Both islands consist of sandy beaches backed by low dunes and are characterized by frequent overwash areas which provide ideal nesting habitat for shorebirds, including the piping plover.

3. Species Potentially in the Action Area

3.1. Piping Plover

3.1.1. Description and Distribution

The Atlantic Coast piping plover population was listed as threatened on January 10, 1986.

Piping plovers are small, beige and white shorebirds with a black band across their breast and forehead. The plover breeds on coastal beaches from Newfoundland and southeastern Quebec to North Carolina and winter primarily on the Atlantic Coast from North Carolina to Florida, although some migrate to the Bahamas and West Indies. Plovers typically feed on invertebrates such as marine worms, fly larvae, beetles, crustaceans, and mollusks. Feeding areas include intertidal portions of ocean beaches, washover areas, mudflats, sandflats, wrack lines, and shorelines of coastal ponds, lagoons, or salt marshes (USFWS, 2000b)

3.1.2. Nesting

After they establish nesting territories and conduct courtship rituals beginning in late March or early April, piping plover pairs form shallow depressions (nests) in the sand to lay eggs. Nests are situated above the high tide line on coastal beaches, sandflats at the ends of sand spits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, and washover areas cut into or between dunes. Nest sites are shallow scraped depressions in substrates ranging from fine grained sand to mixtures of sand and pebbles, shells or cobble. They may also nest on areas where suitable dredge material has been deposited. Nests are usually found in areas with little or no vegetation although, on occasion, piping plovers will nest under stands of American beachgrass (*Ammophila breviligulata*) or other vegetation (USFWS, 2000b). Plovers typically lay four eggs that hatch in about 25 days (USFWS, 2007).

3.1.3. Status of Species in the Action Area

Since 1996, when monitoring was initiated at all CNWR units, (including Assateague, Assawoman, and Metompkin) there has been an increasing trend in the number of nesting pairs (Table 1). However, since 2004, nesting has remained static and decreased at the Hook and Overwash areas, respectively, and has increased slightly at Assawoman and north Metompkin. The number of chicks fledged per nesting pair has decreased for all four areas (Table 2).

Table 1. Record of Piping Plover Pairs and Number of Young Fledged at CNWR.

Year	# Pairs	# Young Fledged	Comments
1988[a]	32	27	0.84 young fledged/pair
1989[a]	32	36	1.13 young fledged/pair
1990[a]	42	24	0.57 young fledged/pair
1991[a]	38	30	0.79 young fledged/pair
1992[a]	36	19	0.53 young fledged/pair
1993[b]	41	56	1.37 young fledged/pair
1994[b]	41	71	1.73 young fledged/pair
1995[b]	45	44	0.98 young fledged/pair
1996[c]	51	83	1.63 young fledged/pair
1997[c]	62	43	0.69 young fledged/pair
1998[c]	62	69	1.11 young fledged/pair
1999[c]	55	74	1.35 young fledged/pair
2000[c]	63	98	1.56 young fledged/pair
2001[c]	73	134	1.84 young fledged/pair
2002[c]	76	95	1.25 young fledged/pair
2003[c]	72	147	2.04 young fledged/pair
2004[c]	97	221	2.28 young fledged/pair
2005[c]	118	167	1.42 young fledged/pair
2006[c]	117	121	1.03 young fledged/pair
2007[c]	98	110	1.12 young fledged/pair
2008[c]	117	96	0.82 young fledged/pair

[a] Data from Assateague Island
[b] Data from Assateague, Assawoman, and Metompkin Islands
[c] Data from Assateague, Assawoman, Metompkin, and Cedar Islands

USFWS, 2008a

Table 2. Piping Plover Nesting Activities at the Hook and Overwash Areas on Assateague Island, Assawoman Island, and North Metompkin Island.

AREA	YEAR	NESTING PAIRS	NESTS ATTEMPTS	NO. EGGS	EGGS HATCHED	CHICKS FLEDGED	FLEDGLINGS / NESTING PAIR
Hook	2004	27	30	105	90	70	2.59
	2005	32	39	143	91	58	1.81
	2006	27	30	102	72	37	1.37
	2007	22	30	94	18	24	1.09
	2008	30	36	108	71	21	0.70
Overwash	2004	11	11	43	33	26	2.36
	2005	8	12	48	27	16	2.00
	2006	8	10	29	16	4	0.50
	2007	6	8	22	6	6	1.00
	2008	6	6	20	13	5	0.84
Assawoman	2004	23	23	92	87	61	2.65
	2005	30	37	123	62	34	1.14
	2006	23	25	84	64	28	1.22
	2007	23	25	88	68	40	1.74
	2008	26	35	114	74	30	1.15
North Metompkin	2004	4	4	7	7	7	1.75
	2005	3	6	21	5	3	1.00
	2006	6	7	22	10	9	1.50
	2007	6	6	21	13	10	1.67
	2008	7	8	N/A	N/A	8	1.14

USFWS, 2008b

Piping plover nesting habitat has been delineated on Wallops Island dune and overwash areas at the northern and southern reaches of the property. As south Wallops Island has experienced substantial erosion (3.3 m [11 ft]/year), suitable habitat is increasingly less abundant. According to Mitchell (2009, pers. comm.), no nesting plovers have been observed on south Wallops Island since at least 2000. Simultaneously, north Wallops Island has been accreting, thus presenting additional potential habitat for plover nesting.

Annually between 1996 and 2008, piping plovers were observed feeding, although exact numbers were not recorded. Five nesting attempts were made on north Wallops Island during 2007 and 2008 but none were successful in producing fledglings. During 2006, one pair of plovers nested but the nest was abandoned due to attempted predation by a fox. Nests were also observed in 2005 (2 pairs, 1 nest lost to fox predation and second pair chicks were lost); 2004 (1 pair – 3 chicks fledged); 2001 (1 pair unsuccessful); 1998 (1 pair unsuccessful); 1996 (3 pairs with 2 chicks total fledged). There were no nests observed in 2003, 2002, 2000, 1999, and 1997 (Table 3).

In 2009, four piping plover pairs have attempted nests on north Wallops Island. Of these, three have been successful at producing at least seven fledglings (Scharle, 2009).

Table 3. Record of Piping Plover Pairs and Number of Young Fledged at WFF.

Year	# Pairs	# Young Fledged	Comments
1986	2	0	All at south end of Island
1987	2	3	1.5 young fledged/pair; All at south end
1988	0	0	No nesting
1989	5	Unknown	All at south end
1990	5	Unknown	All at south end
1991	3	Unknown	All at south end
1992	4	5	1.25 young fledged/pair; All at south end
1993	3	4	1.33 young fledged/pair; All at south end
1994	3	2	0.67 young fledged/pair; All at south end
1995	2	4	2.00 young fledged/pair; All at south end
1996	3	2	0.67 young fledge/pair; 1 pair, 0 fledged at south end
1997	0	0	No nesting
1998	1	0	
1999	0	0	No nesting
2000	0	0	No nesting
2001	1	0	
2002	0	0	No nesting
2003	1	0	A pair of plovers scraped, but made no other attempts at nesting
2004	1	3	3.00 young fledged/pair
2005	2	0	One nest was predated (fox), the other nest hatched by the chicks were later lost
2006	1	0	Nest was set up with enclosure; a fox tried digging under enclosure to get nest but did not succeed. The nest however was abandoned due to this event.
2007	3	0	All nests were exclosed. One nest was predated by a fox, one nest lost to tide
2008	2	0	2 pairs of plovers scraped at north end, but made no other attempts at nesting

NASA, 2008

3.2. Loggerhead Sea Turtle

3.2.1. Description and Distribution

The loggerhead sea turtle was listed as a federally threatened species on July 28, 1978.

The loggerhead is perhaps the most common of the sea turtles and the only one that still regularly nests on the U.S. Atlantic Coast, on beaches from New Jersey to Florida. This reddish-brown turtle averages 0.9 m (3 ft) in length and weighs about 136 kilograms (kg) (300 pounds [lbs]). The loggerhead sea turtle's powerful jaws are well suited to eating hard-shelled prey. It feeds on crabs and other crustaceans, mollusks, jellyfish, and sometimes fish and eelgrass (New York DEC, 2006a). Loggerhead sea turtles are found globally, preferring temperate and subtropical waters. In the western Atlantic, they range from the Canadian Maritime Provinces south to Argentina. Within its range, the species inhabits warm waters on continental shelves and areas among islands. Estuaries, coastal streams, and salt marshes are preferred habitats. The loggerhead is the only recurrent nesting species of sea turtle in southeastern Virginia, occurring, during summer, in the Chesapeake Bay south of Baltimore and within all the major tributaries to the Bay, along the Virginia and Maryland Atlantic coast, and in the lagoons and channels in the barrier island systems (Lutcavage and Musick, 1985; Dodd, 1988).

3.2.2. Nesting

Loggerhead nesting in the U.S. typically occurs from Florida to Virginia Beach, Virginia, although there are some recorded nestings as far north as New Jersey (Pritchard, 1979). Musick (1988) concluded that the occasional nestings on beaches as far north as Virginia Beach are beyond the periphery of the normal breeding range. Loggerhead females nest on ocean beaches and occasionally on estuarine shorelines with suitable sand. Nests are typically made between the high tide line and the dune front. Females deposit eggs on a 2-4 year cycle, and produce an average of 1-7 nests in any one breeding season (Ehrhart, 1979; Dodd, 1988; Ernst et al., 1994). Nesting in southeastern Virginia generally occurs from late May through July, with an occasional nest produced in August.

3.2.3. Status of Species in the Action Area

From 1974 to 2006, there were 17 confirmed sea turtle nests on CNWR, all of which were loggerheads (USFWS, 2008a). Seven of these nests were located within the action area (six in the Overwash area, and one on the Hook).

In mid-July 2008, a loggerhead nest was discovered by NASA personnel on north Wallops Island (Figure 1). Following flood inundation from several fall storms, CNWR personnel recovered approximately 170 eggs from the nest in October 2008. None were viable.

3.3. Green Sea Turtle

3.3.1. Description and Distribution

The green sea turtle was listed as a federally protected species on July 28, 1978. The breeding populations in Florida and the Pacific coast of Mexico are listed as endangered; elsewhere the species is listed as threatened.

Green sea turtles are the largest of all the hard-shelled sea turtles, but have a comparatively small head. While hatchlings are just 50 millimeters (2 inches [in]) long, adults can grow to more than 1.2 m (4 ft) long and weigh 136 to 159 kg (300 to 350 lbs). Adult green sea turtles are unique among sea turtles in that they are herbivorous, feeding primarily on seagrasses, sea lettuce, and algae. Other organisms living on sea grass blades and algae add to the diet (Mager, 1985). This diet is thought to give the turtles greenish colored fat, from which they take their name. A green sea turtle's carapace is smooth and can be shades of black, gray, green, brown, and yellow. Their plastron is yellowish white. In U.S. Atlantic and Gulf of Mexico waters, green turtles are found in inshore and nearshore waters from Texas to Massachusetts, the U.S. Virgin Islands, and Puerto Rico. In Virginia waters, green sea turtle are occasionally seen, but in concentrations less dense than those of loggerheads (Mansfield, 2001).

3.3.2. Nesting

Within the U.S., green sea turtles nest in small numbers in the U.S. Virgin Islands, Puerto Rico, Georgia, South Carolina, and North Carolina, and in larger numbers in Florida. The Florida green turtle nesting aggregation is recognized as a regionally significant colony (USFWS, 2009a). In August 2005, the first documented green sea turtle nest was discovered in Virginia. (MSTJ, 2005) at Virginia Beach, 75 miles southwest of the action area.. Mature females may nest three to seven times per season at about 10- to 18-day intervals. Average clutch sizes vary between 100 and 200 eggs that hatch usually within 45 to 60 days (Hopkins and Richardson, 1984). Hatchlings emerge, mostly at night, travel quickly to the water, and swim out to sea (Carr, 1986).

3.3.3. Status of Species in the Action Area

There have been no documented occurrences of green sea turtle nesting activity on south Assateague, Wallops, Assawoman, or Metompkin Islands (Daisey, 2009b).

3.4. Leatherback Sea Turtle

3.4.1. Description and Distribution

The leatherback sea turtle was listed as a federally endangered species on June 2, 1970.

The leatherback is the largest, deepest diving, most migratory, and widest ranging of all sea turtles. Leatherbacks normally weigh up to 300 kilograms (660 lbs), and attain a carapace length (straight line) of 140 cm (55 in) (Pritchard, 1983). Its shell is composed of a mosaic of small bones covered by firm, rubbery skin with seven longitudinal ridges or keels. The diet of the leatherback consists primarily of soft-bodied animals such as jellyfish and tunicates, juvenile fishes, amphipods, and other soft organisms but it also feeds on sea urchins, squid, crustaceans, blue-green algae, and floating seaweed (USFWS, 2006a). Leatherback turtles may pass through the mid-Atlantic during migration. Concentrations may be found between the Gulf of Maine and Long Island, New York (Shoop and Kenney, 1992). They may also be found in coastal areas of New Jersey and Delaware, as well as around the mouth of the Delaware Bay (USACE, 1995).

3.4.2. Nesting

In the U.S., leatherbacks nest mainly on the Florida coast, although they have been known to nest infrequently as far north as North Carolina. Leatherback females tend to nest on high wave energy, sandy ocean beaches. Females emerge from the swash zone and crawl toward the dune line until they encounter a suitable nest site, typically on open sand at the seaward base of a dune, but sometimes in vegetation. Mature females may nest 1 to 9 times per season at about 9- to 17-day intervals. Average clutch sizes vary between 50 and 170 eggs that hatch usually within 50 to 70 days (Hopkins and Richardson, 1984). Hatchlings emerge, mostly at night, travel quickly to the water, and swim out to sea.

3.4.3. Status of Species in the Action Area

There have been no documented occurrences of leatherback nesting activity on south Assateague, Wallops, Assawoman, or Metompkin Islands (Daisey, 2009b).

In 1996, a leatherback was observed displaying nesting behavior in daylight on the Maryland portion of the Assateague Island National Seashore. Although a possible egg cavity was found on the beach, no eggs were discovered (Rabon et al., 2003). In 2006, a leatherback carcass was discovered on the southern tip of Assawoman Island at Gargatha Inlet.

3.5. Seabeach Amaranth

3.5.1. Description and Distribution

Seabeach amaranth was listed as a federally threatened species on April 7, 1993.

Seabeach amaranth is an annual plant found on the dunes of Atlantic Ocean beaches. The stems are fleshy and pink-red or reddish, with small rounded leaves that are 1.3 to 2.5 cm (0.5 to 1.0 in) in diameter. The leaves, with indented veins, are clustered toward the tip of the stem and have a small notch at the rounded tip. Flowers and fruits are relatively inconspicuous, borne in clusters along the stems. Germination occurs over a relatively long period of time, generally from April to July. Upon germination, the species forms a small unbranched sprig, but soon begins to branch profusely into a clump. This clump often reaches 30 cm (12 in) in diameter and consists of five to 20 branches. Occasionally, a clump may get as large as a meter (3 ft) or more across, with 100 or more branches.

Historically, seabeach amaranth occurred in 31 counties in nine states from Massachusetts to South Carolina. Seabeach amaranth occurs on barrier island beaches, where its primary habitat consists of overwash flats at accreting ends of islands and lower foredunes and upper strands of noneroding beaches. It occasionally establishes small temporary populations in other habitats, including sound-side beaches, blowouts in foredunes, and sand and shell material placed as beach replenishment or dredge spoil. Seabeach amaranth occupies a narrow beach zone that lies at elevations from 0.2 to 1.5 m (0.7 ft to 5 ft) above mean high tide, the lowest elevations at which vascular plants regularly occur. Seaward, the plant grows only above the high tide line, as it is intolerant of even occasional flooding during the growing season (Weakley and Bucher, 1992).

Landward, seabeach amaranth does not occur more than approximately one meter (3 ft) above the beach elevation on the foredune, or anywhere behind it, except in overwash areas. The species is, therefore, dependent on a terrestrial, upper beach habitat that is not flooded during the growing season. This zone is generally absent on beaches that are experiencing high rates of erosion. Seabeach amaranth is never found on beaches where the foredune is scarped by undermining water at high or storm tides (Weakley and Bucher, 1992).

Seabeach amaranth appears to be intolerant of competition and does not occur on well-vegetated sites. The species appears to need extensive areas of barrier island beaches and inlets, functioning in a relatively natural and dynamic manner. These characteristics allow it to move around in the landscape as a fugitive species, occupying suitable habitat as it becomes available.

The species is currently found in New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, and South Carolina (USFWS, 2009b).

3.5.2. Status of the Species in the Action Area

The species was rediscovered on Assateague Island in 1998, the first time in more than 30 years that amaranth had been observed on the island. Data from CNWR indicate that plant numbers have varied substantially. Since 2001, as many as 69 plants and as few as 0 plants have been identified on CNWR; of those, only 1 plant has been found in the action area. A single plant was identified in the Hook area in 2004 (USFWS, 2008a).

Although suitable habitat exists to support the species on both north and south Wallops Island and the beaches of Assawoman and Metompkin Islands, no known occurrences have been recorded.

3.6. Red Knot

3.6.1. Description and Distribution

The red knot is currently a candidate species for protection under the Endangered Species Act.

The red knot is a medium-sized shorebird that undertakes an annual 30,000 km (19,000 mi) hemispheric migration, from breeding grounds in the high Arctic to wintering grounds in Patagonia and Tierra del Fuego. The birds' final stopover during the northern migration is the Delaware Bay, which is the most crucial spring stopover because it is the final stop at which the birds feed on the eggs of spawining horseshoe crabs in preparation for their nonstop leg to the Arctic. The birds rest and feed in the Delaware Bay between late April and early June with the population peaking May 15th through 30th (Baker et al., 2004).

The red knot principally uses marine habitats during migration. Coastal habitats along the mouths of bays and estuaries are preferred, providing sandy beaches to forage (Harrington, 1996; 2001). High wave-energy is associated with these areas (Harrington et al., 1986; Vooren and Chiaradia, 1990; Blanco et al., 1992). Red knots are also known to use tidal flats in more sheltered bays or lagoons in search of benthic invertebrates or horseshoe crab eggs (Harrington et al. 1986; Harrington 1996, 2001; Tsipoura and Burger, 1999).

3.6.2. Status of the Species in the Action Area

During its northern migration, the Virginia barrier islands provide an important stopover area for a large number of individuals In the mid-1990s, 3 years of aerial surveys showed that numbers of red knots moving through the barrier islands of Virginia between mid-May and the second week of June reach 8,000 to 10,000 individuals (Watts and Truitt, 2000). During the 2009 migration season flock sizes of 100 to 145 birds were observed in the Overwash and Hook areas of Assateague Island. In late May 2009, flocks of 5 to 30 individuals were observed on south Assawoman Island. On May 8, USFWS observed a flock size of almost 1,300 individuals on north Wallops Island (USWS, 2009c). In late May 2009, flocks of approximately 20 to 200 red knots were observed on north Wallops Island (USFWS, 2009c).

4. Effects of the Actions

4.1. Piping Plover

4.1.1. Direct and Indirect Effects

Under the proposed action, no construction is planned for areas within known piping plover nesting habitat. Noise from the construction activities would be of short duration and would likely present minor startle reactions. Temporary interruption of foraging and nesting activities for piping plover may occur as a result of static fire tests and launch activities. The nesting area designated on the northern end of Wallops Island is approximately 6.7 km (4 mi) from Pad 0-A and 7.2 km (4.5 mi) from Pad 0-B. Calculations were performed using a formula employed by the WFF Range Safety Office to estimate noise levels based upon rocket motor thrust and distance from the launch pad (NASA, 1973). Taurus II launches and static fire tests would generate noise levels of approximately 111 dB at the northern Wallops Island nesting area. This area is not expected to be adversely affected by emissions or noise. The northernmost point of the designated plover habitat on the southern end of the island is approximately 1.55 km (1.0 mi) from Pad 0-A and 1.1 km (0.7 mi) from Pad 0-B. Noise levels of 124 dB would be expected from Taurus II launches and static fire tests at this northernmost point; 129 dB would be expected from the ongoing LMLV-3(8)-class launches.

Noise generated from rocket launches is generally low-frequency, of short duration, and occurs infrequently. Naturally occurring background noises in the nesting area, such as heavy wave action (up to 119 dB at 300 hertz) and nearby thunder 120 dB, (Stewart, 1994; LHH, 2005) are more frequent and of longer duration than noise from a rocket launch. Moreover, USFWS monitoring of piping plover nests on Assawoman Island after the only orbital launch to occur from Pad 0-B during plover nesting season found no apparent anomalous behavior among the nesting plovers (Daisey, pers. comm., 2009a).

The 1997 USFWS guidance for managing fireworks near piping plover habitats recommends that a minimum 1.2 km (0.75 mi) distance be established between the piping plover nests and fireworks. These same guidelines were referenced by USFWS in its July 14, 1997, Biological Opinion for construction of Pad 0-B. Fireworks noise outputs would be comparable to the noise intensity at Pad 0-A or 0-B during a launch or static fire and would likely last for a considerably longer period of time. As launches and static fire tests under the Proposed Action would occur at a greater distance and shorter duration than those discussed in the 1997 USFWS fireworks guidance, no substantial effect on the piping plover is anticipated. Ongoing launches from Pad 0-B would occur closer than guidance distance of 1.2 km (0.75 mi) from the nearest potential habitat, however the noise would be of short duration, also presenting no substantial effects.

Open burning of sounding rocket motors occurs approximately 75 m (250 ft) north of the piping plover habitat on the southern end of Wallops Island. Employing the same formula referenced above that correlates rocket motor thrust to noise, expected noise levels at the northernmost plover nesting boundary would be approximately 138 dB for a mid-sized sounding rocket motor. In a letter dated February 27, 1998, from NASA to USFWS, NASA summarized a telephone conference between USFWS, VDGIF, and NASA. The telephone conference discussed the 1997 USFWS Biological Opinion on impacts to the piping plover and the agreement that NASA could conduct year-round open burning of rocket motors at the open burning site located north of the southern piping plover habitat without adversely impacting the piping plovers. Consequently, the twice per year 52-second static firing related to the Proposed Action also would not result in adverse impacts on the piping plover or its habitat.

Air quality modeling conducted for the launch of Taurus II at WFF showed that the limit of the near-field exhaust cloud ("near field" is defined as the region near the launch pad where the rocket exhaust cloud is formed) would extend approximately 200 m (660 ft) away from Pad 0-A during static fire and approximately 100 m (330 ft) away from Pad 0-A during launch. The cloud would then begin to rise into the atmosphere where it would reach a "ceiling," and then drift back down to the ground (NASA, 2009b). Because of wind and atmospheric mixing, the exhaust cloud is predicted to move a minimum of approximately 5 km (3 mi) downwind from Pad 0-A before "touching down." By the time the exhaust cloud has moved downwind and resettled, the constituents from the rocket exhaust would be significantly dispersed and their concentrations significantly lowered. No adverse effect upon piping plover would be expected.

NASA's 1997 Launch Range Expansion EA assessed the peak concentrations of hydrogen chloride, carbon monoxide, and aluminum oxide from a solid rocket motor (the LMLV-3[8]) at a distance of 1.4 km (0.87 mi); this distance was selected because it is the boundary to the nearest sensitive receptor from Launch Pad 0-B, piping plover nesting habitat. A comparison of the estimated peak concentrations of the three exhaust compounds at a distance of 1.4 km (0.87 mi) to the OSHA Threshold Limit Values (TLV)-Time Weighted Average (TWA) for Chemical Substances demonstrated that their levels were well below exposure standards established to protect human worker health. TLV-TWA values were chosen for comparison purposes because these limits are more conservative than the TLV-Short Term Exposure Level exposure indices. Human health exposure standards have been established well below levels shown to affect laboratory animals (NASA, 1997).

Indirect effects to nesting plovers may occur from security patrols on the Wallops beach during times prior to launch, however with the active plover monitoring program currently in use along the WFF beach, such effects are highly unlikely.

4.1.2. Actions to Reduce Adverse Effects

NASA would continue to coordinate with CNWR and U.S. Department of Agriculture (USDA) personnel in monitoring the Wallops Island beach for piping plover activity. These personnel routinely monitor Assateague, Wallops Island, Assawoman, and Metompkin Island beaches for piping plovers during nesting season. Any nests discovered would be appropriately marked with a Global Positioning System (GPS) unit, identified with signage, and closed to personnel or visitor access.

Additionally, educational signs would be posted at all beach access points to raise awareness of the species and to provide contact information. Basic species identification would be included in the natural resources training module of the WFF Environmental Management System (EMS), a requirement of all new employees at the facility. WFF would continue to distribute its annual piping plover nesting announcement; this annual message is sent to all WFF employees informing them of the potential for encountering the protected species.

Frequency of roving security patrols is expected to decrease in the future as closed circuit TV cameras are installed on Wallops Island to survey all of the beach areas. Patrols would be limited to responses to incursions detected by these cameras.

4.1.3. Conclusion

The effects from the proposed and ongoing actions would be infrequent and given historical nesting sites of piping plovers, likely be limited to startle effects, and NASA will continue to monitor for plovers and implement mitigation measures. However, NASA cannot discount the possibility that plovers will nest in areas that have not been heretofore utilized for that purpose, whereupon effects upon the species may be more substantial. Therefore, NASA concludes that the actions “may affect,” and are “likely to adversely affect” the piping plover. However, with implementation of the above monitoring and mitigation measures, the effects will be minimized to the greatest extent possible.

4.2. Loggerhead, Green, and Leatherback Sea Turtles

4.2.1. Direct and Indirect Effects

Under the Proposed Action, interior and exterior facility lighting would be necessary to maintain required visibility for safety, security, and mission preparation requirements. The proposed Payload Processing Facility, approximately 650 m (2,130 ft) from the north Wallops Island Beach; and the proposed launch complex at existing Pad 0-A, approximately 200 m (650 ft) from the south Wallops Island beach, would present sources of artificial light during times when sea turtles may be nesting. Additionally, under current operations, Pad 0-B, which is located immediately west of the south Wallops Island beach, would be lit during pre-launch preparations. It is expected that lighting would be visible to nesting turtles and hatchlings within the action area.

Artificial lighting can be detrimental to sea turtles in several ways. Field observations have shown a correlation between lighted beaches and reduced sea turtle nesting (Mortimer, 1982, Raymond 1984, Mattison et al., 1993). Witherington (1992a) directly correlates artificial lighting with deterring sea turtles from nesting. In these experiments, loggerhead turtles showed a strong tendency to avoid beaches with artificial lights that have predominantly blue and green wavelengths.

Adult females rely on visual brightness cues to find their way back to the ocean after nesting, those that nest on lighted beaches may be disoriented and have difficulty finding their way back to the ocean. In the lighted beach experiments described by Witherington (1992a), few nesting turtles returning to the sea were misdirected by lighting; however those turtles that were distracted spent a large portion of the night wandering in search of the ocean.

Hatchling sea turtles, which typically emerge from nests at night, move toward the brightest, most open horizon, which is over the ocean. However, bright light sources on or near the beach may attract hatchlings in the wrong direction, exposing them to predation, desiccation, entrapment in debris or vegetation, and exhaustion. Artificial lights can also disorient hatchlings once they reach the water. Hatchlings have been observed to exit the surf onto land where lighting is nearby (Daniel and Smith, 1947; Carr and Ogren, 1960; Witherington, 1986).

Loggerhead turtles demonstrate a strong preference for short-wavelength light (Witherington and Bjorndal, 1991, Witherington, 1992b). Loggerheads are most strongly attracted to light in the near ultraviolet to green region and showed differing responses to light in the yellow region of the spectrum depending on light intensities. At intensities of yellow light comparable to a full moon or a dawn sky, loggerhead hatchlings showed an aversion response to yellow light sources, but at low, nighttime intensities, loggerheads were weakly attracted to yellow light.

Witherington and Martin (1996) draw a simple conclusion regarding problem lighting: “an artificial light source is likely to cause problems for sea turtles if light from the sources can be seen by an observer on the beach.” If any glowing portion of a luminaire is directly visible on the beach, then this source of light is likely to be a problem for sea turtles. Bright or numerous sources of lights, especially those directed upward, will illuminate sea mist and low clouds, creating a distinct sky glow visible from the beach.

Nesting turtles could also be directly affected by rocket exhaust immediately adjacent to launch pad 0-A. Effects could include burns, auditory effect (deafening), and potential asphyxiation from elevated levels of carbon monoxide in the exhaust plume. Effects from pad 0-B would be similar; with the exception that hydrogen chloride gas would be expected in exhaust from solid-fueled rockets (NASA, 1997).

Such effects are highly unlikely as noise and lighting from pre-test and launch operations would likely deter the female turtle from nesting nearby. Additionally, as estimated from the rocket exhaust modeling performed for the proposed launch of the Taurus II launch vehicle, toxic plumes at ground level would only be expected within approximately the first 100 m (330 ft) of the launch pad (NASA, 2009b). The nearest beach is approximately 200 m(660 ft) south of pad 0-A and is immediately adjacent to pad 0-B, however that area is regularly inundated by the tides, precluding it from being a viable sea turtle nest site. The area with the nearest beach suitable for turtle nesting (i.e., contains sand above the high tide line) is more than 1,000 m and 550 m (42,000 ft and 1,800 ft) away from 0-A and 0-B, respectively.

The low frequency vibrations caused by a static fire test or rocket launch could affect the success of sea turtle nests. Sea turtle embryos become attached to egg walls within six to twelve hours after deposition (Boulon 1999, Sill et al. 2000, NCWRC 2003). The embryo is sensitive and can be dislodged from the egg wall with minimal movement or rotation resulting in death (Boulon 1999, Sill et al. 2000, Katz and Ambrosy 2001, NCWRC 2003). As with the effects of the exhaust, the potential for such effects is low as the nearest suitable nesting beach is more than 1,000 and 550 m (42,000 ft and 1,800 ft) south of launch pads 0-A and 0-B, respectively. Additionally, recent experience at Cape Canaveral Air Force Station indicates that the three Space Shuttle launches that have taken place during the 2009 turtle nesting season have not produced substantial adverse effects; over 900 nests were present with the closest nests approximately 500 m (1,600 ft) from Launch Complex 39 (Shaffer, pers. comm., 2009).

Indirect effects to nesting turtles and hatchlings may occur from security patrols during times prior to launch. Without proper minimization measures, vehicles can crush eggs, kill hatchlings, and disturb nesting adults; tire ruts can trap hatchlings attempting the reach the ocean (NMFS and USFWS 1991a, NMFS and USFWS 1991b, NMFS and USFWS 1992, Fangman and Rittmaster 1993, Nester and Frazer 2007).

4.2.2. Actions to Reduce Adverse Effects

To mitigate the effects of lighting from the proposed facilities, NASA and MARS would install "turtle friendly" exterior lighting on all new facilities. Low pressure sodium lighting, which are monochromatic and emit only yellow wavelengths, would be installed to the greatest extent allowable under safety, facility security, and operational requirements. Additionally, shielding measures would be employed to reduce the likelihood of adult and hatchling disorientations and misorientations.

Illumination of these facilities would be kept to a minimum until operations or pre-launch preparations dictated their necessity. Launch vehicle uplighting is currently employed at pad 0-B and is planned for Pad 0-A, however it would only be in use when the vehicle is physically sitting on the pad, which would typically be no more than 24-48 hours prior to launch. Employing similar lighting management measures at Cape Canaveral Air Force Station has successfully reduced estimated turtle hatchling misorientations from over 4 percent in 1989 to less than 0.01 percent in 1999 (USFWS, 2000a).

NASA would continue to coordinate with CNWR and USDA personnel in monitoring the Wallops Island beach for sea turtle activity. These personnel routinely monitor Assateague, Wallops Island, Assawoman, and Metompkin Island beaches for piping plovers during nesting season. Sea turtle nesting activity would be expected during this same time. Any nests discovered would be appropriately marked with a GPS unit, identified with signage, and closed to personnel and visitor access. During the expected hatch window, the path between the nest and the surf zone would be cordoned off to ensure that ruts from off-road vehicles do not preclude hatchlings from safely reaching the ocean.

Additionally, educational signs would be posted at all beach access points to raise awareness of the species and to provide contact information. Basic species identification would be included in the natural resources training module of the WFF Environmental Management System (EMS), a requirement of all new employees at the facility. WFF would add sea turtles to its annual piping plover nesting announcement; this annual message is sent to all WFF employees informing them of the potential for encountering the protected species.

Frequency of roving security patrols is expected to decrease in the future as closed circuit TV cameras are installed on Wallops Island to survey all of the beach areas. Patrols would be limited to responses to incursions detected by these cameras.

4.2.3. Conclusion

Lighting of the proposed and existing facilities would be a necessity for their safe and effective operation. Security patrols must occur to ensure facility security. Noise and vibrations would be inherent with test and launch operations. Therefore, NASA concludes that these actions "may affect," and are "likely to adversely affect" the loggerhead, green, and leatherback sea turtles. However, with implementation of the above monitoring and mitigation measures, the effects will be minimized to the greatest extent possible.

4.3. Seabeach Amaranth

4.3.1. Direct and Indirect Effects

Under the proposed action, all construction activities would be located outside of the beach and dune environment within which the species is found. Under both the proposed and ongoing actions, the species could be susceptible to scorching from hot rocket exhaust, however as the nearest suitable habitat (beach above normal high tide line) is currently 1.1 km (0.7 mi) south of the southernmost launch pad, adverse effects would be highly unlikely.

Potential indirect adverse effects on seabeach amaranth from both the proposed and ongoing orbital launch operations include trampling or crushing of unprotected plants by pedestrian or vehicular traffic (e.g., roving security patrols) on the beach.

4.3.2. Actions to Reduce Adverse Effects

Seabeach amaranth would be expected to grow in areas suitable for both piping plover and sea turtle nesting. As such, NASA would continue to coordinate with CNWR and USDA staff during their monitoring efforts along the Wallops Island beach. If discovered, plants would be marked with a GPS unit and symbolically fenced to provide a minimum 3 m (10 ft) buffer zone around individual plants or groups of plants. Additionally, educational signs would be posted at all beach access points to raise awareness of the species and to provide contact information. Basic species identification would be included in the natural resources training module of the WFF EMS, a requirement of all new employees at the facility. WFF would also add seabeach amaranth to its annual piping plover nesting announcement to better communicate the potential for encountering the plant on the Wallops Island beach.

As discussed for sea turtles, the decrease in security patrols on the Wallops Island beach will likely reduce the potential for adversely affecting the protected plant.

4.3.3. Conclusion

Although the potential for individual plants to be affected by the proposed and ongoing operations exists, it is very remote. Based on very low species density in the area, and with the implementation of mitigation measures such as regular surveys, employee education, and exclusion if identified, NASA determines that the adverse effects of both the proposed and ongoing orbital launch operations at WFF "may affect," but are "not likely to adversely affect" seabeach amaranth.

4.4. Red Knot

4.4.1. Direct and Indirect Effects

Under the proposed action, all construction activities would be located outside of the beach and lagoon environments within which the species typically would stopover and/or feed.

Operations under the proposed and ongoing actions, including pre-launch preparations, static fire tests, and launches, could initiate a startle response in individuals foraging along the nearby beaches or in the lagoon environment toward the west. Effects would likely be temporary, with the birds leaving the area due to the high intensity, short duration noise event.

The potential for acute adverse effects including scorching, inhalation of toxic rocket exhaust gases, and deafening exists, however it is very unlikely as unnatural noise and lighting from pre-test and launch operations would likely deter the birds from inhabiting the areas within the immediate vicinity of the launch pads prior to and during orbital launch operations.

Indirect effects on the species could be expected from roving security patrols and would likely initiate a startle effect from those individual foraging or resting on the nearby beach.

4.4.2. Actions to Reduce Adverse Effects

Red knots would be expected to be present in areas suitable for both piping plover and sea turtle nesting during similar times of year. As such, NASA would continue to coordinate with CNWR and USDA staff during their monitoring efforts along the Wallops Island beach. Additionally, educational signs would be posted at all beach access points to raise awareness of the species. Basic species identification will be included in the natural resources training module of the WFF EMS, a requirement of all new employees at the facility. WFF would add the red knot to its annual piping plover nesting announcement; this annual message is sent to all WFF employees informing them of the potential for encountering the protected species.

4.4.3. Conclusion

The effects on the red knot would likely be confined to temporary startle effects that may disrupt feeding, and any adverse effects would be highly unlikely. Therefore, if the red knot is listed as a threatened or endangered species in the future, NASA determines that the proposed and continuing actions "may affect," but are "not likely to adversely affect" the red knot.

5. Cumulative Effects

NASA is unaware of any state, tribal, local, or private actions that are reasonably certain to occur within the action area considered in this BA. Federal agencies own and manage a majority of the property in the action area. Additionally, as nearly all of the non-federally owned lagoon areas in the western portion of the action area would be considered either navigable waters of the U.S. or jurisdictional wetlands, such areas would be subject to Clean Water Act and Rivers and Harbors

Act permitting, thus requiring Section 7 Endangered Species Act review. Therefore, NASA is not aware of any cumulative effects in the action area.

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Appendix D
Agency Consultation

Appendix G

USFWS Section 7 Consultation

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
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July 14, 1997

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Re: Range Operations Expansion at Wallops Flight Facility, Accomack County, Virginia

Gentlemen:

The U.S. Fish and Wildlife Service (Service) has reviewed the National Aeronautics and Space Administration's (NASA) proposal to expand range operations at Wallops Flight Facility, Accomack County, Virginia. NASA's April 22, 1997 request for formal consultation was received on April 22, 1997. This document represents the Service's biological opinion on the effects of that action on the piping plover (*Charadrius melodus*), federally listed threatened, in accordance with Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). A complete administrative record of this consultation is on file in this office.

I. CONSULTATION HISTORY

02-27-97 The Service received a copy of the Environmental Assessment for Range Operations Expansion at the NASA Goddard Space Flight Center's Wallops Flight Facility with a cover letter requesting our review regarding federally listed species.

04-09-97 The Service sent a letter to NASA providing comments on the Environmental Assessment and indicated that the project, as proposed, may affect the piping plover.

Mr. Potterton and Colonel Reardon 2

04-22-97 The Service met with NASA, the Virginia Department of Game and Inland Fisheries (VDGIF), and the Virginia Commercial Space Flight Authority to discuss the proposed project. NASA provided the Service with a letter regarding their estimate of the piping plover habitat to be impacted by the proposed project.

04-22-97 The Service received NASA's request to initiate formal consultation.

05-06-97 The Service sent a letter to the Corps indicating that NASA had requested formal consultation and no Corps' permits should be issued for this project until formal consultation has been completed.

II. BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

NASA proposes to enhance national launch capabilities through improvements to infrastructure and expansion of launch range capabilities. The major actions include: (1) establishment of a commercial Spaceport, (2) improvements to infrastructure to support a commercial Spaceport, (3) expanding launch operations to accommodate twelve orbital launches per year, and (4) restoration of the historical level and nature of operations at Wallops Flight Facility. The only action that may affect the piping plover is the use of launch pad 0-B. Construction of launch pad 0-B is proposed and will be used in conjunction with the existing launch pad 0-A to launch no more than twelve orbital launches per year from Wallops Flight Facility in Accomack County, Virginia (Figure 1). NASA has stated that a minimum of 60 to 90 days is required to prepare for a single launch event at one of the two pads.

Pad 0-B will be 19,000 square feet with a 170 foot high service tower. Other equipment will also be attached to this pad to facilitate launch operations. This facility would support the launching of expendable launch vehicles capable of placing small-to-medium payloads into orbit. Vehicle and payload handling within the pad and service tower area will be accomplished by a 75-ton capacity bridge crane. The proposed construction site will impact 1,315 square meters (m) (approximately 1/3 acre) of wetlands. The entire island is located within the 100-year flood plain. As part of the project, NASA has agreed to monitor piping plovers. The monitoring plan is in Appendix A.

Damage to local biological resources resulting from launch activities can be anticipated within a 1,000 m radius of the launch pad. The principal impacts radiate approximately 200 to 300 m within the combustion path. Searing of vegetation and injury or death to fauna can occur within this zone. Interruption of faunal activities is expected within a 1,000 m radius of the launch pad for 2 to 10 minutes during launch operations. The combustion products and initial sound blast will be directed toward the Atlantic Ocean. Launches may be conducted during any time of the year and any time of the day or night.

RANGEWIDE STATUS OF THE SPECIES

Life History

Piping plovers are small beige and white shorebirds with a black band across their breast and forehead. They typically feed on small invertebrates within intertidal surf zones, mud flats, tidal pool edges, barrier flats, and sand flats. The nesting season typically lasts from late April to late July. The nest is a shallow depression in the sand, typically lined with bits of broken seashells or fine pebbles. Incubation lasts for 26 to 30 days and is shared equally by both adults. The chicks leave the nest within hours of hatching and begin feeding on their own as soon as they can stand. Chicks are defended by the adults and can fly after 28 to 35 days. A more detailed and comprehensive description of the life history of the plover is provided in the recovery plan (U.S. Fish and Wildlife Service 1996).

Status of the Species Within its Range

Piping plovers occur in three disjunct populations in North America: Northern Great Plains, Great Lakes, and Atlantic Coast. The Atlantic Coast piping plover breeds on coastal beaches from Newfoundland to North Carolina (and occasionally South Carolina) and winters along the coast from North Carolina south, along the Gulf Coast and in the Caribbean (U.S. Fish and Wildlife Service 1996). The recovery plan divides the Atlantic Coast population into four recovery units: Atlantic Canada, New England, New York-New Jersey, and Southern (Delaware, Maryland, Virginia, and North Carolina).

Since 1986, the Atlantic Coast population has increased from 790 pairs to 1,347 pairs in 1996. However, most of the apparent increase between 1986 and 1989 is attributable to increased survey effort in two states. In addition, the population increase between 1989 and 1995 was very unevenly distributed. Between 1989 and 1995, the New England subpopulation increased by 346 pairs, while the New York-New Jersey and the Southern subpopulations gained 82 and 16 pairs, respectively, and the Atlantic Canada population decreased by 34 pairs. Substantially higher productivity rates have also been observed in New England than elsewhere in the Atlantic Coast population's range. In 1996, all recovery units either declined or increased less than expected based on 1995 productivity data. The Southern recovery unit declined 13% between 1995 and 1996. This is significant because the recovery plan ties recovery of the species to improved status of all four recovery units. The relative lack of recovery of the Southern subpopulation has heightened concern over any proposed activities which would further impede recovery in this area. Recovery of the Atlantic Coast piping plover population is occurring in the context of an extremely intensive protection effort now being implemented on an annual basis. Pressure on Atlantic Coast beach habitat from development and human disturbance is pervasive and unrelenting, and the species is sparsely distributed (U.S. Fish and Wildlife Service (1996).

In Virginia, piping plovers nest in Accomack and Northampton Counties on the barrier islands and on beaches in the Cities of Hampton and Portsmouth. Between 1989 and 1991, the number of piping plover pairs in Virginia increased from 100 to 131. In 1992, the number of nesting pairs was 97, and since then there have been serious population fluctuations. In 1996, only 87 pairs of plovers were documented. Annual productivity (numbers of chicks fledged/pair) has fluctuated widely, but was relatively high in 1996.

Threats to the Species

Loss and degradation of habitat due to development and shoreline stabilization have been major contributors to the species' decline. Disturbance by humans and pets often reduces the functional suitability of habitat and causes direct and indirect mortality of eggs and chicks. Predation has also been identified as a major factor limiting piping plover reproductive success at many Atlantic Coast sites. Substantial evidence shows that human activities are affecting types, numbers, and activity patterns of predators, thereby exacerbating natural predation (U.S. Fish and Wildlife Service 1996). A more detailed and comprehensive description of threats to the plover is provided in the recovery plan (U.S. Fish and Wildlife Service 1996).

Recovery Goals and Accomplishments

The Atlantic Coast population of the piping plover was listed at threatened in 1986. The primary recovery objective is to remove the Atlantic Coast plover population from the list of Endangered and Threatened Wildlife and Plants by achieving well-distributed increases in numbers and productivity of breeding pairs and providing for long-term protection of breeding and wintering plovers and their habitat. Delisting may be considered when the following criteria have been met: (1) increase and maintain for 5 years a total of 2,000 breeding pairs distributed among four recovery units as follows--Atlantic Canada, 400 pairs; New England 525 pairs; New York-New Jersey, 575 pairs; Southern, 400 pairs; (2) verify the adequacy of a 2,000-pair population to maintain heterozygosity and allelic diversity over the long-term; (3) achieve five-year average productivity of 1.5 fledged chicks per pair in each recovery unit, based on data from sites that collectively support at least 90% of the recovery unit's population; (4) institute long-term agreements to assure protection and management sufficient to maintain the population targets and average productivity in each recovery unit; and (5) ensure long-term maintenance of wintering habitat, sufficient in quantity, quality, and distribution to maintain survival rates for a 2,000-pair population. At the present time, these criteria are not close to being accomplished.

ENVIRONMENTAL BASELINE

As defined in 50 CFR 402.02 "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas. 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. The direct and indirect effects of the actions and activities resulting from the federal action must be considered in conjunction with the effects of other past and present federal, state, or private activities, as well as the cumulative effects of reasonably certain future state or private activities within the action area.

The Service has determined that the action area for this project is the portion of Wallops Island within 1,207 m (0.75 miles) south of launch pad 0-B.

Status of the Species in the Action Area - Piping plovers have nested at the north and south end of Wallops Island. The plover nesting area on the north end of the island is approximately 7 kilometers from the proposed project site. No impacts are expected to occur to the plovers at the north end of the island and only concerns related to plovers at the south end of the island will be addressed. Information about the plover at the southern end of the island is detailed below.

Wallops Island (Southern End) Piping Plover Data

Year	# Pairs	# Young Fledged	Comments
1986	2	0	
1987	2	3	
1988	0	0	
1989	5	unknown	
1990	5	unknown	
1991	3	unknown	
1992	4	5	1.25 young fledged/pair
1993	3	4	1.33 young fledged/pair
1994	3	2	0.67 young fledged/pair
1995	2	4	2.00 young fledged/pair
1996	1	0	Initial nest and renesting attempt both lost to predation by red fox.

Suitable plover nesting habitat at the southern end of the island was mapped and measured before and after the storms of 1991-1992. There was a 77% increase in the amount of nesting habitat available between years. Despite the increase in available habitat, there was no significant increase in numbers of nesting piping plovers, and their distribution throughout the available habitat remained similar to previous years, suggesting that birds were not available to colonize the newly created habitat (VDGIF 1992-1993). At the present time, the habitat at the southern end of Wallops is becoming less suitable due to encroaching vegetation (B. Cross, VDGIF, pers. comm. 1997; VDGIF 1995-1996).

The plover nesting and foraging area at the south end of the island is approximately 1,087 m from the proposed launch pad. Therefore, it is estimated that only the small portion (approximately

400 square meters) of existing plover habitat within the action area will be affected by launches at pad 0-B.

Effects of the Action - No information is available on the effects of rocket launches on foraging and nesting shorebirds. The most similar action for which Service has such information relates to fireworks displays (U.S. Fish and Wildlife Service 1997). Direct impacts to plovers from fireworks early in the breeding season may cause plovers to abandon their territories. Plovers will often abandon their nests and broods during fireworks displays, exposing eggs and chicks to weather and predators. If a flightless chick were to become permanently separated from its parents during the confusion, mortality is almost certain. Abandonment of colonies as a result of fireworks has been documented in other colonial-nesting birds. For example, a fireworks display in New Jersey caused permanent abandonment of a least tern (*Sterna antillarum*) colony located more than 250 m away. In addition, temporary abandonment and displays of distress were documented in a least tern colony located greater than 0.75 miles from a fireworks event. The Service's guidance (U.S. Fish and Wildlife Service 1997) recommends that fireworks launch sites be located at least 0.75 miles from the nearest piping plover nesting and/or foraging area.

Direct impacts to the piping plover from the construction of the proposed rocket launch facility are not anticipated because of the distance (1,087 m) from launch pad to the nesting/foraging area. The piping plover may be adversely affected by the noise and light associated with rocket launches. NASA has estimated actual launch operations will last from 2 to 10 minutes. Because no data specific to this type of activity is available, it is difficult to anticipate how plovers will be affected. The Service anticipates that between March 1 and September 15 of any year, depending on the time of year, time of day, and proximity to the launch site, plovers will temporarily abandon the area during migration and/or the breeding season. While temporary abandonment of eggs or chicks does increase the chances of predation and exposure to the elements, actual mortality or reduced productivity is very unlikely. Similarly, a brief interruption in foraging will not result in significant impacts. The Service anticipates minimal impacts to the plover because of the short duration of the disturbance, the long distance between the disturbance and the area used by plovers, the limited number of launches during the nesting season, and the lack of other disturbances (e.g., recreation) to the plovers at this site.

Cumulative Effects - Cumulative effects include the effects of future state, 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 cumulative effects.

CONCLUSION

After reviewing the current status of the piping plover throughout its range and in the action area, 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 construction and use of launch pad 0-

B, as proposed, is not likely to jeopardize the continued existence of the piping plover. No critical habitat has been designated for this species, therefore, none will be affected.

III. INCIDENTAL TAKE STATEMENT

Sections 4(d) and 9 of the ESA, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harm is further defined 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 as 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 any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the federal agency or applicant. 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 a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

AMOUNT OR EXTENT OF TAKE

The Service does not anticipate the proposed action will incidentally take any piping plovers due to the short duration of the disturbance, the distance between the launch pad and the plover nesting/foraging area, the limited number of launches that are likely to occur during the nesting season, and the lack of other disturbances (e.g., recreation).

IV. 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 and other recovery activities, or to develop information to benefit the species. The Service recommends that following be implemented by NASA:

- Whenever possible, conduct launches during daylight hours.
- Provide more substantial fencing at the perimeter of piping plover use areas at the north and south ends of island to prevent human intrusion.
- Post the fenced areas with "sensitive wildlife area" signs.
- Close the piping plover use areas from March 1 through September 15 of every year to discourage human intrusion.

- o Piping plover nests should be protected with predator exclosures upon completion of the clutch.

In order for the Service to be kept informed of actions that minimize or avoid adverse effects or benefit listed species or their habitats, the Service requests notification of the implementation of any of these conservation recommendations by NASA.

V. REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the action outlined in the NASA 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 and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the 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 this opinion does not contain national security or confidential business information, the Service will provide copies to the appropriate state natural resource agencies ten business days after the date of this opinion.

The Service appreciates this opportunity to work with NASA and the Corps in fulfilling our mutual responsibilities under the ESA. Please contact Cindy Schulz of this office at (804) 693-6694, extension 127, if you require additional information.

Sincerely,

Karen L. Mayne

Karen L. Mayne
Supervisor
Virginia Field Office

Enclosures

LITERATURE CITED

U.S. Fish and Wildlife Service. 1996. Piping plover (*Charadrius melodus*), Atlantic Coast Population, Revised Recovery Plan. Hadley, MA. 258pp.

U.S. Fish and Wildlife Service. 1997. Guidelines for managing fireworks in the vicinity of piping plovers and seabeach amaranth on the U.S. Atlantic Coast. Unpublished Report. Hadley, MA. 5pp.

Virginia Department of Game and Inland Fisheries. 1992-1993. Annual report nongame and endangered wildlife program. Richmond, VA.

Virginia Department of Game and Inland Fisheries. 1995-1996. Annual report nongame and endangered wildlife program. Richmond, VA.

APPENDIX A

NASA PIPING PLOVER MONITORING PLAN FOR ROCKET LAUNCHES FROM PAD 0-B WALLOPS ISLAND, VIRGINIA

1. Monitoring of piping plovers at the south end of Wallops Island will occur during the first three launches from launch pad 0-B that take place between March 1 and September 15. Depending on the results of the surveys, additional years of monitoring may be required at the discretion of the Service. Monitoring will be conducted daily for 7 consecutive days prior to a launch, during the launch (as dictated by human safety considerations), and for 7 consecutive days after the day of the launch. If it is not possible to monitor during the launch, monitoring will occur immediately before and after the launch. Monitoring should occur twice daily, early in the morning and late in the evening. Each monitoring event should be no longer than one hour and should only be as long as is required to collect the data listed below. A delay of the launch date may require additional monitoring. Each monitoring event will include:

    - A detailed, to scale, map indicating the location of plovers and their nests in relation to the launch pad.
    - Counts and locations of chicks.
    - Habitat description of the areas utilized by the plover and in immediate vicinity of each nest.
    - Dates for laying of each egg, if observed.
    - Dates for loss of any chicks.
    - Indices of predator abundance (presence or absence at the nest, track counts, etc.).
    - Documentation of any sources of additional disturbance.
    - Eggs counts per nest.
    - Behavior of individual plovers (e.g., foraging, brooding, leaving area). This will include determining the frequency of incubation and causes and duration of any interruption to incubation or chick foraging.
    - If pre-fledged young are present, their movements (foraging area and distance and direction moved from nest) should be plotted throughout the monitoring period.
    - Peck rates should be measured for pre-fledged young during five-minute observation periods conducted during each monitoring event. The number of observation periods sufficient for analysis should be determined by the observer.
    - On each data sheet, the following information should be recorded: date, start/stop time of observations, observer's name, weather conditions (e.g., raining, sunny), and temperature.
    - The above information should also be recorded for Wilson's plovers to increase the sample size.

2. A summary report along with copies of any field notes will be submitted to the Service, at the address provided below, within 10 days of the last day of monitoring for each launch event. Monitoring will be conducted by an individual approved by the Service and the

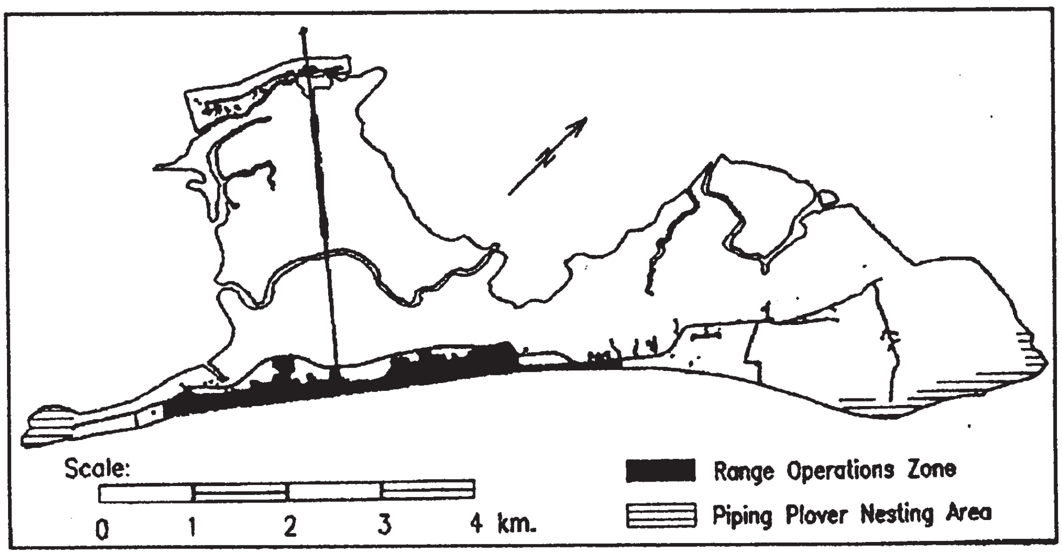
VDGIF. The name and qualifications of the individual must be provided to the Service at least 90 days before the first day of monitoring for the first launch event to be monitored.

3. Within 30 days of providing the Service with the monitoring report for the third launch taking place between March 1 and September 15, NASA will contact the Service to arrange a meeting to discuss the necessity, duration, and intensity of additional monitoring.

4. All information to be provided to the Service should be sent to:

Virginia Field Office
U.S. Fish and Wildlife Service
P.O. Box 99
6669 Short Lane
Gloucester, VA 23061
Phone (804) 693-6694
Fax (804) 693-9032

Figure 1. Location of the National Aeronautics and Space Administration's Proposed Launch Pad 0-B and Piping Plover Use Area on Wallops Island in Accomack County, Virginia.



National Aeronautics and
Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099

RECEIVED
GLOUCESTER

Reply to Attn of: 205.W

February 27, 1998

United States Department of the Interior
Fish and Wildlife Service
Ecological Services
Attn: Ms. Cindy Schulz
P.O. Box 99
Gloucester, VA 23061

Subject: Beach Closure Dates for the Endangered Piping Plover at the National Aeronautics and Space Administration Goddard Space Flight Center's Wallops Flight Facility (NASA GSFC's WFF), Wallops Island, VA

Ref: (a) Telecons between C. Schulz/U. S. Fish and Wildlife Service (USFWS), Bob Cross/Virginia Department of Game and Inland Fisheries (VDGIF), and John C.Brinton/NASA on 2/20/98, and 2/25/98
(b) USFWS Biological Opinion for Range Operations Expansion at WFF, dated 7/14/97

During reference (a) telephone conversations, it was agreed to close the north and south ends of Wallops Island's beaches from March 15 through September 15 to help protect the piping plover. This is a change to Section IV. Conservation Recommendations in the reference (b) Biological Opinion for Range Operations Expansion at WFF, which specifies "close the piping plover use areas from March 1 through September 15 of every year to discourage human intrusion." According to Bob Cross of the VDGIF, piping plover nesting activity should begin on Wallops Island after March 15.

It was also agreed that NASA could conduct year round open burn/open detonation (OB/OD) of rocket motors. The OB/OD facility is just north of the fencing, at the perimeter of the piping plover use area, at the south end of Wallops Island.

Please contact John C. Brinton, Environmental Protection Specialist, at 757-824-1327 with any questions or comments.

William B. Bott
Environmental Group Leader

Concurrence: Cindy Schulz
Cindy Schulz
USFWS Biologist

cc:
VDIGF/Mr. B. Cross

Approved: Karen L. Mayne
Supervisor
Virginia Field Office
3/10/98

Figure K-1 United States Fish and Wildlife Service Letter

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL ENVIRONMENTAL SATELLITE, DATA
AND INFORMATION SERVICE
WALLOPS COMMAND AND DATA ACQUISITION STATION
WALLOPS, VIRGINIA 23337

May 28, 2009

Joshua A. Bundick
NEPA Program Manager
National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099

Dear Mr. Bundick:

The National Oceanic and Atmospheric Administration (NOAA) has reviewed the Draft Environmental Assessment (EA) for the Expansion of the Wallops Flight Facility Launch Range.[1] The expansion is proposed to upgrade the existing launch range at Wallops Island, with the overall purpose to achieve an increase in the number of medium-to-large, suborbital-to-orbital spacecraft launches, from a maximum of 12 per year to a maximum of 18 per year. The expansion would also permit an additional two static test firings per year.

This letter provides comments regarding the content of the EA in two areas of NOAA concern. Toward that end, the mission of the WCDAS, along with mission critical usage of radio frequencies and possible impacts to that usage, are briefly described.

The NOAA Wallops Command and Data Acquisition Station (WCDAS) at the Wallops Main Base is located approximately 5-8 miles NNW to N of the various facilities associated with the launch range expansion project. The mission of WCDAS includes ensuring scheduled flow of accurate weather and climate data from NOAA satellites to designated user subsystems. Its mission includes executing spacecraft (satellite) commands and schedules, acquiring, maintaining, and distributing a continuous flow of meteorological satellite data via two-way radio frequency (RF) data links, and managing, operating, and maintaining the station. Consequently, the WCDAS is an extensive user of the RF spectrum employing numerous frequency bands for multiple purposes. Studies and analyses have been performed in the past to ensure protection of the WCDAS, and similar NOAA facilities, and these studies include descriptions of spectrum usage and assessments of RF Interference (RFI).[2,3,4,5,6] It is in the nature of satellite links that they are sensitive to RFI due to the requirement to detect very low power signals from distant satellites. Geostationary and low earth orbiting, national and international, satellite systems are accessed and the station uses two-way microwave and domestic satellite data links to fulfill its mission. The use of RF spectrum is critical to fulfilling the mission of WCDAS.

It is noted that the draft EA presented a rather thorough examination of the various potentials for impacts to the biological and socio-economic environmental resources. With regard to the assessment of the potential impacts to the physical environment, NOAA has identified two areas that are briefly discussed in the EA for which there is not enough information to permit an assessment of potential impact to the WCDAS:

1. The EA contains several brief references to communications instrumentation (p 9) and ground-based surveillance and radar tracking systems (pp 9 and 11) that will be employed during launch activities. Additionally, the use of RF telemetry systems and data links between the spacecraft and ground systems is to be expected. The NOAA WCDAS has always been able to coexist with past launches without significant disruption to NOAA activities. However, the text contained in section 2.2.1.7 on p 22 of the EA mentions minor modifications to "communications support, radar, and antenna improvements". Without specific technical information regarding the proposed modifications and improvements, NOAA is unable to assess any potential impacts to sensitive NOAA receiving systems from changes to said systems. Information required to perform an assessment might include a brief description of the equipment improvements or modifications, along with the technical characteristics of the improved/modified systems (i.e. changes in transmitter power output and/or antenna types/gains, and changes in antenna locations, orientation, or pointing direction, etc).

2. The EA contains reference to loss of forest (p 112) due to construction activities. There is evidence from past technical studies that specific stands of the existing natural tree cover, located between the various Wallops Island transmitter systems and the Wallops Flight Facility, provide a degree of RF isolation (increased propagation loss) to potential interfering signals from high-power transmitters located on Wallops Island and vicinity. This RF isolation currently contributes to allowing the sensitive receiver systems at the WCDAS to generally operate satisfactorily with transmitting systems in the local environment. Without more specific information regarding areas of trees or vegetation that are designated for removal, NOAA is unable to determine if performance degradation to the sensitive WCDAS receiver systems may increase.

In summary, coordination and planning for the launch range expansion will be of interest to the WCDAS. The draft EA (Reference 1) should identify: 1) specific modifications (if any) proposed for the locations or technical characteristics of the communications, radar, and telemetry systems, and 2) the stands of tree cover or vegetation that is proposed for removal on a suitable map.

Sincerely,

Van D. Crawford
Manager, Wallops CDA Station

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

MAY 18 2009

Joshua A. Bundick
National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, Virginia 23337
Attn: 250.W

Dear Mr. Bundick,

This is in response to your letter dated April 23, 2009 regarding the Draft Environmental Assessment (EA) for the proposed expansion of the launch range at the Goddard Space Flight Center's Wallops Flight Facility (WFF). WFF is located in the northeastern portion of Accomack County, Virginia, on the Delmarva Peninsula, and is comprised of three separate land masses: the Main Base, Wallops Mainland, and Wallops Island. Mid Atlantic Regional Spaceport (MARS) facilities are located on Wallops Island and include Launch Complex 0, comprised of Launch Pads 0-A and 0-B. The National Aeronautics and Space Administration (NASA) has requested comments on the EA and its conclusion that the project will have no effect on any species listed as threatened or endangered by NOAA's National Marine Fisheries Service (NMFS).

Proposed Project

The proposed action is to expand an upgrade NASA and MARS facilities to support up to and including medium large class suborbital and orbital expendable launch vehicle launch activities from WFF. The site improvements to support launch operations include:

- Minor modifications to the boat dock on the north end of Wallops Island, including the installation of sheet pile (pile driving), additional fendering, and armor stone. Depths within the existing approach channel and boat basin are maintained to a depth of 4 feet at low tide;
- Construction of a dedicated Payload Fueling Facility (PFF), a facility dedicated to payload processing, and storage;
- Construction of new roads and minor upgrades to existing roads;
- Construction of a new launch complex in approximately the same location as the existing Pad 0-A, including a Liquid Fueling Facility (LFF); and
- Minor interior modifications to launch support facilities.

NMFS listed species in Project Area

Four species of federally threatened or endangered sea turtles under the jurisdiction of NMFS can be found seasonally in the coastal waters of Virginia from early May –November of each year. Loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempi*), and green sea turtles (*Chelonia mydas*) are present in these waters mainly during late spring, summer and early fall when water temperatures are relatively warm. While federally endangered leatherback sea turtles (*Dermochelys coriacea*) may be found in the waters off Virginia during the same time frame as well, this species is unlikely to occur in the action area as it is typically found in deeper, more offshore waters.

Several studies have examined the seasonal distribution of sea turtles in the mid-Atlantic, including Virginia. Sea turtles begin appearing in nearshore habitats of the mid-Atlantic as water temperatures rise in the spring and remain throughout the warmer months. Sea turtles are typically found in Virginia when water temperatures are greater than 11°C. In early May, as water temperatures continue to rise farther northward, Kemp's ridleys and loggerheads begin to appear in Virginia (Morrealle and Standora 2005). As temperatures decline in the fall, sea turtles leave their coastal habitats and join a larger contingent of other turtles migrating southward to overwinter (Morrealle and Standora 2005, Musick and Limpus 1997). Studies summarized in Morreale and Standora (2005) indicate that loggerhead and Kemp's ridley sea turtles begin to appear in Virginia waters in May and begin leaving Virginia waters by the first week of November. Similar migratory patterns are expected for green and leatherback sea turtles (Shoop and Kenney 1992; Morreale 1999).

Conclusions

The proposed project involves several types of construction activities in order to improve launch operations. Of particular concern for the NMFS is the modifications proposed for the boat dock, specifically the installation of steel sheet piles which will require pile driving. Pile driving can cause an increase in underwater noise levels, as well as, an increase in suspended sediment, which can affect the hearing and behavior of marine species. As listed species of sea turtles are likely to occur in the proposed project area, effects to sea turtle species may result from the construction activities (i.e., pile driving) proposed for Goddard Space Flight Center's Wallops Flight Facility. As such, NMFS recommends that NASA initiate consultation pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended. NASA should submit a determination of effects along with justification for the determination and a request for concurrence to NMFS. If NASA determines that the project is "not likely to adversely affect" any listed species (i.e., when effects of the proposed project on listed species are expected to be discountable, insignificant or completely beneficial) and NMFS concurs with this determination, NMFS will reply to NASA in a letter that will convey the concurrence, thus completing Section 7 consultation. If the NASA determines that the project is "likely to adversely affect" any listed species (i.e., if any adverse effect to listed species may occur as a direct or indirect result of the proposed action and the effects are not: discountable, insignificant, or beneficial) or NMFS does not concur with the NASA's "not likely to adversely affect" determination, formal Section 7 consultation, resulting in the issuance of a Biological Opinion with an appropriate Incidental Take Statement, may be required. Any effects that amount to the take of a listed species (defined by the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct") are not discountable, insignificant or entirely beneficial. Therefore, if any take is anticipated, formal consultation is required. In addition, if other action agencies (i.e. Army Corps of Engineers) will be involved in the proposed will be involved in the proposed project, effects of their actions should also be included with the information sent by NASA to NMFS. Should you have any questions about this correspondence please contact Danielle Palmer at (978) 282-8468 or by e-mail (Danielle.Palmer@Noaa.gov).

Sincerely,

Mary A. Colligan
Assistant Regional Administrator for
Protected Resources

Ec: Greene, F/NER4
O'Brien
Palmer

File Code: Sec 7 NASA Goddard Space Flight Center's Wallops Flight Facility launch expansion
PCTS: I/NER/2009/02268

JNS 7/9/09

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

JUL - 8 2009

Joshua A. Bundick
National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, Virginia 23337
Attn: 250.W

Dear Mr. Bundick,

This is in response to your letter dated May 28, 2009 regarding the proposed expansion of the launch range at the Goddard Space Flight Center's Wallops Flight Facility (WFF). WFF is located in the northeastern portion of Accomack County, Virginia, on the Delmarva Peninsula, and is comprised of three separate land masses: the Main Base, Wallops Mainland, and Wallops Island. Mid Atlantic Regional Spaceport (MARS) facilities are located on Wallops Island and include Launch Complex 0, comprised of Launch Pads 0-A and 0-B. In the Draft Environmental Assessment (EA) the National Aeronautics and Space Administration (NASA) made the preliminary determination that the proposed project will have no effect on any species listed as threatened or endangered. However, limited project details were available at the time of the Draft EA's issuance. Since then, as plans for the project have matured NASA has determined that proposed project may affect, but is not likely to adversely affect any species listed as threatened or endangered under the jurisdiction of NOAA's National Marine Fisheries Service (NMFS) and has requested that NMFS concur with this determination.

Proposed Project

The proposed action is to expand and upgrade WFF to support up to and including medium large class suborbital and orbital expendable launch vehicle launch activities from WFF. The site improvements to support launch operations include:

- Construction of a dedicated Payload Fueling Facility (PFF), a facility dedicated to payload processing, and storage;
- Construction of new roads and minor upgrades to existing roads;
- Construction of a new launch complex in approximately the same location as the existing Pad 0-A, including a Liquid Fueling Facility (LFF);
- Minor interior modifications to launch support facilities; and
- Minor modifications to the boat dock on the north end of Wallops Island, which is situated on the bay side (i.e., Powells Bay) of the Delmarva Peninsula. Depths within the existing approach channel and boat basin are maintained to a depth of 4 feet at low tide. In order to widen the vehicular approach to the boat dock, NASA will install approximately seven, 18-inch steel sheet piles on either side of the existing 42-foot wide

steel pile bulkhead, effectively widening the current bulkhead by approximately 11 feet on each side. The bulkhead is located on the landward side of the existing 26 foot by 42 foot concrete hardstand at the interface of land and water; the proposed piles will be installed in the same alignment. In addition, approximately fifteen of these 18-inch steel sheet piles will be installed perpendicular to the bulkhead improvements described above, extending each side of the structure approximately 23 feet toward land. All pilings will be installed from land with the preferred method being a vibratory hammer; an impact hammer may be necessary at times if site conditions dictate. The project will likely take place in the summer or fall seasons, with total construction time estimated to be less than a week. The Army Corps of Engineers (ACOE) is the permitting agency for this portion of the WFF expansion project[1], and therefore, serves as an interrelated action to the proposed project. NASA, however, is the lead federal agency for the proposed project and consultation.

Throughout the project, NASA will implement the following measures to minimize any potential effects to sea turtles from the proposed boat dock modifications:

- Each day prior to pile driving, or prior to resuming pile driving after a greater than 30 minute pause, a trained observer will perform a visual sweep of the adjacent waterways. If listed sea turtles are observed within 500 yards of the project site, pile driving will be suspended until the turtle has moved outside of this 500 yard exclusion zone.
- During pile driving, a trained observer will be stationed at a point at which the Wallops Island boat basin canal intersects the Virginia Inside Passage, approximately 450 yards northwest of the project site. If turtles are observed entering the exclusion zone, this information will be immediately communicated to the construction contractor and work will be halted until the turtle is back outside of the 500 yard buffer.
- To the greatest extent practicable, NASA will direct its construction contractor to install pilings by vibratory techniques rather than hammer methods as this will reduce the noise and vibration within and adjacent to the project site.

NMFS listed species in Project Area

The proposed project is located at the Goddard Space Flight Center's Wallops Flight Facility, which is situated on the Delmarva Peninsula of Virginia. 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" (50CFR§402.02). For this project, the action area includes the on land portion of the proposed construction activities on Wallops Island as well as the underwater area where effects of pile driving at Wallops Island boat dock (i.e., increase in suspended sediment, underwater noise levels) will be experienced. Based on the analysis of pile driving activities (i.e., the type and size of the piles to be driven), effects of increased under water noise will be experienced from a 10-1000 meter radius of the pile to be driven (Laughlin 2005; Jones and Stoke 2007; Illinworth and Rodkin, Inc. 2007). In addition, the action area includes the trajectory of orbital class launches and the associated impact points of orbital debris that may fall into the Atlantic Ocean. Launch trajectories/azimuth's from WWF are generally between 90 and 160 degrees from WWF. Along this trajectory range, potential impact points of falling debris

[1] Permits issued by the ACOE: CWA Section 404 permit and Rivers and Harbors Act Section 10 permit.

may occur between 80 nautical miles (nm)-1125nm from WFF. As such the action area includes the construction activities occurring on WFF, the in water work surrounding boat dock modifications (effects felt 10-1000meter radius of the pile being driven), and the area of the Atlantic Ocean, along the 90-160 degree trajectory, 80-1125nm from WWF, where orbital debris may fall.

Sea Turtle Species
Four species of federally threatened or endangered sea turtles under the jurisdiction of NMFS can be found seasonally in the coastal waters of Virginia from early May –November of each year. Loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempi*), and green sea turtles (*Chelonia mydas*) are present in these waters mainly during late spring, summer and early fall when water temperatures are relatively warm. While federally endangered leatherback sea turtles (*Dermochelys coriacea*) may be found in the waters off Virginia during the same time frame as well, this species is unlikely to occur in the action area as it is typically found in deeper, more offshore waters.

Several studies have examined the seasonal distribution of sea turtles in the mid-Atlantic, including Virginia. Sea turtles begin appearing in nearshore habitats of the mid-Atlantic as water temperatures rise in the spring and remain throughout the warmer months. Sea turtles are typically found in Virginia when water temperatures are greater than 11°C. In early May, as water temperatures continue to rise farther northward, Kemp's ridleys and loggerheads begin to appear in Virginia (Morrealle and Standora 2005). As temperatures decline in the fall, sea turtles leave their coastal habitats and join a larger contingent of other turtles migrating southward to overwinter (Morrealle and Standora 2005, Musick and Limpus 1997). Studies summarized in Morreale and Standora (2005) indicate that loggerhead and Kemp's ridley sea turtles begin to appear in Virginia waters in May and begin leaving Virginia waters by the first week of November. Similar migratory patterns are expected for green and leatherback sea turtles (Shoop and Kenney 1992; Morreale 1999).

Whale Species
Federally listed species of whales may be found seasonally off the Atlantic coast of Virginia. Federally endangered North Atlantic right whales have been found off the coast of Virginia from November 1 – May 31, approximately 30 nautical miles from shore. Humpback whales feed during the spring, summer, and fall over a range that encompasses the eastern coast of the United States and may be found in Virginia waters from September 1 – April 30. Fin (*Balaenoptera physalus*) and Sperm (*Physter macrocephalus*) whales are also seasonally present in the waters off of Virginia, but are typically found in deeper offshore waters. Fin whales are likely to be present off the coast of Virginia from October – January and Sperm whales may be present in these waters from March - May. Although listed species of whales may not occur in the portion of the action area where construction activities are occurring on Wallops Island or in the waters surrounding the boat dock, listed species of whales are likely to present in more offshore waters within the portion of the action area where orbital debris could fall (i.e. 80nm-1125nm from WFF).

Effects of the Action

The proposed project will involve the following construction activities:

Pile Driving at WWF Boat Dock

The proposed project will involve driving, non-continuously, steel sheet piles at the boat dock on Wallop's Island. The installation of piles via pile driving can produce underwater sound pressure waves that can affect aquatic species. The available literature indicates that the single strike of a steel sheet pile results in a sound exposure level (SEL) up to about 155 to 160 dB re 1 μPa^2-sec at a distance of 10 meters from the source (Jones & Stokes 2007). However, if a vibratory hammer is used to install the sheet piles, sound exposure levels are 10-20 dB lower. These levels are dependent not only on the pile and hammer characteristics, but also on the geometry and boundaries of the surrounding underwater and benthic environment. As the distance from the source increases, underwater sound levels produced by pile driving are known to dissipate rapidly. Illinworth and Rodkin, Inc. (2007) have conducted underwater sound level measurements as far as 1,000 meters from various types of piles being driven. Within this distance attenuation rates in the range 2 to 10 dB per doubling of distance have been observed for all types of piles.

The hearing capabilities of sea turtles are poorly known and there is little available information on the effects of noise on sea turtles. Current thresholds for determining impacts to marine mammals and sea turtles typically center around root-mean-square (RMS) received levels of 180 dB re 1μPa for potential injury, 160 dB re 1μPa for behavioral disturbance/harassment from a non-continuous noise source, and 120 dB re 1μPa for behavioral disturbance/harassment from a continuous noise source. As noted above, sound levels may be as high as 160 dB within 10 meters of the pile being driven but will be lower than 160 dB within 1000 meters or less of the pile being driven. However, based on studies done on sea turtle occurrence, behavior, and movements (i.e. Morreale and Standora (1990)), the habitat characteristics of the portion of the action area located at the boat dock (i.e. depths of 4 feet at low tide) are inconsistent with the preferred habitats of sea turtles. As such, it is extremely unlikely that sea turtle species will occur in the action area where pile driving will occur (i.e., within 10-1000 meters of the sheet pile being driven) and therefore, it is extremely unlikely that sea turtle species will be exposed to sound levels at or above 160 dB. However, even if transient sea turtle species occurred in the action area the stop-work provisions and sound minimization techniques implemented for the proposed project will prevent sea turtles from being exposed to sound levels that could harm or disturb sea turtle species that enter the action area as all work will be stopped as soon as a sea turtle is observed within 500 yards of the project site. Based on this information, the noise effects of pile driving on sea turtle species is discountable.

The installation of sheet piles will disturb bottom sediments. However, little increase in sedimentation or turbidity is expected to result from these construction activities. If any sediment plume does occur, it is expected to be small and suspended sediment is expected to settle out of the water column within a few hours and any increase in turbidity will be short term. Additionally, as noted above, it is extremely unlikely that sea turtle species will occur in the action area due to the shallow habitat characteristics of the approach channel and boat basin. As such, any effects of pile driving are expected to be discountable.

Other Construction Activities
Although the other construction activities, such as construction of new roads, PFF, and launch pad complex, will have no effect on sea turtles because the work will occur above the surface of the water where these species will not be present, any spills or leaks of pollutants from these activities could potentially occur and enter the marine environment and therefore, effect sea turtle species. However, toxic concentrations of pollutants are not anticipated in the nearshore and open ocean areas of the action area due to the mixing and dilution associated with wave movements and the vastness of the ocean environment. As such, pollutant presence in the marine environment will be short term. Based on this information, it is extremely unlikely that sea turtle and whale species will be exposed to high concentrations of pollutants that could pose a threat to the health and survival of listed species of sea turtles and whales, as any pollutant that may enter the marine environment will be diluted rapidly as a result of wave movements.

Construction activities of the proposed project will also involve the construction of a new launch complex, which will allow for six additional launches from the WFF from Pad 0-A. With this site improvement, WWF will be able to undertake 18 total orbital class launches per year (12 from Pad 0-B and 6 from Pad 0-A). With each launch, there is a potential of debris to fall within the Atlantic Ocean (80nm-1125nm from WWF). This falling debris has the potential to hit sea turtle or whale species within the Atlantic Ocean. However, based on only 18 launches being done per year, the vastness of the ocean, and the low density and wide distribution of whale and sea turtle species in the Atlantic Ocean, it is extremely unlikely for listed species of sea turtles and whales to be effected by orbital debris falling into the Atlantic Ocean. In addition, in a memo to NASA dated April 3, 2003 regarding the taking of marine mammals incidental to rocket launches, NMFS concluded that no letter of incidental take was needed for WFF as the level of impact from WWF activities (i.e., rocket launches) on marine mammals didn't warrant a letter of authorization as it was extremely unlikely to occur. Based on this information, the likelihood of falling debris hitting or impacting listed species of sea turtles or whales within the Atlantic Ocean is extremely low and unlikely to occur. As such, NMFS is able to conclude that the effects of falling orbital debris on listed species of whales and sea turtles is discountable.

Conclusions
Based on the analysis that all effects to listed sea turtles will be insignificant or discountable, NMFS is able to concur with the determination that the project proposed by NASA and the granting of a permit by the ACOE for proposed boat dock modifications at the WFF, is not likely to adversely affect any listed species under NMFS jurisdiction. Therefore, no further consultation pursuant to section 7 of the ESA is required. Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in the consultation; (b) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the consultation; or (c) If a new species is listed or critical habitat

designated that may be affected by the identified action. Should you have any questions about this correspondence please contact Danielle Palmer at (978) 282-8468 or by e-mail (Danielle.Palmer@Noaa.gov).

Sincerely,

Patricia A. Kurkul
Regional Administrator

Ec: Greene
O'Brien
Nichols
Palmer,

File Code: Sec 7 NASA Goddard Space Flight Center's Wallops Flight Facility launch expansion
PCTS: I/NER/2009/02925

"Bundick, Joshua A. (WFF-2500)"
<joshua.a.bundick@nasa.gov>

08/12/2009 08:40 AM

To "Suzanne_Richert@URSCorp.com" <Suzanne_Richert@URSCorp.com>, "Silbert, Shari A. (WFF-200.C)[EG&G, Inc. (WICC)]"

cc

bcc

Subject FW: EFH; NASA Wallops Island Flight Facility

-----Original Message-----
From: David L O'Brien [mailto:David.L.O'Brien@noaa.gov]
Sent: Tuesday, August 11, 2009 3:59 PM
To: Bundick, Joshua A. (WFF-2500)
Subject: EFH; NASA Wallops Island Flight Facility

Hello Josh,

It was nice speaking with you yesterday regarding the draft EA you previously sent for my review regarding the proposed Expansion of the Wallops Flight Facility Launch Range. Following a review of the draft document and based on your description of the proposed project which includes the installation of approximately 25 linear ft. of sheet pile bulkhead, it is the opinion of NOAA Fisheries Service that the proposed bulkhead construction will not result in substantial adverse effects to EFH, managed species or their prey species.

As you know, under the Magnuson-Stevens Act (MSA), federal agencies who permit, authorize, or undertake actions with the potential to adversely affect essential fish habitat (EFH) must coordinate with NOAA Fisheries Service. To satisfying the EFH consultation requirements mandated under the MSA, the lead federal action agency must submit an EFH assessment to NOAA Fisheries Service, upon which our agency then consults. The Northeast Regional Office Habitat Conservation Division's (HCD) website http://www.nero.noaa.gov/hcd/ provides useful information regarding EFH designations, assessments and the consultation process. An EFH assessment can be incorporated into a NEPA document such as the EA being prepared for the Expansion of the Wallops Flight Facility Launch Range.

As I mentioned yesterday, I would welcome an opportunity to further discuss the role of NOAA Fisheries, EFH, EFH assessment and the consultation process with you and other interested staff at your facility. I am available next Wednesday, August 19th to conduct a brief 30-45 minute presentation that overviews EFH and the consultation process and to answer any questions you may have. I am happy to arrive at your offices around 10 am if that is convenient for you and look forward to learning more about your agency and the mission of Wallops Island Flight Facility.

Please let me know if meeting next Wednesday works for your schedule. I look forward to seeing you soon.

Regards,

Dave

--
David O'Brien
NOAA Fisheries Service
Habitat Conservation Division

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7580 Spencer Rd.
Gloucester Point, VA 23062
phone 804-684-7828
fax   804-684-7910
David.L.O'Brien@noaa.gov

Silbert, Shari A. (WFF-200.C)[EGG, Inc. (WICC)]

From:	Bundick, Joshua A. (WFF-2500)
Sent:	Wednesday, May 27, 2009 8:07 AM
To:	Suzanne_Richert@URSCorp.com; Silbert, Shari A. (WFF-200.C)[EG&G, Inc. (WICC)]
Subject:	FW: Launch range expansion comments
Attachments:	NASA- Launch range expansion- draft EA comments.doc

-----Original Message-----
From: Ortiz, Adrianna CIV SCSC, PW [mailto:adrianna.ortiz1@navy.mil]
Sent: Tuesday, May 26, 2009 4:45 PM
To: Bundick, Joshua A. (WFF-2500)
Cc: Ailes, Marilyn CIV SCSC, M221
Subject: Launch range expansion comments

I apologize for getting these comments to you past the deadline. Once again these are only the comments from within the environmental office, not of the Commanding officer or anybody else in the main office. The summer intern and myself reviewed the entire document upon which we based our comments. If you have question please contact feel free to contact me.

Adrianna Ortiz

Student Ecologist
Navy Surface Combat Systems Center
Wallops Island, VA 23337
Phone: (757) 824-2083
Fax: (757) 824-2086
E-mail: adrianna.ortiz1@navy.mil

Subject: LAUNCH RANGE EXPANSION DRAFT ENVIRONMENTAL ASSESSMENT

1. Thank you for the copy of the Draft Environmental Assessment (EA) for the proposed launch range expansion on Wallops Island, Virginia. We at Surface Combat Systems Center Environmental Office have reviewed the proposal and would like to address a few issues. We understand that due to the need of the expansion and the specific details therein, there is only one alternative action mentioned. However, we feel that there needs to be alternatives listed in detail for various pieces such as possible locations for roads and possible sites for wetland mitigation. The destruction to wetlands is not clearly explained. Acreage is given, but the specific locations and wetland type are missing. We recommend that further details be given on wetland destruction as well as mitigation, along with possible locations of roads to the proposed buildings.

2. NASA has been actively developing plans to control if not reverse shoreline erosion on the southern end of Wallops Island for some time now. Although this draft EA does discuss the problems of shoreline erosion, no actions are being taken within this project to ensure the future of the proposed structures, especially at Pad 0-A. It is unclear from Figure 5 if the revised launch pad will have a new building associated with it. We recommend that the figure include a drawing of the building if applicable. We also recommend that forethought in engineering include mitigating the risk of storm overwash by elevating structures off the ground, and/or enclosing the various tanks (gases and oils) to shield them from the salt water preserving their integrity.

3. Modifications to the boat dock on the northern end of Wallops are listed, but are lacking detail. The draft EA does not mention the importance to wildlife of the waters surrounding this boat dock, although it does mention the essential fish habitat (EFH) near pad 0-A. We recommend that more detail be given for which part of the boat dock area will be hardened and by what means. An additional figure would be very helpful to support the text. Also we recommend that the National Marine Fisheries Services be consulted to ensure that the marsh adjacent to the boat dock is not classified as EFH.

4. The increase of water usage due to the proposed action was not considered significant since the total usage was still within the constraints of the current permit. We would like to reiterate that the expected monthly increase of 44% and expected

annual increase of 25% would still increase the demand to the sole source aquifer. We recommend that the water be conserved as much as possible to ensure future water supplies to Wallops Island.

5. From the description given, the deluge basin will be completely filled prior to each launch. After the launch the pH levels of the water within will be tested before being released into an unlined containment pond. From there the water will drain into the surrounding ecosystem until completely drained from the basin. We would like to mention that the surrounding water is very shallow and has a low turnover rate. By introducing large amounts of nitrogen sources this water is likely to undergo eutrophication, leading to other water quality problems such as low oxygen levels (Ryther and Dunstan 1971). Since this area has been labeled as EFH, it is reasonable to assume that degraded water quality will greatly impact the fish community (Kemp et al. 2005). We recommend that other water quality parameters such as total nitrogen or other possible contaminants be tested for before release to the secondary containment pond. We also recommend that potential impacts to water quality be further investigated and minimized where possible.

6. Section ‘4.2.4 Noise’, discusses the potential noises from construction, transportation, and launches. Piping plovers are mentioned as a potential receptor and more details are given later. Under the subheading ‘sonic booms’, it states that noise impacts to wildlife will be discussed below. However, this subject is not brought up until ‘4.3.2 Terrestrial Wildlife and Migratory Birds, and even there the information given is vague. The proposed payload fueling facility building is near the known peregrine falcon (listed by Virginia as threatened (VDGIF 2009)) nest on Wallops Island, VA. We recommend that the potential impact from noise disturbances be further evaluated for other wildlife, especially the peregrine falcon.

7. Laser use is brought up and some background information on the various classes of lasers is described. For this specific proposal the class of lasers is not mentioned, nor are the potential impacts to wildlife. We recommend that details be given to better characterize the use and potential risks of lasers.

8. In section ‘4.3.2 Terrestrial Wildlife and Migratory Birds’, under ‘launch activities’, there is confusion about the closures of Assateague during the launches. First it states that all

launches from Pad 0-B require the closure of the southern end of Assateague Island. It then contradicts by stating that Assateague has become a popular observation location for viewing the launches. The last portion of this section digresses as it begins to talk about the inputs of educational resources NASA has brought to the community. We recommend that the role of Assateague during launches be clarified and the information regarding education be placed in the appropriate section, '4.4.1 Population, Employment and Income'.

9. Section,'3.4 Department of Transportation Section 4(F) Lands' discusses regulations concerning the conversion of publicly owned parks, recreational areas, wildlife and waterfowl refuges, and public or private historical sites to non-recreational lands. Section '3.4.2 Public Lands and Refuges', mentions the validity of these regulations not only to public land holdings, but also to 'Federal lands'. It is our understanding that the incorporation of 'federal lands' in this section is an error. We recommend its removal or clarification if applicable.

10. Last we have noticed that approximately one whole page from the reference section ('Section Eight References') was from a NASA source. We recommend that outside sources be integrated into the document to support in-house research effort findings.

Literature cited

Kemp, W. M., W. R. Boynton, J. E. Adolf, D. F. Boesch, W. C. Boicourt, G. Brush, J. C. Cornwell, T. R. Fisher, P. M. Glibert, J. D. Hagy, L.W. Harding, E. D. Houde, D. G. Kimmel, W. D. Miller, R. I. E. Newell, M. R. Roman, E. M. Smith, J. C. Stevenson. 2005. Eutrophication of Chesapeake Bay: historical trends and ecological interactions. Marine Ecological Progress Series 303:1-29

Ryther, J. H. and W. M. Dunstan. 1971. Nitrogen, phosphorous, and eutrophication in the coastal marine environment. Science 171(3975):1008-1013

Virginia Department of Game and Inland Fisheries (VDGIF) Special Status Faunal Species in Virginia. Updated February 3, 2009.
http://www.dgif.virginia.gov/wildlife/virginiatescspecies.pdf

JAB 6/22/09

COMMONWEALTH of VIRGINIA

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Secretary of Natural Resources

David K. Paylor
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June 18, 2009

Mr. Joshua A. Bundick
WFF NEPA Manager
Environmental Office
NASA Wallops Flight Facility
Wallops Island, Virginia 23337

RE: Draft Environmental Assessment and Federal Consistency Determination for the Expansion of the Wallops Flight Facility Launch Range, Accomack County, (DEQ 09-083F).

Dear Mr. Bundick:

The Commonwealth of Virginia has completed its review of the April 2009 Draft Environmental Assessment (EA) and Federal Consistency Determination (FCD) (received April 24, 2009) for the Expansion of the Wallops Flight Facility Launch Range in Accomack County. The Department of Environmental Quality (DEQ) is responsible for coordinating Virginia's review of federal environmental documents and responding to appropriate federal officials on behalf of the Commonwealth. DEQ is also responsible for coordinating Virginia's review of FCDs submitted pursuant to the Coastal Zone Management Act (CZMA) and providing the state's response. The following agencies and locality participated in the review of the EA and FCD for this proposal:

Department of Environmental Quality
Department of Conservation and Recreation
Department of Game and Inland Fisheries
Department of Agriculture and Consumer Services
Virginia Marine Resources Commission
Department of Forestry
Department of Mines, Minerals and Energy
Department of Historic Resources
Department of Transportation
Accomack County

The Accomack-Northampton Planning District Commission was also invited to comment on the proposal.

PROJECT DESCRIPTION

The National Aeronautics and Space Administration (NASA) plans to expand the launch range at Wallops Island Flight Facility (WFF) in Accomack County. The proposed action is intended to expand and upgrade NASA and Mid-Atlantic Regional Spaceport (MARS) facilities to support launch activities from WFF for up to and including the medium-large class suborbital and orbital expendable launch vehicle (ELV). Components of the proposed action include:

- facility construction and infrastructure improvements;
- testing, fueling, and processing operations;
- up to two static fire tests per year; and
- launching an additional six vehicles and associated spacecraft per year from Pad 0-A.

Site improvements to support launch operations include:

- minor modifications to the boat dock on the north end of Wallops Island;
- construction of a dedicated Payload Fueling Facility (PFF), a Payload Processing Facility (PPF) and storage;
- construction of new roads and minor upgrades to existing roads;
- construction of a new launch complex in approximately the same location as the existing Pad 0-A, including a Liquid Fueling Facility (LFF); and
- minor interior modifications to launch support facilities.

CONCLUSION

Based on the information provided in the Draft Environmental Assessment and comments from reviewers, the Commonwealth of Virginia has no objection to the proposal as presented, provided NASA complies with all applicable laws and regulations.

Provided activities are performed in accordance with the recommendations which follow, this project is unlikely to have significant effects on ambient air quality, water quality, important farmland, wetlands, and wildlife resources. NASA should coordinate closely with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and the Virginia Department of Game and Inland Fisheries to ensure that impacts on protected species including shorebirds, sea turtles and marine mammals are adequately avoided and minimized.

ENVIRONMENTAL IMPACTS AND MITIGATION

1. Water Quality & Wetlands. According to the EA (page ii), construction activities, spills or leaks of pollutants during construction activities, spill or leaks during transportation of materials or from storage facilities, and launch failures that may result in release of liquid propellants would all have the potential to affect surface waters including approximately 5.7 acres of wetlands. Prior to construction, NASA and MARS would complete a jurisdictional wetland delineation, obtain all necessary permits and implement mitigation measures to ensure no net loss of wetlands.

The document (page 21) states that a water deluge system would be constructed to absorb the heat load and suppress vibration and noise from the engines. The deluge system would include a 100,000-gallon aboveground water storage tank, pumps, and a trench and retention basin for the deluge water. Once used, the deluge water would be discharged to a 12,500-square-foot concrete-lined retention basin and tested for potential release via a water control structure to a newly constructed unlined stormwater basin.

1(a) Agency Jurisdiction. The State Water Control Board (SWCB) promulgates Virginia's water regulations, covering a variety of permits to include Virginia Pollutant Discharge Elimination System (VPDES) Permit, Virginia Pollution Abatement Permit, Surface and Groundwater Withdrawal Permit, and the Virginia Water Protection Permit (VWPP). The VWPP is a state permit which governs wetlands, surface water, and surface water withdrawals/impoundments. It also serves as § 401 certification of the federal *Clean Water Act* § 404 permits for dredge and fill activities in waters of the U.S. The VWPP Program is under the Office of Wetlands and Water Protection/Compliance, within the DEQ Division of Water Quality Programs. In addition to central office staff that review and issue VWP permits for transportation and water withdrawal projects, the seven DEQ regional offices perform permit application reviews and issue permits for the covered activities.

1(b) Virginia Water Protection Permit. The DEQ Tidewater Regional Office (TRO) notes that the facility expansion will involve impacts to surface waters and wetlands that are regulated by the VWPP program.

1(c) Virginia Pollutant Discharge Elimination System. According to the DEQ-TRO, it appears that the existing VPDES permit for Wallops Island may require modification to address any new discharges of process wastewater and industrial stormwater. If the quench water used during rocket launches will require an adjustment to its pH, the discharge of this treated wastewater will require a permit under the VPDES program. Furthermore, DEQ-TRO will evaluate whether stormwater runoff from the rocket launch pads should be covered in the permit. The existing VPDES permit for the NASA

Wallops Island facility is currently being reviewed by DEQ for reissuance. Therefore, any additional discharges will be included in DEQ's permit evaluation.

DEQ-TRO notes that the proposed deluge system will use 100,000 gallons of potable groundwater for each launch or static fire. DEQ-TRO believes that this is not the best use of potable water from the Eastern Shore confined aquifer system.

1(d) Recommendation. DEQ-TRO recommends that NASA investigate the feasibility of constructing a shallow water table well for the sole purpose of filling the storage tank for the deluge system, provided a reusable source of water is not available. The deluge system water that would be discharged to the concrete-lined retention basin should be recycled back to the storage tank even if some treatment is necessary. Groundwater would only be needed to make up for water loss after the initial filling of the storage tank.

In general, DEQ recommends that stream and wetland impacts be avoided to the maximum extent practicable. To minimize unavoidable impacts to wetlands and waterways, DEQ recommends the following practices:

- Use directional drilling from upland locations for stream crossings, to the extent practicable. If directional drilling is not feasible, stockpile the material excavated from the trench for replacement.
- Operate machinery and construction vehicles outside of stream-beds and wetlands; use synthetic mats when in-stream work is unavoidable;
- Construct the trench for the utility line in a manner that does not drain the wetlands (for example, backfilling with extensive gravel layers thereby creating a French drain effect).
- Preserve the top 12 inches of trench material removed from wetlands for use as wetland seed and root-stock in the excavated area.
- Erosion and sedimentation controls should be designed in accordance with the most current edition of the Virginia Erosion and Sediment Control Handbook. These controls should be in place prior to clearing and grading, and maintained in good working order to minimize impacts to state waters. The controls should remain in place until the area is stabilized.
- Place heavy equipment, located in temporarily impacted wetland areas, on mats, geotextile fabric, or use other suitable measures to minimize soil disturbance, to the maximum extent practicable.
- Restore all temporarily disturbed wetland areas to pre-construction conditions and plant or seed with appropriate wetlands vegetation in accordance with the cover type (emergent, scrub-shrub, or forested). The applicant should take all appropriate measures to promote re-vegetation of these areas. Stabilization and

restoration efforts should occur immediately after the temporary disturbance of each wetland area instead of waiting until the entire project has been completed.
- Place all materials which are temporarily stockpiled in wetlands, designated for use for the immediate stabilization of wetlands, on mats, geotextile fabric in order to prevent entry in State waters. These materials should be managed in a manner that prevents leachates from entering state waters and must be entirely removed within thirty days following completion of that construction activity. The disturbed areas should be returned to their original contours, stabilized within thirty days following removal of the stockpile, and restored to the original vegetated state.
- All non-impacted surface waters within the project or right-of-way limits that are within 50 feet of any clearing, grading, or filling activities should be clearly flagged or marked for the life of the construction activity within that area. The project proponent should notify all contractors that these marked areas are surface waters where no activities are to occur.

Measures should be employed to prevent spills of fuels or lubricants into state waters.

1(e) Requirements. According to DEQ-TRO, the following would apply to the expansion of the Wallops Flight Facility launch range:

- **VWPP.** NASA must prepare and submit a Joint Permit Application (JPA) for review by DEQ-TRO for anticipated project impacts to surface waters and wetlands.

- **VPDES.** Modifications to NASA's existing VPDES facility permit will be evaluated as part of the current permit reissuance process.

2. Subaqueous Lands Management. The EA does not discuss potential project impacts to subaqueous lands.

2(a) Agency Jurisdiction. The Virginia Marine Resources Commission (VMRC), pursuant to Section 28.2-1204 of the Code of Virginia, has jurisdiction over any encroachments in, on, or over any state-owned rivers, streams, or creeks in the Commonwealth. For any development that involves encroachments channelward of ordinary high water along natural rivers and streams, a permit is required from VMRC.

The VMRC serves as the clearinghouse for the Joint Permit Application (JPA) used by the:

- VMRC for encroachments on or over state-owned subaqueous beds as well as tidal wetlands;

- U.S. Army Corps of Engineers (Corps) for issuing permits pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act;
- DEQ for issuance of a Virginia Water Protection Permit; and
- local wetlands board for impacts to wetlands.

2(b) Agency Comments. According to VMRC, it appears that the proposed project does not fall under VMRC's jurisdiction. Therefore, no authorization would be required from VMRC. However, if any portion of the proposed project extends channelward of mean low water, or falls within the coastal primary sand dunes/beaches of Accomack County, authorization may be required from VMRC.

For further information, contact George Badger, VMRC at (757) 414-0710.

3. Erosion and Sediment Control, and Stormwater Management. According to the EA (page 84), construction activities, including grading, clearing, filling, and excavation, would result in disturbance of the ground surface and would have the potential to cause soil erosion. NASA and MARS would minimize adverse impacts to soils by acquiring VSMP permits as necessary, and developing and implementing site-specific stormwater pollution prevention plans and erosion and sediment control plans prior to ground-disturbing activities.

3(a) Agency Jurisdiction. DCR's Division of Soil and Water conservation administers the *Virginia Erosion and Sediment Control Law and Regulations* (*VESCL&R*) and *Virginia Stormwater Management Law and Regulations* (*VSWML&R*).

3(b) Erosion and Sediment Control and Stormwater Management Plans. According to the Department of Conservation and Recreation (DCR), NASA and its authorized agents conducting regulated land-disturbing activities on private and public lands in the state must comply with *VESCL&R*, *VSWML&R* including coverage under the general permit for stormwater discharge from construction activities, and other applicable federal nonpoint source pollution mandates (e.g. Clean Water Act-Section 313, federal consistency under the Coastal Zone Management Act). Clearing and grading activities, installation of staging areas, parking lots, roads, buildings, utilities, borrow areas, soil stockpiles, and related land-disturbing activities that result in the land disturbance of equal to or greater than 10,000 square feet would be regulated by *VESCL&R*. Accordingly, NASA must prepare and implement an erosion and sediment control (ESC) plan to ensure compliance with state law and regulations. The ESC plan is submitted to the DCR Regional Office that serves the area where the project is located for review for compliance. NASA is ultimately responsible for achieving project compliance through oversight of on site contractors, regular field inspection, prompt action against non-compliant sites, and other mechanisms consistent with agency policy. [Reference: VESCL §10.1-567]

3(c) Virginia Stormwater Management Program General Permit for Stormwater Discharges from Construction Activities. DCR is responsible for the issuance, denial, revocation, termination and enforcement of the Virginia Stormwater Management Program (VSMP) General Permit for Stormwater Discharges from Construction Activities related to municipal separate storm sewer systems (MS4s) and construction activities for the control of stormwater discharges from MS4s and land disturbing activities under the Virginia Stormwater Management Program.

Therefore, the operator or owner conducting land-disturbing activities equal to or greater than one acre are required to register for coverage under the General Permit for Discharges of Stormwater from Construction Activities and develop a project-specific stormwater pollution prevention plan (SWPPP). Construction activities requiring registration also includes land disturbance of less than one acre of total land area that is part of a larger common plan of development or sale if the larger common plan of development will ultimately disturb equal to or greater than one acre. The SWPPP must be prepared prior to submission of the registration statement for coverage under the general permit and the SWPPP must address water quality and quantity in accordance with the VSMP *Permit Regulations*. General information and registration forms for the General Permit are available on DCR's website at: http://www.dcr.virginia.gov/soil_and_water/vsmp.shtml. [Reference: Virginia Stormwater Management Act §10.1-603.1 *et seq.*; VSMP Permit Regulations 4 VAC-50 *et seq.]*

4. Air Pollution Control. According to the EA (page iii), construction activities would generate fugitive dust and combustion emissions would occur as a result of site improvements. Operation of generators and boilers would result in emissions of pollutants. NASA and MARS would minimize adverse impacts to air quality by implementing site-specific construction and industrial best management practices.

4(a) Agency Jurisdiction. DEQ's Air Quality Division, on behalf of the State Air Pollution Control Board, is responsible to develop regulations that become Virginia's *Air Pollution Control Law*. DEQ is charged to carry out mandates of the state law and related regulations as well as Virginia's federal obligations under the *Clean Air Act* as amended in 1990. The objective is to protect and enhance public health and quality of life through control and mitigation of air pollution. The division ensures the safety and quality of air in Virginia by monitoring and analyzing air quality data, regulating sources of air pollution, and working with local, state and federal agencies to plan and implement strategies to protect Virginia's air quality. The appropriate regional office is directly responsible for the issue of necessary permits to construct and operate all stationary sources in the region as well as to monitor emissions from these sources for compliance. As a part of this mandate, the environmental documents of new projects to be undertaken in the state are also reviewed. In the case of certain projects, additional evaluation and demonstration must be made under the general conformity provisions of state and federal law.

4(b) Ozone Attainment Area. According to the DEQ Air Division, the project site is located in an ozone (O_3) attainment area. NASA should take all reasonable precautions to limit emissions of volatile organic compounds (VOCs) and oxides of nitrogen (NO_x), principally by controlling or limiting the burning of fossil fuels.

4(c) Fugitive Dust. During construction, fugitive dust must be kept to a minimum by using control methods outlined in 9 VAC 5-50-60 *et seq.* of the *Regulations for the Control and Abatement of Air Pollution.* These precautions include, but are not limited to, the following:

- Use, where possible, of water or chemicals for dust control;
- Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials;
- Covering of open equipment for conveying materials; and
- Prompt removal of spilled or tracked dirt or other materials from paved streets and removal of dried sediments resulting from soil erosion.

4(d) Open Burning. If project activities include the burning of construction or demolition material, this activity must meet the requirements under 9 VAC 5-130 *et seq.* of the *Regulations* for open burning, and it may require a permit. The *Regulations* for open burning provide for, but do not require, the local adoption of a model ordinance concerning open burning. NASA should contact Accomack County officials to determine what local requirements, if any, exist.

4(e) Minor New Source Review. According to DEQ-TRO, on May 8, 2009 the Wallops Flight Facility submitted a permit application for this project under Article 6 (Minor New Source Review). TRO is currently in the process of determining permit applicability for this project under Air Regulation Article 6 (minor NSR). Minor new source review is a preconstruction review and permit for new stationary sources or modifications (physical changes or changes in the method of operation) that emit, or have the potential to emit, less than 100 tons or more per year of any regulated air pollutant. The program was established to implement the requirements of §§ 110(a)(2)(C) and 112 of the federal *Clean Air Act* and associated regulations and is codified in Article 6 (9 VAC 5-80-1100 *et seq.*).

5. Solid and Hazardous Wastes and Hazardous Materials. The EA (page 105) states that construction activities would include the use of hazardous materials and hazardous waste generation (i.e., solvents, hydraulic fluid, oil, and antifreeze). With implementation of safety measures and proper procedures for the handling, storage, and disposal of hazardous materials and wastes during construction activities, no adverse impacts are anticipated during construction.

5(a) Agency Comments. DEQ's Waste Division finds that hazardous waste issues and sites were addressed in the report. However, solid waste is not addressed. The report includes a search of waste-related data bases. A geographic information system (GIS) database search did not reveal any waste sites within a half mile radius that would impact or be impacted by project activities.

5(b) Data File Search. The Waste Division performed a cursory review of DEQ data files and determined that the facility is under DEQ's Federal Facilities Installation Restoration Program (VA8800010763). This refers to a site (scrapyard site) on the mainland at WFF separate from Wallops Island. According to the January 2008 Record of Decision (ROD) for the site, a Removal Action conducted at the site in 2003 removed the contaminated soil thereby eliminating the need to conduct further remedial action. Post-Removal Action sampling and studies conducted from 2003 through 2006, confirmed that no action is required. The ROD states that NASA and the Environmental Protection Agency (EPA) have determined, and DEQ concurred, that no remedial action is necessary at the site to ensure protection of public health or welfare or the environment.

The following websites may prove helpful in locating additional information for this identification number:

- http://www.epa.gov/superfund/sites/cursites/index.htm or
- http://oaspub.epa.gov/enviro/ef_home2.waste.

5(c) Waste Management. Any soil that is suspected of contamination or wastes that are generated during construction-related activities must be tested and disposed of in accordance with applicable federal, state, and local laws and regulations. All demolition and construction waste, including excess soil, must be characterized in accordance with the *Virginia Hazardous Waste Management Regulations* prior to disposal at an appropriate off-site facility.

5(d) Asbestos-containing Material and Lead-based Paint. All structures being demolished or removed, should be checked for asbestos-containing materials (ACM) and lead-based paint (LBP) prior to demolition. If ACM or LBP are found, in addition to the federal waste-related regulations mentioned above, state regulations 9 VAC 20-80-640 for ACM and 9 VAC 20-60-261 for LBP must be followed.

5(e) Recommendation. DEQ encourages all construction projects and facilities to implement pollution prevention principles, including the reduction, reuse, and recycling of all solid wastes generated. All generation of hazardous wastes should be minimized and handled appropriately.

6. Petroleum Storage Tanks. According to the EA (page 105), all new petroleum facilities, tanks, and storage areas would be subject to DEQ Storage Tank Program regulations. Spills or releases from temporary or permanent underground storage tanks and aboveground storage tanks would be immediately reported to the WFF Fire Department, which would contact the WFF Environmental Office. The WFF Environmental Office would properly characterize the spill or release, notify DEQ if necessary, arrange for remediation, and dispose of contaminated soils and groundwater.

6(a) Petroleum Storage Tank Cleanups. According to DEQ-TRO, twenty-three petroleum releases have been reported at the Wallops Flight Facility in Accomack County, one of which is a currently an active case. However, there are no active cases in the Launch Range area. Petroleum contaminated soils or groundwater generated during construction of this project must be characterized and disposed of properly.

6(b) Requirements. NASA must comply with the following requirements of the Storage Tank Program.

- The relocation, removal or closure of any regulated aboveground or underground petroleum storage tank(s) must be reported to DEQ TRO.
- Spills or other accidental releases of petroleum or other hazardous products from construction activities must be reported to the DEQ Tidewater Regional Office Pollution Response Program (Prep).
- If evidence of a petroleum release is discovered during implementation of the project, it must be reported to DEQ-TRO.
- If any regulated ASTs or USTs are closed, relocated or altered, NASA must notify DEQ-TRO.
- If the construction of this project will include the use of portable ASTs (>660 gallons) for equipment fuel, these tank(s) must be registered with DEQ-TRO using AST Registration form 7540-AST. This form is available at the DEQ web site at www.deq.virginia.gov.

7. Herbicides and Pesticides. DEQ recommends that the use of herbicides or pesticides for construction or landscape maintenance should be in accordance with the principles of integrated pest management. The least toxic pesticides that are effective in controlling the target species should be used. Contact the Department of Agriculture and Consumer Services at (804) 786-3501 for more information.

8. Natural Heritage Resources. The document does not discuss the Virginia Natural Heritage Program administered by the Virginia Department of Conservation and Recreation Division of Natural Heritage and possible project impacts on any natural heritage resources in the area.

8(a) Agency Jurisdiction. The mission of the Virginia Department of Conservation and Recreation is to conserve Virginia's natural and recreational resources. DCR supports a variety of environmental programs organized within seven divisions including the Division of Natural Heritage. The Natural Heritage Program's (DCR-DNH) mission is conserving Virginia's biodiversity through inventory, protection, and stewardship. The *Virginia Natural Area Preserves Act*, 10.1-209 through 217 of the *Code of Virginia*, was passed in 1989 and codified DCR's powers and duties related to statewide biological inventory: maintaining a statewide database for conservation planning and project review, land protection for the conservation of biodiversity, and the protection and ecological management of natural heritage resources (the habitats of rare, threatened, and endangered species, significant natural communities, geologic sites, and other natural features).

8(b) Agency Comments. DCR-DNH searched its Biotics Data System for occurrences of natural heritage resources in the project area. According to the information currently in DCR files, part of the proposed expansion project is located within the North Assawoman-South Wallops Island Conservation Site. Conservation sites are tools for representing key areas of the landscape that warrant further review for possible conservation action because of the natural heritage resources and habitat they support. Conservation sites are polygons built around one or more rare plant, animal, or natural community designed to include the element and, where possible, its associated habitat, and buffer or other adjacent land thought necessary for the element's conservation. Conservation sites are given a biodiversity significance ranking based on the rarity, quality, and number of element occurrences they contain; on a scale of 1-5, 1 being most significant. The North Assawoman-South Wallops Island Conservation Site has been given a biodiversity significance ranking of B2, which represents a site of very high significance. The natural heritage resource of concern at this site is:

piping plover, *Charadrius melodus*, G3/S2B,S2BS1N/LT/LT

The piping plover inhabits coastal areas, utilizing the flat, sandy beaches of barrier islands for breeding (Cross, 1991). Threats to this species include predation of eggs and young and the development and disturbance of barrier island breeding sites (Cross, 1991). This species is listed as threatened by the United States Fish and Wildlife Service (USFWS) and the Virginia Department of Game and Inland Fisheries (DGIF).

8(c) State-listed Plant and Insect Species. The *Endangered Plant and Insect Species Act of 1979*, Chapter 39 §3.1-1020 through 1030 of the *Code of Virginia*, as amended, authorizes the Virginia Department of Agriculture and Consumer Services (VDACS) to conserve, protect, and manage endangered and threatened species of plants and insects. The VDACS Virginia Endangered Plant and Insect Species Program personnel cooperates with the U.S. Fish and Wildlife Service (USFWS), DCR-DNH and other agencies and organizations on the recovery, protection or conservation of listed threatened or endangered species and designated plant and insect species that are rare throughout their worldwide ranges. In those instances where recovery plans, developed by USFWS, are available, adherence to the order and tasks outlined in the plans are followed to the extent possible.

Under a Memorandum of Agreement established between VDACS and DCR, DCR represents VDACS in comments regarding potential impacts on State-listed threatened and endangered plant and insect species. DCR finds that the current activity will not affect any documented State-listed plants or insects. Furthermore, VDACS notes that information in its database does not include any documented occurrences of threatened or endangered plant and insect species in the vicinity of the project area. VDACS does not anticipate the proposed action to have significant adverse impacts as it relates to VDACS' responsibilities for the protection of listed endangered and threatened plant and insect species.

8(d) State Natural Area Preserves. DCR files do not indicate the presence of any State Natural Area Preserves under the agency's jurisdiction in the project vicinity.

8(e) Finding. DCR concurs with the finding attributed to USFWS in the EA (page 66) that negative impacts to the piping plover from the proposed action are unlikely.

8(f) Recommendations. DCR-DNH recommends that NASA perform the following:

- continue monitoring piping plover populations;
- continue coordinating with the USFWS and DGIF to ensure compliance with protected species legislation, due to the legal status of the Piping Plover; and
- contact DCR-DNH, Rene Hypes at (804) 371-2708 for an update on natural heritage information if a significant amount of time passes before the project is initiated since new and updated information is continually added to Biotics.

9. Wildlife Resources and Protected Species. According to the EA (page 66), an April 22, 1997, Section 7 consultation with USFWS determined that the range expansion and operations would not result in the incidental take of any piping plovers because of the short duration of the disturbance, the long distance between the disturbance and the area used by plovers, the limited number of launches during the nesting season, and the lack of other disturbances (e.g., recreation) to the plovers on Wallops Island.

9(a) Agency Jurisdiction. The Department of Game and Inland Fisheries (DGIF), as the Commonwealth's wildlife and freshwater fish management agency, exercises enforcement and regulatory jurisdiction over wildlife and freshwater fish, including state or federally listed endangered or threatened species, but excluding listed insects (*Virginia Code* Title 29.1). The DGIF is a consulting agency under the *U.S. Fish and Wildlife Coordination Act* (16 U.S.C. sections 661 *et seq.*), and provides environmental analysis of projects or permit applications coordinated through DEQ and several other state and federal agencies. DGIF determines likely impacts upon fish and wildlife resources and habitat, and recommends appropriate measures to avoid, reduce, or compensate for those impacts.

9(b) Agency Comments.

(i) **Nesting Shorebirds**

According to DGIF, Virginia's barrier islands represent a critically important breeding area for a number of beach nesting shorebirds and seabirds that are of high conservation concern, including the federally-listed threatened piping plover *(Charadrius melodus),* the state-listed endangered Wilson's plover (*C. wilsonia*), the American oystercatcher (*Haematopus palliatus*), which is ranked nationally as a high conservation priority species in the US Shorebird Conservation Plan (Brown *et al.* 2001), the state-listed threatened gull-billed tern (*Sterna nilotica*), and the least tern (*S. antillarum*), which is a state species of special concern.

Piping Plover and Wilson's Plover. The Commonwealth's northern barrier islands that extend from Assateague Island south to Cedar Island typically support over 75% of Virginia's piping plover breeding population and in some years over 90% of the Commonwealth's breeding pairs have occurred on the northern islands (Boettcher *et al.* 2007). Since 2000, Virginia's Wilson's plover breeding population has been confined to Assawoman, Metompkin and Cedar islands with the exception of 2008 when one pair was discovered nesting on Assateague Island (Wilke *et al.* 2009).

American Oystercatcher. The barrier islands support over 50% of Virginia's American oystercatcher breeding population with a significant proportion occurring on Metompkin and Cedar islands (Wilke *et al.* 2005; Wilke *et al.* 2009). Moreover, oystercatcher productivity rates along the barrier island chain are some of the highest reported on the US Atlantic coast, suggesting that the islands may serve as important population sources for the east coast population (Wilke 2008).

Least Tern and Gull-billed Tern. The barrier islands also provide critical breeding habitat for least terns; since 1975 35%-67% of the Commonwealth's population has been documented on the barrier island chain (VDGIF, unpubl. data). Virginia's statewide gull-billed tern breeding population has declined from approximately 2,000 pairs in the mid-1970's (Erwin *et al.* 1998) to fewer than 300 pairs in the last three years with the majority of nesting occurring on Virginia's seaside marshes and barrier islands (VDGIF, unpubl. data). While gull-billed terns are able to exploit barrier island and marsh habitats with equal success in response to rapidly changing conditions (Boettcher and Wilke 2009), the barrier islands remain important habitat for the declining species in Virginia.

Red Knot. Over the past 20 years, the red knot (*Calidris canutus rufa*) population has declined by over 80% (Morrison *et al.* 2004) and this species is currently a candidate for federal listing under the Endangered Species Act. A significant portion of the population that migrates north along the US Atlantic coast in the spring uses the barrier islands as stopover sites (Smith *et al.* 2008). This includes Wallops Island where more than 1,000 birds have been recorded during a single survey (Center for Conservation Biology, The Nature Conservancy, and VDGIF, unpubl. data).

Other Avian Species. Other barrier island nesting species of greatest conservation need (as defined in Virginia's Wildlife Action Plan, available at www.bewildva.com) include black skimmer (*Rynchops niger*), common tern (*S. hirundo*), royal tern (*S. maxima*) and sandwich tern (*S. sandvicensis*) (VDGIF 2005).

Collectively, the aforementioned avian species' habitat requirements include broad beaches with low discontinuous dunes and expansive sand-shell flats. In addition, piping plover broods require unimpeded access from beach nest sites to the moist-soil ecotones of backside marshes and mudflats for forage and cover (Boettcher *et al.* 2007).

(ii) Sea Turtles

Loggerhead Sea Turtle. Virginia is the northern extreme of the federally-listed threatened loggerhead sea turtle (*Caretta caretta*) nesting range. While the majority of the Commonwealth's nesting activity has been confined to southern mainland beaches (Fort Story-VA/NC border), nesting activity on the northern barrier islands, including Wallops Island, has increased slightly in recent years (VDGIF, unpubl. data). Nesting sea turtles typically nest on dynamic ocean beaches that have a wide berm and a relatively intact natural dune system. This species typically avoids or has poor nesting success on armored beaches, which over time, become devoid of dry beach and natural primary dune systems.

(iii) Impacts of Increased Rocket Launches

DGIF is concerned that the EA does not adequately characterize possible impacts upon wildlife and the resources that support them resulting from the proposed increase in rocket launches. The EA acknowledges that animals (although they limit it to terrestrial mammals) will demonstrate a startle response. This is particularly significant in the case of nearby nesting birds. If birds are scared off their nesting sites, this may result in nest abandonment, leading to unsuccessful breeding or brooding, depending on the time of year of the launch. Over time and depending on the number of launches during the breeding season (for most species in the area, not including bald eagle, this is April 1 through August 15 of any year), this could result in significant impacts upon these populations. Rocket launches also may be detrimental to migrating species.

It is DGIF's understanding that rocket launches at WFF have precluded staff at the Chincoteague National Wildlife Refuge (CNWR) from accessing Assawoman Island for the purposes of monitoring beach nesting birds, including piping plovers. This is significant in light of the fact that there may be adverse impacts upon these birds during launches and that the number of launches per year may increase. In this case, monitoring of these nesting birds is all the more important and should be accommodated by NASA.

9(c) Recommendations. DGIF recommends that the following information and analysis be included in the final EA:

- fully address the impacts associated with the proposed expansion of the WFF upon the habitat requirements of avian species;
- update Section 3.2.3-Table 12: Threatened and Endangered Species in the WFF Area, to reflect the state status of these species as follows:
    - leatherback sea turtle-Virginia status is endangered
    - hawksbill sea turtle-Virginia status is endangered
    - Kemp's Ridley sea turtle-Virginia status is endangered
    - loggerhead sea turtle-Virginia status is threatened
    - Atlantic green sea turtle-Virginia status is threatened
    - fin whale-Virginia status is endangered
    - humpback whale- Virginia status is endangered
    - northern right whale-Virginia status is endangered;
- include the following listed species also known from the vicinity of Wallops Island in Table 12:
    - state-listed threatened bald eagle
    - federal- and state-listed endangered sperm whale
    - federal- and state-listed endangered sei whale
    - federal- and state-listed endangered blue whale
    - federal- and state-listed endangered Florida manatee (subspecies of the West Indian manatee);
- fully evaluate these additional species for impacts associated with the launch and reentry of rockets from Mid-Atlantic Regional Spaceport on Wallops Island in addition to any other activities associated with the proposed upgrades to the facility;

- include the red knot in Table 12, a federal candidate species and a species listed in Tier IV (Moderate Conservation Need) of Virginia's Wildlife Action Plan's list of Species of Greatest Conservation Need;
- address the impacts of increased rocket launches on wildlife resources and provide alternatives for operations at Mid-Atlantic Regional Spaceport that may avoid, minimize or mitigate such impacts (this may include options such as a reduced number of launches during the breeding season); and
- detail the number of planned launches from Mid-Atlantic Regional Spaceport and the effect that an increase in the number of launches, if proposed, may have on nearby wildlife resources (this should include a detailed discussion about cumulative impacts).

DGIF offers the following recommendations regarding the proposed development activities to minimize overall impacts to wildlife and natural resources:

- coordinate with the National Marine Fisheries Service (NMFS) regarding possible impacts upon sea turtle nesting habitat and impacts upon them that may result from the ongoing maintenance dredging in the approach channel to the existing boat docks.
- coordinate with USFWS regarding possible impacts upon federally listed species associated with the proposed work.

Contact Amy Ewing, DGIF at (804) 367-2733, for additional information regarding these comments.

10. Forest Resources. According to the EA (page 113), construction of the Payload Fueling Facility (PFF), Payload Processing Facility (PPF) and access roads would result in the removal of up to 2 acres of trees.

10(a) Agency Jurisdiction. The mission of the Virginia Department of Forestry (VDOF) is to protect and develop healthy, sustainable forest resources for Virginians. VDOF was established in 1914 to prevent and suppress forest fires and reforest bare lands. Since the Department's inception, it has grown and evolved to encompass other protection and management duties including: protecting Virginia's forests from wildfire, protecting Virginia's waters, managing and conserving Virginia's forests, managing state-owned lands and nurseries, and managing regulated incentive programs for forest landowners.

10(b) Agency Comments. VDOF finds that the proposed project would have no significant impact on the forest resources of the Commonwealth.

For additional information, contact Todd Groh, VDOF at (434) 977-6555 ext. 3344.

11. Geologic and Mineral Resources. The EA (page 85) states that construction of the pile foundation to support the Pad 0-A infrastructure would require driving precast concrete piles to depths of approximately 90 feet below ground surface. The piles are expected to penetrate the surficial coastal deposits and terminate in the Yorktown Formation. Although the driven piles would create long-term changes to the subsurface geology immediately around the driven piles, the changes would be limited in extent and are considered negligible.

11(a) Agency Jurisdiction. The mission of the Department of Mines, Minerals and Energy (DMME), Division of Mineral Resources (DMR) is to enhance the development and conservation of energy and mineral resources in a safe and environmentally sound manner to support a more productive economy in Virginia. Serving as Virginia's geological survey, DMME-DMR generates, collects, compiles, and evaluates geologic data, creates and publishes geologic maps and reports, works cooperatively with other state and federal agencies, and is the primary source of information on geology, mineral and energy resources, and geologic hazards for both the mineral and energy industries and the general public. DMME-DMR also provides the necessary geologic support for those divisions of DMME that regulate the permitting of new mineral and fuel extraction sites, miner safety, and land reclamation.

11(b) Conclusion. DMME anticipates that the proposed action would have no significant impact to mineral resources.

For additional information, contact Matt Heller, DMME at (434) 951-6351.

12. Transportation Impacts. According to the EA (page 16), NASA would make transportation improvements including the construction of new roads and minor upgrades to existing roads to transport cargo from the existing boat dock on the north end of Wallops Island to the proposed PFF or PPF, from the PPF or PFF to the HIF, and from the HIF to the launch pads. New road construction could be up to 2,178 feet of 20 foot wide road, adding approximately 1 acre of additional asphalt pavement. The widening or straightening of existing roads could add up to an additional 0.5 acre of pavement.

12(a) Agency Jurisdiction. The Virginia Department of Transportation (VDOT) provides comments pertaining to potential impacts to existing and future transportation systems.

12(b) Agency Comments. The Virginia Department of Transportation (VDOT) notes that there is one transportation improvement project in the vicinity of WFF in the FY 10-15 Six Year Improvement Program or the Secondary Six Year Program. That project is the Route 175 Chincoteague Bridge Replacement (UPC # 1896).

12(c) Conclusion. VDOT concludes that any additional traffic or traffic disruptions related to the proposed action would be negligible.

12(d) Recommendation. Any VDOT land use requirements, lane closures, traffic control or work zone safety issues should be closely coordinated with Accomack County and the VDOT Accomac Residency Office at (757) 787-1550.

For more information, contact Melanie Allen, VDOT at (804) 786-5360.

13. Historic Structures and Archaeological Resources. According to the EA (page v), the proposed action may have indirect visual and auditory effects on identified historic properties in the area of potential effect, including the U.S. Coast Guard Lifesaving Station and Observation Tower, but these effects would not likely be adverse. NASA has determined that the proposed construction would have no effect on archaeological resources.

13(a) Agency Jurisdiction. The Department of Historic Resources (DHR) conducts reviews of projects to determine their effect on historic structures or cultural resources under its jurisdiction. DHR, as the designated State's Historic Preservation Office (SHPO), ensures that federal actions comply with Section 106 of the *National Historic Preservation Act of 1966* (*NHPA*), as amended, and its implementing regulation at 36 CFR Part 800. The *NHPA* requires federal agencies to consider the effects of federal projects on properties that are listed or eligible for listing on the National Register of Historic Places. Section 106 also applies if there are any federal involvements, such as licenses, permits, approvals or funding.

13(b) Agency Comments. Pursuant to Section 106 of the *National Historic Preservation Act*, as amended, and its implementing regulation 36 CFR Part 800, DHR has requested additional information from NASA to determine project impacts on historic resources. The Wallops Cost Guard Station and associated tower (001-0027-0100 and 001-9927-0101) have been determined eligible for listing in the National Register of Historic Places (NRHP). A memorandum of agreement (DHR File No. 2004-0147) is currently under development to address the adverse effects of this proposal on these resources.

13(c) Requirements. Pursuant to *Section 106*, NASA must:

- continue to coordinate the development of the MOA with DHR; and
- contact the National Park Service (NPS) at Assateague Island National Seashore regarding the effect of the proposed action on the NRHP-listed Assateague Beach Lifeboat Station. Contact Trish Kicklighter, NPS Superintendent or Carl Zimmerman, NPS Resource Management Specialist with this request.

14. Local Review.

14(a) Agency Jurisdiction. In accordance with CFR 930, Subpart A, § 930.6(b) of the *Federal Consistency Regulations*, DEQ, on behalf of the state, is responsible for securing necessary review and comment from other state agencies, the public, regional government agencies, and local government agencies, in determining the Commonwealth's concurrence or objection to a federal consistency certification.

14(b) Local Comments. The Accomack County Administrators Office fully supports the proposed action.

Contact Steve Miner, Accomack County Administrator at (757) 787-5700 for additional information.

15. Pollution Prevention. DEQ advocates that principles of pollution prevention be used in all construction projects as well as in facility operations. Effective siting, planning, and on-site Best Management Practices (BMPs) will help to ensure that environmental impacts are minimized. However, pollution prevention techniques also include decisions related to construction materials, design, and operational procedures that will facilitate the reduction of wastes at the source.

15(a) Recommendations. We have several pollution prevention recommendations that may be helpful in the construction of this project and in the operation of the facility:

- Consider development of an effective Environmental Management System (EMS). An effective EMS will ensure that the facility is committed to minimizing its environmental impacts, setting environmental goals, and achieving improvements in its environmental performance. DEQ offers EMS development assistance and it recognizes facilities with effective Environmental Management Systems through its Virginia Environmental Excellence Program.
- Consider environmental attributes when purchasing materials. For example, the extent of recycled material content, toxicity level, and amount of packaging should be considered and can be specified in purchasing contracts.
- Consider contractors' commitment to the environment (such as an EMS) when choosing contractors. Specifications regarding raw materials and construction practices can be included in contract documents and requests for proposals.
- Choose sustainable materials and practices for infrastructure construction and design. These could include asphalt and concrete containing recycled materials, and integrated pest management in landscaping, among other things.
- Integrate pollution prevention techniques into the facility maintenance and operation, to include the following: inventory control (record-keeping and

centralized storage for hazardous materials), product substitution (use of non-toxic cleaners), and source reduction (fixing leaks, energy-efficient HVAC and equipment). Maintenance facilities should be designed with sufficient and suitable space to allow for effective inventory control and preventative maintenance.

DEQ's Office of Pollution Prevention provides information and technical assistance relating to pollution prevention techniques and EMS. For more information, contact DEQ's Office of Pollution Prevention, Sharon Baxter at (804) 698-4344.

16. Energy Conservation. The proposed facility should be planned and designed to comply with state and federal guidelines and industry standards for energy conservation and efficiency. For example, the energy efficiency of the facility can be enhanced by maximizing the use of the following:

- thermally-efficient building shell components (roof, wall, floor, windows, and insulation);
- facility siting and orientation with consideration towards natural lighting and solar loads
- high efficiency heating, ventilation, air conditioning systems;
- high efficiency lighting systems and daylighting techniques; and
- energy-efficient office and data processing equipment.

Please contact Matt Heller, Department of Mines, Minerals, and Energy at (434) 951-6351 for additional information.

17. Water Conservation. The following recommendations will result in reduced water use associated with the operation of the facility.

- Grounds should be landscaped with hardy native plant species to conserve water as well as lessen the need to use fertilizers and pesticides.
- Convert turf to low water-use landscaping such as drought resistant grass, plants, shrubs and trees.
- Low-flow toilets should be installed in new facilities. Otherwise, offset older toilets with a plastic jug of pebbles and water to minimize flushing.
- Consider installing low flow restrictors and aerators to faucets.
- Improve irrigation practices by:
    - upgrading sprinkler clock; water at night, if possible, to reduce evapotranspiration (lawns need only 1 inch of water per week, and do not need to be watered daily; overwatering causes 85% of turf problems);
    - installing a rain shutoff device; and
    - collecting rainwater with a rain bucket or cistern system with drip lines.

- Consider replacement of old equipment such as washers and dishwashers with new high-efficiency machines to reduce water useage by 30-50% per use.
- Check for and repair leaks (toilets and faucets) during regular routine maintenance activities.

FEDERAL CONSISTENCY UNDER THE COASTAL ZONE MANAGEMENT ACT

Pursuant to the Coastal Zone Management Act of 1972, as amended, federal activities located inside or outside of Virginia's designated coastal management area that can have reasonably foreseeable effects on coastal resources or coastal uses must, to the maximum extent practicable, be implemented in a manner consistent with the Virginia Coastal Resources Management Program (VCP) (also called the Virginia Coastal Zone Management Program). The VCP consists of a network of programs administered by several agencies. The DEQ coordinates the review of federal consistency determinations with agencies administering the Enforceable and Advisory Policies of the VCP. A federal consistency determination was submitted with the EA that includes an analysis of the enforceable policies of the VCP.

Federal Consistency Public Participation

In accordance with 15 CFR § 930.2, public notice of the proposed action was published on DEQ's web site from May 1, 2009 to May 22, 2009. No public comments were received in response to the notice.

Federal Consistency Concurrence

Based on our review of NASA's consistency determination, and the comments and recommendations submitted by agencies administering the enforceable policies of the VCP, DEQ concurs that this proposal is consistent with the VCP. However, other state approvals which may apply to this project are not included in this concurrence. Therefore, NASA must ensure that this project is constructed and operated in accordance with all applicable federal, state, and local laws and regulations. We encourage NASA to consider the advisory policies of the VCP as well (see Attachment 2).

REGULATORY AND COORDINATION NEEDS

1. Water Quality and Wetland Impacts. Water quality and wetland impacts associated with this proposal will require a Virginia Water Protection Permit issued by the DEQ Tidewater Regional Office pursuant to Virginia Code §62.1-44.15:5. A wetland delineation utilizing methods outlined in the 1987 Corps delineation manual should be prepared and confirmed by the Corps. Both the delineation and the subsequent confirmation by the Corps should clearly identify the presence of all wetlands, not just those deemed "jurisdictional" under the Clean Water Act. A Joint Permit Application may be obtained from and submitted to VMRC which serves as a clearinghouse for the joint permitting process involving the VMRC, DEQ, Corps, and local wetlands boards. For additional information and coordination regarding the VWPP, contact Bert Parolari (DEQ-TRO) at (757) 518-2166.

Modifications to NASA's existing Virginia Pollutant Discharge Elimination System permit may be required as a result of possible new stormwater discharges and modifications to existing discharges that may occur related to the proposed expansion. The *Virginia Pollutant Discharge Elimination System Permit Regulation* (9 VAC 25-31) sets forth the policies and procedures that are followed in the administration of the permit program. NASA must continue to coordinate with DEQ-TRO on the reissuance of the facility's VPDES permit. Contact James McConathy, DEQ-TRO at (757) 518-2165 for additional information.

2. Erosion and Sediment Control and Stormwater Management.

2(a) Erosion and Sediment Control and Stormwater Management. NASA must ensure that it is in compliance with *Virginia's Erosion and Sediment Control Law* (Virginia Code 10.1-567) and *Regulations* (4 VAC 50-30-30 *et seq.*) and *Stormwater Management Law* (Virginia Code 10.1-603.5) and *Regulations* (4 VAC 3-20-210 *et seq.*). Activities that disturb 10,000 square feet or more of land would be regulated by VESCL&R and VSWML&R. NASA is encouraged to contact DCR's Suffolk Regional Office at (757) 925-2468, for assistance with developing or implementing an ESC plan to ensure project conformance.

2(b) Virginia Stormwater Management Program General Permit for Stormwater Discharges from Construction Activities. For projects involving land-disturbing activities one acre or more, NASA is required to develop a project-specific stormwater pollution prevention plan and apply for registration coverage under the Virginia Stormwater Management Program General Permit for Discharges of Stormwater from Construction Activities. Specific questions regarding the Stormwater Management Program requirements should be directed to Holly Sepety, DCR, at (804) 225-2613.

3. Air Quality Regulations. This project may be subject to air regulations administered by the Department of Environmental Quality. The following sections of Virginia Administrative Code are applicable:

- 9 VAC 5-40-5490 *et seq.* for asphalt paving operations;
- 9 VAC 5-50-60 *et seq.* governing fugitive dust emissions;

- 9 VAC 5-130 *et seq.* for open burning; and
- 9 VAC 5-80-1100 *et seq.* for Minor New Source Review.

For additional information and coordination, contact Jane Workman, DEQ-TRO at (757) 518-2112. Also, contact the Accomack County for any local requirements on open burning.

4. Solid and Hazardous Wastes. All solid waste, hazardous waste, and hazardous materials must be characterized and managed in accordance with all applicable federal, state, and local environmental regulations. Some of the applicable state laws and regulations are:

- Virginia Waste Management Act (Code of Virginia Section 10.1-1400 *et seq.*);
- Virginia Hazardous Waste Management Regulations (VHWMR) (9 VAC 20-60);
- Virginia Solid Waste Management Regulations (VSWMR) (9 VAC 20-80); and
- Virginia Regulations for the Transportation of Hazardous Materials (9 VAC 20-110).

Dredge spoils, when managed in accordance with the Virginia State Water Control Board or other Virginia state agencies with similar authority, are conditionally exempt from the solid waste regulations (9VAC 20-80-60.E) and are excluded from the waste barging regulations (9VAC 20-170-10).

Some of the applicable Federal laws and regulations are:

- Resource Conservation and Recovery Act (RCRA) (42 U.S.C. Section 6901 *et seq.*);
- Title 40 of the Code of Federal Regulations; and
- U.S. Department of Transportation Rules for Transportation of Hazardous materials (49 CFR Part 107).

4(a) Asbestos-Containing Material. It is the responsibility of the owner or operator of a demolition activity, prior to the commencement of the demolition, to thoroughly inspect the affected part of the facility where the operation will occur for the presence of asbestos, including Category I and Category II nonfriable asbestos containing material (ACM). Upon classification as friable or non-friable, all waste ACM shall be disposed of in accordance with the Virginia Solid Waste Management Regulations (9 VAC 20-80-640), and transported in accordance with the Virginia regulations governing Transportation of Hazardous Materials (9 VAC 20-110-10 *et seq.*). Contact the DEQ Waste Management Program for additional information, (804) 698-4021, and the Department of Labor and Industry, Ronald L. Graham at (804) 371-0444.

4(b) Lead-Based Paint. If applicable, the proposed project must comply with the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) regulations, and with the Virginia Lead-Based Paint Activities Rules and Regulations. For additional information regarding these requirements contact the Department of Professional and Occupational Regulation, David Dick at (804) 367-8588.

5. Storage Tanks. If evidence of a petroleum release is discovered during construction of this project, NASA must contact the DEQ Tidewater Regional Office, Lynne Smith at (757) 518-2055 or Gene Siudyla at (757) 518-2117.

The use of portable fuel AST(s) with a capacity of greater than 660 gallons, the tank(s) must be registered with DEQ using *AST Registration Form 7540-AST*. Tank registration may be accomplished by contacting Tom Madigan, DEQ Tidewater Regional Office, at (757) 518-2115 or by e-mail at temadigan@deq.virginia.gov.

6. Protected Species. NASA should coordinate closely with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and the Virginia Department of Game and Inland Fisheries to ensure that impacts on protected species including shorebirds, sea turtles and marine mammals are adequately avoided and minimized. For additional information, contact Amy Ewing, DGIF at (804) 367-2211.

7. Historic and Archaeological Resources. NASA must continue to coordinate this project with the Department of Historic Resources in accordance with Section 106 of the *National Historic Preservation Act*, as amended, and its implementing regulation 36 CFR 800, particularly with respect to the completion of the MOA for project impacts on historic resources. For additional information and coordination, contact Ronald Grayson, DHR at (804) 367-2323, ext. 105.

Thank you for the opportunity to review the Draft Environmental Assessment and Federal Consistency Determination for the Expansion of Wallops Flight Facility Launch Range in Accomack County. Detailed comments of reviewing agencies are attached for your review. Please contact me at (804) 698-4325 or John Fisher at (804) 698-4339 for clarification of these comments.

Sincerely,

Ellie Irons, Manager
Office of Environmental Impact Review

Enclosures

cc: Michelle Hollis, DEQ-TRO
Paul Kohler, DEQ-ORP
Tony Watkinson, VMRC
Amy Ewing, DGIF
Keith Tignor, VDACS
Matt Heller, DMME
Todd Groh, VDF
Roger Kirchen, DHR
Melanie Allen, VDOT
Steven Minor, Accomack County
Paul Berge, Accomack-Northampton PDC

Attachment 2

Advisory Policies for Geographic Areas of Particular Concern

a. Coastal Natural Resource Areas - These areas are vital to estuarine and marine ecosystems and/or are of great importance to areas immediately inland of the shoreline. Such areas receive special attention from the Commonwealth because of their conservation, recreational, ecological, and aesthetic values. These areas are worthy of special consideration in any planning or resources management process and include the following resources:

a) Wetlands
b) Aquatic Spawning, Nursery, and Feeding Grounds
c) Coastal Primary Sand Dunes
d) Barrier Islands
e) Significant Wildlife Habitat Areas
f) Public Recreation Areas
g) Sand and Gravel Resources
h) Underwater Historic Sites.

b. Coastal Natural Hazard Areas - This policy covers areas vulnerable to continuing and severe erosion and areas susceptible to potential damage from wind, tidal, and storm related events including flooding. New buildings and other structures should be designed and sited to minimize the potential for property damage due to storms or shoreline erosion. The areas of concern are as follows:

i) Highly Erodible Areas
ii) Coastal High Hazard Areas, including flood plains.

c. Waterfront Development Areas - These areas are vital to the Commonwealth because of the limited number of areas suitable for waterfront activities. The areas of concern are as follows:

i) Commercial Ports
ii) Commercial Fishing Piers
iii) Community Waterfronts

Although the management of such areas is the responsibility of local government and some regional authorities, designation of these areas as Waterfront Development Areas of Particular Concern (APC) under the VCRMP is encouraged. Designation will allow the use of federal CZMA funds to be used to assist planning for such areas and the implementation of such plans. The VCRMP recognizes two broad classes of priority uses for waterfront development APC:

i) water access dependent activities;
ii) activities significantly enhanced by the waterfront location and complementary to other existing and/or planned activities in a given waterfront area.

Advisory Policies for Shorefront Access Planning and Protection

a. Virginia Public Beaches - Approximately 25 miles of public beaches are located in the cities, counties, and towns of Virginia exclusive of public beaches on state and federal land. These public shoreline areas will be maintained to allow public access to recreational resources.

b. Virginia Outdoors Plan - Planning for coastal access is provided by the Department of Conservation and Recreation in cooperation with other state and local government agencies. The Virginia Outdoors Plan (VOP), which is published by the Department, identifies recreational facilities in the Commonwealth that provide recreational access. The VOP also serves to identify future needs of the Commonwealth in relation to the provision of recreational opportunities and shoreline access. Prior to initiating any project, consideration should be given to the proximity of the project site to recreational resources identified in the VOP.

c. Parks, Natural Areas, and Wildlife Management Areas - Parks, Wildlife Management Areas, and Natural Areas are provided for the recreational pleasure of the citizens of the Commonwealth and the nation by local, state, and federal agencies. The recreational values of these areas should be protected and maintained.

d. Waterfront Recreational Land Acquisition - It is the policy of the Commonwealth to protect areas, properties, lands, or any estate or interest therein, of scenic beauty, recreational utility, historical interest, or unusual features which may be acquired, preserved, and maintained for the citizens of the Commonwealth.

e. Waterfront Recreational Facilities - This policy applies to the provision of boat ramps, public landings, and bridges which provide water access to the citizens of the Commonwealth. These facilities shall be designed, constructed, and maintained to provide points of water access when and where practicable.

f. Waterfront Historic Properties - The Commonwealth has a long history of settlement and development, and much of that history has involved both shorelines and near-shore areas. The protection and preservation of historic shorefront properties is primarily the responsibility of the Department of Historic Resources. Buildings, structures, and sites of historical, architectural, and/or archaeological interest are significant resources for the citizens of the Commonwealth. It is the policy of the Commonwealth and the VCRMP to enhance the protection of buildings, structures, and sites of historical, architectural, and archaeological significance from damage or destruction when practicable.

DEPARTMENT OF ENVIRONMENTAL QUALITY
TIDEWATER REGIONAL OFFICE
ENVIRONMENTAL IMPACT REVIEW COMMENTS

May 26, 2009

PROJECT NUMBER: 09-083F

PROJECT TITLE: Expansion of the Wallops Flight Facility Launch Range

As Requested, TRO staff has reviewed the supplied information and has the following comments:

Petroleum Storage Tank Cleanups:

Twenty three petroleum releases have been reported at the Wallops Flight Facility in Accomack County, one of which is a currently active case. There are no active cases in the Launch Range area. If evidence of a petroleum release is discovered during the implementation of this project, it must be reported to DEQ. Contact Ms. Lynne Smith at (757) 518-2055 or Mr. Gene Siudyla at (757) 518-2117. Petroleum contaminated soils or ground water generated during implementation of this project must be properly characterized and disposed of properly.

Petroleum Storage Tank Compliance/Inspections:

The relocation, removal or closure of any regulated aboveground or belowground petroleum storage tank(s) must be reported to the DEQ Tidewater Regional Office (attn: Tom Madigan) 5636 Southern Blvd. Virginia Beach, VA 23462. Phone (757) 518-2115. Spills or other accidental releases of petroleum or other hazardous products from construction activities must be reported to the DEQ Tidewater Regional Office Pollution Response Program (Prep) at (757) 518-2077.

Virginia Water Protection Permit Program (VWPP):

The proposed project will clearly require a permit from the VWP program for impacts to wetlands and other surface waters. As such, the project proponents should prepare and submit a Joint Permit Application for review. Provided that all necessary permits are obtained and complied with this project should be consistent with the requirements of this program.

Air Permit Program :

Wallops Flight facility has submitted an application for this project to TRO. The application was received on 5/8/09. TRO is currently in the process of determining permit applicability for this project under Air Regulation Article 6 (minor NSR).

Water Permit Program :

VPDES Permit Program – In reviewing the documentation presented for this project, it appears that there is a potential for the need to modify the existing VPDES permit for Wallops Island to address new discharges of process waste water and, possibility industrial storm water. If it is anticipated that rocket launching quench water will require pH adjustment, the discharge of this treated waste water will require a permit. It also appears that DEQ will want to evaluate whether storm water runoff from the rocket launch pads should be covered in the permit. Since the Wallops Island facility is currently in the process of VPDES Permit reissuance, it is a convenient time to discuss and evaluate the need for these possible additions.

GW – The proposed deluge system will use 100,000 gallons of potable ground water for each launch or static fire. This is not the best use of potable water from the Eastern Shore confined aquifer system and the feasibility of a reuse source of water should be investigated. If a reuse source of water is not available then the feasibility of a shallow water table well constructed for the sole purpose of filling the storage tank should be investigated. The deluge water is proposed to be discharged to a concrete lined retention basin prior to release. The water from this basin should be recycled back to the storage tank even if some treatment is necessary. Ground water would then only be needed as make up water after the initial filling of the storage tank.

Waste Permit Program :
All demolition debris including excess soil must be characterized in accordance with the Virginia Hazardous Waste Management Regulations and dipsoed of at an appropriate facility. The procedures described to manage hazardous waste generated during operations appear to comply with the virgnia Hazardous Waste Management Regulations.

The staff from the Tidewater Regional Office thanks you for the opportunity to provide comments.

Sincerely,

Michelle R. Hollis
Environmental Specialist
5636 Southern Blvd.
VA Beach, VA 23462
(757) 518-2146
(757) 518-2009 Fax
mrhollis@deq.virginia.gov

COMMONWEALTH *of* VIRGINIA

L. Preston Bryant, Jr.
Secretary of Natural Resources

Marine Resources Commission
2600 Washington Avenue
Third Floor
Newport News, Virginia 23607

Steven G. Bowman
Commissioner

May 13, 2009

Mr. John E. Fisher
c/o Department. Of Environmental Quality
Office of the Environmental Impact Review
629 East Main Street, Sixth Floor
Richmond, Virginia 23219

Re: 09-083F
"Expansion of Wallops Flight Facility Launch Range"

Dear Mr. Fisher:

You have inquired regarding site improvements to support launch operations for the launch and/or reentry of reusable suborbital rockets from the Mid-Atlantic Regional Spaceport (MARS) on Wallops Island, Virginia.

The Marine Resources Commission requires a permit for any activities that encroach upon or over, or take use of materials from the beds of the bays, ocean, rivers and streams, or creeks which are the property of the Commonwealth.

Based upon my review of the "Environmental Assessment for the Expansion of Wallops Flight Facility Launch Range", dated April 2009, it would appear that your project will not be in the Commission's jurisdiction, therefore, no authorization would be required from the Marine Resources Commission.

For your information, however, if any portion of the proposed project extends channelward of mean low water or falls within the Coastal Primary Sand Dunes/Beaches of Accomack County, authorization may be required from the Marine Resources Commission.

If I may be of further assistance, please do not hesitate to contact me at (757) 414-0710.

Sincerely,

George H. Badger, III
Environmental Engineer

L. Preston Bryant, Jr.
Secretary of Natural Resources

Joseph H. Maroon
Director

RECEIVED
Office of Environmental Impact Review

COMMONWEALTH of VIRGINIA

DEPARTMENT OF CONSERVATION AND RECREATION

203 Governor Street
Richmond, Virginia 23219-2010
(804) 786-6124

MEMORANDUM

Date: May 20, 2009

TO: John Fisher, DEQ

From: Robert S. Munson, Planning Bureau Manager, DCR-DPRR

Subject: DEQ 09-083F, NASA Expansion of the Wallops Flight Facility Launch Range

Division of Natural Heritage

The Department of Conservation and Recreation's Division of Natural Heritage (DCR) has searched its Biotics Data System for occurrences of natural heritage resources from the area outlined on the submitted map. Natural heritage resources are defined as the habitat of rare, threatened, or endangered plant and animal species, unique or exemplary natural communities, and significant geologic formations.

According to the information currently in our files, part of this project is located within the North Assawoman: South Wallops Island Conservation Site. Conservation sites are tools for representing key areas of the landscape that warrant further review for possible conservation action because of the natural heritage resources and habitat they support. Conservation sites are polygons built around one or more rare plant, animal, or natural community designed to include the element and, where possible, its associated habitat, and buffer or other adjacent land thought necessary for the element's conservation. Conservation sites are given a biodiversity significance ranking based on the rarity, quality, and number of element occurrences they contain; on a scale of 1-5, 1 being most significant. The North Assawoman: South Wallops Island Conservation Site has been given a biodiversity significance ranking of B2, which represents a site of very high significance. The natural heritage resource of concern at this site is:

Piping Plover	*Charadrius melodus*	G3/S2B,S2BS1N/LT/LT

The Piping Plover inhabits coastal areas, utilizing the flat, sandy beaches of barrier islands for breeding (Cross, 1991). Threats to this species include predation of eggs and young and the development and disturbance of barrier island breeding sites (Cross, 1991). Please note that this species is listed as threatened by the United States Fish and Wildlife Service (USFWS) and the Virginia Department of Game and Inland Fisheries (VDGIF).

DCR concurs with the USFWS that negative impacts to the piping plover are unlikely. However, DCR recommends continuing the monitoring of the piping plover populations. Furthermore, due to the legal status of the Piping Plover, DCR recommends continued coordination with the USFWS and VDGIF to ensure compliance with protected species legislation.

In addition, our files do not indicate the presence of any State Natural Area Preserves under DCR's jurisdiction in the project vicinity.

Under a Memorandum of Agreement established between the Virginia Department of Agriculture and Consumer Services (VDACS) and the Virginia Department of Conservation and Recreation (DCR), DCR represents VDACS in comments regarding potential impacts on state-listed threatened and endangered plant and insect species. The current activity will not affect any documented state-listed plants or insects.

New and updated information is continually added to Biotics. Please contact DCR for an update on this natural heritage information if a significant amount of time passes before it is utilized.

The Virginia Department of Game and Inland Fisheries maintains a database of wildlife locations, including threatened and endangered species, trout streams, and anadromous fish waters that may contain information not documented in this letter. Their database may be accessed from http://vafwis.org/fwis/ or contact Shirl Dressler at (804) 367-6913.

Division of Soil and Water Conservation

The applicant and their authorized agents conducting regulated land disturbing activities on private and public lands in the state must comply with the Virginia Erosion and Sediment Control Law and Regulations (VESCL&R), Virginia Stormwater Management Law and Regulations including coverage under the general permit for stormwater discharge from construction activities, and other applicable federal nonpoint source pollution mandates (e.g. Clean Water Act-Section 313, Federal Consistency under the Coastal Zone Management Act). Clearing and grading activities, installation of staging areas, parking lots, roads, buildings, utilities, borrow areas, soil stockpiles, and related land-disturbance activities that result in the land-disturbance of equal to or greater than 10,000 square feet would be regulated by VESCL&R. Accordingly, the applicant must prepare and implement erosion and sediment control (ESC) plan to ensure compliance with state law and regulations. The ESC plan is submitted to the DCR Regional Office that serves the area where the project is located for review for compliance. The applicant is ultimately responsible for achieving project compliance through oversight of on site contractors, regular field inspection, prompt action against non-compliant sites, and other mechanisms consistent with agency policy. [Reference: VESCL §10.1-567;].

General Permit for Discharges of Stormwater from Construction Activities:
The operator or owner of construction activities involving land disturbing activities equal to or greater than one acre are required to register for coverage under the General Permit for Discharges of Stormwater from Construction Activities and develop a project specific stormwater pollution prevention plan (SWPPP). Construction activities requiring registration also includes the land-disturbance of less than one acre of total land area that is part of a larger common plan of development or sale if the larger common plan of development will ultimately disturb equal to or greater than one acre. The SWPPP must be prepared prior to submission of the registration statement for coverage under the general permit and the SWPPP must address water quality and quantity in accordance with the Virginia Stormwater Management Program (VSMP) Permit Regulations. General information and registration forms for the General Permit are available on DCR's website at http://www.dcr.virginia.gov/soil_&_water/vsmp.shtml [Reference: Virginia Stormwater Management Law Act §10.1-603.1 et seq.; VSMP Permit Regulations §4VAC-50 et seq.]

The remaining DCR divisions have no comments regarding the scope of this project. Thank you for the opportunity to comment.

CC: Amy Ewing, VDGIF
Tylan Dean, USFWS

Literature Cited

Cross, R.R. 1991. Piping Plover. In Virginia's Endangered Species: Proceedings of a Symposium. K. Terwilliger ed. The McDonald and Woodward Publishing Company, Blacksburg, Virginia. pp. 501-502.

DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR PROGRAM COORDINATION

ENVIRONMENTAL REVIEW COMMENTS APPLICABLE TO AIR QUALITY

TO: John E. Fisher **DEQ - OEIA PROJECT NUMBER: 09 – 083F**

RECEIVED

MAY 1 1 [illegible]

DEQ-Office of Environmental Impact Review

PROJECT TYPE: ☐ STATE EA / EIR **X FEDERAL EA / EIS** ☐ SCC

X CONSISTENCY DETERMINATION

PROJECT TITLE: EXPANSION OF THE WALLOPS FLIGHT FACILITY LAUNCH RANGE

PROJECT SPONSOR: NATIONAL AERONAUTICS & SPACE ADMINISTRATION

PROJECT LOCATION: **X OZONE ATTAINMENT AREA**

REGULATORY REQUIREMENTSMAY BE APPLICABLE TO: **X CONSTRUCTION**
☐ OPERATION

STATE AIR POLLUTION CONTROL BOARD REGULATIONS THAT MAY APPLY:

1. ☐ 9 VAC 5-40-5200 C & 9 VAC 5-40-5220 E – STAGE I
2. ☐ 9 VAC 5-40-5200 C & 9 VAC 5-40-5220 F – STAGE II Vapor Recovery
3. ☐ 9 VAC 5-40-5490 et seq. – Asphalt Paving operations
4. **X 9 VAC 5-40-5600 et seq. – Open Burning**
5. **X 9 VAC 5-50-60 et seq. Fugitive Dust Emissions**
6. ☐ 9 VAC 5-50-130 et seq. - Odorous Emissions; Applicable to___________________
7. ☐ 9 VAC 5-50-160 et seq. – Standards of Performance for Toxic Pollutants
8. ☐ 9 VAC 5-50-400 Subpart_____, Standards of Performance for New Stationary Sources, designates standards of performance for the_____________________________
9. ☐ 9 VAC 5-80-10 et seq. of the regulations – Permits for Stationary Sources
10. ☐ 9 VAC 5-80-1700 et seq. Of the regulations – Major or Modified Sources located in PSD areas. This rule may be applicable to the ______________________________
11. ☐ 9 VAC 5-80-2000 et seq. of the regulations – New and modified sources located in non-attainment areas
12. ☐ 9 VAC 5-80-800 et seq. Of the regulations – Operating Permits and exemptions. This rule may be applicable to ____

COMMENTS SPECIFIC TO THE PROJECT:

____

(Kotur S. Narasimhan)
Office of Air Data Analysis

DATE: May 8, 2009

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

MEMORANDUM

TO: John Fisher, Environmental Program Planner

FROM: Paul Kohler, Waste Division Environmental Review Coordinator

DATE: June 16, 2009

COPIES: Sanjay Thirunagari, Waste Division Environmental Review Manager; file

SUBJECT: Environmental Impact Report: Expansion of the Wallops Flight Facility Launch Range; 09-083F

The Waste Division has completed its review of the Environmental Impact report for the Expansion of the Wallops Flight Facility Launch Range project in Wallops Island, Virginia. We have the following comments concerning the waste issues associated with this project:

Only hazardous waste issues were addressed in the report. The text indicates that a search of waste-related data bases was conducted. A GIS database search did not reveal any waste sites within a half mile radius that would impact or be impacted by the subject site. The Waste Division staff performed a cursory review of its data files and determined that the facility is under DEQ's Federal Facilities Installation Restoration Program (VA7800020888, NASA GSFC WALLOPS FLIGHT FACILITY, LQG & TSD & VA8800010763, NASA GSFC WALLOPS FLIGHT FACILITY, LQG). The following websites may prove helpful in locating additional information for these identification number: http://www.epa.gov/superfund/sites/cursites/index.htm or http://oaspub.epa.gov/enviro/ef_home2.waste. Paul Herman of DEQ's Federal Facilities Program has been contacted for his review of this determination and will reply in a separate memo, if he identifies any additional issues.

Any soil that is suspected of contamination or wastes that are generated during construction-related activities must be tested and disposed of in accordance with applicable Federal, State, and local laws and regulations. Some of the applicable state laws and regulations are: Virginia Waste Management Act, Code of Virginia Section 10.1-1400 *et seq.*; Virginia Hazardous Waste Management Regulations (VHWMR) (9VAC 20-60); Virginia Solid Waste Management Regulations (VSWMR) (9VAC 20-80); Virginia Regulations for the Transportation of Hazardous Materials (9VAC 20-110). Some of the applicable Federal laws and regulations are: the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. Section 6901 *et seq.*, and the applicable regulations contained in Title 40 of the Code of Federal Regulations; and the U.S. Department of Transportation Rules for Transportation of Hazardous materials, 49 CFR Part 107.

"Any sediment that is suspected of contamination or hazardous or solid wastes that are generated, transported, disposed, stored, or treated, as defined in the Virginia Solid and Hazardous Waste Regulations must be tested and handled in accordance with applicable Federal, State, and local laws and regulations. (Dredge spoils, when managed in accordance with the Virginia State Water Control Board or other Virginia state agencies with similar authority, are conditionally exempt from the solid waste regulations (9VAC 20-80-60.E) and are excluded from the waste barging regulations (9VAC 20-170-10). Also, any treatment, storage, or disposal of hazardous wastes must be conducted in concert with applicable state laws and regulations. Some of the applicable state laws and regulations are: Virginia Waste Management Act, Code of Virginia Section 10.1-1400 *et seq.*; Virginia Hazardous Waste Management Regulations (VHWMR) (9VAC 20-60); Virginia Solid Waste Management Regulations (VSWMR) (9VAC 20-80); Virginia Regulations for the Transportation of Hazardous Materials (9VAC 20-110). Some of the applicable Federal laws and regulations are: the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. Section 6901 *et seq.*, and the applicable regulations contained in Title 40 of the Code of Federal Regulations; and the U.S. Department of Transportation Rules for Transportation of Hazardous materials, 49 CFR Part 107."

Also, all structures being demolished/renovated/ removed should be checked for asbestos-containing materials (ACM) and lead-based paint prior to demolition. If ACM or LBP are found, in addition to the federal waste-related regulations mentioned above, State regulations 9VAC 20-80-640 for ACM and 9VAC 20-60-261 for LBP must be followed.

Please note that DEQ encourages all construction projects and facilities to implement pollution prevention principles, including the reduction, reuse, and recycling of all solid wastes generated. All generation of hazardous wastes should be minimized and handled appropriately.

If you have any questions or need further information, please contact Paul Kohler at (804) 698-4208.

If you cannot meet the deadline, please notify JOHN FISHER at 804/698-4339 prior to the date given. Arrangements will be made to extend the date for your review if possible. An agency will not be considered to have reviewed a document if no comments are received (or contact is made) within the period specified.

REVIEW INSTRUCTIONS:

A. Please review the document carefully. If the proposal has been reviewed earlier (i.e. if the document is a federal Final EIS or a state supplement), please consider whether your earlier comments have been adequately addressed.

B. Prepare your agency's comments in a form which would be acceptable for responding directly to a project proponent agency.

C. Use your agency stationery or the space below for your comments. **IF YOU USE THE SPACE BELOW, THE FORM MUST BE SIGNED AND DATED.**

Please return your comments to:

MR.JOHN E. FISHER
DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL IMPACT REVIEW
629 EAST MAIN STREET, SIXTH FLOOR
RICHMOND, VA 23219
FAX #804/698-4319
jefisher@deq.virginia.gov

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MAY 2 0 2009

DEQ-Office of Environmental Impact Review

JOHN E. FISHER
ENVIRONMENTAL PROGRAM PLANNER

COMMENTS

Based on information in our database, no T/E plant and insect species are documented to occur in the vicinity of the project area. At this time, we do not anticipate this project will have significant adverse affect as it relates to VDACS' responsibilities for the preservation of agricultural lands and the protection of listed endangered and threatened plant and insect species.

(signed) (Keith R. Tignor) (date) May 21, 2009

(title) Endangered Species Coordinator

(agency) VDACS, Office of Plant and Pest Services

PROJECT # 09-083F **4/07**

Fisher,John

From: Amy.Ewing@dgif.virginia.gov
Sent: Wednesday, May 27, 2009 11:57 AM
To: Fisher,John
Cc: Ruth.Boettcher@dgif.virginia.gov
Subject: ESSLog# 26554_09-083F_Expansion of Wallops Flight Facility Launch Range

We have reviewed the draft EA for the subject project and offer the following information about the wildlife and resources known from Virginia's Barrier Islands for consideration during finalization of the EA.:

Virginia's barrier islands represent a critically important breeding area for a number of beach nesting shorebirds and seabirds that are of high conservation concern, including the federally Threatened piping plover *(Charadrius melodus),* the state Endangered Wilson's plover (*C. wilsonia*), the American oystercatcher (*Haematopus palliatus*), which is ranked nationally as a high conservation priority species in the US Shorebird Conservation Plan (Brown *et al.* 2001), the state Threatened gull-billed tern (*Sterna nilotica*), and the least tern (*S. antillarum*), which is a state species of special concern. The Commonwealth's northern barrier islands that extend from Assateague Island south to Cedar Island typically support over 75% of Virginia's piping plover breeding population and in some years over 90% of the Commonwealth's breeding pairs have occurred on the northern islands (Boettcher *et al.* 2007). Since 2000, Virginia's Wilson's plover breeding population has been confined to Assawoman, Metompkin and Cedar islands with the exception of 2008 when one pair was discovered nesting on Assateague Island (Wilke *et al.* 2009). The barrier islands support over 50% of Virginia's American oystercatcher breeding population with a significant proportion occurring on Metompkin and Cedar islands (Wilke *et al.* 2005; Wilke *et al.* 2009). Moreover, oystercatcher productivity rates along the barrier island chain are some of the highest reported on the US the Atlantic coast, suggesting that the islands may serve as important population sources for the east coast population (Wilke 2008). The barrier islands also provide critical breeding habitat for least terns; since 1975 35% – 67% of the Commonwealth's population has been documented on the barrier island chain (VDGIF, unpubl. data). Virginia's statewide gull-billed tern breeding population has declined from approximately 2,000 pairs in the mid-1970's (Erwin *et al.* 1998) to fewer than 300 pairs in the last three years with the majority of nesting occurring on Virginia's seaside marshes and barrier islands (VDGIF, unpubl. data). While gull-billed terns are able to exploit barrier island and marsh habitats with equal success in response to rapidly changing conditions (Boettcher and Wilke 2009), the barrier islands remain important habitat for the declining species in Virginia. Other barrier island nesting species of greatest conservation need (as defined in Virginia's Wildlife Action Plan, available at www.bewildva.com) include black skimmer (*Rynchops niger*), common tern (*S. hirundo*), royal tern (*S. maxima*) and sandwich tern (*S. sandvicensis*) (VDGIF 2005).

Collectively, the aforementioned avian species' habitat requirements include broad beaches with low discontinuous dunes and expansive sand-shell flats. In addition, piping plover broods require unimpeded access from beach nest sites to the moist-soil ecotones of backside marshes and mudflats for forage and cover (Boettcher *et al.* 2007). We recommend that impacts upon these resources associated with the proposed expansion of the WFF be fully addressed in the EA.

Over the past 20 years, the red knot (*Calidris canutus rufa*) population has declined by over 80% (Morrison *et al.* 2004) and this species is currently a candidate for federal listing under the Endangered Species Act. A significant portion of the population that migrates north along the US Atlantic coast in the spring uses the barrier islands as stopover sites (Smith *et al.* 2008). This includes Wallops Island where more than 1,000 birds have been recorded during a single survey (Center for Conservation Biology, The Nature Conservancy, and VDGIF, unpubl. data).

Virginia is the northern extreme of the federally Threatened loggerhead sea turtle (*Caretta caretta*) nesting range. While the majority of the Commonwealth's nesting activity has been confined to southern mainland beaches (Fort Story - NC/VA border), nesting activity on the northern barrier islands, including Wallops Island, has increased slightly in recent years (VDGIF, unpubl. data). Nesting sea turtles typically nest on dynamic ocean beaches that have a wide berm and a relatively intact natural dune system. This species typically avoids or has poor nesting success on armoured beaches, which over time, become devoid of dry beaches and natural primary dune systems.

We recommend the following changes/additions to the EA:

Section 3.2.3 - Table 12: Threatened and Endangered Species in the WFF Area
This table should be updated to reflect the state status of these species as follows:

leatherback sea turtle - Virginia status is Endangered
hawksbill sea turtle - Virginia status is Endangered
Kemp's Ridley sea turtle - Virginia status is Endangered
loggerhead sea turtle - Virginia status is Threatened
Atlantic green sea turtle - Virginia status is Threatened

fin whale - Virginia status is Endangered
humpback whale - Virginia status is Endangered
northern right whale - Virginia status is Endangered

In addition, this table should include the following listed species also known from the vicinity of Wallops Island. The EA should fully evaluate these additional species for impacts associated with the launch and reentry of rockets from Mid-Atlantic Regional Spaceport on Wallops Island in addition to any other activities associated with the proposed upgrades to the facility.

state Threatened bald eagle
federal Endangered state Endangered sperm whale
federal Endangered state Endangered sei whale
federal Endangered state Endangered blue whale
federal Endangered state Endangered Florida manatee (subspecies of the West Indian manatee)

Further, we recommend that the table include red knot, a federal candidate species and a species listed in Tier IV (Moderate Conservation Need) of Virginia's Wildlife Action Plan's list of Species of Greatest Conservation Need.

We are concerned that the EA does not adequately characterize possible impacts upon wildlife and the resources that support them resulting from the proposed increase in rocket launches. The EA does acknowledge that animals (although they limit it to terrestrial mammals) will demonstrate a startle response. This is particularly significant in the case of nearby nesting birds. If birds are scared off their nesting sites, this may result in nest abandonment, leading to unsuccessful breeding or brooding, depending on the time of year of the launch. Over time and depending on the number of launches during the breeding season (for most species in the area, not including bald eagle, this is April 1 through August 15 of any year), this could result in significant impacts upon these populations. Rocket launches also may be detrimental to migrating species. We recommend that the PEIS, and subsequent documents, address this issue and provide alternatives for operations at Mid-Atlantic Regional Spaceport that may avoid, minimize or mitigate such impacts. This may include options such as a reduced number of launches during the breeding season. We further recommend that the PEIS and subsequent documents detail the number of planned launches from Mid-Atlantic Regional Spaceport and the affect that an increase in the number of launches, if proposed, may have on nearby wildlife resources. This should include a detailed discussion about cumulative impacts.

To our knowledge, rocket launches at this site have precluded staffs at CNWR from accessing Assawoman Island for the purposes of monitoring beach nesting birds, including piping plovers. This is significant in light of the fact that there may be adverse impacts upon these birds during launches and that the number of launches per year may increase. In this case, monitoring of these nesting birds is all the more important and should be accommodated by the FAA.

We recommend coordination with the NMFS regarding possible impacts upon sea turtle nesting habitat and impacts upon them that may result from maintenance dredging associated with the expansion of WFF. In addition, we recommend coordination with USFWS regarding possible impacts upon federally listed species associated with the proposed work.

We defer comments on the Consistency Determination for this project to VMRC as they have jurisdiction over marine resources in the CZMA.

Thank you, Amy

Amy M. Ewing
Environmental Services Biologist
Virginia Dept. of Game and Inland Fisheries
4010 West Broad Street
Richmond, VA 23230
804-367-2211
amy.ewing@dgif.virginia.gov

Fisher,John

From: Groh, Todd (DOF)
Sent: Thursday, June 04, 2009 12:36 PM
To: Fisher,John
Subject: Several EIRs - DOF's Response

John,

REF: Runway 16L/34R Extension, Manassas Regional Airport, Project #09-072F

The Department of Forestry finds no significant impact to the forest resources of the Commonwealth for this project.

REF: Expansion of the Wallops Flight Facility Launch Range, Project #09-083F

The Department of Forestry finds no significant impact to the forest resources of the Commonwealth for this project.

REF: Mayo River-Rakes Tract Acquisition, Project #09-099S

The Department of Forestry finds no significant impact to the forest resources of the Commonwealth for this project.

Todd A. Groh, Assistant Director
Forest Resource Management Division
Virginia Department of Forestry
900 Natural Resources Drive, Suite 800
Charlottesville, VA 22903
Phone: 434-220-9044
Mobile: 434-981-8882
Fax: 434-296-2369

If you cannot meet the deadline, please notify JOHN FISHER at 804/698-4339 prior to the date given. Arrangements will be made to extend the date for your review if possible. An agency will not be considered to have reviewed a document if no comments are received (or contact is made) within the period specified.

REVIEW INSTRUCTIONS:

A. Please review the document carefully. If the proposal has been reviewed earlier (i.e. if the document is a federal Final EIS or a state supplement), please consider whether your earlier comments have been adequately addressed.

B. Prepare your agency's comments in a form which would be acceptable for responding directly to a project proponent agency.

C. Use your agency stationery or the space below for your comments. **IF YOU USE THE SPACE BELOW, THE FORM MUST BE SIGNED AND DATED.**

Please return your comments to:

MR.JOHN E. FISHER
DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL IMPACT REVIEW
629 EAST MAIN STREET, SIXTH FLOOR
RICHMOND, VA 23219
FAX #804/698-4319
jefisher@deq.virginia.gov

JOHN E. FISHER
ENVIRONMENTAL PROGRAM PLANNER

COMMENTS

I do not anticipate an impact to mineral resources.

(signed) [signature]   (date) 5/26/09

(title) Geologist Mgr

(agency) DMME

PROJECT # 09-083F   **4/07**

RECEIVED
MAY 14 2009
DEQ-Office of Environmental Impact Review

COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION
1700 North Main Street
SUFFOLK, VIRGINIA 23434

DAVID S. EKERN, P.E.
COMMISSIONER

May 14, 2009

To: Melanie L. Allen
Environmental Program Planner
Virginia Department of Transportation

From: Tony Gibson
Transportation Planning Engineer
VDOT Hampton Roads District

Subject: Review of Environmental Assessment for Consistency Determination
Expansion of the Wallops Flight Facility Launch Range
Accomack County, Virginia

The Hampton Roads District Planning Section has reviewed the above referenced environmental evaluation for impacts to the existing and future transportation system. Our preliminary review does not indicate any negative impacts to the transportation system at this time.

There is one transportation improvement project in the vicinity of the Wallops Flight Facility Launch Range in the FY 10-15 Six Year Improvement Program or the Secondary Six Year Program. That project is UPC #1896- Route 175- Chincoteague Bridge Replacement.

We can only conclude any additional traffic or traffic disruptions regarding this process being considered are negligible.

This improvement/construction should note coordination with VDOT's Accomac Residency is required if any facilities or improvements impact VDOT right of way. Otherwise, this office has no objections to the proposed improvements.

If further assistance is needed, please advise.

Cc: Eric Stringfield
Bobby Isdell

COMMONWEALTH *of* VIRGINIA

L. Preston Bryant, Jr.
Secretary of Natural Resources

Department of Historic Resources
2801 Kensington Avenue, Richmond, Virginia 23221-0311

May 26, 2009

Mr. Randall Stanley
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099

Re: Mid-Atlantic Regional Spaceport
Wallops Island
DHR File #: 2009-0691
Date Received: April 27, 2009

Dear Mr. Stanley:

We have received information regarding our review of the above referenced undertaking, including a copy of the report DRAFT *Environmental Assessment for the Expansion of the wallops Flight Facility Launch Range* (URS: 1009). Additional information is needed before we will be able to comment on the effect of the project on historic resources. The following information is needed.

1. The Wallops Coast Guard Station and associated tower (001-0027-0100 and 001-0027-0101 respectively) are referenced in the Draft Environmental Assessment (EA). These resources have been determined Eligible for listing in the National Register of Historic Places (NRHP). Currently there is an agreement is under development with DHR to address the adverse effects to these resources, DHR File No. 2004-0147. What is the status of the agreement? The last correspondence we have concerning the agreement is dated December, 2008. Please provide a status update of the MOA including any relocation plans currently in development.

2. We recommend that you request the comments of the National Park Service (NPS) Assateague Island National Seashore regarding indirect effects to the NRHP-listed Assateague Beach Lifeboat Station. According to the NPS directory, Trish Kicklighter is Superintendent and Carl Zimmerman is the Resource Management Specialist. These comments will allow us to better comment on the effects of the proposed undertaking.

We will complete our review upon receipt of the requested data. If you have any questions about our comments, please contact me at ron.grayson@dhr.virginia.gov or (804) 367-2323, Ext. 105.

Sincerely,

Ronald Grayson, RPA, Archaeologist
Office of Review and Compliance

cc John Fisher, Department of Environmental Quality

If you cannot meet the deadline, please notify JOHN FISHER at 804/698-4339 prior to the date given. Arrangements will be made to extend the date for your review if possible. An agency will not be considered to have reviewed a document if no comments are received (or contact is made) within the period specified.

REVIEW INSTRUCTIONS:

A. Please review the document carefully. If the proposal has been reviewed earlier (i.e. if the document is a federal Final EIS or a state supplement), please consider whether your earlier comments have been adequately addressed.

B. Prepare your agency's comments in a form which would be acceptable for responding directly to a project proponent agency.

C. Use your agency stationery or the space below for your comments. **IF YOU USE THE SPACE BELOW, THE FORM MUST BE SIGNED AND DATED.**

Please return your comments to:

MR.JOHN E. FISHER
DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL IMPACT REVIEW
629 EAST MAIN STREET, SIXTH FLOOR
RICHMOND, VA 23219
FAX #804/698-4319
jefisher@deq.virginia.gov

JOHN E. FISHER
ENVIRONMENTAL PROGRAM PLANNER

COMMENTS

Fully Support!

(signed) [signature] (date) April 29, 2009

(title) County Administrator

(agency) County of Accomack

PROJECT # 09-083F **4/07**

COMMONWEALTH of VIRGINIA

L. Preston Bryant, Jr.
Secretary of Natural Resources

Marine Resources Commission
2600 Washington Avenue
Third Floor
Newport News, Virginia 23607

Steven G. Bowman
Commissioner

May 13, 2009

Mr. Joshua A. Bundick
Wallops Flight Facility NEPA Program Manager
c/o National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility (250.W)
Wallops Island, Virginia 23337

"Expansion of Wallops Flight Facility Launch Range"

Dear Mr. Bundick:

You have inquired regarding site improvements to support launch operations for the launch and/or reentry of reusable suborbital rockets from the Mid-Atlantic Regional Spaceport (MARS) on Wallops Island, Virginia.

The Marine Resources Commission requires a permit for any activities that encroach upon or over, or take use of materials from the beds of the bays, ocean, rivers and streams, or creeks which are the property of the Commonwealth.

Based upon my review of the "Environmental Assessment for the Expansion of Wallops Flight Facility Launch Range", dated April 2009, it would appear that your project will not be in the Commission's jurisdiction, therefore, no authorization would be required from the Marine Resources Commission.

For your information, however, if any portion of the proposed project extends channelward of mean low water or falls within the Coastal Primary Sand Dunes/Beaches of Accomack County, authorization may be required from the Marine Resources Commission.

If I may be of further assistance, please do not hesitate to contact me at (757) 414-0710.

Sincerely,

George H. Badger, III
Environmental Engineer

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

June 3, 2009

Mr. Joshua A. Bundick
NEPA Program Manager
NASA Wallops Flight Facility
Code 250.W/EWLR EA
Building F-160, Room W-160
Wallops Island, VA 23337

RE: Draft Environmental Assessment for the Expansion of the Wallops Flight Facility Launch Range, Wallops Island, VA

Dear Mr. Bundick:

In accordance with the National Environmental Policy Act (NEPA) of 1969 and Section 309 of the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has reviewed the Draft Environmental Assessment (EA) for the Expansion of the Wallops Flight Facility Launch Range, Wallops Island, VA.

The purpose of the proposed action is to enhance the respective National Aeronautics and Space Administration (NASA) and Mid-Atlantic Regional Spaceport (MARS) facilities at Wallops Flight Facility (WFF) to accommodate a wider variety of new launch vehicles and payloads, and to support launching of spacecraft from Pad 0-A. The need for the proposed action is to ensure the continued viability of NASA and MARS in serving the rapidly growing civil, defense, academic, and commercial aerospace market.

The Proposed Action includes expanding and upgrading NASA and MARS facilities to support up to and including medium large class suborbital and orbital expendable launch vehicle (ELV) launch activities from WFF. Components of the Proposed Action include facility construction and infrastructure improvements; testing, fueling, and processing operations; up to two static fire tests per year; and launching an additional six vehicles and associated spacecraft per year from Pad 0-A.

The examination and comparison of alternatives under consideration for a project is the heart of the environmental document, as described in the regulations of the Council on Environmental Quality (CEQ) (40 CFR 1502.14). To make a complete and comprehensive evaluation of the alternatives for the expansion of the Wallops Flight Facility Launch Range, all facets of decision-making should be thoroughly examined to assist in making a comparative analysis. It is through this comparison that the public is able to make informed decisions with regard to the merits of the project and the advantages and disadvantages of each of the alternatives being studied. EPA is concerned that the subject draft EA does not evaluate a range of alternatives appropriate for a NEPA document. Other EPA concerns and detailed comments on the EA are presented in an attachment to this letter for your consideration.

Of additional concern are the number of proposed projects planned on Wallops Island and their impacts upon the natural environment. Although an environmental analysis is planned for the projects mentioned in Section 4.5.1, page 134, EPA suggests that it is possible that projects, including the proposed action, may be connected activities and could be addressed within one Environmental Impact Statement (EIS) in order to fully assess all actions and alternatives, and their relative environmental impacts to Wallops Island. In addition, since multiple tenants occupy the WFF, including the US Navy, it is important to address any activities and projects that may be in the foreseeable future to thoroughly assess all potential environmental impacts.

During project review to determine compliance with the Clean Water Act Section 404(b)(1) Guidelines (for potential impacts to wetlands or waters of the US), EPA will also consider a number of factors associated with the series of proposed activities on Wallops Island, including whether the projects should be evaluated together, whether alternatives were considered in sufficient detail to meet the Sec 404 guidelines, whether impacts are acceptable given that the project does not require access or proximity to the aquatic environment (is not "water-dependent").

We believe it would be prudent for NASA, EPA and other federal partners to arrange a call or meeting to discuss more details of projects planned for the Wallops Island facility. EPA appreciates the opportunity to comment on the Wallops Island Flight Facility Launch Range EA and looks forward to additional coordination on other activities that are pending for the area. If you have any questions regarding these comments, please feel free to contact Ms. Karen DelGrosso, principal staff contact at (215) 814-2765.

Sincerely,

Barbara J. Rudnick
NEPA Team Leader
Office of Environmental Programs

Attachment

Technical Comments

Alternatives

As presented in the draft EA, only the No Action Alternative and the Proposed Action were described which does not provide an adequate Alternatives Analysis. The draft EA states on page 15 that "Because hundreds of millions of dollars in existing NASA and MARS infrastructure are already available for use, and WFF contains the only NASA-owned and operated launch range, WFF is the only launch site that can meet the stated Purpose and Need of enabling low-cost, quick turn-around aerospace research and commercial assess to space." "Therefore, no other launch sites were considered to be reasonable." It is important that the draft EA address the consideration of other alternatives sites within the WFF, other NASA facilities, or other comparable sites. A comparison of proposed sites is critical to the environmental analysis.

Wetlands

Page 36 states that an extensive wetland system borders Wallops Island. The island has non-tidal freshwater emergent wetlands, several small freshwater ponds, freshwater forested shrub wetlands, estuarine intertidal emergent wetlands, maritime forests and marsh wetlands. The total size of the wetlands should be provided.

The Proposed Action would result in the loss of 5.7 acres of wetlands. One acre of tidal wetlands would be filled for construction of the Pad 0-A ramp and road improvements and 4.7 acres of non-tidal wetlands would be filled by construction of the Payload Processing Facility (PPF) and its access road. NASA has determined that there are no practicable alternatives for the location of the Pad 0-A ramps and road or the PPF due to siting constraints. It is important to note that the size and functional values of all impacted wetlands be analyzed and a mitigation plan for their replacement developed.

In addition, when the wetland impact for the Proposed Action is combined with future projects, the total wetland impact is significant. For instance, the Alternative Energy Project would impact one acre of tidal wetlands in the central part of Wallops Island, and the North Unmanned Aerial Vehicle Airstrip (UAV) would impact 21 acres of tidal and non-tidal wetlands on north Wallops Island.

Page 86 states that "Prior to construction, NASA and MARS would complete a jurisdictional wetland delineation in accordance with the USACE 1987 Wetland Delineation Manual and regional guidelines to determine the precise location and size of the wetland area that would be adversely affected." Wetlands present on, or immediately surrounding the site should be delineated according to the 1989 Federal Manual for Identifying and Delineating Jurisdictional Wetlands. This information should be provided in the environmental documentation.

The draft EA also states, "NASA and MARS would notify the public and coordinate with applicable agencies including USACE, and VDEQ, VMRC, and the Accomack County Wetlands Board; these agencies would be notified of potential impacts to wetlands by VMRC through the JPA process." The text also reads, "Because the Proposed Action would involve federally funded and authorized impacts on jurisdictional wetlands, this EA serves as NASA's means for facilitating public review as required by EO 11990." It is important then to include within the environmental documentation all impacts to jurisdictional wetlands (including size and location of wetlands) and coordinate with applicable agencies in the planning process.

Page 87 states, "A release of unspent RP-1 from ELV may create a thin film of petroleum on the water surface near the impact area." "Due to the volume of this release into the nearby tidal wetlands, temporary impacts on water quality in the tidal wetlands may be adverse; however, because mitigation and cleanup measures would be implemented, the potential long-term impacts on tidal wetlands would not be significant." The size of the tidal wetlands should be indicated and mitigation and cleanup measures identified.

The impacts to wetlands which can occur from launch activities such as exhaust plume and other hazards such as radiant heat transfer or direct exposure to the high temperature exhaust gas mixture should be identified?

Protection of Children from Environmental Health Risks and Safety Risks

NASA prepared an Environmental Justice Implementation Plan (EJIP). Page 74 states, "The closest day care centers, schools, camps, nursing homes, and hospitals are addressed within the EJIP." The draft EA does not specify the proximity of these sensitive resource areas. A summary of the data in the EJIP should be presented.

Cultural Resources

As noted on page 76, the last survey of cultural resources was conducted in 2004. Will there be an updated survey to look at properties that may now have achieved 50 years of age since 2004?

Stormwater Management

As stated on page 84, "Permanent stormwater control measures such as retention basins would be constructed and implemented in compliance with the Virginia Stormwater Management Regulations to provide adequate drainage for the new building sites, and to mitigate the effects of increased runoff from impervious surfaces." "Therefore, with permanent stormwater measures incorporated into the site design, no significant impacts on topography and drainage are anticipated."

It is not evident from the draft EA where the retention basins would be constructed. It is important to note that according to the guidelines developed by the Interagency Stormwater/Wetlands Workgroup, it is the recommendation of the EPA to discourage the utilization of non-tidal wetland systems for stormwater treatment and management. Numerous studies have shown that siting these facilities in wetlands leads to the degradation of aquatic ecosystems by contributing to thermal pollution and downstream warming. Furthermore, an in-stream stormwater management and water quality treatment facility will alter hydrology and increase erosion and sedimentation rates. Retaining stormwater and changing the natural flow rate will alter the natural level of the water table and change the surrounding wetlands vegetation. Water temperature, habitat composition, and food availability are all directly affected when streamside vegetation is lost. Stormwater management structures in wetlands will not prevent pollutants such as spills, sediment, heavy metals, petroleum, rocket propellant, etc from entering the surface waters since the structures are already in the surface water. Wetlands are important components to the aquatic ecosystem that provide flood flow resynchronization, maintenance of water quality, habitat and nutrient uptake functions. EPA's mandates include the preservation of these environmentally significant values and functions.

Floodplains

As stated on page 88, "All facility construction and infrastructure improvements would take place within the 100-year and 500-year floodplain." "Because Wallops Island is the location for WFF's core launch range functions, and is entirely within the floodplain, no practicable alternatives exist." It is important to note that floodplain encroachment must be evaluated and coordinated with the Federal Emergency Management Agency (FEMA). Federal Executive Order 11988 (Floodplain Management) states, "If an agency has determined to, or proposes to conduct, support or allow an action to be located in a floodplain, the agency shall consider alternatives to avoid adverse effects and incompatible development in the floodplains." Where no practicable alternatives exist, Executive Order 11988 goes on to state, "If property used by the general public has suffered flood damage or is located in an identified flood hazard area, the responsible agency shall provide on structures, and other places where appropriate, conspicuous delineation of past and probable flood height in order to enhance public awareness and knowledge about flood hazards." To promote public safety, we recommend that at a minimum, a permit condition be included to require conspicuous delineation of past and probable future flood heights at multiple locations across the project site. These signs should be in place within six months of permit issuance.

In addition, the draft EA states that "NASA and MARS would minimize floodplain impacts and protect and restore the natural and beneficial functions of floodplains to the maximum extent possible." The text should state how NASA and MARS plan to protect and restore the natural and beneficial functions of the floodplains.

Air Quality

Page 98 states, "The conclusion of the workshop, based on evaluation of scientific studies performed in the United States, Europe, and Russia was that the effects of launch vehicle propulsion exhaust emissions on stratospheric ozone depletion, acid rain, toxicity, air quality, and global warming were extremely small compared to other human activities." To make a fair comparison, the types of human activities referenced should be identified.

Terrestrial Habitat

Page 112 states "Long-term adverse impacts to vegetation would occur due to the loss of forest, shrub, and wetland plant communities due to the construction of the PPF, PFF, and Pad 0-A ramp and road improvement; however, these impacts would be localized and would not present a substantial adverse effect." As with wetlands, the loss of forest and shrub should be quantified and delineated.

Threatened and Endangered Species

Page 116 states, "Therefore, NASA has determined that the once a year static firing related to the Proposed Action also would not result in adverse impacts on the piping plover or its habitat." However, as stated on page 113, "...noise from static fire activities would be of longer duration, but infrequent (not more than two per year)." Clarification of exactly how many static fire activities per year should be documented. Consultation with U.S. Fish and Wildlife Service and Virginia Department of Game and Inland Fisheries is recommended to determine impacts (if any) to the piping plover or its habitat which may result from the static fire activities and open burning of rocket motors.

Miscellaneous

Page 2, Section 1.2.1.3 Federal Aviation Administration, mentions the term reentry activities/operations at least three times. Please explain and/or describe reentry activities.

Page 9 states, "Pad 0-A is a facility for launch vehicles with up to a 90,909-kg (200,000-lb) maximum load. Originally designed for the Conestoga vehicle, which was launched once in October 1995, Pad 0-A has been inactive; its launch service gantry (a large vertical structure with platforms at different levels used for erecting and servicing expandable launch vehicles [ELVs] before launch) and portions of the existing launch pad were removed in fall 2008, rendering Pad 0-A unusable for launching until a new gantry is built." Explain why the gantry was removed? Is this a typical activity after so many launches, was this done because it was found to be unsafe, or was the size of the gantry no longer useable?

Page 35 states that, "This western boundary of Wallops Island includes a section of the Virginia Inside Passage, a federally maintained navigational channel frequently used by commercial and recreational boaters alike." What is the notification system used to warn boaters of a launch activity?

Page 102 states, "NASA and MARS personnel and the public would be notified in advance of launch dates and times." The means of notification should be specified.

Page 105 states, "If a flight approaches corridor limits, the flight would be destroyed by Range Safety personnel." The text should describe how the flight is destroyed, the impacts, and potential resources that may be threatened.

Page 106 states, "Fueling of ELVs with LOX and RP-1, and pressurized gases would take place at the Liquid Fueling Facility (LFF) adjacent to Pad 0-A." The area surrounding the LFF should be described and potential resources that can be impacted from the hazardous waste and materials identified.

Page 106 states, "Payload processing may require limited use of chemicals considered toxic under CERCLA (NASA, 1997)." Describe the type of toxic chemicals used.

Page 109 states, "Potential toxic corridors (transportation routes) are defined in mission-specific Operations and Safety Directives—further information is provided in the Transportation discussion in Section 4.4.5 of this EA." It is not apparent in Section 4.4.5 that a discussion was provided.

Page 109 states, "In addition, the hazardous waste streams likely to be generated by the Proposed Action are not anticipated to substantially increase the amount of hazardous waste currently generated by WFF." This statement needs to be explained. "Hazardous waste streams" should be described.

COMMONWEALTH of VIRGINIA

L. Preston Bryant, Jr.
Secretary of Natural Resources

Department of Historic Resources

2801 Kensington Avenue, Richmond, Virginia 23221-0311

Kathleen S. Kilpatrick
Director

Tel: (804) 367-2323
Fax: (804) 367-2391
TDD: (804) 367-2386
www.dhr.virginia.gov

May 26, 2009

Mr. Randall Stanley
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 2337-5099

Re: Mid-Atlantic Regional Spaceport
Wallops Island
DHR File #: 2009-0691
Date Received: April 27, 2009

Dear Mr. Stanley:

We have received information regarding our review of the above referenced undertaking, including a copy of the report DRAFT *Environmental Assessment for the Expansion of the wallops Flight Facility Launch Range* (URS: 1009). Additional information is needed before we will be able to comment on the effect of the project on historic resources. The following information is needed:

1. The Wallops Coast Guard Station and associated tower (001-0027-0100 and 001-0027-0101 respectively) are referenced in the Draft Environmental Assessment (EA). These resources have been determined Eligible for listing in the National Register of Historic Places (NRHP). Currently there is an agreement is under development with DHR to address the adverse effects to these resources, DHR File No. 2004-0147. What is the status of the agreement? The last correspondence we have concerning the agreement is dated December, 2008. Please provide a status update of the MOA including any relocation plans currently in development

2. We recommend that you request the comments of the National Park Service (NPS) Assateague Island National Seashore regarding indirect effects to the NRHP-listed Assateague Beach Lifeboat Station. According to the NPS directory, Trish Kicklighter is Superintendent and Carl Zimmerman is the Resource Management Specialist. These comments will allow us to better comment on the effects of the proposed undertaking.

We will complete our review upon receipt of the requested data. If you have any questions about our comments, please contact me at: ron.grayson@dhr.virginia.gov or (804) 367-2323, Ext. 105.

Sincerely,

Ronald Grayson, RPA, Archaeologist
Office of Review and Compliance

cc: John Fisher, Department of Environmental Quality

COMMONWEALTH of VIRGINIA

L. Preston Bryant, Jr.
Secretary of Natural Resources

Department of Historic Resources
2801 Kensington Avenue, Richmond, Virginia 23221-0311

Kathleen S. Kilpatrick
Director

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TDD: (804) 367-2386
www.dhr.virginia.gov

July 15, 2009

Mr. Randall Stanley
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 2337-5099

Re: Mid-Atlantic Regional Spaceport
Wallops Island
DHR File #: 2009-0691
Additional Information Received: July 2, 2009

Dear Mr. Stanley:

We have received information regarding our review of the above referenced undertaking, including a copy of the report DRAFT *Environmental Assessment for the Expansion of the wallops Flight Facility Launch Range* (URS: 1009) and comments from the Assateague Island National Seashore, Based upon the information provided, we concur with your determination that the proposed alternatives detailed in the aforementioned report will *not adversely affect any historic properties*. In the event that previously unrecorded historic properties are discovered during project activities, stop work in the area and contact DHR immediately.

Additionally, we look forward to further coordination on this project and the Memorandum of Agreement concerning the Wallops Coast Guard Station and associated tower.

If you have any questions about our comments, please contact me at: ron.grayson@dhr.virginia.gov or (804) 367-2323, Ext. 105.

Sincerely,

Ronald Grayson, RPA, Archaeologist
Office of Review and Compliance

cc: John Fisher, Department of Environmental Quality
Carl Zimmerman, Assateague Island National Seashore

COMMONWEALTH of VIRGINIA

L. Preston Bryant, Jr.
Secretary of Natural Resources

Department of Historic Resources
2801 Kensington Avenue, Richmond, Virginia 23221-0311

Kathleen S. Kilpatrick
Director

Tel: (804) 367-2323
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www.dhr.virginia.gov

August 24, 2009

Mr. Randall Stanley
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 2337-5099

Re: Mid-Atlantic Regional Spaceport
Wallops Island
DHR File #: 2009-0691
Additional Information Received: August 12, 2009

Dear Mr. Stanley:

We have received information regarding our review of the above referenced undertaking, including additional alternatives to be incorporated with this project. Based upon the information provided, we concur with your determination that the proposed alternatives detailed in the aforementioned report will *not adversely affect any historic properties*. In the event that previously unrecorded historic properties are discovered during project activities, stop work in the area and contact DHR immediately.

Additionally, we look forward to receipt of the final Environmental Assessment for this project incorporating all alternatives in a single document.

If you have any questions about our comments, please contact me at: ron.grayson@dhr.virginia.gov or (804) 367-2323, Ext. 105.

Sincerely,

Ronald Grayson, RPA, Archaeologist
Office of Review and Compliance

cc: John Fisher, Department of Environmental Quality
Carl Zimmerman, Assateague Island National Seashore

United States Department of the Interior
National Park Service
Assateague Island National Seashore
7206 National Seashore Lane Berlin, Maryland 21811

4190 (H4217)

JUL -2 2009

Joshua Bundick
NEPA Program Manager
National Aeronautics and Space Administration
Goddard Space Flight Facility
Wallops Flight Facility
Wallops Island, VA 23337

Dear Mr. Bundick:

Thank you for the opportunity to comment on the draft environmental assessment for the proposed expansion of the launch range at the Wallops Flight Facility. After consulting with our cultural resource advisors, we concur with your assessment that the proposed action will not result in adverse indirect effects on the cultural landscape and vistas associated with the Assateague Beach Coast Guard Station located on Assateague Island, Virginia. As you noted, the existing viewshed from the perspective of the Coast Guard Station looking towards Wallops Island has been significantly altered by the previous development of facilities supporting the Wallops Flight Facility mission. As such, the proposed new infrastructure will not appreciably alter the existing visual characteristics of the area.

It is, however, unfortunate that the proposed action may necessitate the removal and/or demolition of the historic Wallops Beach Lifeboat Station and Observation Tower. As you are aware, the Wallops facility was one of three Coast Guard lifeboat stations operating in the vicinity; the other two being the former Pope Island Station (no longer extant) and the Assateague Beach Station. With the loss of the Wallops Station, the Assateague Beach Station would become the sole reminder of the historic activities of the Coast Guard in the Chincoteague area; a significant component of the region's cultural heritage.

According to the Environmental Assessment, the future of the Wallops Station is still being negotiated with the Commonwealth of Virginia. Should there be a need to mitigate the impacts of whatever disposition is ultimately selected, I would ask that you consider the Assateague Beach Station as a potential mitigation option. The two Stations were contemporaneous, similar in purpose and many physical characteristics, and located in close proximity to one another. As such, action to enhance the conservation of and public access to the Assateague Beach Station seems to be an entirely reasonable approach to mitigating the loss of the Wallops Station.

Should the need for mitigation come to pass, I would be pleased to discuss the matter in greater depth at your convenience. Again, thank you for the opportunity to comment on the environmental assessment.

Sincerely,

Trish Kichlighter

Trish Kichlighter

cc: Ronald Grayson, Virginia Department of Historic Resources
Ethel Eaton, Virginia Department of Historic Resources
Lou Hinds, Chincoteague National Wildlife Refuge

Silbert, Shari A. (WFF-200.C)[EGG, Inc. (WICC)]

From: Bundick, Joshua A. (WFF-2500)
Sent: Wednesday, May 27, 2009 8:07 AM
To: Suzanne_Richert@URSCorp.com; Silbert, Shari A. (WFF-200.C)[EG&G, Inc. (WICC)]
Subject: FW: Launch range expansion comments
Attachments: NASA- Launch range expansion- draft EA comments.doc

-----Original Message-----
From: Ortiz, Adrianna CIV SCSC, PW [mailto:adrianna.ortiz1@navy.mil]
Sent: Tuesday, May 26, 2009 4:45 PM
To: Bundick, Joshua A. (WFF-2500)
Cc: Ailes, Marilyn CIV SCSC, M221
Subject: Launch range expansion comments

I apologize for getting these comments to you past the deadline. Once again these are only the comments from within the environmental office, not of the Commanding officer or anybody else in the main office. The summer intern and myself reviewed the entire document upon which we based our comments. If you have question please contact feel free to contact me.

Adrianna Ortiz

Student Ecologist
Navy Surface Combat Systems Center
Wallops Island, VA 23337
Phone: (757) 824-2083
Fax: (757) 824-2086
E-mail: adrianna.ortiz1@navy.mil

Subject: LAUNCH RANGE EXPANSION DRAFT ENVIRONMENTAL ASSESSMENT

1. Thank you for the copy of the Draft Environmental Assessment (EA) for the proposed launch range expansion on Wallops Island, Virginia. We at Surface Combat Systems Center Environmental Office have reviewed the proposal and would like to address a few issues. We understand that due to the need of the expansion and the specific details therein, there is only one alternative action mentioned. However, we feel that there needs to be alternatives listed in detail for various pieces such as possible locations for roads and possible sites for wetland mitigation. The destruction to wetlands is not clearly explained. Acreage is given, but the specific locations and wetland type are missing. We recommend that further details be given on wetland destruction as well as mitigation, along with possible locations of roads to the proposed buildings.

2. NASA has been actively developing plans to control if not reverse shoreline erosion on the southern end of Wallops Island for some time now. Although this draft EA does discuss the problems of shoreline erosion, no actions are being taken within this project to ensure the future of the proposed structures, especially at Pad 0-A. It is unclear from Figure 5 if the revised launch pad will have a new building associated with it. We recommend that the figure include a drawing of the building if applicable. We also recommend that forethought in engineering include mitigating the risk of storm overwash by elevating structures off the ground, and/or enclosing the various tanks (gases and oils) to shield them from the salt water preserving their integrity.

3. Modifications to the boat dock on the northern end of Wallops are listed, but are lacking detail. The draft EA does not mention the importance to wildlife of the waters surrounding this boat dock, although it does mention the essential fish habitat (EFH) near pad 0-A. We recommend that more detail be given for which part of the boat dock area will be hardened and by what means. An additional figure would be very helpful to support the text. Also we recommend that the National Marine Fisheries Services be consulted to ensure that the marsh adjacent to the boat dock is not classified as EFH.

4. The increase of water usage due to the proposed action was not considered significant since the total usage was still within the constraints of the current permit. We would like to reiterate that the expected monthly increase of 44% and expected

annual increase of 25% would still increase the demand to the sole source aquifer. We recommend that the water be conserved as much as possible to ensure future water supplies to Wallops Island.

5. From the description given, the deluge basin will be completely filled prior to each launch. After the launch the pH levels of the water within will be tested before being released into an unlined containment pond. From there the water will drain into the surrounding ecosystem until completely drained from the basin. We would like to mention that the surrounding water is very shallow and has a low turnover rate. By introducing large amounts of nitrogen sources this water is likely to undergo eutrophication, leading to other water quality problems such as low oxygen levels (Ryther and Dunstan 1971). Since this area has been labeled as EFH, it is reasonable to assume that degraded water quality will greatly impact the fish community (Kemp et al. 2005). We recommend that other water quality parameters such as total nitrogen or other possible contaminants be tested for before release to the secondary containment pond. We also recommend that potential impacts to water quality be further investigated and minimized where possible.

6. Section ‘4.2.4 Noise’, discusses the potential noises from construction, transportation, and launches. Piping plovers are mentioned as a potential receptor and more details are given later. Under the subheading ‘sonic booms’, it states that noise impacts to wildlife will be discussed below. However, this subject is not brought up until ‘4.3.2 Terrestrial Wildlife and Migratory Birds, and even there the information given is vague. The proposed payload fueling facility building is near the known peregrine falcon (listed by Virginia as threatened (VDGIF 2009)) nest on Wallops Island, VA. We recommend that the potential impact from noise disturbances be further evaluated for other wildlife, especially the peregrine falcon.

7. Laser use is brought up and some background information on the various classes of lasers is described. For this specific proposal the class of lasers is not mentioned, nor are the potential impacts to wildlife. We recommend that details be given to better characterize the use and potential risks of lasers.

8. In section ‘4.3.2 Terrestrial Wildlife and Migratory Birds’, under ‘launch activities’, there is confusion about the closures of Assateague during the launches. First it states that all

launches from Pad 0-B require the closure of the southern end of Assateague Island. It then contradicts by stating that Assateague has become a popular observation location for viewing the launches. The last portion of this section digresses as it begins to talk about the inputs of educational resources NASA has brought to the community. We recommend that the role of Assateague during launches be clarified and the information regarding education be placed in the appropriate section, ‘4.4.1 Population, Employment and Income’.

9. Section,’3.4 Department of Transportation Section 4(F) Lands’ discusses regulations concerning the conversion of publicly owned parks, recreational areas, wildlife and waterfowl refuges, and public or private historical sites to non-recreational lands. Section ‘3.4.2 Public Lands and Refuges’, mentions the validity of these regulations not only to public land holdings, but also to ‘Federal lands’. It is our understanding that the incorporation of ‘federal lands’ in this section is an error. We recommend its removal or clarification if applicable.

10. Last we have noticed that approximately one whole page from the reference section (‘Section Eight References’) was from a NASA source. We recommend that outside sources be integrated into the document to support in-house research effort findings.

Literature cited

Kemp, W. M., W. R. Boynton, J. E. Adolf, D. F. Boesch, W. C. Boicourt, G. Brush, J. C. Cornwell, T. R. Fisher, P. M. Glibert, J. D. Hagy, L.W. Harding, E. D. Houde, D. G. Kimmel, W. D. Miller, R. I. E. Newell, M. R. Roman, E. M. Smith, J. C. Stevenson. 2005. Eutrophication of Chesapeake Bay: historical trends and ecological interactions. Marine Ecological Progress Series 303:1-29

Ryther, J. H. and W. M. Dunstan. 1971. Nitrogen, phosphorous, and eutrophication in the coastal marine environment. Science 171(3975):1008-1013

Virginia Department of Game and Inland Fisheries (VDGIF) Special Status Faunal Species in Virginia. Updated February 3, 2009.
http://www.dgif.virginia.gov/wildlife/virginiatescspecies.pdf

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE
WALLOPS COMMAND AND DATA ACQUISITION STATION
WALLOPS, VIRGINIA 23337

May 28, 2009

Joshua A. Bundick
NEPA Program Manager
National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099

Dear Mr. Bundick:

The National Oceanic and Atmospheric Administration (NOAA) has reviewed the Draft Environmental Assessment (EA) for the Expansion of the Wallops Flight Facility Launch Range.[1] The expansion is proposed to upgrade the existing launch range at Wallops Island, with the overall purpose to achieve an increase in the number of medium-to-large, suborbital-to-orbital spacecraft launches, from a maximum of 12 per year to a maximum of 18 per year. The expansion would also permit an additional two static test firings per year.

This letter provides comments regarding the content of the EA in two areas of NOAA concern. Toward that end, the mission of the WCDAS, along with mission critical usage of radio frequencies and possible impacts to that usage, are briefly described.

The NOAA Wallops Command and Data Acquisition Station (WCDAS) at the Wallops Main Base is located approximately 5-8 miles NNW to N of the various facilities associated with the launch range expansion project. The mission of WCDAS includes ensuring scheduled flow of accurate weather and climate data from NOAA satellites to designated user subsystems. Its mission includes executing spacecraft (satellite) commands and schedules, acquiring, maintaining, and distributing a continuous flow of meteorological satellite data via two-way radio frequency (RF) data links, and managing, operating, and maintaining the station. Consequently, the WCDAS is an extensive user of the RF spectrum employing numerous frequency bands for multiple purposes. Studies and analyses have been performed in the past to ensure protection of the WCDAS, and similar NOAA facilities, and these studies include descriptions of spectrum usage and assessments of RF Interference (RFI).[2,3,4,5,6] It is in the nature of satellite links that they are sensitive to RFI due to the requirement to detect very low power signals from distant satellites. Geostationary and low earth orbiting, national and international, satellite systems are accessed and the station uses two-way microwave and domestic satellite data links to fulfill its mission. The use of RF spectrum is critical to fulfilling the mission of WCDAS.

It is noted that the draft EA presented a rather thorough examination of the various potentials for impacts to the biological and socio-economic environmental resources. With regard to the assessment of the potential impacts to the physical environment, NOAA has identified two areas that are briefly discussed in the EA for which there is not enough information to permit an assessment of potential impact to the WCDAS:

1. The EA contains several brief references to communications instrumentation (p 9) and ground-based surveillance and radar tracking systems (pp 9 and 11) that will be employed during launch activities. Additionally, the use of RF telemetry systems and data links between the spacecraft and ground systems is to be expected. The NOAA WCDAS has always been able to coexist with past launches without significant disruption to NOAA activities. However, the text contained in section 2.2.1.7 on p 22 of the EA mentions minor modifications to "communications support, radar, and antenna improvements". Without specific technical information regarding the proposed modifications and improvements, NOAA is unable to assess any potential impacts to sensitive NOAA receiving systems from changes to said systems. Information required to perform an assessment might include a brief description of the equipment improvements or modifications, along with the technical characteristics of the improved/modified systems (i.e. changes in transmitter power output and/or antenna types/gains, and changes in antenna locations, orientation, or pointing direction, etc).

2. The EA contains reference to loss of forest (p 112) due to construction activities. There is evidence from past technical studies that specific stands of the existing natural tree cover, located between the various Wallops Island transmitter systems and the Wallops Flight Facility, provide a degree of RF isolation (increased propagation loss) to potential interfering signals from high-power transmitters located on Wallops Island and vicinity. This RF isolation currently contributes to allowing the sensitive receiver systems at the WCDAS to generally operate satisfactorily with transmitting systems in the local environment. Without more specific information regarding areas of trees or vegetation that are designated for removal, NOAA is unable to determine if performance degradation to the sensitive WCDAS receiver systems may increase.

In summary, coordination and planning for the launch range expansion will be of interest to the WCDAS. The draft EA (Reference 1) should identify: 1) specific modifications (if any) proposed for the locations or technical characteristics of the communications, radar, and telemetry systems, and 2) the stands of tree cover or vegetation that is proposed for removal on a suitable map.

Sincerely,

Van D. Crawford

Van D. Crawford
Manager, Wallops CDA Station

Appendix E

Air Quality Background Information for Construction and Operational Emissions

USAF Air Conformity Applicability Model

Emissions Summary Information

Scenario: WFF LREA - Alt 1 w/ HIF
Installation: LANGLEY AFB

Emissions Summary Report For 2009

	Emissions, Ton/Year					
SOURCE CATEGORY	**CO**	**NOX**	**SO2**	**VOC**	**PM10**	**PM2.5**
Area Sources						
Other Phase I Const. - Grading Ops.	0.00	0.00	0.00	0.00	19.48	0.00
Other Phase II Const. - Acres Paved	0.00	0.00	0.00	0.00	0.00	0.00
Other Phase II Const. - Mobile Equip.	1.66	3.96	0.49	0.36	0.32	0.00
Other Phase II Const. - Non-Res. Arch. Ctgs.	0.00	0.00	0.00	0.07	0.00	0.00
Other Phase II Const. - Res. Arch. Ctgs.	0.00	0.00	0.00	0.00	0.00	0.00
Other Phase II Const. - Stationary Equip.	11.26	0.29	0.01	0.42	0.01	0.00
Other Phase II Const. - Workers Trips	0.18	0.01	0.00	0.01	0.00	0.00
Other Phase I Const. - Grading Equip.	0.18	0.66	0.07	0.07	0.05	0.00
Total	13.27	4.93	0.57	0.94	19.87	0.00
Grand Total	13.27	4.93	0.57	0.94	19.87	0.00

USAF Air Conformity Applicability Model

Emissions Summary Information

Scenario: WFF LREA - Alt 1 w/ HIF
Installation: LANGLEY AFB

Emissions Summary Report For 2010

	Emissions, Ton/Year					
SOURCE CATEGORY	**CO**	**NOX**	**SO2**	**VOC**	**PM10**	**PM2.5**
Area Sources						
Other Phase II Const. - Workers Trips	0.26	0.01	0.00	0.01	0.00	0.00
Other Phase II Const. - Acres Paved	0.00	0.00	0.00	0.00	0.00	0.00
Other Phase II Const. - Mobile Equip.	2.39	5.70	0.70	0.52	0.46	0.00
Other Phase II Const. - Non-Res. Arch. Ctgs.	0.00	0.00	0.00	0.12	0.00	0.00
Other Phase II Const. - Stationary Equip.	16.21	0.42	0.02	0.61	0.01	0.00
Other Phase II Const. - Res. Arch. Ctgs.	0.00	0.00	0.00	0.00	0.00	0.00
Total	18.86	6.13	0.73	1.26	0.47	0.00
Point Sources						
Other Const. - Facility Heating	0.04	0.05	0.00	0.00	0.00	0.00
Total	0.04	0.05	0.00	0.00	0.00	0.00
Grand Total	18.90	6.18	0.73	1.26	0.48	0.00

USAF Air Conformity Applicability Model

Emissions Summary Information

Scenario: WFF LREA - Alt 1 w/ HIF
Installation: LANGLEY AFB

Emissions Summary Report For 2011

SOURCE CATEGORY	CO	NOX	SO2	VOC	PM10	PM2.5
	Emissions, Ton/Year					
Point Sources						
Other Const. - Facility Heating	0.09	0.11	0.00	0.01	0.01	0.00
Total	0.09	0.11	0.00	0.01	0.01	0.00
Grand Total	0.09	0.11	0.00	0.01	0.01	0.00

USAF Air Conformity Applicability Model

Emissions Summary Information

Scenario: WFF LREA - Alt 1 w/ HIF
Installation: LANGLEY AFB

Emissions Summary Report For 2012

SOURCE CATEGORY	Emissions, Ton/Year CO	NOX	SO2	VOC	PM10	PM2.5
Area Sources						
Other Phase I Const. - Grading Equip.	0.04	0.16	0.02	0.02	0.01	0.00
Other Phase I Const. - Grading Ops.	0.00	0.00	0.00	0.00	4.73	0.00
Other Phase II Const. - Acres Paved	0.00	0.00	0.00	0.00	0.00	0.00
Other Phase II Const. - Mobile Equip.	2.55	6.08	0.75	0.56	0.49	0.00
Other Phase II Const. - Non-Res. Arch. Ctgs.	0.00	0.00	0.00	0.16	0.00	0.00
Other Phase II Const. - Res. Arch. Ctgs.	0.00	0.00	0.00	0.00	0.00	0.00
Other Phase II Const. - Stationary Equip.	17.28	0.45	0.02	0.65	0.01	0.00
Other Phase II Const. - Workers Trips	0.27	0.01	0.00	0.01	0.00	0.00
Total	20.14	6.70	0.79	1.39	5.25	0.00
Point Sources						
Other Const. - Facility Heating	0.09	0.11	0.00	0.01	0.01	0.00
Total	0.09	0.11	0.00	0.01	0.01	0.00
Grand Total	20.23	6.81	0.79	1.40	5.26	0.00

USAF Air Conformity Applicability Model

Emissions Summary Information

Scenario: WFF LREA - Alt 1 w/ HIF
Installation: LANGLEY AFB

Emissions Summary Report For 2013

	Emissions, Ton/Year					
SOURCE CATEGORY	**CO**	**NOX**	**SO2**	**VOC**	**PM10**	**PM2.5**
Point Sources						
Other Const. - Facility Heating	0.14	0.18	0.00	0.01	0.01	0.00
Total	0.14	0.18	0.00	0.01	0.01	0.00
Grand Total	0.14	0.18	0.00	0.01	0.01	0.00

USAF Air Conformity Applicability Model

Emissions Summary Information

Scenario: WFF LREA - Alt 2
Installation: LANGLEY AFB

Emissions Summary Report For 2009

SOURCE CATEGORY	Emissions, Ton/Year					
	CO	NOX	SO2	VOC	PM10	PM2.5
Area Sources						
Other Phase II Const. - Workers Trips	0.04	0.00	0.00	0.00	0.00	0.00
Other Phase I Const. - Grading Ops.	0.00	0.00	0.00	0.00	15.02	0.00
Other Phase II Const. - Acres Paved	0.00	0.00	0.00	0.00	0.00	0.00
Other Phase II Const. - Mobile Equip.	0.38	0.91	0.11	0.08	0.07	0.00
Other Phase II Const. - Non-Res. Arch. Ctgs.	0.00	0.00	0.00	0.03	0.00	0.00
Other Phase II Const. - Res. Arch. Ctgs.	0.00	0.00	0.00	0.00	0.00	0.00
Other Phase I Const. - Grading Equip.	0.14	0.51	0.05	0.05	0.04	0.00
Other Phase II Const. - Stationary Equip.	2.58	0.07	0.00	0.10	0.00	0.00
Total	3.14	1.49	0.17	0.26	15.14	0.00
Grand Total	3.14	1.49	0.17	0.26	15.14	0.00

USAF Air Conformity Applicability Model

Emissions Summary Information

Scenario: WFF LREA - Alt 2
Installation: LANGLEY AFB

Emissions Summary Report For 2010

SOURCE CATEGORY	Emissions, Ton/Year CO	NOX	SO2	VOC	PM10	PM2.5
Area Sources						
Other Phase II Const. - Mobile Equip.	1.71	4.08	0.50	0.37	0.33	0.00
Other Phase II Const. - Non-Res. Arch. Ctgs.	0.00	0.00	0.00	0.12	0.00	0.00
Other Phase II Const. - Res. Arch. Ctgs.	0.00	0.00	0.00	0.00	0.00	0.00
Other Phase II Const. - Stationary Equip.	11.60	0.30	0.02	0.43	0.01	0.00
Other Phase II Const. - Workers Trips	0.18	0.01	0.00	0.01	0.00	0.00
Other Phase II Const. - Acres Paved	0.00	0.00	0.00	0.00	0.00	0.00
Total	13.49	4.39	0.52	0.94	0.34	0.00
Point Sources						
Other Const. - Facility Heating	0.01	0.01	0.00	0.00	0.00	0.00
Total	0.01	0.01	0.00	0.00	0.00	0.00
Grand Total	13.50	4.40	0.52	0.94	0.34	0.00

USAF Air Conformity Applicability Model

Emissions Summary Information

Scenario: WFF LREA - Alt 2
Installation: LANGLEY AFB

Emissions Summary Report For 2011

	Emissions, Ton/Year					
SOURCE CATEGORY	**CO**	**NOX**	**SO2**	**VOC**	**PM10**	**PM2.5**
Point Sources						
Other Const. - Facility Heating	0.05	0.06	0.00	0.00	0.00	0.00
Total	0.05	0.06	0.00	0.00	0.00	0.00
Grand Total	0.05	0.06	0.00	0.00	0.00	0.00

Date : 12/19/2007 09:20 AM

Commonwealth of Virginia
Department of Environmental Quality

Annual Update for Calendar Year: 2007

Registration#: 40909
Plant Name: US NASA - Wallops Island
Physical Location: Island Facility
Mailing Address: NASA GSFC Wallops Flight Facility
Building F-160, Room C-166
Wallops Island, VA 23337 5099

Region: TRO
County: 001 Accomack County
Plant ID: 00031
Contact Person: Mitchell, Joel (Joe)
Telephone: (757)824-1127
Employees: 100
Principal Product: space launch
SIC: 9661 NAICS: 927110
Inspector: Williams, Willis
Classification: Synthetic Minor

Summary Data for Calendar Year: ~~2006~~ 2007

Stk	Pt	Seg	Segment Description	SCC	Annual Thruput	Units	% Sulfur	% Ash	Heat Content (mmbtu/ SCC unit)	% Overall Effic	Primary Control Equip	Secondary Control Equip	% Annual Thruput Dec Feb	Mar May	Jun Aug	Sep Nov	Operating Schedule Hr Dy	Dy Wk	Hr Yr	% Space Heat	Ht (ft)	Dia (ft)	Stack Parameters Exit Temp (f)	Exit Flow Rate (ACFM)	Plume Ht (ft)	Elevation (ft)
1	1	1	#2 OIL/ALL BOILERS & FURN	10200503	~~147.8~~ 152	1000 Gallons Burned	.3	0	138				40	20	10	30	24	7	3000	99.9	20	2	350	6500		7
1	1	2	PROPANE/ALL FURNACES	10201002	~~1.15~~ 0.74	1000 Gallons Burned	.1	0	91.5				40	20	10	30	24	7	3000	99.9	20	2	350	6500		7
1	1	3	OFF-SPEC JET FUEL/ALL BOILERS	10200503	0 ✓	1000 Gallons Burned	.5		127				40	20	10	30	24	7	3000	99.9	20	2	350	6500		7
2	2	1	#2 OIL/DIESEL GENS & PUMP	20200102	~~1.8~~ 2.0	1000 Gallons Burned	.3	0	138				25	25	25	25	1	1	300	0	10	2	700	5000		7
2	2	2	OFF-SPEC JET FUEL/DIESEL GENERATORS	10200503	0 ✓	1000 Gallons Burned	.5		127				25	25	25	25	1	1	300	0	10	2	700	5000		7
1	3	1	PAINT BOOTH BLDG X-30	40200110	~~28.8~~ 5.0	Gallons of Coating	0	0	0				25	25	25	25	8	5	400	0	15	2	80	1000		7

Enclosure 1

Date : 12/19/2007 09:20 AM

Commonwealth of Virginia
Department of Environmental Quality

Annual Update for Calendar Year: 2007

Registration#: 40217
Plant Name: NASA Wallops
Physical Location: NASA Wallops
Mailing Address: NASA GSFC Wallops Flight Facility
Building F-160, Room C-166
Wallops Island, VA 23337 5099

Region: TRO
County: 001 Accomack County
Plant ID: 00005
Contact Person: Mitchell, Joel (Joe)
Telephone: (757)824-1127
Employees: 900
Principal Product: research
SIC: 9711 NAICS: 928110
Inspector: Williams, Willis
Classification: Synthetic Minor

Summary Data for Calendar Year: ~~2006~~ 2007

Stk	Pt	Seg	Segment Description	SCC	Annual Thruput	Units	% Sulfur	% Ash	Heat Content (mmbtu/ SCC unit)	% Overall Effic	Primary Control Equip	Secondary Control Equip	% Annual Thruput: Dec Feb	Mar May	Jun Aug	Sep Nov	Operating Schedule: Hr Dy	Dy Wk	Hr Yr	% Space Heat	Stack Parameters: Ht (ft)	Dia (ft)	Exit Temp (f)	Exit Flow Rate (ACFM)	Plume Ht (ft)	Elevation (ft)
1	1	1	D8-208 C-BROOKS 600/#6	10300402	~~205.35~~ 137.10	1000 Gallons Burned	.5	.5	150				22	72	5	1	24	7	8760	99.9	65	2	475	12700		30
1	1	2	D8-208 C-BROOKS 600/#2	10300501	~~1.98~~ 0	1000 Gallons Burned	.3	0	140				22	72	5	1	24	7	8760	99.9	65	2	475	12700		30
2	3	1	D8-210 C-BROOKS/#6-OIL	10300402	~~157.76~~ 253.29	1000 Gallons Burned	.5	.5	150				54	1	1	44	24	7	8760	99.9	65	2	475	12700		30
2	3	2	D8-210 C-BROOKS/#2-OIL	10300501	~~1.8~~ 2.0	1000 Gallons Burned	.5	0	140				54	1	1	44	24	7	8760	99.9	65	2	475	12700		30
1	4	1	D8-211 C-BROOKS/#6	10300402	~~163.2~~ 203.46	1000 Gallons Burned	.5	.5	150				2	2	56	40	24	7	8760	99.9	65	3	240	12700		30
	4	2	D8-211 C-BROOKS/#2	10300501	~~4.36~~ 0.13	1000 Gallons Burned	.5	0	140				2	2	56	40	24	7	8760	99.9	65	3	240	12700		30
	5	1	ALL OTHER #2 OIL BOILERS/HEATERS	10300501	~~149.68~~ 141.27	1000 Gallons Burned	.3	0	140				40	25	10	25	24	7	8760	99.9	15	1.1	400	1140		30
	5	2	ALL #2 OIL EMERGENCY GENERATORS & PUMPS	20100102	~~10.21~~ 5.17	1000 Gallons Burned	.3	0	140				~~40~~ 25	25	~~10~~ 25	25	24	7	8760	~~99.9~~ 0	15	1.1	400	1140		30

Enclosure 1

Commonwealth of Virginia
Department of Environmental Quality

Annual Update for Calendar Year: 2007

Registration#: 40217
Plant Name: NASA Wallops
Physical Location: NASA Wallops
Mailing Address: NASA GSFC Wallops Flight Facility
Building F-160, Room C-166
Wallops Island, VA 23337 5099

Region: TRO
County: 001 Accomack County
Plant ID: 00005
Contact Person: Mitchell, Joel (Joe)
Telephone: (757)824-1127
Employees: 900
Principal Product: research
SIC: 9711 NAICS: 928110
Inspector: Williams, Willis
Classification Synthetic Minor

Summary Data for Calendar Year: ~~2006~~ 2007

Stk	Pt	Seg	Segment Description	SCC	Annual Thruput	Units	% Sulfur	% Ash	Heat Content (mmbtu/ SCC unit)	% Overall Effic	Primary Control Equip	Secondary Control Equip	% Annual Thruput Dec Feb	% Annual Thruput Mar May	% Annual Thruput Jun Aug	% Annual Thruput Sep Nov	Operating Schedule Hr Dy	Operating Schedule Dy Wk	Operating Schedule Hr Yr	% Space Heat	Stack Parameters Ht (ft)	Stack Parameters Dia (ft)	Stack Parameters Exit Temp (f)	Stack Parameters Exit Flow Rate (ACFM)	Stack Parameters Plume Ht (ft)	Stack Parameters Elevation (ft)
5	6	1	GASOLINE MARKETING	40600302	~~83.89~~ 88.28	1000 Gallons Transferred	0	0	0				25	25	25	25	24	7	8760	0					50	30
5	6	2	FILLING GAS TANKS	40600401	~~79.86~~ 86.29	1000 Gallons Pumped	0	0	0				25	25	25	25	24	7	8760	0					50	30
6	7	1	BLDG N-159 PAINT BOOTH	40200410	~~0~~ 3.36	Gallons of Coating							25	25	25	25	12	5	3000		20	1	100	2100		20
7	8	1	BLDG F-16 PAINT BOOTH	40200110	~~0~~ 0.19	Gallons of Coating							25	25	25	25	12	5	3000		20	1	100	2100		20
8	9	1	LP Gas Combustion Units	10301002	~~1.03~~ 3.70	1000 Gallons Burned	.1	0	1000				25	25	25	25	24	7	8760	0	14	1.7	400	30461		
9	10	1	Soil Vapor Extractor	30510499	~~4.43~~ 2.14	Tons Processed	0	0					25	25	25	25	24	7	8760	0	12	1	68	4000		15

URS

Sally Atkins /Herndon/URSCorp

06/16/2009 03:45 PM

To "Bundick, Joshua A. (GSFC-250.0)" <Joshua.A.Bundick@nasa.gov>

cc Mike_Kendall@URSCorp.com, "Silbert, Shari A. (GSFC-200.C)[EGG]" <shari.a.silbert@nasa.gov>, Suzanne_Richert@URSCorp.com, vijay_apte@urscorp.c

bcc

Subject Re: Heat Loads.

Here you go

"Bundick, Joshua A. (GSFC-250.0)" <Joshua.A.Bundick@nasa.gov>

"Bundick, Joshua A. (GSFC-250.0)" <Joshua.A.Bundick@nasa.gov>

01/26/2009 10:59 AM

To <Suzanne_Richert@URSCorp.com>, <Mike_Kendall@URSCorp.com>, <Sally_Atkins@URSCorp.com>, <vijay_apte@urscorp.com>

cc "Silbert, Shari A. (GSFC-200.C)[EGG]" <shari.a.silbert@nasa.gov>

Subject Heat Loads.

FYI- estimated heat load of Payload Fueling Building-1.7Million BTU/Hour
Heat load of Payload Processing Building (20% larger)-2.04 Million BTU/Hour

Assume size/layout of Fueling building is that shown in the email I sent last week.
Assume the Processing Building would be similar to WFF building H-100, but 20 percent larger.

Please let me know if you need more.

Josh

Josh Bundick
Environmental Office
NASA Wallops Flight Facility
Code 250.W, Building F-160, Room W160
Wallops Island, VA 23337

Phone: (757) 824-2319
Fax: (757) 824-1819
Email: Joshua.A.Bundick@nasa.gov

NASA Wallops Island EA - ACAM Data Entry Summary

Note: ACAM Output Reports state Langley AFB but it is for NASA Wallops Island
Results reported in the tables in Section 4 of EA added Construction Activities emissions from ACAM (except facility heating emissions) to Stationary Sources emissions calculated using an Excel spreadsheet.

Alternative 1

Facility	HIF	PFF	PPF	Pad A-0	Transportation	Boat Dock Mod
Building Square Footage (ft^3)[a]	26,000	7,500	12,000	5,000	0	0
Area Graded (acres)	6.80	1.10	4.10	6.40	2.70	0.10
Grading Duration (days)[b]	30	30	30	30	90	30
Area Paved (acres)	0.25	0.30	1.80	2.20	2.60	0.00
Construction Duration (days)[c]	335	335	335	335	90	180
Construction Start	Aug-09	Mar-12	Mar-12	Nov-09	Nov-09	Nov-09

[a] From Josh Bundick, NASA, e-mail attachment, dated 1/26/09.
[b] Grading duration of 30 days assumed for building projects and 90 days for transportation projects.
[c] Construction phase duration of 335 days assumed for building projects and 90 days for transportation projects.

NASA Wallops Island EA - ACAM Data Entry Summary
Alternative 2

Facility	V-45	Pad A-0	Transportation	Boat Dock Mod
Building Square Footage (ft^3)[a]	11,000	5,000	0	0
Area Graded (acres)	1.90	6.40	2.70	0.10
Grading Duration (days)[b]	30	30	90	30
Area Paved (acres)	1.40	2.20	2.60	0.00
Construction Duration (days)[c]	335	335	90	180
Construction Start	Nov-09	Nov-09	Nov-09	Nov-09

[a] From Josh Bundick, NASA, e-mail attachment, dated 1/26/09. Except V-45 size from his email dated 8/6/09.
[b] Grading duration of 30 days assumed for building projects and 90 days for transportation projects.
[c] Construction phase duration of 335 days assumed for building projects and 90 days for transportation projects.

NASA Wallops Island EA – Potential to Emit

Boilers and Furnaces	HIF	PFF	PPF	Pad A-0	Transportation	Boat Dock Mod	TOTAL
Heat Load (MMBtu/hr)	1.5[a]	1.7[a]	2.04[a]	0[a]	0[a]	0[a]	3.74
Potential Fuel Use (gal/yr)[b]	0.00	108701	130441	0.00	0.00	0.00	**239142**

Emissions from No. 2 Oil Combustion in Boilers and Furnaces

Pollutant	Emission Factor[c]	Emission Factor Units	Emissions (tpy)
CO	5	lb/1000 gal	0.60
NOX	20	lb/1000 gal	2.39
SO2	2.13	lb/1000 gal	0.25
VOC	0.34	lb/1000 gal	0.04
PM10	1.08	lb/1000 gal	0.13
PM2.5	0.83	lb/1000 gal	0.10

Emergency Generators

3 generators x 500 hours operation per year (ea.)	=	1,500	hr/yr
x 1502 hp[d]	=	2,253,000	hp-hr/yr
x 7000 Btu/hp-hr x 1 MMBtu/1,000,000 Btu	=	15,771	MMBtu/yr

Emissions from Diesel-Fired Emergency Generators

Pollutant	Emission Factor[e]	Emission Factor Units	Emissions (tpy)
CO	2.8	lb/hr	2.10
NOX	19.33	lb/hr	14.50
SO2	0.015	lb/MMBtu	0.12
VOC	0.34	lb/hr	0.26
PM10	0.24	lb/hr	0.18
PM2.5	0.24	lb/hr	0.18

Total Project PTE

Pollutant	Emissions (tpy)
CO	2.70
NOX	16.89
SO2	0.37
VOC	0.30
PM10	0.31
PM2.5	0.28

[a] From Sally Atkins e-mail attachment, dated 3/3/2009.

[b] Boiler fuel use calculated based on 8760 hours of operation per year at full load.

[c] Emission factors from EPA AP-42. Section 1.3., Tables 1.3-1 (NOX, CO, SO2), 1.3-3 (VOC), 1.3-7 (PM10, PM2.5). NMTOC factor from Table 1.3-3 used to represent VOC. No. 2 oil sulfur content of 0.015% assumed. (9/98)

[d] Horsepower rating of 1502 for a Caterpillar C32 DITA engine conservatively assumed for generators. Gen Set Package Performance Data [DM7714], February 28, 2008.

[e] Not to exceed emission factors from Gen Set Package Performance Data [DM7714] used for CO, NOx, VOC and particulate (February 28, 2008). Total HC factor used for VOC. All PM assumed to be PM2.5. SO2 emission factor from EPA AP-42. Section 3.4, Table 3.4-1. (10/96) Assumes diesel sulfur content of 0.015%.

****NOTE: ONLY USE CALCULATIONS BELOW THIS LINE**

Alternative 1

Emissions from LPG Commerical Boilers - HIF

Pollutant	Factor	Unit	PTE Emissions (TPY)	Estimated Actuals (TPY)
PM, filterable	0.2	lb/1000 gal	0.01	0.00
PM, condensable	0.5	lb/1000 gal	0.02	0.00
PM, total	0.7	lb/1000 gal	0.03	0.01
SO2	0	lb/1000 gal	0.00	0.00
Nox	13	lb/1000 gal	0.62	0.09
N2O	0.9	lb/1000 gal	0.04	0.01
CO2	12,500	lb/1000 gal	599.45	89.92
CO	7.5	lb/1000 gal	0.36	0.05
TOC	1	lb/1000 gal	0.05	0.01
CH4	0.2	lb/1000 gal	0.01	0.00

PTE Fuel Use (gallons): 95,912
Assuming 15% use (gallons): 14,387

Emissions from No. 2 Oil Combustion in Boilers and Furnaces - PPF and PFF

Pollutant	Emission Factor[c]	Emission Factor Units	PTE Emissions (tpy)	Estimated Actuals (tpy)
CO	5	lb/1000 gal	0.60	0.09
NOX	20	lb/1000 gal	2.39	0.36
SO2	2.13	lb/1000 gal	0.25	0.04
VOC	0.34	lb/1000 gal	0.04	0.01
PM10	1.08	lb/1000 gal	0.13	0.02
PM2.5	0.83	lb/1000 gal	0.10	0.01

PTE Fuel Use (gallons): 239,142
Assuming 15% use (gallons): 35,871

***2 generators, one at PPF, one at PFF, none at HIF**

Emergency Generators (PTE)

2 generators x 500 hours operation per year (ea.)	=	1,000	hr/yr
x 1502 hp[d]	=	1,502,000	hp-hr/yr
x 7000 Btu/hp-hr x 1 MMBtu/1,000,000 Btu	=	10,514	MMBtu/yr

Emissions from Diesel-Fired Emergency Generators (PPF and PFF)

Pollutant	Emission Factor[e]	Emission Factor Units	PTE Emissions (tpy)	Estimated Actuals (tpy)
CO	2.8	lb/hr	1.40	0.14
NOX	19.33	lb/hr	9.67	0.97
SO2	0.015	lb/MMBtu	0.08	0.01
VOC	0.34	lb/hr	0.17	0.02
PM10	0.24	lb/hr	0.12	0.01
PM2.5	0.24	lb/hr	0.12	0.01

SUMMARY:

Actuals

Alternative 1 w/ HIF **HIF will have heat pumps & Cooling tower; water will be heated via 1,500 MBH Propane Boiler

**HIF will have no back-up generator; PPF and PFF are assumed to have equivalent gensets and fuel oil boilers just to be safe

Pollutant	2009	2010	2011	2012	2013	2014
CO	None	22.48	0.05	0.05	0.17	0.28
NOX		0.0016	0.09	0.09	0.76	1.42
SO2		0.0000	0.00	0.00	0.02	0.05
VOC		0.0018	0.01	0.01	0.02	0.03
PM10		0.0013	0.01	0.01	0.02	0.04
PM2.5		0.0013	0.01	0.01	0.02	0.03

PTE

Pollutant	PTE (tpy)
CO	2.36
NOX	12.68
SO2	0.33
VOC	0.26
PM10	0.28
PM2.5	0.25

***Generator use assumed to be 50 hours per year x 2 (none at HIF)**

Emergency Generators (Actuals)

2 generators x 50 hours operation per year (ea.)	=	100	hr/yr
x 1502 hp[d]	=	150,200	hp-hr/yr
x 7000 Btu/hp-hr x 1 MMBtu/1,000,000 Btu	=	1,051	MMBtu/yr

Alternative 2

Emissions from No. 2 Oil Combustion in Boilers and Furnaces - V-45 (PPF Equivalent)

Pollutant	Emission Factor[c]	Emission Factor Units	PTE Emissions (tpy)	Estimated Actuals
CO	5	lb/1000 gal	0.60	0.05
NOX	20	lb/1000 gal	2.39	0.20
SO2	2.13	lb/1000 gal	0.25	0.02
VOC	0.34	lb/1000 gal	0.04	0.00
PM10	1.08	lb/1000 gal	0.13	0.01
PM2.5	0.83	lb/1000 gal	0.10	0.01

PTE Fuel Use (gallons): 130,441
Assuming 15% use (gallons): 19,566

SUMMARY:

Alternative 2 * 1 generator for V-45; 1 fuel oil boiler for V-45 equivalent heat of PPF

Actuals

Pollutant	2009	2010	2011	2012	2013	2014
CO	None	0.0297	0.12	Same	Same	Same
NOX		0.1697	0.68			
SO2		0.0062	0.02			
VOC		0.0030	0.01			
PM10		0.0041	0.02			
PM2.5		0.0035	0.01			

PTE

Pollutant	PTE (tpy)
CO	1.30
NOX	7.22
SO2	0.29
VOC	0.13
PM10	0.19
PM2.5	0.16

***One Generator (V-45 addition)**

Emergency Generators (PTE)

1 generators x 500 hours operation per year (ea.)	=	500	hr/yr
x 1502 hp[d]	=	751,000	hp-hr/yr
x 7000 Btu/hp-hr x 1 MMBtu/1,000,000 Btu	=	5,257	MMBtu/yr

Emissions from Diesel-Fired Emergency Generators (V-45 addition)

Pollutant	Emission Factor[e]	Emission Factor Units	PTE Emissions (tpy)	Estimated Actuals (tpy)
CO	2.8	lb/hr	0.70	0.07
NOX	19.33	lb/hr	4.83	0.48
SO2	0.015	lb/MMBtu	0.04	0.0039
VOC	0.34	lb/hr	0.09	0.01
PM10	0.24	lb/hr	0.06	0.01
PM2.5	0.24	lb/hr	0.06	0.01

***Generator use assumed to be 50 hours per year x 1 (at V-45)**

Emergency Generators (Actuals)

1 generators x 50 hours operation per year (ea.)	=	50	hr/yr
x 1502 hp[d]	=	75,100	hp-hr/yr
x 7000 Btu/hp-hr x 1 MMBtu/1,000,000 Btu	=	526	MMBtu/yr

Appendix F

Air Quality Modeling Background Information on REEDM and ALOHA and Raw Data for ALOHA Model

Background on REEDM

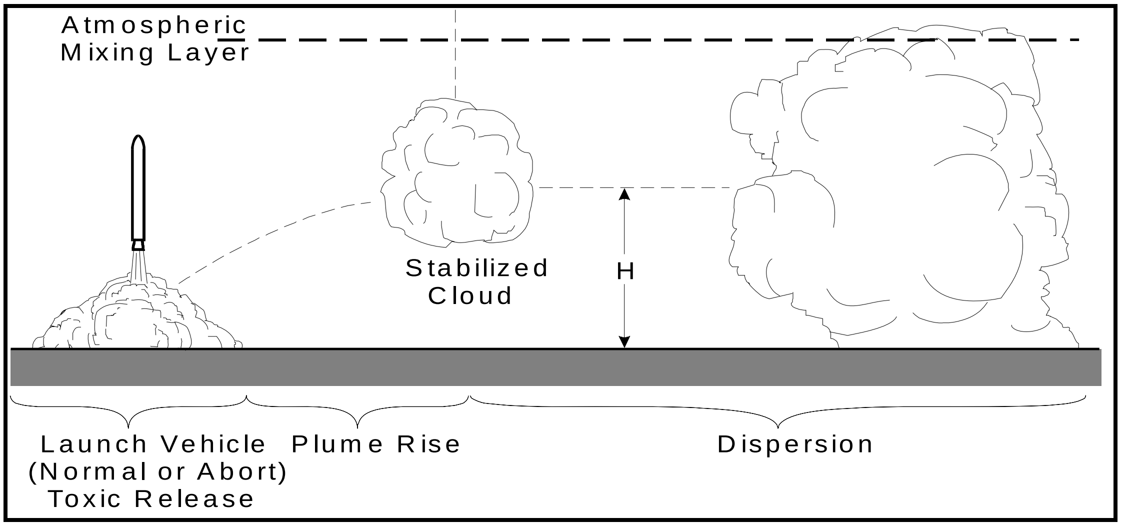
The REEDM model is a toxic dispersion model specifically tailored to address the large buoyant source clouds generated by rocket launches, test firings, and catastrophic launch vehicle explosions. REEDM falls in the category of "Gaussian puff" atmospheric dispersion models in that the initial mass distribution of toxic materials within the cloud at the time the cloud reaches thermal stabilization height in the atmosphere is assumed to be normally distributed. By making the Gaussian mass distribution assumption, the differential equation defining mass diffusion can be solved in closed form using exponential functions and may be readily implemented in a fast running computer program.

REEDM processes an emission event in the following sequence:

1. Process vehicle related data
2. Process meteorological data
3. Define the initial size, shape, location, and heat content of the exhaust cloud
4. Calculate the buoyant cloud rise rate and cloud growth rate to estimate the cloud stabilization height above ground, size, and downwind position
5. Determine whether or not part of the stabilized cloud is above a capping atmospheric temperature inversion
6. Transport the cloud disks downwind and grow the disk size using climatologic model estimates of atmospheric turbulence intensity
7. Calculate concentrations at ground receptor points and determine the peak concentration as a function of downwind distance
8. Report concentration as a function of distance from the source origin (e.g., launch pad)

REEDM was designed to primarily predict hazard conditions downwind from the stabilized exhaust cloud. REEDM does not directly calculate or report cloud concentrations during the buoyant cloud rise phase; however, advanced model users can manually extract sufficient pertinent cloud data from internal calculations to derive concentration estimates during the cloud rise phase. One assumption that REEDM makes about the nature and behavior of a rocket exhaust cloud is that it can be initially defined as a single cloud entity that grows and moves, but remains as a single cloud during the formation and cloud rise phases. A consequence of this assumption is that once the cloud lifts off the ground during the buoyant cloud rise phase, there will be no predicted cloud chemical concentration on the ground immediately below the cloud. Ground level concentrations will be predicted to remain at zero ppm until the some of the elevated cloud material is eventually brought back down to ground level by mixing due to atmospheric turbulence. This concept is illustrated in Figure F-1.

Figure F-1. Conceptual Illustration of Rocket Exhaust Source Cloud Formation, Cloud Rise, and Cloud Atmospheric Dispersion (NASA, 2009).

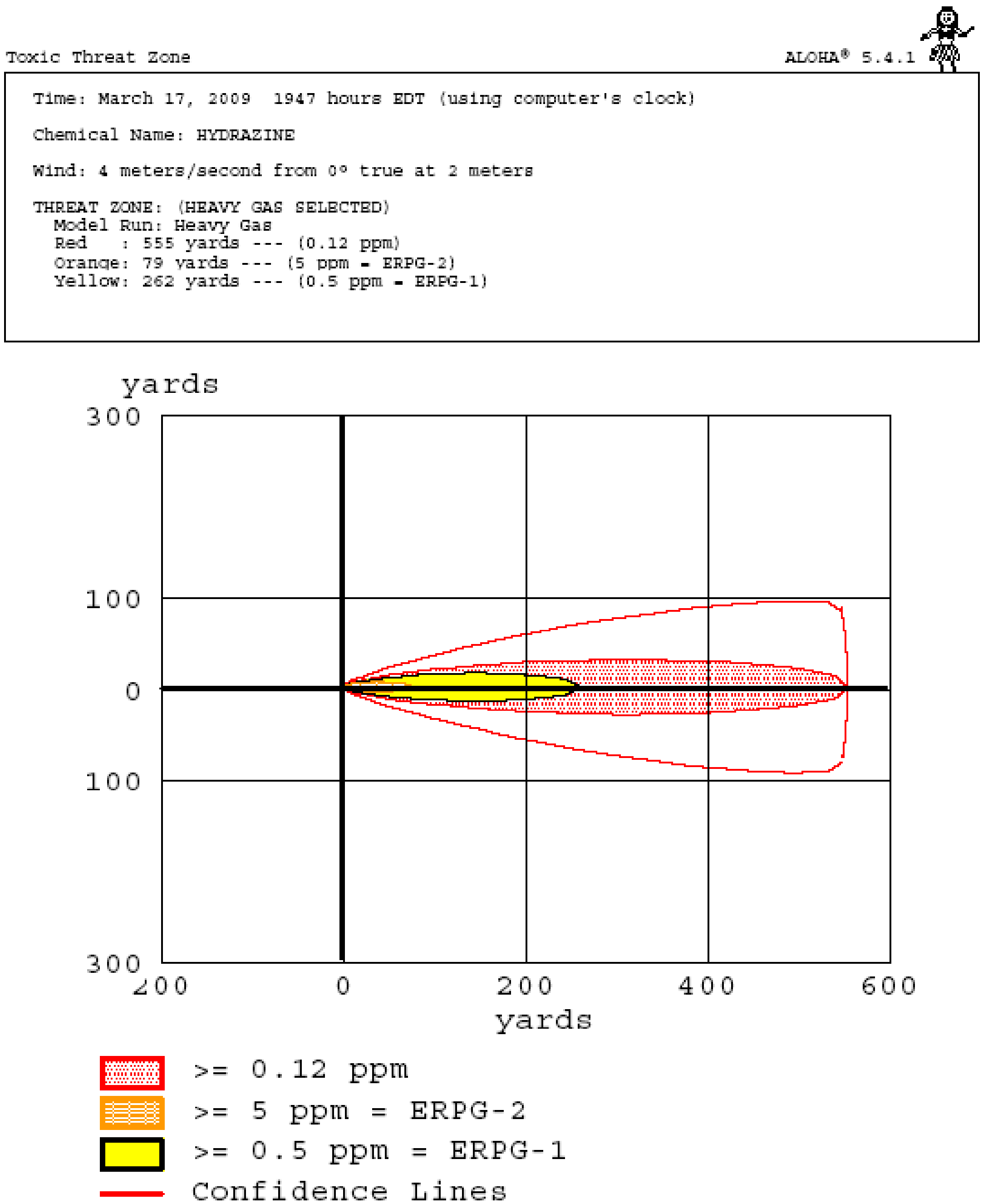


Background on ALOHA

The ALOHA model was designed with first emergency responders in mind. In particular, its air dispersion model is intended to be used to estimate the areas of impact near a short-duration chemical release where key hazards—toxicity, flammability, thermal radiation, or overpressure—may exceed user-specified Levels of Concern (LOCs).

ALOHA can model the dispersion of a cloud of pollutant gas in the atmosphere and display a diagram (i.e., a threat zone plot) that shows an overhead view of the regions, or threat zones, in which it predicts that key LOCs will be exceeded. To obtain a threat zone estimate, at least one LOC must be chosen. ALOHA will suggest default LOCs, and the user may keep those or choose up to three other LOCs. For toxic gas dispersion scenarios, an LOC is a threshold concentration of the gas at ground level—usually the concentration above which a hazard is believed to exist. The type of LOC will depend on the scenario. For each LOC chosen, ALOHA estimates a threat zone where the hazard is predicted to exceed that LOC at some time after a release begins. These zones are displayed on a single threat zone plot. If three LOCs are chosen, then ALOHA will display the threat zones in red, orange, and yellow. When ALOHA's default LOCs are selected, the red zone represents the worst hazard. Figure F-2 presents an example run from ALOHA indicating various threat zones.

Figure F-2: Example Threat Zone Plot in ALOHA Model



LOCs are usually based on one of the following parameters:

- Acute Exposure Guideline Levels (AEGLs) developed by the National Research Council's Advisory Committee.
- Emergency Response Planning Guidelines (ERPGs) developed by the ERPG committee of the American Industrial Hygiene Association. These were developed as planning guidelines to anticipate human adverse health effects caused by exposure to toxic chemicals.
- Temporary Emergency Exposure Limits (TEELs) are temporary toxic LOCs similar to ERPGs and are defined by the U.S. Department of Energy for use when ERPGs are not available.
- The Immediately Dangerous to Life or Health level is a limit established for selecting respirators for use in workplaces by the National Institute for Occupational Safety and Health (NIOSH). Immediately Dangerous to Life or Health is an estimate of the maximum concentration in the air to which a healthy worker could be exposed to without suffering permanent or escape-impairing health effects.

There are two separate dispersion models in ALOHA: Gaussian and heavy gas. ALOHA uses the Gaussian model to predict how gases that have a buoyancy equivalent to air will disperse in the atmosphere. The heavy gas dispersion calculations that are used in ALOHA are based on those used in the DEGADIS model, one of several well-known heavy gas models.

Like any model, ALOHA cannot be more accurate than the information entered during the modeling analysis. Therefore, it is important to enter the most accurate information. The modeler must choose a value that would give the worst-case scenario, or run multiple scenarios and compare the results. Additionally, ALOHA's models use atmospheric information to estimate the spread of the chemical release. If any of the atmospheric conditions (e.g., wind speed) change substantially during a response, it is recommended to correct the inputs and create a new threat zone plot, as the old plot may no longer be accurate.

Examples of conditions that can produce unreliable results during modeling runs using ALOHA include:

- Very low wind speeds;
- Very stable atmospheric conditions;
- Wind shifts and terrain steering effects; or
- Concentration patchiness, particularly near the release source.

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.73 (sheltered single storied)
Time: February 4, 2009 2100 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: HYDRAZINE Molecular Weight: 32.05 g/mol
ERPG-3: 30 ppm ERPG-2: 5 ppm ERPG-1: 0.5 ppm
IDLH: 50 ppm
Carcinogenic risk - see CAMEO
Normal Boiling Point: 236.3° F Ambient Boiling Point: 236.3° F
Vapor Pressure at Ambient Temperature: 0.0050 atm
Ambient Saturation Concentration: 4,971 ppm or 0.50%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
Inversion Height: 1000 feet
Stability Class: E (user override) Air Temperature: 40° F
Relative Humidity: 50% Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Area: 900 square feet Puddle Mass: 504.7 kilograms
Soil Type: Default Ground Temperature: 40° F
Initial Puddle Temperature: Ground temperature
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 0.657 pounds/min
(averaged over a minute or more)
Total Amount Released: 37.6 pounds

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
Red LOC (0.12 ppm) Max Threat Zone: 1536 yards

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.71 (sheltered single storied)
Time: February 4, 2009 2100 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: HYDRAZINE Molecular Weight: 32.05 g/mol
ERPG-3: 30 ppm ERPG-2: 5 ppm ERPG-1: 0.5 ppm
IDLH: 50 ppm
Carcinogenic risk - see CAMEO
Normal Boiling Point: 236.3° F Ambient Boiling Point: 236.3° F
Vapor Pressure at Ambient Temperature: 0.029 atm
Ambient Saturation Concentration: 28,929 ppm or 2.89%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
No Inversion Height
Stability Class: D Air Temperature: 90° F
Relative Humidity: 50% Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Diameter: 7.2 feet Puddle Volume: 5 gallons
Soil Type: Default Ground Temperature: 90° F
Initial Puddle Temperature: Ground temperature
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 0.172 pounds/min
(averaged over a minute or more)
Total Amount Released: 9.13 pounds

FOOTPRINT INFORMATION: (HEAVY GAS SELECTED)
Model Run: Heavy Gas
Red LOC (0.12 ppm) Max Threat Zone: 584 yards

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.71 (sheltered single storied)
Time: February 4, 2009 0700 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: HYDRAZINE Molecular Weight: 32.05 g/mol
ERPG-3: 30 ppm ERPG-2: 5 ppm ERPG-1: 0.5 ppm
IDLH: 50 ppm
Carcinogenic risk - see CAMEO
Normal Boiling Point: 236.3° F Ambient Boiling Point: 236.3° F
Vapor Pressure at Ambient Temperature: 0.029 atm
Ambient Saturation Concentration: 28,929 ppm or 2.89%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
No Inversion Height
Stability Class: D Air Temperature: 90° F
Relative Humidity: 50% Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Area: 900 square feet Puddle Mass: 504.7 kilograms
Soil Type: Default Ground Temperature: 90° F
Initial Puddle Temperature: Ground temperature
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 3.22 pounds/min
(averaged over a minute or more)
Total Amount Released: 174 pounds

FOOTPRINT INFORMATION: (HEAVY GAS SELECTED)
Model Run: Heavy Gas
Red LOC (0.12 ppm) Max Threat Zone: 1.5 miles

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.63 (sheltered single storied)
Time: February 4, 2009 0700 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: HYDRAZINE Molecular Weight: 32.05 g/mol
ERPG-3: 30 ppm ERPG-2: 5 ppm ERPG-1: 0.5 ppm
IDLH: 50 ppm
Carcinogenic risk - see CAMEO
Normal Boiling Point: 236.3° F Ambient Boiling Point: 236.3° F
Vapor Pressure at Ambient Temperature: 0.015 atm
Ambient Saturation Concentration: 14,958 ppm or 1.50%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
No Inversion Height
Stability Class: D Air Temperature: 70° F
Relative Humidity: 50% Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Diameter: 7.2 feet Puddle Volume: 5 gallons
Soil Type: Default Ground Temperature: 70° F
Initial Puddle Temperature: Ground temperature
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 0.0941 pounds/min
(averaged over a minute or more)
Total Amount Released: 5.23 pounds

FOOTPRINT INFORMATION: (HEAVY GAS SELECTED)
Model Run: Heavy Gas
Red LOC (0.12 ppm) Max Threat Zone: 417 yards

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.62 (sheltered single storied)
Time: February 4, 2009 2100 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: NITROGEN TETROXIDE Molecular Weight: 92.01 g/mol
Normal Boiling Point: 70.1° F Ambient Boiling Point: 70.1° F
Vapor Pressure at Ambient Temperature: 0.99 atm
Ambient Saturation Concentration: 996,775 ppm or 99.7%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
Inversion Height: 1000 feet
Stability Class: E (user override) Air Temperature: 70° F
Relative Humidity: 30% Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Diameter: 7.2 feet Puddle Volume: 5 gallons
Soil Type: Default Ground Temperature: 70° F
Initial Puddle Temperature: Ground temperature
Release Duration: 9 minutes
Max Average Sustained Release Rate: 13.5 pounds/min
(averaged over a minute or more)
Total Amount Released: 60.2 pounds

FOOTPRINT INFORMATION: (HEAVY GAS SELECTED)
Model Run: Heavy Gas
Red LOC (1.0 ppm) Max Threat Zone: 1,181 yards

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.73 (sheltered single storied)
Time: February 4, 2009 2100 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: NITROGEN TETROXIDE Molecular Weight: 92.01 g/mol
Normal Boiling Point: 70.1° F Ambient Boiling Point: 70.1° F
Vapor Pressure at Ambient Temperature: 0.44 atm
Ambient Saturation Concentration: 438,008 ppm or 43.8%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
Inversion Height: 1000 feet
Stability Class: E (user override) Air Temperature: 40° F
Relative Humidity: 30% Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Area: 472 square feet Puddle Mass: 321.7 kilograms
Soil Type: Default Ground Temperature: 40° F
Initial Puddle Temperature: Ground temperature
Release Duration: 16 minutes
Max Average Sustained Release Rate: 69.6 pounds/min
(averaged over a minute or more)
Total Amount Released: 709 pounds

FOOTPRINT INFORMATION: (GAUSS SELECTED)
Dispersion Module: Gaussian
Red LOC (1.0 ppm) Max Threat Zone: 1.8 miles

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.73 (sheltered single storied)
Time: February 4, 2009 0700 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: NITROGEN TETROXIDE
Molecular Weight: 92.01 g/mol
Normal Boiling Point: 70.1° F
Ambient Boiling Point: 70.1° F
Vapor Pressure at Ambient Temperature: 0.44 atm
Ambient Saturation Concentration: 438,008 ppm or 43.8%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
Inversion Height: 1000 feet
Stability Class: E (user override)
Air Temperature: 40° F
Relative Humidity: 30%
Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Area: 472 square feet
Puddle Mass: 321.7 kilograms
Soil Type: Default
Ground Temperature: 40° F
Initial Puddle Temperature: Ground temperature
Release Duration: 16 minutes
Max Average Sustained Release Rate: 69.6 pounds/min
(averaged over a minute or more)
Total Amount Released: 709 pounds

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
Red LOC (1.0 ppm) Max Threat Zone: 1.8 miles

```
SITE DATA INFORMATION:
  Location: WALLOPS FLIGHT FACILITY, VIRGINIA
  Building Air Exchanges Per Hour: 0.71 (sheltered single storied)
  Time: February 4, 2009  2100 hours EST (user specified)

CHEMICAL INFORMATION:
  Chemical Name: NITROGEN TETROXIDE      Molecular Weight: 92.01 g/mol
  Normal Boiling Point: 70.1° F          Ambient Boiling Point: 70.1° F
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
  Wind: 4 meters/sec from 0° true at 3 meters
  No Inversion Height
  Stability Class: D                     Air Temperature: 90° F
  Relative Humidity: 50%                 Ground Roughness: 10.0 centimeters
  Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
  Puddle Area: 472 square feet           Puddle Mass: 321.7 kilograms
  Soil Type: Default                     Ground Temperature: 90° F
  Initial Puddle Temperature: 70.1° F
  Release Duration: 7 minutes
  Max Average Sustained Release Rate: 185 pounds/min
     (averaged over a minute or more)
  Total Amount Released: 709 pounds

FOOTPRINT INFORMATION: (GAUSS SELECTED)
  Dispersion Module: Gaussian
  Red LOC (1.0 ppm) Max Threat Zone: 1.9 miles
```

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.73 (sheltered single storied)
Time: February 4, 2009 0700 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: NITROGEN TETROXIDE Molecular Weight: 92.01 g/mol
Normal Boiling Point: 70.1° F Ambient Boiling Point: 70.1° F
Vapor Pressure at Ambient Temperature: 0.44 atm
Ambient Saturation Concentration: 438,008 ppm or 43.8%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
No Inversion Height
Stability Class: D Air Temperature: 40° F
Relative Humidity: 30% Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Diameter: 7.2 feet Puddle Volume: 5 gallons
Soil Type: Default Ground Temperature: 40° F
Initial Puddle Temperature: Ground temperature
Release Duration: 15 minutes
Max Average Sustained Release Rate: 6.33 pounds/min
(averaged over a minute or more)
Total Amount Released: 61.2 pounds

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
Red LOC (1.0 ppm) Max Threat Zone: 564 yards

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.71 (sheltered single storied)
Time: February 24, 2009 2155 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: MON-3 Molecular Weight: 90.14 g/mol
Default LOC-3: 30 ppm Default LOC-2: 20 ppm Default LOC-1: 10 ppm
IDLH: 50 ppm
Normal Boiling Point: 49.4° F Ambient Boiling Point: 49.3° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
Inversion Height: 1000 feet
Stability Class: E (user override) Air Temperature: 90° F
Relative Humidity: 50% Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Diameter: 7.2 feet Puddle Volume: 5 gallons
Soil Type: Default Ground Temperature: 90° F
Initial Puddle Temperature: 49.3° F
Release Duration: 20 minutes
Max Average Sustained Release Rate: 24.4 pounds/min
(averaged over a minute or more)
Total Amount Released: 160 pounds

FOOTPRINT INFORMATION:
Dispersion Module: Gaussian
Red LOC (1 ppm) Max Threat Zone: 1612 yards

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.71 (sheltered single storied)
Time: February 5, 2009 1207 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: MON-3 Molecular Weight: 90.14 g/mol
Default LOC-3: 30 ppm Default LOC-2: 20 ppm Default LOC-1: 10 ppm
IDLH: 50 ppm
Normal Boiling Point: 49.4° F Ambient Boiling Point: 49.3° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
No Inversion Height
Stability Class: D Air Temperature: 90° F
Relative Humidity: 50% Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Area: 149 square feet Puddle Mass: 268.8 kilograms
Soil Type: Default Ground Temperature: 90° F
Initial Puddle Temperature: 49.3° F
Release Duration: 20 minutes
Max Average Sustained Release Rate: 87.3 pounds/min
(averaged over a minute or more)
Total Amount Released: 593 pounds

FOOTPRINT INFORMATION: (HEAVY GAS SELECTED)
Model Run: Heavy Gas
Red LOC (1 ppm) Max Threat Zone: 1.3 miles

```
SITE DATA INFORMATION:
  Location: WALLOPS FLIGHT FACILITY, VIRGINIA
  Building Air Exchanges Per Hour: 0.73 (sheltered single storied)
  Time: February 5, 2009  2107 hours EST (user specified)

CHEMICAL INFORMATION:
  Chemical Name: MON-3                    Molecular Weight: 90.14 g/mol
  Default LOC-3: 30 ppm   Default LOC-2: 20 ppm   Default LOC-1: 10 ppm
  IDLH: 50 ppm
  Normal Boiling Point: 49.4° F           Ambient Boiling Point: 49.3° F
  Vapor Pressure at Ambient Temperature: 0.74 atm
  Ambient Saturation Concentration: 743,692 ppm or 74.4%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
  Wind: 4 meters/sec from 0° true at 3 meters
  No Inversion Height
  Stability Class: D                      Air Temperature: 40° F
  Relative Humidity: 50%                  Ground Roughness: 10.0 centimeters
  Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
  Puddle Area: 149 square feet            Puddle Mass: 268.8 kilograms
  Soil Type: Default                      Ground Temperature: 40° F
  Initial Puddle Temperature: Ground temperature
  Release Duration: 52 minutes
  Max Average Sustained Release Rate: 41.4 pounds/min
     (averaged over a minute or more)
  Total Amount Released: 593 pounds

FOOTPRINT INFORMATION: (HEAVY GAS SELECTED)
  Model Run: Heavy Gas
  Red LOC (1 ppm) Max Threat Zone: 1,645 yards
```

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.71 (sheltered single storied)
Time: February 24, 2009 1200 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: METHYLHYDRAZINE Molecular Weight: 46.07 g/mol
AEGL-3: 16 ppm AEGL-2: 5.3 ppm
TEEL-3: 20 ppm TEEL-2: 0.5 ppm TEEL-1: 0.2 ppm
IDLH: 20 ppm
Carcinogenic risk - see CAMEO
Normal Boiling Point: 190.0° F Ambient Boiling Point: 189.9° F
Vapor Pressure at Ambient Temperature: 0.087 atm
Ambient Saturation Concentration: 87,286 ppm or 8.73%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
No Inversion Height
Stability Class: D Air Temperature: 90° F
Relative Humidity: 50% Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Area: 833 square feet Puddle Mass: 357.95 kilograms
Soil Type: Default Ground Temperature: 90° F
Initial Puddle Temperature: Ground temperature
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 12.3 pounds/min
(averaged over a minute or more)
Total Amount Released: 658 pounds

FOOTPRINT INFORMATION: (HEAVY GAS SELECTED)
Model Run: Heavy Gas
Red LOC (0.24 ppm) Max Threat Zone: 1.8 miles

```
SITE DATA INFORMATION:
  Location: WALLOPS FLIGHT FACILITY, VIRGINIA
  Building Air Exchanges Per Hour: 0.62 (sheltered single storied)
  Time: February 24, 2009  0700 hours EST (user specified)

CHEMICAL INFORMATION:
  Chemical Name: METHYLHYDRAZINE         Molecular Weight: 46.07 g/mol
  AEGL-3: 16 ppm     AEGL-2: 5.3 ppm
  TEEL-3: 20 ppm     TEEL-2: 0.5 ppm     TEEL-1: 0.2 ppm
  IDLH: 20 ppm
  Carcinogenic risk - see CAMEO
  Normal Boiling Point: 190.0° F         Ambient Boiling Point: 189.9° F
  Vapor Pressure at Ambient Temperature: 0.047 atm
  Ambient Saturation Concentration: 46,839 ppm or 4.68%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
  Wind: 4 meters/sec from 0° true at 3 meters
  Inversion Height: 1000 feet
  Stability Class: E (user override)     Air Temperature: 70° F
  Relative Humidity: 50%                 Ground Roughness: 10.0 centimeters
  Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
  Puddle Area: 803 square feet           Puddle Mass: 357.95 kilograms
  Soil Type: Default                     Ground Temperature: 70° F
  Initial Puddle Temperature: Ground temperature
  Release Duration: ALOHA limited the duration to 1 hour
  Max Average Sustained Release Rate: 6.65 pounds/min
     (averaged over a minute or more)
  Total Amount Released: 351 pounds

FOOTPRINT INFORMATION: (GAUSS SELECTED)
  Dispersion Module: Gaussian
  Red LOC (0.24 ppm) Max Threat Zone: 2.1 miles
```

SITE DATA INFORMATION:
Location: WALLOPS FLIGHT FACILITY, VIRGINIA
Building Air Exchanges Per Hour: 0.73 (sheltered single storied)
Time: February 24, 2009 0700 hours EST (user specified)

CHEMICAL INFORMATION:
Chemical Name: METHYLHYDRAZINE Molecular Weight: 46.07 g/mol
AEGL-3: 16 ppm AEGL-2: 5.3 ppm
TEEL-3: 20 ppm TEEL-2: 0.5 ppm TEEL-1: 0.2 ppm
IDLH: 20 ppm
Carcinogenic risk - see CAMEO
Normal Boiling Point: 190.0° F Ambient Boiling Point: 189.9° F
Vapor Pressure at Ambient Temperature: 0.016 atm
Ambient Saturation Concentration: 16,474 ppm or 1.65%

ATMOSPHERIC INFORMATION: (MANUAL INPUT OF DATA)
Wind: 4 meters/sec from 0° true at 3 meters
No Inversion Height
Stability Class: D Air Temperature: 40° F
Relative Humidity: 50% Ground Roughness: 10.0 centimeters
Cloud Cover: 5 tenths

SOURCE STRENGTH INFORMATION:
Puddle Diameter: 7.2 feet Puddle Volume: 5 gallons
Soil Type: Default Ground Temperature: 40° F
Initial Puddle Temperature: Ground temperature
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 0.146 pounds/min
(averaged over a minute or more)
Total Amount Released: 8.25 pounds

FOOTPRINT INFORMATION: (HEAVY GAS SELECTED)
Model Run: Heavy Gas
Red LOC (0.24 ppm) Max Threat Zone: 293 yards

Appendix G

NASA Report: Evaluation of Taurus II Static Test Firing and Normal Launch Rocket Plume Emissions

Report No. 09-640/5-01

Evaluation of Taurus II Static Test Firing and Normal Launch Rocket Plume Emissions

Subcontract No.
Prime Contract No.
Task No. *5*

Prepared by

Randolph L. Nyman

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Prepared for

National Aeronautics and Space Administration
Wallops Flight Facility, Environmental Office
Code 250
Wallops Island, VA 23337

Under Subcontract to:

Computer Sciences Corporation
7700 Hubble Drive
Lanham-Seabrook, MD 20706

March 18, 2009

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1. INTRODUCTION

The Taurus II launch vehicle is being designed and built by Orbital Sciences Corporation with the objective of launching missions from Wallops Flight Facility (WFF) to service the International Space Station. This report presents the findings of rocket exhaust plume emission and atmospheric dispersion analyses performed for the Taurus II first stage using a large archive of WFF weather balloon soundings. The report also explains the development of input data, describes the basic features of the modeling tools and identifies the assumptions made to support the analyses.

The Taurus II first stage uses liquid propellants commonly found in other modern U.S. built rockets. The first stage fuel is a refined form of kerosene known as RP-1 and the oxidizer is liquid oxygen (LOX). Although these propellants are burned in a fuel rich mixture the exhaust products can be considered environmentally friendly compared to solid propellant exhaust. The use of RP-1/LOX also avoids handling and spill toxic hazards associated with liquid hypergolic propellants. Consequently, the primary chemical exhaust constituent of concern from a toxicity standpoint is carbon monoxide (CO). The hazard associated with exposure to CO can be associated with several industry standard exposure criteria. Since rocket emissions from static test firings or rocket launches are relatively short duration events that only occur a few times a year over the course of the program, short duration or emergency exposure standards are more appropriate than long duration exposure standards designed for work place environments. One such emergency exposure standard is the National Institute for Occupational Safety and Health (NIOSH) definition of the Immediately Dangerous to Life or Health (IDLH) exposure threshold for an airborne chemical. The IDLH is intended to be used in conjunction with workers wearing respirators in contaminated areas, such that if the respirator fails the person could escape the contaminated area without being incapacitated given a maximum exposure of 30 minutes. Perhaps a more appropriate set of exposure guidelines are the Acute Exposure Guideline Levels (AEGLs) that are supported by the EPA. The development of Acute Exposure Guideline Levels (AEGLs) is a collaborative effort of the public and private sectors worldwide. AEGLs are intended to describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals. The National Advisory Committee for the Development of Acute Exposure Guideline Levels for Hazardous Substances (AEGL Committee) is involved in developing these guidelines to help both national and local authorities, as well as private companies, deal with emergencies involving spills, or other catastrophic exposures. The recommended interim AEGLs for carbon monoxide are listed in Table 1-1.

Table 1-1: Interim Acute Exposure Guideline Levels (AEGLs) for Carbon Monoxide.

AEGL Level	10 min Exposure [ppm]	30 min Exposure [ppm]	60 min Exposure [ppm]	4 hr Exposure [ppm]
AEGL 1	NR	NR	NR	NR
AEGL 2	420	150	83	33
AEGL 3	1700	600	330	150

NR = No exposure level recommended due to insufficient or inconclusive data.

Definitions of the AEGL levels are as follows:

AEGL-1 is the airborne concentration, expressed as parts per million or milligrams per cubic meter (ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL-2 is the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL-3 is the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

The time duration that a receptor is exposed to a rocket exhaust plume emission depends upon the cloud transport wind speed and the size of the cloud. The cloud or plume grows in size as it transports downwind. Typical exposure durations are estimated to be in the 10 to 30 minute range but may approach one hour under very light wind conditions.

The report authors do not have toxicological expertise regarding hazardous CO thresholds for flora and fauna that may be of environmental concern. The selection of the most appropriate exposure level to apply to exposed flora and fauna is left to the judgment of others. It is however noted here that the vast majority of emission scenarios evaluated in this study predict far field maximum ground level CO concentrations below 10 parts per million (ppm), which is quite benign relative to all published human hazardous thresholds.

There are two emission scenarios of concern for the Taurus II environmental assessment:

1. Static test firing of the first stage while the stacked vehicle is held stationary on the launch pad. In this scenario the two first stage engines are both ignited and are run through a 52 second thrust profile that ramps the engines up to full performance (112.9%) and back down. Exhaust from the rocket engine nozzles is directed downward into a flame trench and deflected through the flame duct such that the exhaust gases are diverted away from the launch vehicle and nearby facilities. The exhaust plume exits the flame duct at supersonic velocity and the flow is approximately parallel to and slightly above the ground.

2. Normal launch of the Taurus II vehicle. In this scenario a fully configured launch vehicle with payload is ignited on the launch pad at time T-0. The vehicle is held on the pad for approximately 2 seconds as the first stage engines build thrust and then hold-downs are released allowing the vehicle to begin ascent to orbit. During ascent the vehicle velocity steadily increases resulting in a time and altitude varying exhaust product emission rate. Initially the rocket engine exhaust is largely directed into and through the flame duct. As the vehicle lifts off from the pad and clears the launch tower, a portion of the exhaust plume impinges on the pad structure and is directed radially around the launch pad stand. The portion of the rocket plume that interacts with the launch pad and flame trench is referred to as the “ground cloud”. As the vehicle climbs to several hundred feet above the pad, the rocket plume reaches a point where the gases no longer interact with the ground surface and the exhaust plume is referred to as the “contrail cloud”.

The concepts of the ground and contrail clouds are illustrated in Figure 1-1 using a Titan IV launch from Cape Canaveral as an example. For atmospheric dispersion analyses of rocket emissions that could affect receptors on the ground, it has been standard practice at the Federal Ranges (Cape Canaveral and Vandenberg Air Force Base) to simulate the emissions from the ascending launch vehicle from the ground to a vehicle altitude of approximately 3000 meters. The operational toxic dispersion analysis tool used by the Federal Ranges for launch support and public risk assessment is Version 7.13 of the Rocket Exhaust Effluent Diffusion Model (REEDM). This same computer program was used to perform the dispersion analyses for the Taurus II emission scenarios. The features of REEDM pertinent to this study are discussed in the next section.

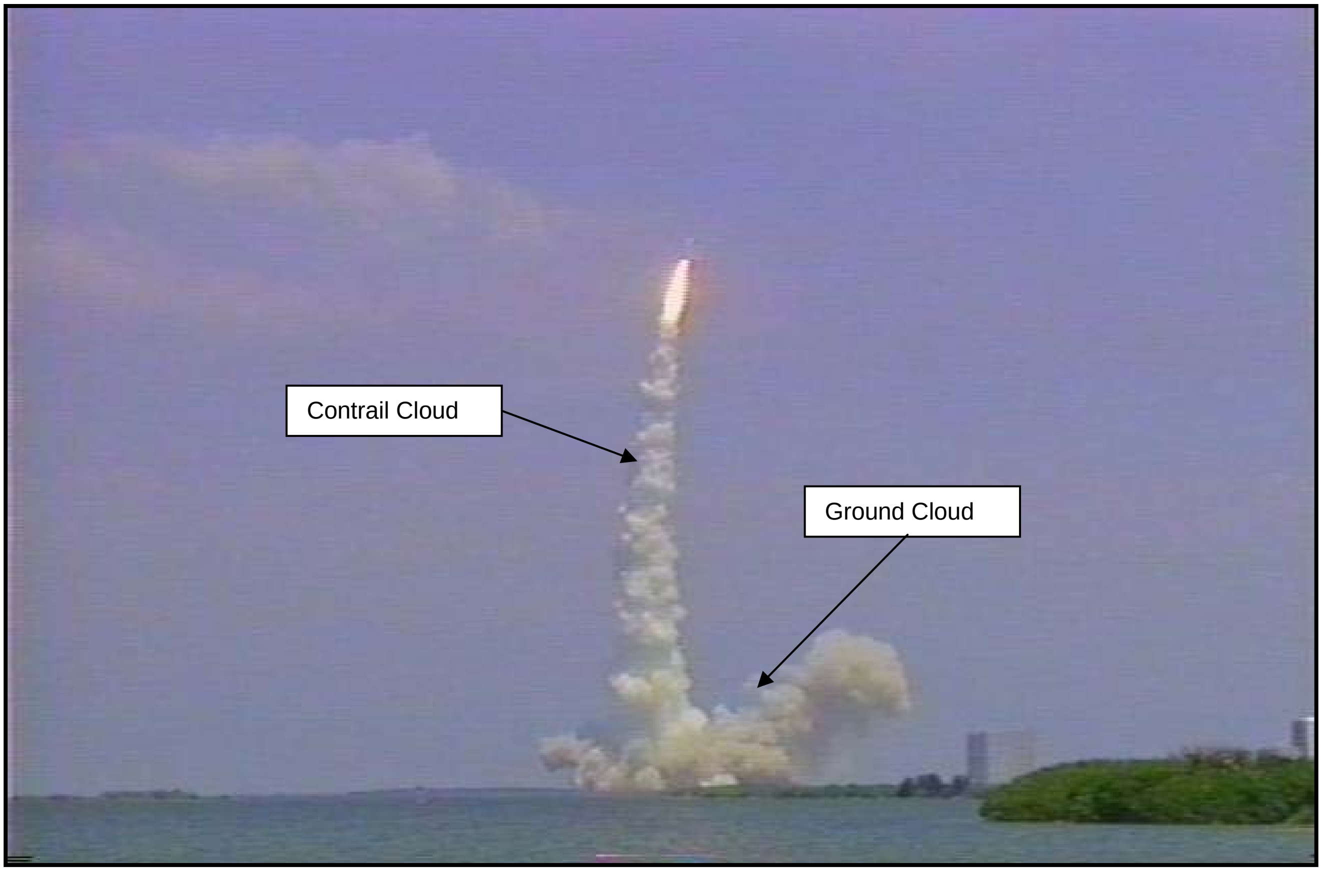

Figure 1-1. Illustration of the Ground Cloud and Contrail Cloud Portions of a Titan IV Rocket Emission Plume Associated With Normal Vehicle Launch.

2. THE ROCKET EXHAUST EFFLUENT DISPERSION MODEL (REEDM)

REEDM is a toxic dispersion model specifically tailored to address the large buoyant source clouds generated by rocket launches, test firings and catastrophic launch vehicle explosions. Under ongoing Air Force support, REEDM evolved from the NASA Multi-Layer Diffusion Model, which was written initially to evaluate environmental effects associated with the Space Shuttle, and has been generalized to handle a wide variety of launch vehicle types and propellant combinations. REEDM falls in the category of "Gaussian puff" atmospheric dispersion models in that the initial mass distribution of toxic materials within the cloud at the time the cloud reaches thermal stabilization height in the atmosphere is assumed to be normally distributed. By making the Gaussian mass distribution assumption, the differential equation defining mass diffusion can be solved in closed form using exponential functions and may be readily implemented in a fast running computer program. Gaussian puff models are still widely used by the EPA for environmental and permitting studies, by Homeland Security and the Defense Threat Reduction Agency for assessment of chemical, biological and radiological materials, and by the petrochemical industry for accidental releases of industrial chemicals.

REEDM processing of an emission event can be partitioned into the following basic steps:

1. Acquire and process vehicle related data from an input vehicle database file.

2. Acquire and process meteorological data, which in this study is a combination of archived weather balloon soundings used in conjunction with an internal REEDM climatological turbulence algorithm.

3. Acquire the chemical composition and thermodynamic properties of the rocket exhaust emissions and define the initial size, shape, location and heat content of the exhaust cloud (herein referred to as the "source term" or "source cloud"). REEDM has an internal propellant equilibrium combustion model that is used to compute these terms for vehicle catastrophic failure modes but for normal launch and static test firing scenarios this data is calculated external to REEDM and placed in the vehicle database file read by REEDM.

4. Iteratively calculate the buoyant cloud rise rate and cloud growth rate to achieve a converged estimate of the cloud stabilization height above ground, size and downwind position. The cloud rise equations evaluate both cloud thermodynamic state as well as the local atmospheric stability, which is defined by the potential temperature lapse rate.

5. Partition the stabilized cloud into disks and mark whether or not part of the stabilized cloud is above a capping atmospheric temperature inversion. Inversions (or other sufficiently stable air masses) act as a barrier to gaseous mixing and are treated in REEDM as reflective boundaries.

6. Transport the cloud disks downwind and grow the disk size using climatologic model estimates of atmospheric turbulence intensity. Turbulence intensity is a function of wind speed and solar radiation intensity. Turbulence varies with time of day and cloud cover conditions because these influence the solar radiation intensity.

7. Calculate concentrations at ground receptor points and determine the plume or cloud track "centerline" that defines the peak concentration as a function of downwind distance. Concentration at any given receptor point is computed as the sum of exposure contributions from each cloud disk. Concentration is solved using the closed form Gaussian dispersion equation and accounts for the effect of ground and capping inversion reflections.

8. Report concentration centerline values in table format as a function of distance from the source origin (e.g. launch pad)

There are other features and submodels of REEDM that are more fully described in the REEDM technical description manual and will not be reviewed in this report.

There are several important assumptions made in REEDM that have a bearing on this Environmental Assessment study. REEDM was designed to primarily predict hazard conditions downwind from the stabilized exhaust cloud. REEDM does not directly calculate or report cloud concentrations during the buoyant cloud rise phase, however, advanced model users can extract sufficient pertinent cloud data from internal calculations to derive concentration estimates during the cloud rise phase manually. One assumption that REEDM makes about the nature and behavior of a rocket exhaust cloud is that it can be initially defined as a single cloud entity that grows and moves but remains as a single cloud during the formation and cloud rise phases. A consequence of this assumption is that once the cloud lifts off the ground during the buoyant cloud rise phase, there will be no predicted cloud chemical concentration on the ground immediately below the cloud. Ground level concentrations will be predicted to remain at zero ppm until the some of the elevated cloud material is eventually brought back down to ground level by mixing due to atmospheric turbulence. This concept is illustrated in Figure 2-1 and it is noted that REEDM is designed to report concentrations downwind from the stabilized cloud position. The region downwind from the stabilized exhaust cloud is referred to as the "far field". It is also noted here that the most concentrated part of these rocket exhaust clouds remains at an altitude well above the ground level. REEDM is not able to model stochastic uncertainty in the source cloud and atmospheric flow such that if a gust of wind, small turbulence eddy or nuance of the launch pad flame duct structure causes a small portion of the main exhaust cloud to detach from the main cloud, the model will not correctly predict the transport, dispersion or concentration contribution from the detached cloud material. Likewise if there are strong atmospheric updrafts or down drafts, such as associated with development of thunderstorm cells or towering cumulus clouds, REEDM will not correctly model strong vertical displacements of the entire exhaust cloud or strong shearing forces that may completely breakup the cloud under such conditions (these are not favorable conditions for launch either and a planned launch would never be conducted with strong thunderstorm and cloud development activity in the launch area).

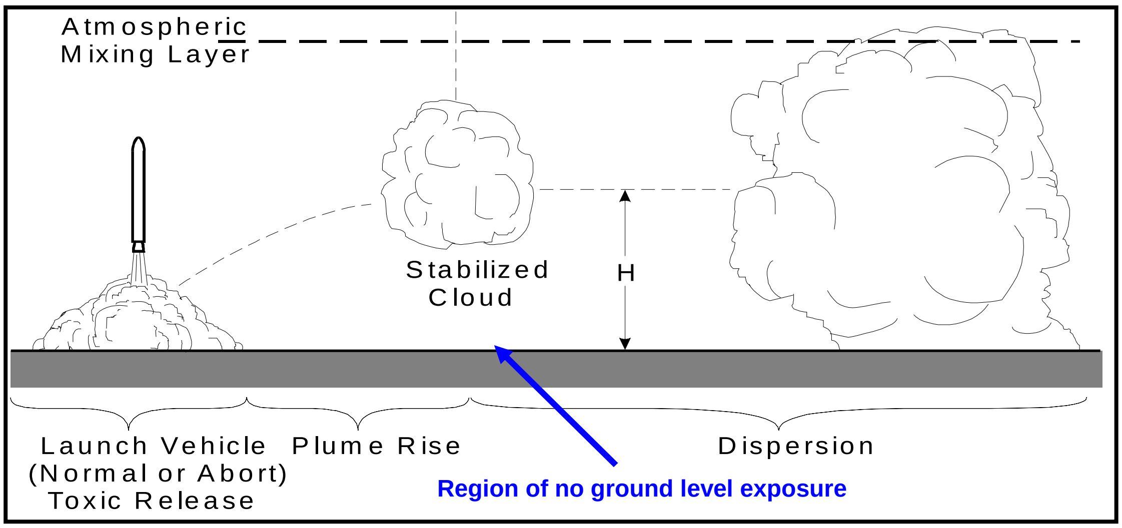

Figure 2-1. Conceptual Illustration of Rocket Exhaust Source Cloud Formation, Cloud Rise and Cloud Atmospheric Dispersion.

REEDM is also somewhat constrained by the Gaussian assumptions inherent in the model that require a single average transport wind speed and direction. The portion of the atmosphere selected for averaging the transport winds has been improved over the years of operational use at the Air Force ranges. Old versions of REEDM averaged the winds over the entire boundary layer, which in the absence of a capping inversion, was treated as being 3000 meters deep. The modern version of REEDM now selects the appropriate atmospheric layer based on the stabilization height of the cloud, the top of the cloud and the location of the reflective boundary layers. Comparison of REEDM predicted rocket exhaust cloud transport direction and speed with Doppler weather radar tracks of rocket exhaust clouds has indicated that the modern version of REEDM performs very satisfactorily in predicting the correct average cloud transport direction and speed. The "multi-layer" aspect of REEDM is still retained from its early development and refers to the partitioning of the stabilized rocket exhaust cloud into "disks" of cloud material assigned to meteorological levels at different altitudes. The altitude bands are typically 20 to 50 meters in depth. REEDM models the initial formation of a rocket exhaust cloud as either an ellipsoid or a sphere and predicts the buoyant could rise of the source as a single cloud entity. Once the cloud is predicted to have achieved a condition of thermal stability in the atmosphere, the cloud is partitioned into disks. The placement of each disk relative to the source origin (e.g. the launch pad) is determined based on the rise time of the cloud through a sequence of meteorological layers that are defined using the measurement levels obtained from a mandatory weather balloon input data file. Each meteorological layer may have a unique wind speed and direction that displaces the cloud disk in the down wind direction. The initial placement of cloud disks that are associated with the lower portion of the overall source cloud are not influenced by winds above their stabilized altitude level whereas disks near the top of the stabilized cloud will be displaced by the winds all the way from the ground level to the disk stabilization altitude. Thus the vertical stack of cloud disks can be displaced relative to each other due to the influence of wind speed and direction shears. The concept of the stabilized cloud partition into disks is illustrated in Figure 2-2.

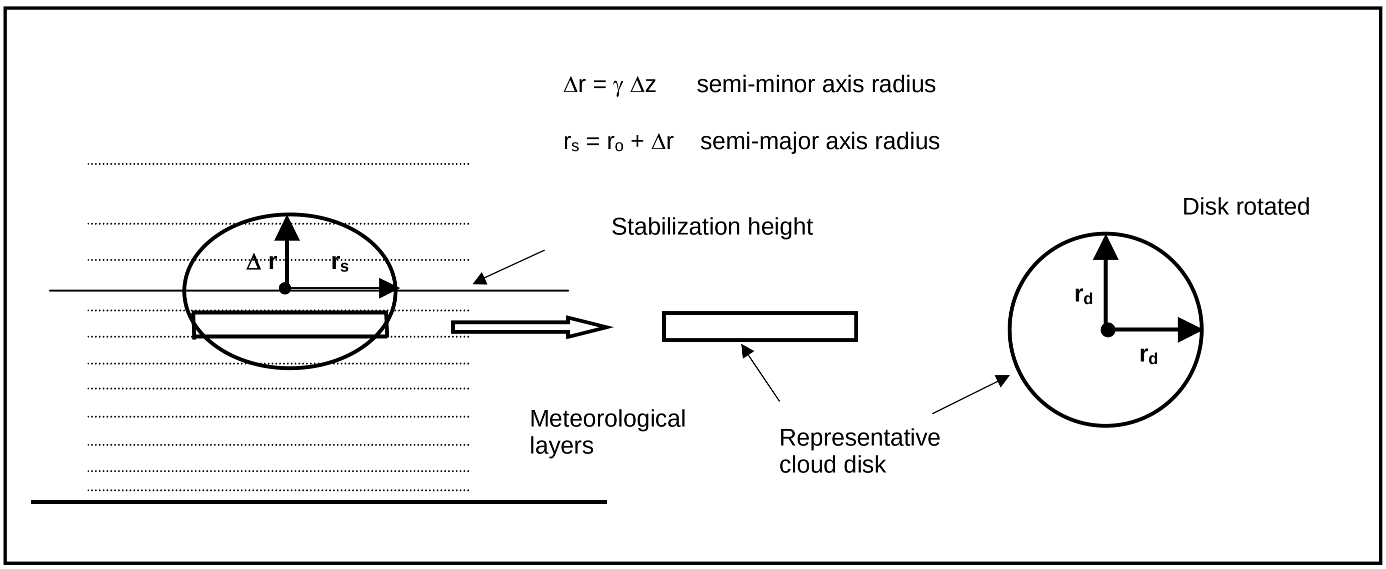

Figure 2-2. Illustration of REEDM Partitioning a Stabilized Cloud into Disks.

Once the cloud disks positions are initialized, future downwind transport applies the same average atmospheric boundary layer transport wind speed and direction to each cloud disk as illustrated in Figure 2-3.

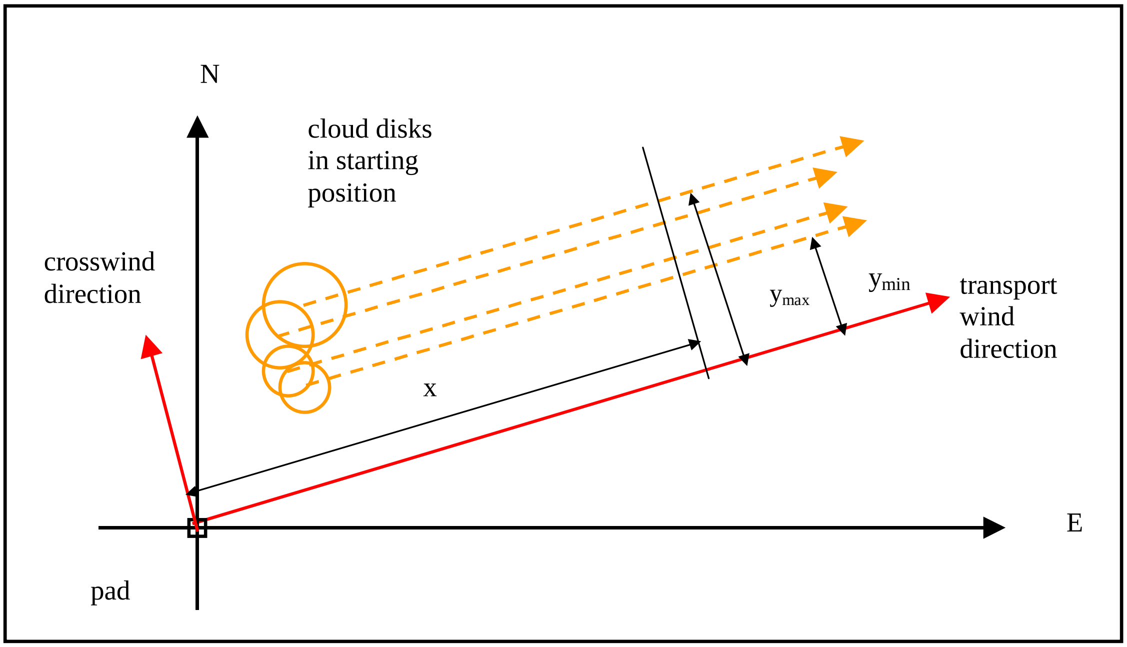

Figure 2-3. Illustration of Straight Line Transport of Stabilized Exhaust Cloud Disks Using Average Mixing Layer Wind Speed and Direction.

The assumption of straight-line transport used in REEDM during the cloud transport and dispersion phase ignores the possibility of complex wind fields that might arise in mountainous terrain or that could evolve during passage of a seabreeze front or synoptic scale weather front. It is recommended that the assumption of uniform winds be limited to plume transport distances of less that 20 kilometers. As will be shown in the analysis results section, REEDM predicted typical ranges of 5 to 10 kilometers from the launch pad to the location of the maximum far field ground level CO concentration point, thus the assumption of straight line transport should not be a problem.

In both Taurus II scenarios the exhaust emissions from the rocket combustion are at several thousand degrees Kelvin and are highly buoyant. The high temperature of these exhaust emissions causes the plume to be less dense than the surrounding atmosphere and buoyancy forces acting on the cloud cause it to lift off the ground and accelerate vertically. As the buoyant cloud rises, it entrains ambient air and grows in size while also cooling. In this initial cloud rise phase, the growth of the cloud volume is due primarily to internal velocity gradients and mixing induced by large temperature gradients within the cloud itself. Even though the cloud is entraining air and cooling by virtue of mixing hot combustion gases with cooler ambient air, the net thermal buoyancy in the cloud is conserved and the cloud will continue to rise until it either reaches a stable layer in the atmosphere or the cloud vertical velocity becomes slow enough to be damped by viscous forces. REEDM applies the following solution of Newton's second law of motion to a buoyant cloud in the atmosphere to iteratively predict cloud stabilization height:

$$z(t) = \left[\frac{3F_m}{u\gamma^2\sqrt{s}} \sin\left(t\sqrt{s}\right) + \frac{3F_c}{u\gamma^2 s}\left(1-\cos\left(t\sqrt{s}\right)\right) + \left(\frac{r_o}{\gamma}\right)^3 \right]^{1/3} - \frac{r_o}{\gamma}$$

where:

s = atmospheric stability parameter = $\dfrac{g}{\theta_a}\ \dfrac{\Delta\theta_a}{\Delta Z}$ [sec^{-2}]

g = gravitational acceleration constant = 9.81 [m/sec^2]

θ_a = potential temperature of ambient air [K]

F_m = $r_o^2 w_o u$ = initial vertical momentum [m^4/sec^2]

u = mean ambient wind speed [m/sec]

w_o = initial vertical velocity [m/sec] (typically = 0.0)

r_o = initial plume cross-sectional radius [m]

F_c = initial buoyancy = $\dfrac{g\,\dot{q}}{\pi\,\rho_c\,C_p\,T_a}$ [m^4/s^3]

C_p = specific heat of exhaust cloud gases [cal/kg K]

γ = air entrainment coefficient (dimensionless)

z = plume height at time t [m]

$\dot{q}$ = initial plume heat flux [cal/sec]

T_a = ambient air temperature [K]

ρ_c = density of exhaust cloud gases [kg/m^3]

A critical parameter in the cloud rise equation is the rate of ambient air entrainment that is defined by the dimensionless air entrainment coefficient, γ. Cloud growth as a function of altitude is assumed to be linearly proportional and the air entrainment coefficient defines the constant of proportionality. REEDM's cloud rise equations have been compared with observations and measurements of Titan rocket ground clouds and a best-fit empirical cloud rise air entrainment coefficient has been derived from the test data, a sample of which is illustrated in Figure 2-4.

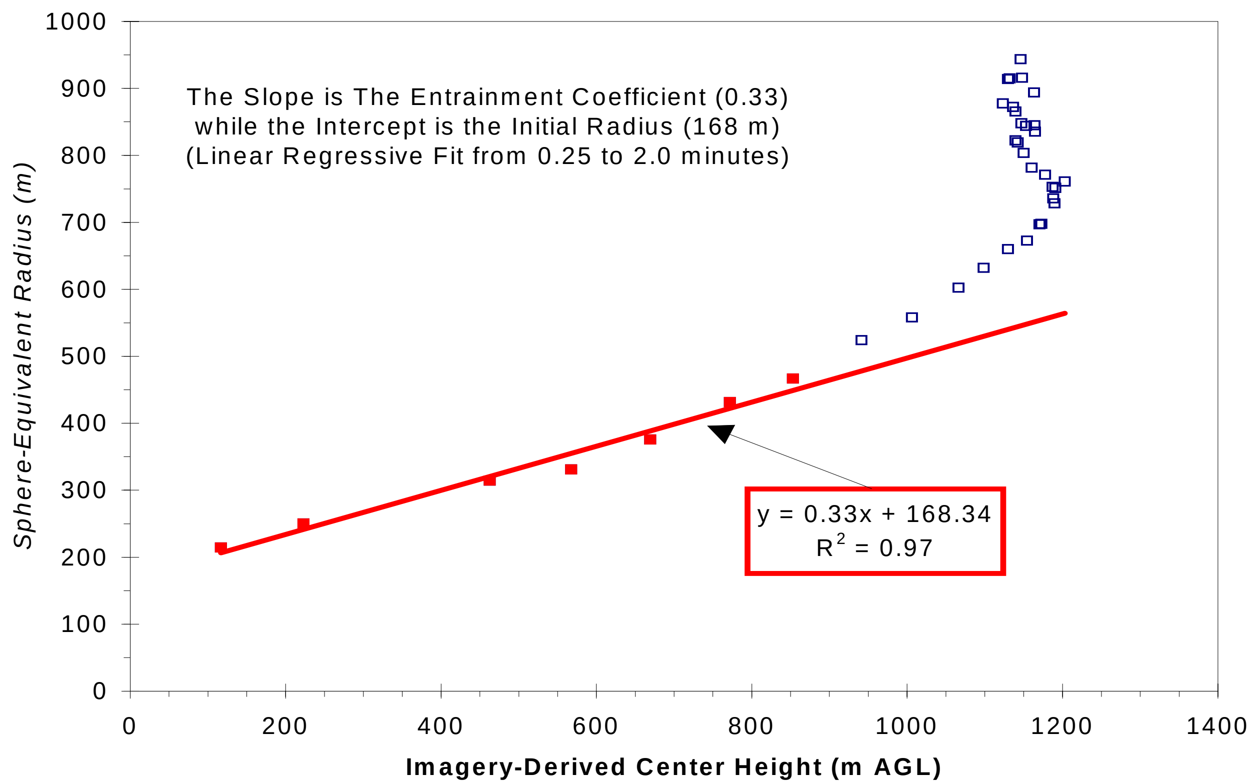

Figure 2-4. Observed Cloud Growth Versus Height for Titan IV A-17 Mission.

The Taurus II buoyant source clouds are predicted to rise from 500 to 1300 meters above the ground depending on atmospheric lapse rate conditions.

3. TAURUS II DATA DEVELOPMENT

Proper specification of vehicle characterization input data is critical to the overall toxic dispersion analysis problem. While many vehicle input parameters are straightforward and readily verifiable (e.g. types and amounts of propellants loaded on the vehicle), other parameters inherently involve greater uncertainty and are not readily verifiable (e.g. amount of ambient air entrained into the rocket plume at the flame duct inlet). In this report section the vehicle input data values used in the REEDM Taurus II normal launch and static test firing scenario analyses are itemized and explained. Input parameters that entail significant uncertainty were treated in a conservative fashion in the sense that choices were made to favor overestimating rather than underestimating the toxic chemical concentrations being evaluated for the Environmental Assessment study. Information pertaining to the vehicle propellant loads, burn rates and expected nominal launch flight trajectory were provided by WFF NASA or Orbital Sciences personnel and converted by ACTA into REEDM database format.

3.1 Normal Launch Vehicle Data

The following data items represent the vehicle data needed to characterize the normal launch scenario and are presented in the REEDM database format.

```
#05.00                       VEHICLE DATA SECTION
   VEHICLE TYPE = 4, NAME =     TAURUS-II,
   TIME HEIGHT COEFFICIENTS A,B,C =     0.967700,     0.471980,       2.2000,
#05.01 NORMAL LAUNCH ENGINE DATA FOR STAGES IGNITED AT LIFT-OFF:
   NUMBER OF IGNITED SRB'S           =   0,
   SOLID FUEL MASS             (LBM) =   0.0000000,
   SOLID FUEL BURN RATE      (LBM/S) =   0.0000000,
   LIQUID FUEL MASS            (LBM) =  142735.000,
   LIQUID FUEL BURN RATE     (LBM/S) =   645.90000,
   LIQUID OXIDIZER MASS        (LBM) =  390779.000,
   LIQUID OXIDIZER BURN RATE (LBM/S) =   1768.2000,
   AIR ENTRAINMENT RATE IN GROUND CLOUD       (LBM/S) =   0.0000000,
   TOTAL DELUGE WATER ENTRAINED IN GROUND CLOUD (LBM) =   0.0000000,
   AIR ENTRAINMENT RATE IN ROCKET CONTRAIL    (LBM/S) =   0.0000000,
   VEHICLE HEIGHT TO WHICH PLUME CONTRIBUTES TO GROUND CLOUD (FT) = 525,
   GROUND CLOUD INITIAL AVERAGE TEMPERATURE         (F) =  3487,
   GROUND CLOUD INITIAL HEAT CONTENT          (BTU/LBM) =  3475,
   INITIAL VERTICAL VELOCITY OF GROUND CLOUD     (FT/S) =   0.0,
   INITIAL RADIUS OF GROUND CLOUD                  (FT) = 160.0,
   INITIAL HEIGHT OF GROUND CLOUD                  (FT) =   0.0,
   INITIAL X DISPLACEMENT OF GROUND CLOUD FROM PAD (FT) =   0.0,
   INITIAL Y DISPLACEMENT OF GROUND CLOUD FROM PAD (FT) =   0.0,
   PLUME CONTRAIL INITIAL AVERAGE TEMPERATURE       (F) =  3487,
   PLUME CONTRAIL INITIAL HEAT CONTENT        (BTU/LBM) =  3475,
#05.02 NORMAL LAUNCH EXHAUST PRODUCT DATA:
 CHEMICAL NAME     MOL. WT.   MASS FRAC. GAS   MASS FRAC. COND  HAZARDOUS
 GROUND CLOUD:
   CO2              44.011        0.44824         0.00000          Y
   CO               28.011        0.25637         0.00000          Y
   H2O              18.015        0.28893         0.00000          N
```

```
  H2          2.016     0.00557      0.00000      N
  OH         17.007     0.00077      0.00000      N
  H           1.008     0.00006      0.00000      N
  O2         31.999     0.00005      0.00000      N
  O          15.999     0.00001      0.00000      N
  END
CONTRAIL:
  CO2        44.011     0.44824      0.00000      Y
  CO         28.011     0.25637      0.00000      Y
  H2O        18.015     0.28893      0.00000      N
  H2          2.016     0.00557      0.00000      N
  OH         17.007     0.00077      0.00000      N
  H           1.008     0.00006      0.00000      N
  O2         31.999     0.00005      0.00000      N
  O          15.999     0.00001      0.00000      N
  END
```

REEDM does not utilize the launch vehicle trajectory directly; instead a power law fit to the height of the vehicle above ground as a function of time is derived from the trajectory data. The fit achieved with the derived power law time-height coefficients is demonstrated in Figure 3-1

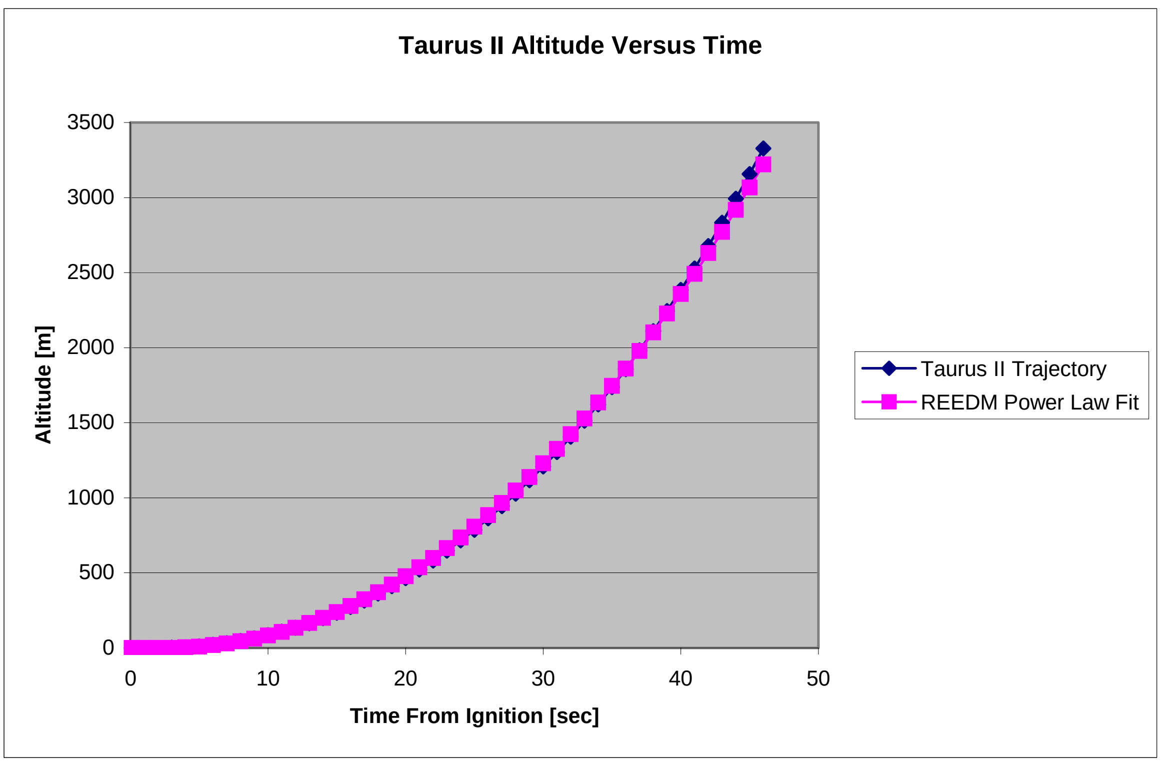

Figure 3-1. Plot of Vendor Taurus II Nominal Trajectory Compared with ACTA Derived Power Law Fit Used in REEDM.

REEDM allows for several chemical additions that may be included in the propellant exhaust of the normal launch ground cloud and the normal launch contrail cloud. In addition to specifying the nominal burn rates of the RP-1 fuel and the LOX oxidizer, the user may optionally consider adding deluge or sound suppression water and entrained ambient air. For these two items the REEDM database serves only as a source of documentation for the assumptions applied in deriving the chemical compositions of the exhaust specified in section #05.02 of the database. It is noted here that "air entrainment" as specified in this section represents the user assumption about the amount of air, if any, added as a ***reactant*** in the propellant combustion calculations. This "air entrainment" definition is not to be confused with the "air entrainment" process that takes place during the cloud rise calculations. REEDM assumes that all chemical combustion reactions are completed before the cloud rise process takes place and REEDM therefore does not attempt to recompute chemical composition and additional heat release during the cloud rise computations.

The REEDM database provides the chemical composition of the normal ground and contrail clouds. A mass fraction is assigned to each constituent and the total exhaust mass in the source cloud is multiplied by this fraction to determine the total mass of each chemical in the exhaust cloud. The molecular weight of each species is used to convert the concentration from mass per unit volume [e.g.mg/m^3] to parts per million. For this study ACTA computed the chemical composition of the Taurus II stage 1 RP-1/LOX exhaust using the NASA Lewis chemical equilibrium combustion model. The ACTA version of the NASA combustion model was modified slightly to output thermodynamic properties of the exhaust mixture that were needed to initialize the REEDM cloud rise equations. ACTA's combustion results for the Taurus II first stage agreed within 2% for the major constituents (CO, CO_2, H_2O) compared with similar data provided by Orbital Sciences 0 as shown in Table 3-1. ACTA ran the NASA combustion model in "rocket" analysis mode using an oxidizer to fuel ratio of 2.7 and a combustion chamber pressure of 2194 PSIA. The Orbital analysis appears to have been conducted with a newer version of the NASA equilibrium combustion model and was executed with a slightly different nozzle to throat area ratio than the ACTA model. The supporting thermodynamic databases between the two versions of the combustion models may also differ slightly. ACTA considers the small chemical composition differences to have insignificant effect on the analysis results and conclusions of this study.

Table 3-1. Comparison of ACTA and Orbital Taurus II Stage-1 Combustion Model Nozzle Exit Results.

Chemical	ACTA Mole Fraction	Orbital Mole Fraction	Ratio ACTA/Orbital
CO_2	0.26632	0.27071	0.984
CO	0.23932	0.23532	1.017
H_2O	0.41938	0.41627	1.007
H_2	0.07231	0.07650	0.945
OH	0.00118	0.00048	2.458
H	0.00144	0.00072	2.000
O_2	0.00004	0.00001	4.000
O	0.00002	0.00000	--

Both ACTA and Orbital ran combustion for only RP-1 and LOX and the chemical compositions listed in Table 3-1 do not consider the shift in chemical equilibrium that takes place if ambient air or water are added to the nozzle exit exhaust mixture.

3.2 Static Test Firing Vehicle Data

The REEDM database also includes a data section used to define the parameters that characterize a static test firing scenario. The data developed for the Taurus II stage-1 static test firing is listed as follows:

```
#05.20 TEST FIRING ENGINE DATA:
   SOLID FUEL MASS                           (LBM) = 123552.,
   SOLID FUEL BURN RATE                    (LBM/S) =   2376.,
   AIR ENTRAINMENT RATE IN CLOUD           (LBM/S) =       0,
   TOTAL DELUGE WATER ENTRAINED IN CLOUD     (LBM) =       0,
   CLOUD INITIAL AVERAGE TEMPERATURE           (F) =    3487,
   CLOUD INITIAL HEAT CONTENT            (BTU/LBM) =    3475,
   INITIAL VERTICAL VELOCITY OF CLOUD       (FT/S) =     0.0,
   INITIAL RADIUS OF CLOUD                    (FT) =   151.1,
   INITIAL HEIGHT OF CLOUD                    (FT) =     0.0,
   INITIAL X DISPLACEMENT OF CLOUD FROM STAND (FT) =     0.0,
   INITIAL Y DISPLACEMENT OF CLOUD FROM STAND (FT) =     0.0,
#05.21 TEST FIRING PLUME CHEMISTRY  DATA:
 CHEMICAL NAME     MOL. WT.   MASS FRAC. GAS   MASS FRAC. COND  HAZARDOUS
   CO2               44.011        0.44824          0.00000          Y
   CO                28.011        0.25637          0.00000          Y
   H2O               18.015        0.28893          0.00000          N
   H2                 2.016        0.00557          0.00000          N
   OH                17.007        0.00077          0.00000          N
   H                  1.008        0.00006          0.00000          N
   O2                31.999        0.00005          0.00000          N
   O                 15.999        0.00001          0.00000          N
   END
```

The REEDM static test firing scenario was originally developed for burns of solid propellant motors and the nomenclature used in the database is outdated and somewhat misleading. In the case of the Taurus II first stage test firing the line items identified as “solid fuel mass” and “solid fuel burn rate” are set to represent the total quantity of RP-1 + LOX and the average burn rate of the RP-1 + LOX mixture consumed during a 52 second static burn. The chemical composition of the static test firing exhaust is set the same as the normal launch ground cloud. As with the normal launch scenario, the effects of plume afterburning and deluge water injection are ignored.

3.3 Conservative Assumptions Applied In Data Development

The REEDM atmospheric dispersion model has been used operationally by the Air Force to make range safety launch decisions since 1989. During that time vehicle databases have been developed for many vehicles (e.g. Space Shuttle, Titan II, Titan III, Titan IV, Delta II, Delta III, Delta IV, Atlas II, Atlas III, Atlas V, Taurus, TaurusXL, Taurus Lite, Minotaur, Peacekeeper, Minuteman II, Minuteman III, Athena, Lance, Scud, ATK-ALV-1). As noted at the beginning of this section, some vehicle data is easily obtained and verified, such as the stage propellant types, quantities and burn rates. Other model input parameters required by REEDM are based on derived values obtained from mathematical and physical models, empirical measurement data or engineering judgment from the vehicle designer or range safety experts.

An example of a derived value is the selection of how much pad deluge water to include with the rocket engine exhaust when defining the normal launch cloud heat content, mass and chemical composition. A typical pad deluge system is comprised of a series of pressure fed sprayers and sprinkers that wet the launch pad, the launch service tower and the flame duct. The deluge system is typically turned on several seconds before the rocket motors are ignited and continues until the rocket has ascended above the launch tower and the plume no longer impinges on the ground. As the vehicle ascends, the rocket plume interaction with the pad structures is time varying, such that the gas flow velocity ranges from supersonic to subsonic and involves multiple shock fronts, reflected shocks, deflected flow from the pad surface, partial flow ducting through the flame trench and plume temperatures that range from 300 to 3000 K. A simple energy balance between the amount of heat available in the plume and the amount of water released in the deluge system may suggest that there is ample energy to vaporize all of the deluge water, but actual observation of launches indicates that residual deluge water is often collected in a concrete containment basin designed to collect residual deluge water. Likewise the initial ignition impulse often blows standing water out of the flame trench or away from the pad and depositing it as droplets before they can be fully mixed with the combustion gases and vaporized. Some parts of the launch plume during vehicle liftoff may become saturated with water vapor and other portions may remain relatively "dry". Thus the task of selecting a specific deluge water inclusion amount for the REEDM database and setting the associated chemical and thermodynamic data for the exhaust products is challenging and typically not estimated by the launch agency or vehicle developer. This type of flow problem is extremely complex and would require advanced computational fluid dynamics analysis that is extremely costly and also constrained by modeling assumptions. Consequently, these types of detailed analyses are rarely performed or conducted only for limited specific design purposes.

Other examples of highly uncertain processes are the mixing of propellants from ruptured tanks in a vehicle explosion, and the fragmentation of a solid rocket motor propellant grain in the event of a case rupture. These latter events are related to vehicle failures that are not considered in this study, however, they illustrate the problem routinely faced by the launch community when attempting to set up REEDM database entries to model these scenarios. Historically the range safety community has taken a conservative approach in setting these uncertain database entries. The vast majority of vehicles characterized in the REEDM database ignore deluge water contributions (a notable exception being Shuttle). One reason for ignoring the deluge water effect is that it is known that water vapor and water droplets scrub hydrogen chloride (a common solid propellant toxic exhaust product) from the launch plume but the degree of the effect is difficult to quantify and verify, therefore ignoring this removal mechanism favors maximizing the downwind ground level concentrations of HCl at receptor sites of concern that must be protected.

The same philosophy of erring in favor of overestimating rather than underestimating potential emission hazards has been applied in this study of the Taurus II carbon monoxide emissions. There are two main factors to which conservative assumptions have been applied in this study; 1) ambient air entrainment and its effect on plume afterburning chemistry, and 2), deluge water injection into the plume. Both of these factors are discussed in further detail in the following paragraphs with an explanation for why it is believed that the REEDM modeling assumptions applied in this study are in fact conservative.

It is recognized that the Taurus II, like most rocket engines, is designed to run somewhat fuel rich for efficiency reasons and that the exhaust products will contain compounds (mainly CO and OH) that are not fully oxidized. Entrainment of ambient air into the superheated gases exiting from the rocket nozzle will allow for further oxidation in the plume, a process referred to as plume afterburning. The rate of air entrainment into the plume and the amount of additional oxidation that occurs in the plume downstream from the nozzle exit plane requires sophisticated computation fluid dynamic (CFD) solutions of the plume flow as it decelerates through multiple shock front to subsonic velocity that are beyond the design capabilities and run time requirements of REEDM. In this study ACTA has ignored the effect of air entrainment on the combustion products and heat content of the normal launch ground cloud and contrail cloud emissions. Ignoring air entrainment and after burning is assumed to be conservative for this study in that the ground level CO concentration predictions will err on the side of overestimating rather than underestimating the concentration for the following two reasons:

1. Ignoring ambient air entrainment in the combustion calculations will favor production of CO rather than CO_2 and CO is the more toxic species.

2. Ignoring ambient air afterburning reduces the total amount of heat released by the combustion process, which in turn leads to a lower stabilized cloud height prediction. Ground level concentrations of cloud chemicals vary approximately with the inverse cube of the stabilization height (e.g. doubling the cloud stabilization height reduces the ground concentrations by about a factor of 8, other factors being constant). Lower stabilization height therefore favors higher ground level CO predictions.

A deluge water system is planned for the Taurus II launch pad and serves to cool pad structures exposed to rocket engine exhaust as well as to suppress acoustic vibrations during motor ignition. An objective of the deluge water system design is to inject water into the plume just downstream of the nozzle exit plane at a rate of 2 lbm of water for every lbm of rocket propellant exhaust. Water is expected to chemically react with the high temperature rocket engine exhaust gases, which are fuel rich. In this situation water acts as an oxidizer and gives up oxygen to convert CO to CO_2 in the plume while simultaneously releasing hydrogen gas. The reaction between high temperature CO and H_2O is referred to as the “water-gas shift” reaction. ACTA evaluated the effect of 2:1 water to rocket exhaust mixing on the plume chemistry immediately downstream of the nozzle exit plane by running the NASA Lewis chemical equilibrium combustion model 0, 0 using the RP-1/LOX nozzle exit products as high temperature reactants at 2193 K mixed with liquid water at 298 K. The input reactant information entered into the combustion model is listed below:

NASA Lewis Combustion Model Input Reactants for RP-1/LOX Exhaust Products and Deluge Water Mixture.

```
THERMO
TRAN
REACTANTS
C 1.     O 2.0                      63.111  -69368.  G 2193.  F
C 1.     O 1.0                      36.096  -11178.  G 2193.  F
H 2.                                 0.784   14240.  G 2193.  F
H 1.                                 0.008   61472.  G 2193.  F
H 2.     O 1.0                      87.345  -68267.  L  298.  O
H 2.     O 1.0                      12.619  -37989.  G 2193.  O
O 2.                                 0.002   15877.  G 2193.  O
O 1.     H 1.0                       9.631   23759.  G 2193.  O
```

```
NAMELISTS
 &inpt2 kase=1,hp=t,p=1.000,of=t,mix=3.2239,siunit=t &end
```

The predicted combustion products and thermodynamic state properties for the exhaust plume + water mixture are listed below. Post combustion products are highlighted. Note that the plume is cooled from 2193 K to 856 K, but remains unsaturated. The predicted amount of CO in the exhaust has dropped from 25.6% to 0.3%, a reduction factor of approximately 100. CO_2 concentration is predicted to decrease from 44.8% to 27.9%. The total amount of CO_2 produced has actually increased but the percentage relative to the total exhaust mixture mass has decreased.

NASA Lewis Combustion Model Output Products for RP-1/LOX Exhaust and Deluge Water Mixture.

```
0                  O/F=   3.2239     PERCENT FUEL=   23.6748     EQUIVALENCE RATIO= 1.0383     PHI=
2.0181
0THERMODYNAMIC PROPERTIES

 P, MPA            0.10132
 T, DEG K           856.32
 RHO, KG/CU M    2.9654-1
 H, KJ/KG         -11095.9
 U, KJ/KG         -11437.6
 G, KJ/KG         -20674.8
 S, KJ/(KG)(K)     11.1861

 M, MOL WT          20.837
 (DLV/DLP)T       -1.00000
 (DLV/DLT)P         1.0000
 CP, KJ/(KG)(K)     1.9758
 GAMMA (S)          1.2531
 SON VEL,M/SEC       654.3
   trace =    0.000000000000000E+000
   npt   =             1
 total product molecular wt. (including condensed sp) = 20.837

0MOLE FRACTIONS

   oxidizer mass fraction =    0.7632520
   fuel mass fraction     =    0.2367480
  C O           -69368.0    44.010  F    0.6311
  C O           -11178.0    28.010  F    0.3610
  H              14240.0     2.016  F    0.0078
  H              61472.0     1.008  F    0.0001
  H O           -68267.0    18.015  O    0.7970
  H O           -37989.0    18.015  O    0.1151
  O              15877.0    31.999  O    0.0000
  O H            23759.0    17.007  O    0.0879

   oxfl =    3.22390007972717
   temperature =    856.317902340247
   Total reactant enthalpy [cal/g] =   -2651.987

   INJECTOR CONDITIONS
```

chemical	mole frac	mole wt	wt kg	wt frac	hval cal/gmole	hf298 cal/gmole	heat cal	heat@stag cal	hstag cal/gmole
H2O	0.82599	18.015	14.88037	0.71412	-52929.2	-57754.7	3985.8	3985.8	-52929.2
CO2	0.13216	44.010	5.81651	0.27914	-87837.4	-93983.8	812.3	812.3	-87837.4
H2	0.03969	2.016	0.08002	0.00384	3910.7	0.6	155.2	155.2	3910.7
CO	0.00215	28.010	0.06027	0.00289	-22342.6	-26398.0	8.7	8.7	-22342.6

```
  total kg products (per kgmole) =     20.83716
```

```
total heat of form. of prod. [cal/gmole] =   -60182.82
enthalpy of prod. at plume T [cal/gmole]=   -55220.72
heat content of prod. @ plume T & V [cal/gmole] =    4962.093
heat content of prod. @ plume T & V [cal/g] =    238.1358
total weight fractions of products =   0.9999962
total mole fractions of products =   0.9999994
gas velocity [m/sec] =   0.0000000E+00
stagnation enthalpy of prod. [cal/gmole]=   -55220.72
heat content of prod. @ stag T & V = 0 [cal/gmole] =    4962.093
heat content of prod. @ stag T & V = 0  [cal/g] =    238.1358
total heat of form. of reac. [cal/g] =   -2651.987
heat of combustion [cal/g] =    236.2465
```

The addition of deluge water has another effect in that it may reduce the net heat content of the cloud in proportion to the amount of liquid deluge water that is converted to gaseous phase and does not chemically react with other plume constituents. The amount of liquid water that is vaporized and then does not re-condense during the cloud rise phase reduces the cloud buoyancy. The effects of deluge water on the plume chemistry and plume rise where ignored in this study, in part because the normal launch plume has a time varying interaction with the deluge system and transitions from a high water injection condition to an essentially dry plume. Ignoring deluge or sound suppression water injection into the plume is expected to be conservative in that it should lead to model predictions that overestimate the downwind ground level CO concentrations. The reduction of in-cloud CO is expected to far outweigh the reduction in cloud stabilization height due to loss of thermal buoyancy.

4. ANALYSIS OF EMISSION SCENARIOS

The REEDM Taurus II database was used in conjunction with a large set of archived WFF weather balloon soundings to predict downwind concentrations of carbon monoxide and to achieve some statistical perspective of the potential toxic hazard corridors associated with normal launch and static test firing scenarios.

4.1 Meteorological Data Preparation

Gaseous dispersion of rocket exhaust clouds is extremely dependent upon the meteorological conditions at the time the source cloud is generated. The presence or absence of temperature inversions, the temperature lapse rate, wind speed and direction, wind shears and atmospheric turbulence are important factors that influence the cloud rise and rate of dispersion of the source cloud. Meteorological conditions that are adverse from a toxic chemical dispersion perspective are light winds with little wind speed or wind direction variation over the first several thousand feet of the atmosphere coupled with a capping temperature inversion just above the top of the stabilized source cloud. An additional adverse factor is suppression of atmospheric turbulence, as occurs at night or under cloudy or marine stratus and fog conditions.

ACTA acquired and ran REEDM analyses for 6432 meteorological cases based on actual weather balloon measurements made at Wallops Flight Facility between 2000 and 2008. The raw weather balloon data was not in a format usable by REEDM and needed to be preprocessed to reduce the number of measurement levels from several thousand to approximately one hundred, to quality control check the raw data, and to output the data in REEDM compatible format. A computer program written by ACTA and delivered to WFF for operational use in 2007 was used to perform the raw data file conversions. A critical part of the conversion process is to test for, and capture, inflection points where temperature, wind speed, wind direction or relative humidity reach minimum or maximum values and change slope as a function of altitude. An example of the weather profile testing algorithm capabilities is illustrated in Figure 4-1, which is contrived test data with positive, negative and infinite slopes and multiple inflection points. The resulting converted files were sorted into daytime and nighttime sets for each month of the year. Data was classified as “daytime” if the balloon release time was between 0600 and 1900 Eastern Standard Time.

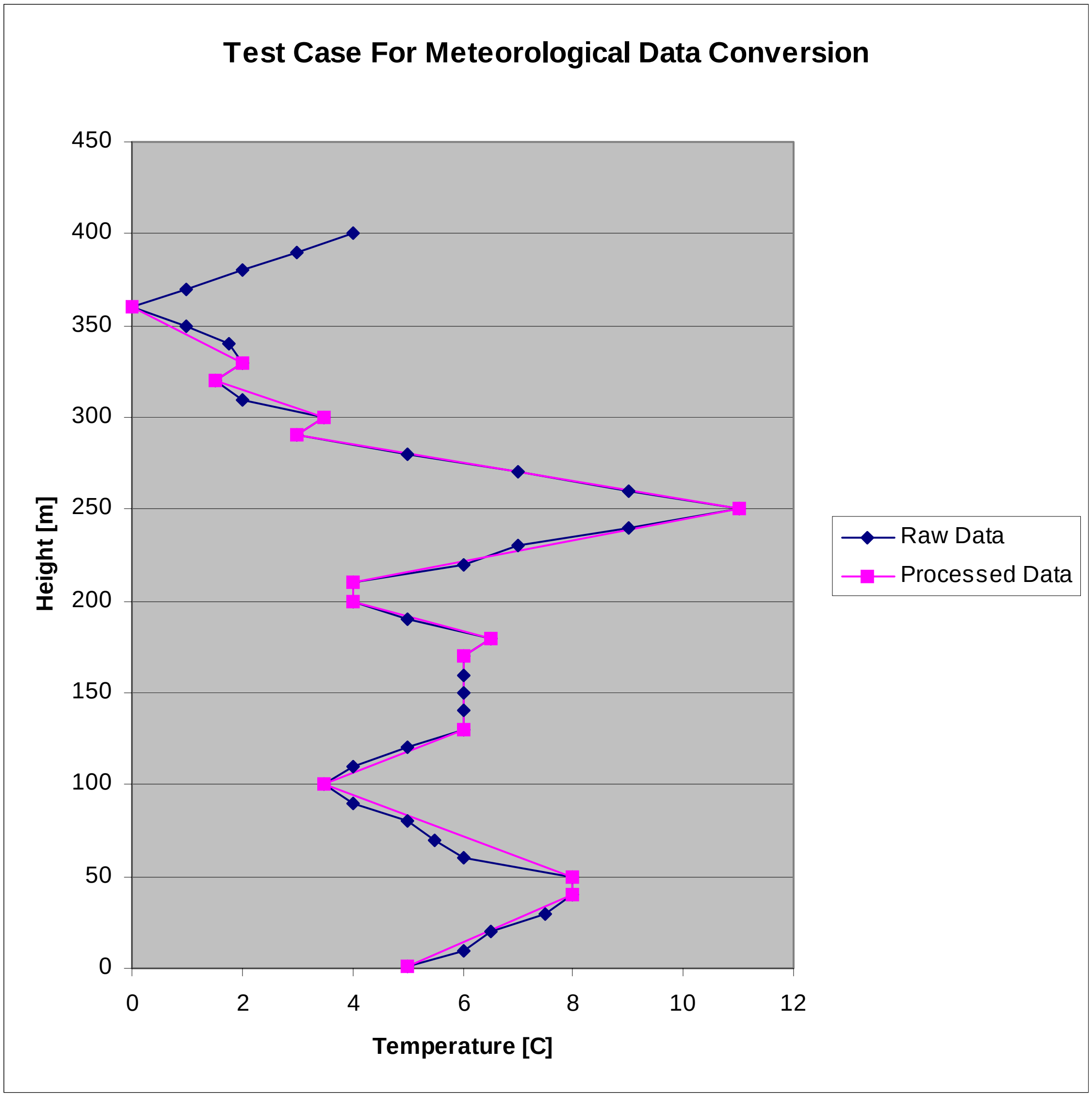

Figure 4-1. Illustration of Testing a Raw Data Profile to Capture Slope Inflection Points that Define Minimum and Maximum Values and Measure Inversions and Shear Effects.

4.2 REEDM Far Field Results For Taurus II Normal Launch Scenario

ACTA executed REEDM in batch processing mode to cycle through all archived meteorological cases and to extract key information to a summary table. Typically REEDM generates an output file for a single weather case that consists of 10 to 20 pages of information on the run setup, intermediate calculated value and tables of concentration versus downwind distance. When processing thousands of cases, saving the standard REEDM output file for each run results in an overwhelming amount of output data. ACTA developed a special batch version of REEDM for the Air Force that has been used over the years to execute thousands of scenarios and condense the REEDM output for all runs into a summary table containing the following critical analysis parameters:

1. Chemical being tracked in REEDM analysis.
2. Concentration threshold used to calculate concentration isopleth beginning and end distances.
3. Meteorological input file name.
4. Zulu time of balloon release.
5. REEDM computed mixing boundary depth.
6. REEDM predicted cloud stabilization height.
7. REEDM predicted average wind speed used to transport exhaust cloud.
8. REEDM predicted average wind direction used to transport exhaust cloud.
9. REEDM predicted maximum ground level concentration.
10. REEDM predicted distance from exhaust cloud source to location of maximum concentration.
11. REEDM predicted bearing from exhaust cloud source to location of maximum concentration.
12. REEDM predicted nearest distance from exhaust cloud source to the location where the ground concentration centerline first exceeds the user defined concentration threshold.
13. REEDM predicted farthest distance from exhaust cloud source to the location where the ground concentration centerline last exceeds the user defined concentration threshold.
14. REEDM predicted bearing from exhaust cloud source to location where the ground concentration centerline last exceeds the user defined concentration threshold.
15. REEDM derived average wind speed shear in the lower planetary boundary layer.
16. REEDM derived average wind direction shear in the lower planetary boundary layer.

17. REEDM derived average horizontal (azimuthal) turbulence intensity in the lower planetary boundary layer.

18. REEDM derived average vertical (elevation) turbulence intensity in the lower planetary boundary layer.

19. REEDM derived average wind speed shear in the region above the planetary boundary layer.

20. REEDM derived average wind direction shear in the region above the planetary boundary layer.

21. REEDM derived average horizontal (azimuthal) turbulence intensity in the region above the planetary boundary layer.

22. REEDM derived average vertical (elevation) turbulence intensity in the region above the planetary boundary layer.

The above list of parameters is provided for REEDM predictions of both peak instantaneous concentration and time weighted average (TWA) concentration. In the runs performed for this study a 1-hour averaging time was used to compute time weighted average concentrations. A fairly short averaging time is appropriate for rocket exhaust cloud exposures because the source cloud typically passes over a receptor with a time scale of tens of minutes rather than hours. The REEDM summary tables from the monthly batch runs were further condensed to identify the meteorological case that produced the highest peak concentration and record the range and bearing from the source location (WFF Taurus II launch Pad-0A). Table 4-1 presents the maximum far field CO peak instantaneous concentration predicted by REEDM for the hypothetical daytime launches of a Taurus II with subsequent dispersion of the normal launch ground and contrail clouds. The far field exposure is REEDM's prediction for concentrations at ground level downwind of the stabilized exhaust cloud. Far field peak CO concentrations ranged from 3 to 8 ppm with the maximum concentration predicted to occur from 5000 to 16000 meters downwind from the launch site. These values represent the maximum concentrations predicted over a sample set of 4704 WFF balloon soundings. Table 4-2 lists the maximum predicted far field 1-hour TWA concentrations of CO for daytime normal launch scenarios. The maximum TWA concentrations are all predicted to be less than 1 ppm. Table 4-3 and Table 4-4 show the REEDM predicted maximum peak and maximum TWA CO far field concentrations for 1728 nighttime cases for Taurus II normal launch scenarios. As with the daytime cases, the peak instantaneous CO concentrations are less than 10 ppm and the peak TWA CO concentrations are less than 1 ppm.

Table 4-1: Taurus II Normal Launch CO Concentration Summary – Daytime Meteorology.

Month	Number of Weather Cases	Peak CO Concentration [ppm]	Distance to Peak CO Concentration [m]	Bearing to Peak CO Concentration [deg]
January	344	4.7	8000	73
February	364	4.9	8000	158
March	397	5.1	7000	285
April	383	6.1	8000	249
May	398	7.9	7000	245
June	392	4.3	6000	258
July	416	5.4	5000	285
August	408	6.0	8000	226
September	413	4.7	9000	22
October	435	2.9	16000	240
November	382	4.0	11000	205
December	372	6.4	6000	83

Table 4-2. Taurus II Normal Launch CO TWA Concentration Summary – Daytime Meteorology.

Month	Number of Weather Cases	Peak CO Concentration [ppm]	Distance to Peak CO Concentration [m]	Bearing to Peak CO Concentration [deg]
January	344	0.22	7000	259
February	364	0.17	3000	23
March	397	0.19	11000	315
April	383	0.23	7000	228
May	398	0.34	11000	300
June	392	0.32	4000	51
July	416	0.32	7000	274
August	408	0.21	6000	133
September	413	0.18	7000	305
October	435	0.24	13000	108
November	382	0.20	28000	120
December	372	0.17	15000	127

Table 4-3: Taurus II Normal Launch CO Concentration Summary – Nighttime Meteorology.

Month	Number of Weather Cases	Peak CO Concentration [ppm]	Distance to Peak CO Concentration [m]	Bearing to Peak CO Concentration [deg]
January	93	5.5	8000	74
February	157	4.0	10000	74
March	162	3.7	10000	176
April	156	6.3	9000	226
May	158	6.2	11000	242
June	152	4.4	7000	114
July	153	4.4	8000	113
August	162	3.4	10000	82
September	163	2.7	9000	356
October	119	2.7	18000	259
November	125	3.8	9000	91
December	128	6.0	7000	149

Table 4-4. Taurus II Normal Launch CO TWA Concentration Summary – Nighttime Meteorology.

Month	Number of Weather Cases	Peak CO Concentration [ppm]	Distance to Peak CO Concentration [m]	Bearing to Peak CO Concentration [deg]
January	93	0.08	9000	74
February	157	.09	24000	77
March	162	0.10	13000	230
April	156	0.60	7000	46
May	158	0.17	16000	120
June	152	0.24	7000	210
July	153	0.15	14000	34
August	162	0.20	12000	223
September	163	0.16	12000	226
October	119	0.08	28000	59
November	125	0.20	7000	202
December	128	0.17	21000	146

The REEDM predicted CO concentrations for all daytime meteorological cases processed in the 8-year sample set was aggregated into bins to evaluate the peak far field concentration probability. This information is provided in Table 4-5 and it is noted that approximately 81% of all daytime meteorological cases resulted in REEDM maximum peak instantaneous ground level CO concentrations of less than 1 ppm.

Table 4-5. REEDM Predicted Maximum Far Field Ground Level Carbon Monoxide Concentrations For Daytime Taurus II Normal Launch Scenarios.

Concentration Bin	Count	Probability
0 - 1	3805	0.809
1 - 2	644	0.137
2 - 3	174	0.037
3 - 4	54	0.011
4 - 5	14	0.003
5 - 6	9	0.002
6 - 7	3	0.001
7 - 8	1	0.0002
8 - 9	0	0.0000
9 - 10	0	0.0000

The REEDM predicted CO 1-hour time weighted average concentrations for all daytime meteorological cases processed in the 8-year sample set was aggregated into bins to evaluate the peak far field TWA concentration probability. This information is provided in Table 4-6 and it is noted that approximately 88% of all daytime meteorological cases resulted in REEDM maximum 1-hour TWA ground level CO concentrations of less than 0.04 ppm. The fact that the TWA concentration is much less than the peak instantaneous concentration is consistent with the short cloud passage time.

The REEDM predicted cloud transport directions were also aggregated into bins representing 45-degree arc corridors around the compass (i.e. N, NE, E, SE, S, SW, W, NW). Table 4-7 indicates the predicted Taurus II normal launch plume direction probability of occurrence observed across the 4704 daytime balloon soundings. It is noted that for the daytime launch scenarios transport of the exhaust plume to the East is favored. The transport direction reflects the average airflow over a depth of approximately 1000 meters, hence the windrose observed for elevated rocket exhaust clouds may differ significantly from a windrose derived from a surface wind tower.

Table 4-6. REEDM Predicted Maximum Far Field Ground Level Carbon Monoxide TWA Concentrations For Daytime Taurus II Normal Launch Scenarios.

1-Hour TWA Concentration Bin	Count	Probability
0.00 – 0.02	1933	0.411
0.02 – 0.04	1464	0.311
0.04 - 0.06	735	0.156
0.06 - 0.08	285	0.061
0.08 - 0.10	126	0.027
0.10 - 0.12	66	0.014
0.12 - 0.14	35	0.007
0.14 - 0.16	18	0.004
0.16 - 0.18	17	0.004
0.18 – 0.20	10	0.002
0.20 – 0.22	3	0.001
0.22 – 0.24	3	0.001
0.24 – 0.26	2	0.0004
0.26 – 0.28	2	0.0004
0.28 – 0.30	2	0.0004
0.30 – 0.32	0	0.0000
0.32 – 0.34	2	0.0004
0.34 – 0.36	1	0.0002
0.36 – 0.38	0	0.0000
0.38 -0.40	0	0.0000

Table 4-7. REEDM Predicted Exhaust Cloud Transport Directions For Daytime Taurus II Normal Launch Scenarios.

Plume Transport Direction Bin	Count	Probability
337.5 – 22.5 (N)	363	0.077
22.5 – 67.5 (NE)	830	0.176
67.5 – 112.5 (E)	801	0.170
112.5 – 157.5 (SE)	976	0.207
157.5 – 202.5 (S)	515	0.109
202.5 – 247.5 (SW)	453	0.096
247.5 – 292.5 (W)	326	0.069
292.5 – 337.5 (NW)	440	0.094

Similar summary tables for the 1728 nighttime Taurus II normal launch simulations were compiled. Table 4-8 shows that the peak CO instantaneous concentration predictions for nighttime conditions continues with a high probability that the maximum far field concentration will be less than 1 ppm.

Table 4-8. REEDM Predicted Maximum Far Field Ground Level Carbon Monoxide Concentrations For Nighttime Taurus II Normal Launch Scenarios.

Concentration Bin	Count	Probability
0 - 1	1390	0.804
1 - 2	237	0.137
2 - 3	67	0.039
3 - 4	23	0.013
4 - 5	7	0.004
5 - 6	2	0.0012
6 - 7	2	0.0012
7 - 8	0	0.0000
8 - 9	0	0.0000
9 - 10	0	0.0000

The REEDM predicted CO 1-hour time weighted average concentrations for all nighttime meteorological cases is provided in Table 4-9 and it is noted that approximately 73% of all nighttime meteorological cases resulted in REEDM maximum 1-hour TWA ground level CO concentrations of less than 0.04 ppm.

Table 4-10 indicates the predicted Taurus II normal launch plume direction probability of occurrence observed across the 1728 nighttime balloon soundings. It is noted that for nighttime launch scenarios transport of the exhaust plume to the East is still favored as it was during the daytime.

Table 4-9. REEDM Predicted Maximum Far Field Ground Level Carbon Monoxide TWA Concentrations For Nighttime Taurus II Normal Launch Scenarios.

1-Hour TWA Concentration Bin	Count	Probability
0.00 – 0.02	817	0.473
0.02 – 0.04	449	0.260
0.04 - 0.06	264	0.153
0.06 - 0.08	114	0.066
0.08 - 0.10	52	0.030
0.10 - 0.12	12	0.007
0.12 - 0.14	6	0.0035
0.14 - 0.16	4	0.0023
0.16 - 0.18	5	0.0029
0.18 – 0.20	0	0.0000
0.20 – 0.22	3	0.0017
0.22 – 0.24	0	0.0000
0.24 – 0.26	0	0.0000
0.26 – 0.28	0	0.0000
0.28 – 0.30	0	0.0000
0.30 – 0.32	0	0.0000
0.32 – 0.34	0	0.0000
0.34 – 0.36	0	0.0000
0.36 – 0.38	0	0.0000
0.38 -0.40	0	0.0000

Table 4-10. REEDM Predicted Exhaust Cloud Transport Directions For Nighttime Taurus II Normal Launch Scenarios.

Plume Transport Direction Bin	Count	Probability
337.5 – 22.5 (N)	61	0.035
22.5 – 67.5 (NE)	315	0.182
67.5 – 112.5 (E)	296	0.171
112.5 – 157.5 (SE)	369	0.214
157.5 – 202.5 (S)	231	0.134
202.5 – 247.5 (SW)	215	0.124
247.5 – 292.5 (W)	106	0.061
292.5 – 337.5 (NW)	135	0.078

4.3 REEDM Far Field Results For The Taurus II Static Test Firing Scenario

REEDM was executed in batch mode using the same archived WFF meteorological soundings to evaluate the formation, transport and ground level concentration of CO from Taurus II static test firings on the launch stand. Table 4-11 presents the maximum peak instantaneous CO concentration predicted for the static test firing. It is noted that in general the static test firing is predicted to produce higher ground level CO concentrations than the normal launch scenario.

Table 4-11: Taurus II Static Test Firing CO Concentration Summary – Daytime Meteorology.

Month	Number of Weather Cases	Peak CO Concentration [ppm]	Distance to Peak CO Concentration [m]	Bearing to Peak CO Concentration [deg]
January	344	10.8	6000	53
February	364	15.5	6000	31
March	397	18.9	6000	34
April	383	13.5	6000	33
May	398	11.6	7000	16
June	392	6.1	8000	21
July	416	5.2	7000	75
August	408	5.2	11000	25
September	413	9.2	8000	249
October	435	5.9	6000	58
November	382	11.8	6000	92
December	372	13.6	8000	37

Table 4-12 lists the predicted daytime CO TWA concentrations for the Taurus II static test firing scenarios. The TWA concentrations are somewhat higher than the corresponding values predicted for the normal launch scenario, but the overall expectation is that the 1-hour TWA CO concentrations will be less than 1 ppm. Table 4-13 and Table 4-14 show the maximum predicted CO instantaneous and 1-hour TWA concentrations for the nighttime static test firing conditions.

Table 4-12. Taurus II Static Test Firing CO TWA Concentration Summary – Daytime Meteorology.

Month	Number of Weather Cases	Peak CO Concentration [ppm]	Distance to Peak CO Concentration [m]	Bearing to Peak CO Concentration [deg]
January	344	0.20	7000	53
February	364	0.27	8000	70
March	397	0.26	5000	46
April	383	0.23	9000	20
May	398	0.25	11000	251
June	392	0.16	5000	61
July	416	0.18	4000	181
August	408	0.14	14000	136
September	413	0.15	7000	241
October	435	0.17	14000	221
November	382	0.23	6000	92
December	372	0.25	9000	37

Table 4-13: Taurus II Static Test Firing CO Ceiling Concentration Summary – Nighttime Meteorology.

Month	Number of Weather Cases	Peak CO Concentration [ppm]	Distance to Peak CO Concentration [m]	Bearing to Peak CO Concentration [deg]
January	93	12.3	6000	100
February	157	8.7	7000	8
March	162	11.4	6000	40
April	156	13.7	5000	58
May	158	7.2	6000	80
June	152	5.9	6000	113
July	153	4.2	8000	83
August	162	4.7	9000	82
September	163	4.6	13000	72
October	119	6.1	8000	59
November	125	6.9	8000	92
December	128	13.6	8000	37

Table 4-14. Taurus II Static Test Firing CO TWA Concentration Summary – Nighttime Meteorology.

Month	Number of Weather Cases	Peak CO Concentration [ppm]	Distance to Peak CO Concentration [m]	Bearing to Peak CO Concentration [deg]
January	93	0.22	7000	100
February	157	0.24	16000	42
March	162	0.21	11000	29
April	156	0.28	7000	58
May	158	0.23	13000	100
June	152	0.15	7000	113
July	153	0.11	18000	83
August	162	0.12	10000	79
September	163	0.30	12000	226
October	119	0.13	12000	152
November	125	0.18	11000	66
December	128	0.25	9000	37

Histograms of REEDM predicted CO concentrations for Taurus II static test firings for all daytime meteorological cases were generated in a similar fashion to the normal launch scenario. Table 4-15 presents the maximum predicted CO concentrations and it is noted that approximately 76% of all daytime meteorological cases resulted in REEDM maximum peak instantaneous ground level CO concentrations of less than 1 ppm. The static test firing scenarios exhibited a trend toward somewhat higher concentrations than predicted for the normal launch.

Table 4-15. REEDM Predicted Maximum Far Field Ground Level Carbon Monoxide Concentrations For Daytime Taurus II Static Test Firing Scenarios.

Concentration Bin	Count	Probability
0 - 1	3568	0.759
1 - 2	632	0.134
2 - 3	195	0.041
3 - 4	125	0.027
4 - 5	51	0.011
5 - 6	48	0.010
6 - 7	21	0.004
7 - 8	18	0.004
8 - 9	14	0.003
9 +	12	0.003

Table 4-16 presents the REEDM predicted CO 1-hour time weighted average concentrations for all daytime meteorological cases processed for the Taurus II static test firing scenario. It is noted that approximately 60% of all daytime meteorological cases resulted in REEDM maximum 1-hour TWA ground level CO concentrations of less than 0.04 ppm.

The REEDM predicted cloud transport directions were also aggregated into bins for the static test firing scenario. Table 4-17 indicates the predicted Taurus II static test firing plume direction probability of occurrence observed across the 4704 daytime balloon soundings. It is noted that for the daytime launch scenarios transport of the exhaust plume to the East is favored.

Table 4-16. REEDM Predicted Maximum Far Field Ground Level Carbon Monoxide TWA Concentrations For Daytime Taurus II Static Test Firing Scenarios.

1-Hour TWA Concentration Bin	Count	Probability
0.00 – 0.02	1468	0.312
0.02 – 0.04	1372	0.292
0.04 - 0.06	863	0.183
0.06 - 0.08	446	0.095
0.08 - 0.10	230	0.049
0.10 - 0.12	138	0.029
0.12 - 0.14	74	0.016
0.14 - 0.16	40	0.009
0.16 - 0.18	29	0.006
0.18 – 0.20	17	0.004
0.20 – 0.22	15	0.003
0.22 – 0.24	6	0.0012
0.24 – 0.26	3	0.0006
0.26 – 0.28	2	0.0004
0.28 – 0.30	0	0.0000
0.30 – 0.32	0	0.0000
0.32 – 0.34	0	0.0000
0.34 – 0.36	0	0.0000
0.36 – 0.38	0	0.0000
0.38 -0.40	0	0.0000

Table 4-17. REEDM Predicted Exhaust Cloud Transport Directions For Daytime Taurus II Static Test Firing Scenarios.

Plume Transport Direction Bin	Count	Probability
337.5 – 22.5 (N)	397	0.084
22.5 – 67.5 (NE)	832	0.177
67.5 – 112.5 (E)	838	0.178
112.5 – 157.5 (SE)	955	0.203
157.5 – 202.5 (S)	489	0.104
202.5 – 247.5 (SW)	440	0.094
247.5 – 292.5 (W)	316	0.067
292.5 – 337.5 (NW)	437	0.093

Similar summary tables for the 1728 nighttime Taurus II static test firing simulations were compiled. Table 4-18 shows that the peak CO instantaneous concentration predictions for nighttime conditions continues with a high probability that the maximum far field concentration will be less than 1 ppm.

Table 4-18. REEDM Predicted Maximum Far Field Ground Level Carbon Monoxide Concentrations For Nighttime Taurus II Static Test Firing Scenarios.

Concentration Bin	Count	Probability
0 - 1	1231	0.712
1 - 2	279	0.161
2 - 3	99	0.057
3 - 4	42	0.024
4 - 5	33	0.019
5 - 6	15	0.009
6 - 7	9	0.005
7 - 8	9	0.005
8 - 9	3	0.002
9 +	3	0.002

The REEDM static test firing predicted CO 1-hour time weighted average concentrations for all nighttime meteorological cases is provided in Table 4-19 and it is noted that approximately 59% of all nighttime meteorological cases resulted in REEDM maximum 1-hour TWA ground level

CO concentrations of less than 0.04 ppm. Static test firing TWA CO concentrations trend higher than those observed in the normal launch simulations.

Table 4-20 indicates the predicted Taurus II static test firing plume direction probability of occurrence observed across the 1728 nighttime balloon soundings. It is noted that for nighttime launch scenarios transport of the exhaust plume to the East is still favored as it was during the daytime.

Table 4-19. REEDM Predicted Maximum Far Field Ground Level Carbon Monoxide TWA Concentrations For Nighttime Taurus II Static Test Firing Scenarios.

1-Hour TWA Concentration Bin	Count	Probability
0.00 – 0.02	605	0.350
0.02 – 0.04	407	0.236
0.04 - 0.06	293	0.170
0.06 - 0.08	197	0.114
0.08 - 0.10	84	0.049
0.10 - 0.12	58	0.034
0.12 - 0.14	31	0.018
0.14 - 0.16	9	0.005
0.16 - 0.18	19	0.011
0.18 – 0.20	11	0.006
0.20 – 0.22	7	0.004
0.22 – 0.24	3	0.002
0.24 – 0.26	2	0.001
0.26 – 0.28	0	0.000
0.28 – 0.30	1	0.001
0.30 – 0.32	1	0.001
0.32 – 0.34	0	0.0000
0.34 – 0.36	0	0.0000
0.36 – 0.38	0	0.0000
0.38 -0.40	0	0.0000

Table 4-20. REEDM Predicted Exhaust Cloud Transport Directions For Nighttime Taurus II Static Test Firing Scenarios.

Plume Transport Direction Bin	Count	Probability
337.5 – 22.5 (N)	72	0.042
22.5 – 67.5 (NE)	321	0.186
67.5 – 112.5 (E)	306	0.177
112.5 – 157.5 (SE)	378	0.219
157.5 – 202.5 (S)	221	0.128
202.5 – 247.5 (SW)	207	0.120
247.5 – 292.5 (W)	92	0.053
292.5 – 337.5 (NW)	131	0.076

4.4 REEDM Near Field Results For Taurus II Normal Launch Scenario

In REEDM terminology the "near field" is defined as the geographical region near the launch pad where the rocket exhaust cloud source is formed and undergoes vertical cloud rise due to buoyancy effects. REEDM is not specifically designed to predict cloud concentrations in this region because the area is typically evacuated during launches due to high risk from debris, blast, fire and toxics hazards. Emissions in this region are of interest for environmental considerations however; therefore ACTA modified the output of REEDM to report intermediate calculations of the exhaust cloud size, position and temperature during the cloud rise phase. Using information about the size and location of the exhaust cloud coupled with the known quantity of exhaust products emitted and the mass fractions of the exhaust chemical constituents allows an estimate to be made of chemical concentrations inside the cloud in the near field. When performing far field calculations, REEDM assumes that the mass distribution of exhaust products in the expanded and diluted exhaust cloud is Gaussian. In the near field, as the source cloud is initially formed, the exhaust products may be more uniformly distributed. ACTA computed in-cloud concentrations in the near field assuming both uniform and Gaussian mass distributions. For the Gaussian distribution the maximum concentration occurs at the cloud centroid and the edge of the cloud is defined as the point where the concentration is 10% of the centroid maximum values. This assumption defines the cloud radius as 2.14 standard deviations.

The size and shape of the near field ground level carbon monoxide concentration pattern depends upon several factors:

1. The dynamics of the exhaust flow emitted from the Taurus II Pad-0A flame duct.

2. The effects of thermal buoyancy that lifts the plume off the ground and imparts vertical acceleration to the hot plume gases.

3. The effect of local wind speed and direction after the jet momentum has dissipated and the plume is beginning to lift off the ground.

The jet dynamics of the high speed exhaust plume venting from the flame duct are largely independent of the weather conditions and are determined by the design of the flame duct and concrete ramp structure at the exit of the duct. These design features were still in development and evaluation at the time of this study. The vertical rise rate of the buoyant cloud after the jet dynamics have dampened are computed by REEDM and were used to estimate the vertical and horizontal cloud displacement from a point where the exhaust plume is assumed to become buoyancy dominated. For normal launches, only a portion of the main engine exhaust vents through the flame duct and some of the ground cloud forms around the launch pad. A detailed computational fluid dynamics flow analysis of the plume interaction with the flame duct and the launch pad surface is not available, however, based on photographs and video of other launch vehicle normal launch ground clouds, it is estimated that the center of the Taurus II normal launch ground cloud will be displaced about 100 meters from the vehicle liftoff position in the direction of the flame duct exit.

REEDM calculations for the near field normal launch cloud rise were processed for 6427 meteorological cases and summarized by month as shown in Table 4-21. REEDM approximates the Taurus II normal launch ground cloud as a sphere the radius of which grows linearly during the buoyant cloud rise phase according to the following relationship:

$$r(z) = r_0 + \gamma \Delta z$$

where:

	$r(z)$	=	cloud radius at height z [m]
	r_o	=	initial cloud radius [m] = 48.8 [m] (160 ft)
	γ	=	air entrainment coefficient = 0.36
	Δz	=	height of cloud centroid above the ground [m]

Based on the forgoing relationship, the spherical cloud will just touch the ground surface when the cloud centroid lifts to approximately 76 meters above the ground. This is also referred to in this report as the “cloud liftoff” point. Beyond this point the downwind ground CO concentration is assumed to be zero until the ground concentrations once again start to occur in the far field due to downward mixing from the stabilized normal launch cloud. The maximum distance from the point where the flame duct horizontal flow dynamics are dampened (REEDM initialization point) to the point where the wind driven normal launch plume lifts off the ground is estimated to be 144 meters. Average distance from the REEDM initialization point to the point of cloud liftoff is estimated to be about 25 meters. These distances are influenced by the initial amount of cloud "exhaust" materials as well as the air entrainment rate assumption. If deluge water injection and combustion air are added to the initial exhaust mass, then the initial cloud radius will be larger and the downwind distance to the liftoff point will be somewhat longer. Given uncertainties in the plume mass entrainment and other modeling assumptions, the maximum travel distance to Taurus II normal launch ground cloud liftoff is estimated at about 200 meters. Thus a circle with a radius of 200 meters centered 100 meters downstream from the flame duct exit would approximately define the region within which a toxic exposure to CO might occur under high surface wind conditions. The average potential toxic exposure zone is expected to be much smaller and is associated with moderate to light surface winds. Maximum ground level CO concentrations inside the near field toxic hazard zone could exceed 7000 ppm.

Table 4-21. Taurus II Normal Launch Near Field CO Concentration Summary.

Month	Number of Weather Cases	Ground CO Concentration at Cloud Liftoff Uniform Distribution [ppm]	Ground CO Concentration at Cloud Liftoff Gaussian Distribution [ppm]	Maximum Distance to Cloud Liftoff [m]	Average Distance to Cloud Liftoff [m]
January	435	7530	1980	78	22
February	521	7420	1950	86	23
March	559	7190	1890	99	25
April	538	8440	2220	93	25
May	556	7250	1910	86	23
June	544	7140	1880	55	21
July	569	6650	1750	62	20
August	570	7790	2050	61	18
September	576	7190	1890	144	21
October	554	7330	1930	98	19
November	507	7870	2070	101	20
December	498	8280	2180	76	22

An example of near field concentration calculations for a normal launch plume with a May meteorological case that produced a low cloud rise is listed below. As the ground cloud rises REEDM assumes it intersects and combines with the contrail cloud above it and the total amount of exhaust mass in the rising cloud continues to increase until the ground cloud stops rising at the stabilization altitude. As previously defined, when the predicted ground cloud radius just equals the height of the ground cloud centroid above the ground, the exhaust cloud is just at the point of lifting off the ground. In Table 4-22 this occurs as the cloud rises through the 8th meteorological layer where the top of the layer is 89.9 meters above the ground and the cloud radius is predicted to be 80.8 meters. At this point the cloud is predicted to have moved 20.6 meters in the downwind direction, has an average temperature of 329.5 Kelvin (133 F) and has an uniform CO concentration of 7615 ppm. As the cloud continues to move downwind it rises further above the ground and only flying birds or tall trees would be exposed to the concentrated cloud exhaust chemicals. This sample normal launch cloud is predicted to stabilize at 440 meters above the ground approximately 200 meters downwind from the initial source formation point and has a predicted radius of 206.9 meters. The bottom of the exhaust cloud would be approximately 233 meters above the ground. The centroid concentration, assuming the mass distribution has transitioned to Gaussian, is predicted to be 3881 ppm with the concentration at the edge of the cloud equal to 388 ppm (10% of the peak centroid concentration).

Table 4-22. Sample Near Field Taurus II Normal Launch Exhaust Cloud Concentration Estimates For a May WFF Meteorological Case.

```
initial cloud radius          [m] =    48.76800
initial cloud height          [m] =   0.0000000E+00
initial cloud rise velocity [m/s] =   0.0000000E+00
```

met layer	cloud height [m]	cloud radius [m]	cloud volume [m**3]	exhaust mass [g]	downwind dist [m]	rise time [sec]	cloud temp [K]	uniform conc [ppm]	Gaussian conc [ppm]
1	11.0	52.4	.60123E+06	.17505E+08	2.3	1.295	590.5	6516.	17152.
2	20.6	55.8	.72845E+06	.23196E+08	5.8	0.632	498.6	7127.	18760.
3	30.2	59.3	.87234E+06	.30021E+08	8.0	0.580	443.6	7703.	20275.
4	39.8	62.7	.10341E+07	.37721E+08	10.1	0.573	407.6	8164.	21489.
5	49.4	66.2	.12148E+07	.46158E+08	12.2	0.584	382.5	8504.	22384.
6	59.3	69.8	.14221E+07	.55242E+08	14.4	0.622	363.7	8694.	22884.
7	69.2	73.3	.16517E+07	.64928E+08	16.7	0.647	349.6	8798.	23158.
8	89.9	80.8	.22091E+07	.75165E+08	20.6	1.451	329.5	7615.	20044.
9	108.5	87.5	.28051E+07	.86432E+08	26.0	1.423	317.9	6896.	18152.

10	126.5	94.0	.34754E+07	.98520E+08	31.5	1.490	310.0	6345.	16701.
11	144.5	100.4	.42446E+07	.11134E+09	37.3	1.605	304.2	5871.	15453.
12	176.0	111.8	.58536E+07	.12482E+09	46.4	3.091	297.9	4773.	12563.
13	207.6	123.2	.78254E+07	.13940E+09	59.1	3.425	294.1	3987.	10494.
14	222.5	128.5	.88963E+07	.15495E+09	69.4	1.734	292.7	3898.	10261.
15	240.2	134.9	.10285E+08	.17095E+09	77.2	2.141	291.2	3720.	9792.
16	295.4	154.8	.15530E+08	.18744E+09	96.9	7.536	288.8	2701.	7111.
17	339.9	170.8	.20869E+08	.20538E+09	127.3	7.224	287.6	2203.	5798.
18	386.5	187.6	.27649E+08	.22438E+09	158.3	9.055	286.9	1816.	4781.
19	440.1	206.9	.37099E+08	.24441E+09	198.2	14.517	286.9	1475.	3881.

4.5 REEDM Near Field Results For Taurus II Static Test Firing Scenario

REEDM calculations for the near field static test firing cloud rise were processed for 6427 meteorological cases and summarized by month as shown in Table 4-23. REEDM approximates the Taurus II static test firing cloud as a sphere the radius of which grows linearly during the buoyant cloud rise phase according to the following relationship:

$$r(z) = r_0 + \gamma \Delta z$$

where:

- $r(z)$ = cloud radius at height z [m]
- r_o = initial cloud radius [m] = 46.05 [m] (151 ft)
- γ = air entrainment coefficient = 0.5
- Δz = height of cloud centroid above the ground [m]

Based on the forgoing relationship, the spherical cloud will just touch the ground surface when the cloud centroid lifts to approximately 91 meters above the ground. The initial cloud radius is calculated using the ideal gas law and the principle of mass conservation applied to the engine RP-1 and LOX propellant consumed in the test firing. Inclusion of deluge water and combustion air injected beyond the nozzle exit plane would increase the cloud exhaust mass and therefore would also increase the estimated initial cloud radius.

Table 4-23. Taurus II Static Test Firing Near Field CO Concentration Summary.

Month	Number of Weather Cases	Ground CO Concentration at Cloud Liftoff Uniform Distribution [ppm]	Ground CO Concentration at Cloud Liftoff Gaussian Distribution [ppm]	Maximum Distance to Cloud Liftoff [m]	Cloud Transport Bearing Associated With Max Cloud Liftoff [deg]	Average Distance to Cloud Liftoff [m]
January	435	3990	1050	212	181	36
February	521	3980	1050	249	298	40
March	559	4010	1055	299	269	43
April	538	3960	1040	271	316	43
May	556	4050	1065	259	302	38
June	544	3980	1050	126	328	33
July	569	4020	1060	161	101	31
August	570	4020	1060	143	333	27
September	576	3970	1040	557*	298	36
October	554	3960	1040	296	309	30
November	507	4050	1065	307	310	33
December	498	4020	1060	211	283	36

* September case with 557-meter downwind distance was under storm conditions with 60 knot surface winds, an unlikely weather condition for conducting a test firing.

Given uncertainties in the static test firing plume mass entrainment and other modeling assumptions, the maximum travel distance to Taurus II static test firing cloud liftoff is estimated at about 350 meters. Thus a circle with a radius of 350 meters centered 200 meters downstream from the flame duct exit would approximately define the region within which a toxic exposure to CO might occur under high surface wind conditions. The average potential toxic exposure zone is expected to be much smaller and is associated with moderate to light surface winds. Maximum ground level CO concentrations inside the near field static test firing toxic hazard zone could exceed 4000 ppm.

5. CONCLUSIONS

A conservative analysis approach has been applied to estimate carbon monoxide concentrations associated with Taurus II normal launch and static test firing scenarios. The analysis is deemed to be conservative in the sense that certain modeling assumptions, such as discounting the effect of uncertain processes such as the plume chemical alterations due to deluge water injection and plume afterburning with ambient air, favor predicting higher carbon monoxide concentrations than are expected to actually occur. The study also evaluated maximum chemical concentrations predicted using a set of over 6000 historical Wallops Flight Facility weather balloon soundings. Thus reasonable worst-case weather conditions should have inherently been captured in the study. The Taurus II first stage propellants are the hydrocarbon based fuel RP-1 and liquid oxygen (LOX). Under design combustion conditions the oxidizer to fuel burn ratio is approximately 2.7, which represents a somewhat fuel rich mixture. The main combustion byproduct of concern is carbon monoxide, which is estimated to comprise approximately 25.6 percent of the exhaust mixture by mass at the rocket nozzle exit. The other main combustion byproducts are carbon dioxide and water vapor. Rocket emissions from both the a normal vehicle launch and a static test firing on the launch pad are extremely hot and therefore less dense than surrounding ambient air and are accelerated vertically due to buoyancy forces that act on the exhaust cloud gases. The effect of buoyancy is to loft the exhaust clouds above the ground to a point of neutral stability in the atmosphere at altitudes ranging from 400 to 1300 meters above the ground. From the stabilization altitude, exhaust cloud materials eventually mix back down to the ground due to atmospheric turbulence, unless the entire cloud is predicted to rise above a capping thermal inversion. The geographic region near the launch pad where the source cloud forms and begins its thermal rise process is referred to as the “near field”. Ground level CO concentrations in the near field region are estimate to be in the 4000 to 20000 ppm range, however the downwind transport distance before the cloud lifts off the ground is predicted to be relatively short—on the order of several hundred meters or less. The geographic region where the stabilized and neutrally buoyant cloud material mixes back to the ground is referred to as the “far field”. REEDM predicts that the peak instantaneous CO concentrations in the far field region are typically less than 1 ppm but have the potential to reach as high as 20 ppm. One-hour time weighted average CO concentrations are estimated to be very low, typically less than 0.04 ppm, and these low TWA values are due to the short cloud passage time over a receptor location (e.g. minutes rather than hours). The far field CO concentration levels are well below published emergency exposure guidelines for humans and are considered to be benign to people, flora and fauna. Near field CO concentrations may reach hazardous levels that exceed the AEGL-3 10-minute exposure threshold or the IDLH exposure threshold. Given the proximity of the near field exposed region to the plume point of origin, other hazards, such as radiant heat transfer or direct exposure to the high temperature exhaust gas mixture, may be more severe than the hazard from CO chemical concentration exposure.

6. REFERENCES

Gordon, Sanford and Bonnie J. McBride, "Computer Program for Calculation of Complex Chemical Equilibrium Compositions, Rocket Performance, Incident and Reflected Shocks, and Chapman-Jouguet Detonations", Interim Revision NASA SP-273, Lewis Research Center, Cleveland OH, March 1976.

Gordon, Sanford and Bonnie J. McBride, "Computer Program for Calculation of Complex Chemical Equilibrium Compositions and Applications, I. Analysis", NASA Reference Publication 1311, Lewis Research Center, Cleveland OH, October 1994.

Dimal Patel, "Taurus2 Quick Look Launch Duct Plume Flow Field", Orbital memorandum to B. Light, November 25, 2008.

Appendix H

Public Notices

PUBLIC NOTICE

Notice of Availability

DRAFT ENVIRONMENTAL ASSESSMENT FOR THE EXPANSION OF THE WALLOPS FLIGHT FACILITY LAUNCH RANGE

In accordance with the requirements of the National Environmental Policy Act (NEPA), NASA Goddard Space Flight Center's Wallops Flight Facility (WFF) invites public comment on the draft Environmental Assessment (EA) for the Expansion of the Wallops Flight Facility Launch Range, Wallops Island, Virginia. NASA has analyzed and addressed the potential impacts of expanding NASA and Mid-Atlantic Regional Spaceport (MARS) facilities to support launching up to an additional six (6) medium large class suborbital and orbital Expendable Launch Vehicles from WFF. The Federal Aviation Administration Office of Commercial Space Transportation has served as a Cooperating Agency in preparing the draft EA.

Under the Proposed Action, physical improvements to WFF may include any or all of the following:

On north Wallops Island, NASA would construct a dedicated payload fueling facility and MARS or a commercial entity would build a new payload processing facility. On south Wallops Island, MARS would construct a new launch complex including a liquid fueling facility, pad access ramp, launch pad, and deluge system in approximately the same location as the existing Pad 0-A. Transportation improvements would be made by NASA and MARS to allow the movement of cargo to the new facilities on Wallops Island. Such improvements could include construction of new roads and minor upgrades to existing roads. Several existing facilities could undergo minor interior modifications to support the additional launches; these facilities could include launch control buildings, communication support systems, radar, and antenna improvements.

As the Proposed Action would involve Federally-funded or authorized construction in the 100-year floodplain and jurisdictional wetlands, this Notice also serves as NASA's means for facilitating early public review as required by Executive Order 11988, Floodplain Management and Executive Order 11990, Protection of Wetlands.

The Proposed Action would have impacts to both environmental and socioeconomic resources, however most are minor and of short duration and none are considered significant. Impacts would be mitigated to the greatest extent practicable to minimize the effects on resource areas.

The draft EA is available for review between April 25, 2009 and May 30, 2009.

Comments are requested by May 30, 2009.

Written comments should be submitted to:
NEPA Program Manager
NASA Wallops Flight Facility
Code 250.W/EWLR EA
Building F-160, Room W-160
Wallops Island, VA 23337
Fax – 757-824-1819
Comments may also be sent electronically to Joshua.A.Bundick@nasa.gov;
Subject: EWLR EA.

The draft EA may be viewed on-line at
http://sites.wff.nasa.gov/code250/docs/EWLR_DEA.pdf

The draft EA is available for review at the following locations:

NASA WFF Technical Library
Building E-105
Wallops Island, Virginia 23337
(757) 824-1065
Hours: Mon-Fri: 8 a.m. - 4:30 p.m.

Eastern Shore Public Library
23610 Front Street
Accomack, Virginia 23301
(757) 787-3400
Hours: Mon, Tues, Wed, Fri: 9 a.m. - 6 p.m.
Thurs: 9 a.m. - 9 p.m.
Sat: 9 a.m. - 1 p.m.

Island Library
4077 Main Street
Chincogeague, Virginia 23336
(757) 336-3460
Hours: Mon: 10 a.m. - 2 p.m.
Tues: 10 a.m. - 5 p.m.
Wed, Fri, Sat: 1 p.m. - 5 p.m.

For further information or to request a copy of the draft EA, please contact the Wallops Flight Facility Public Affairs Office at (757) 824-1579.

ss 4/29 ESN, 4/30'09 CB

PUBLIC NOTICE

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DRAFT ENVIRONMENTAL ASSESSMENT FOR THE EXPANSION OF THE WALLOPS FLIGHT FACILITY LAUNCH RANGE

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NEPA Program Manager
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For further information or to request a copy of the draft EA, please contact the Wallops Flight Facility Public Affairs Office at (757) 824-1579.

ss 4/29 ESN, 4/30'09 CB

Appendix I

Draft EA Comment and Response Matrix

No.	Commenter	Topic Addressed	Comment/Proposed Revision to Text	Response to Comment	Revision to Text
1.	Environmental Protection Agency (EPA)	Alternatives	As presented in the draft EA, only the No Action Alternative and the Proposed Action were described which does not provide an adequate Alternatives Analysis. The draft EA states on page 15 that "Because hundreds of millions of dollars in existing NASA and MARS infrastructure are already available for use, and WFF contains the only NASA-owned and operated launch range, WFF is the only launch site that can meet the stated Purpose and Need of enabling low-cost, quick turn-around aerospace research and commercial assess to space." "Therefore, no other launch sites were considered to be reasonable." It is important that the draft EA address the consideration of other alternatives sites within the WFF, other NASA facilities, or other comparable sites. A comparison of proposed sites is critical to the environmental analysis.	NASA added a new alternative to EA in order to provide an alternative that will minimize the construction of new facilities. Congressional funding specifically for MARS and Wallops Flight Facility was passed in the Omnibus Appropriations Act, 2009, Public Law 111-8, which stated that launches to resupply the International Space Station will occur from Wallops Flight Facility and the MARS. The EA explains why no other NASA facilities are under consideration; however, additional information has been added to clarify the Congressional mandate. The launches cannot take place any further inland due to the hazard arcs and safety buffer distances that are required around each launch pad for public safety.	NASA added an additional proposed action alternative to the EA. The EA has been revised to include additional explanation regarding why no other NASA facilities are under consideration for the proposed action as well as to why the proposed action must occur on Wallops Island.
2.	EPA	Wetlands	Page 36 states that an extensive wetland system borders Wallops Island. The island has non-tidal freshwater emergent wetlands, several small freshwater ponds, freshwater forested shrub wetlands, estuarine intertidal emergent wetlands, maritime forests and marsh wetlands. The total size of the wetlands should be provided.	NASA will provide additional information in the EA regarding total size of the tidal and non-tidal wetlands around and within Wallops Island.	The EA has been revised to include the total acreages of tidal and non-tidal wetlands at Wallops Island.
3.	EPA	Wetlands	The Proposed Action would result in the loss of 5.7 acres of wetlands. One acre of tidal wetlands would be filled for construction of the Pad O-A ramp and road improvements and 4.7 acres of non-tidal wetlands would be filled by construction of the Payload Processing Facility (PPF) and its access road. NASA has determined that there are no practicable alternatives for the location of the Pad 0-A ramps and road or the PPF due to siting constraints. It is important to note that the size and functional values of all impacted wetlands be analyzed and a mitigation plan for their replacement developed.	NASA is currently completing wetland delineations for the wetlands that would be affected by the proposed action. NASA will submit a JPA for review and approval by USACE, DEQ and local agencies and would obtain the necessary permits (potentially permits under Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act, and Virginia Water Protection permit). NASA will avoid and minimize potential impacts to wetlands to the maximum extent practicable and will fully comply with mitigation measures that are determined through the JPA process.	No revision necessary.
4.	EPA	Wetlands	In addition, when the wetland impact for the Proposed Action is combined with future projects, the total wetland impact is significant. For instance, the Alternative Energy Project would impact one acre of tidal wetlands in the central part of Wallops Island, and the North Unmanned Aerial Vehicle Airstrip (UAV) would impact 21 acres of tidal and non-tidal wetlands on north Wallops Island.	NASA is currently completing wetland delineations for the wetlands that would be affected by the proposed action. NASA will submit a JPA for review and approval by USACE, DEQ and local agencies and would obtain the necessary permits (potentially permits under Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act, and Virginia Water Protection permit). NASA will avoid and minimize potential impacts to wetlands to the maximum extent practicable and will fully comply	Anticipated wetland impacts from proposed projects have been revised in Section 4.5, Cumulative Effects.

No.	Commenter	Topic Addressed	Comment/Proposed Revision to Text	Response to Comment	Revision to Text
				with mitigation measures that are determined through the JPA process. Also, NASA's wetlands management plan serves as a mitigation measure, directing NASA to pursue preservation and restoration in addition to the practice of no net loss of wetlands through wetland creation. Impacts from other projects are still being evaluated but it appears that the UAV Airstrip will be substantially less than those initially reported in the draft EA.	
5.	EPA	Wetlands	Page 86 states that "Prior to construction, NASA and MARS would complete a jurisdictional wetland delineation in accordance with the USACE 1987 Wetland Delineation Manual and regional guidelines to determine the precise location and size of the wetland area that would be adversely affected." Wetlands present on, or immediately surrounding the site should be delineated according to the 1989 Federal Manual for Identifying and Delineating Jurisdictional Wetlands. This information should be provided in the environmental documentation.	Currently DEQ and NASA utilize the USACE 1987 Wetland Delineation Manual, and USACE has approved recent wetland delineations conducted by NASA that used the 1987 methodology. Until USACE and DEQ guidelines and approvals change, NASA will continue to use the 1987 manual.	No revision necessary.
6.	EPA	Wetlands	The draft EA also states, "NASA and MARS would notify the public and coordinate with applicable agencies including USACE, and VDEQ, VMRC, and the Accomack County Wetlands Board; these agencies would be notified of potential impacts to wetlands by VMRC through the JPA process." The text also reads, "Because the Proposed Action would involve federally funded and authorized impacts on jurisdictional wetlands, this EA serves as NASA's means for facilitating public review as required by EO 11990." It is important then to include within the environmental documentation all impacts to jurisdictional wetlands (including size and location of wetlands) and coordinate with applicable agencies in the planning process.	NASA is currently completing wetland delineations for the wetlands that would be affected by the proposed action. NASA will submit a JPA for review and approval by USACE, DEQ and local agencies and would obtain the necessary permits (potentially permits under Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act, and Virginia Water Protection permit). NASA will avoid and minimize potential impacts to wetlands to the maximum extent practicable and will fully comply with mitigation measures that are determined through the JPA process.	The text in Section 4.2.2.1 Wetlands has been revised to provide additional detail regarding potential effects to wetlands.
7.	EPA	Wetlands	Page 87 states, "A release of unspent RP-1 from ELV may create a thin film of petroleum on the water surface near the impact area." "Due to the volume of this release into the nearby tidal wetlands, temporary impacts on water quality in the tidal wetlands may be adverse; however, because mitigation and cleanup measures would be implemented, the potential long-term impacts on tidal wetlands would not be significant." The size of the tidal wetlands should be indicated and	Impacts to wetlands from launch activities are discussed in Section 4.2.2 of the EA (Surface Waters Including Wetlands). Examples of mitigation measures that would be utilized during emergency response if a contamination of the wetland were to occur have been added to the EA.	Section 4.2.2 Surface Waters Including Wetlands of the EA has been revised to include examples of mitigation measures that could be utilized in response to contamination of the tidal wetlands.

No.	Commenter	Topic Addressed	Comment/Proposed Revision to Text	Response to Comment	Revision to Text
			mitigation and cleanup measures identified. The impacts to wetlands which can occur from launch activities such as exhaust plume and other hazards such as radiant heat transfer or direct exposure to the high temperature exhaust gas mixture should be identified?		
8.	EPA	Protection of Children from Environmental Health Risks and Safety Risks	NASA prepared an Environmental Justice Implementation Plan (EJIP). Page 74 states, "The closest day care centers, schools, camps, nursing homes, and hospitals are addressed within the EJIP." The draft EA does not specify the proximity of these sensitive resource areas. A summary of the data in the EJIP should be presented.	Section 3.3.4 Environmental Justice has been revised to include the distances of the closest hospital, day care, and public campground. These public facilities are outside of the safety buffer distance of 3.04 kilometers (1.89 miles) surrounding Pad 0-A during launch.	Section 3.3.4 Environmental Justice has been revised to include the distances of the closest hospital, day care, school, and public campground.
9.	EPA	Cultural Resources	As noted on page 76, the last survey of cultural resources was conducted in 2004. Will there be an updated survey to look at properties that may now have achieved 50 years of age since 2004?	The 2006 Integrated Cultural Resource Management Plan (ICRMP) for the NASA WFF recommends that NASA evaluate resources for eligibility for listing in the National Register of Historic Places (NRHP) as they reach fifty years of age. While WFF has not conducted further identification and evaluation since 2004, a plan for a subsequent survey has been submitted and is awaiting funding. However, WFF's approach to Section 106 undertakings is to avoid adverse effects to properties that may be eligible for listing in the NRHP, including those that have not yet been evaluated.	No revision necessary.
10.	EPA	Stormwater	It is not evident from the draft EA [page 84] where the [stormwater] retention basins would be constructed. It is important to note that according to the guidelines developed by the Interagency Stormwater/Wetlands Workgroup, it is the recommendation of the EPA to discourage the utilization of non-tidal wetland systems for stormwater treatment and management. Numerous studies have shown that siting these facilities in wetlands leads to the degradation of aquatic ecosystems by contributing to thermal pollution and downstream warming. Furthermore, an instream stormwater management and water quality treatment facility will alter hydrology and increase erosion and sedimentation rates. Retaining stormwater and changing the natural flow rate will alter the natural level of the water table and change the surrounding wetlands vegetation. Water temperature, habitat composition, and food availability are all directly affected when streamside vegetation is lost.	Because final design of the proposed facilities has not been completed, the locations of permanent stormwater retention basins, if used, are currently not known. However, if permanent stormwater retention basins were included in facility design, they would not be placed within a waterway, stream, or wetland in order to preserve the existing hydraulic function and quality of these surface waters.	No revision necessary.

No.	Commenter	Topic Addressed	Comment/Proposed Revision to Text	Response to Comment	Revision to Text
			Stormwater management structures in wetlands will not prevent pollutants such as spills, sediment, heavy metals, petroleum, rocket propellant, etc from entering the surface waters since the structures are already in the surface water. Wetlands are important components to the aquatic ecosystem that provide flood flow resynchronization, maintenance of water quality, habitat and nutrient uptake functions. EPA's mandates include the preservation of these environmentally significant values and functions.		
11.	EPA	Floodplains	As stated on page 88, "All facility construction and infrastructure improvements would take place within the 100-year and 500-year floodplain." It is important to note that floodplain encroachment must be evaluated and coordinated with the Federal Emergency Management Agency (FEMA). Federal Executive Order 11988 (Floodplain Management) states, "If an agency has determined to, or proposes to conduct, support or allow an action to be located in a floodplain, the agency shall consider alternatives to avoid adverse effects and incompatible development in the floodplains." Where no practicable alternatives exist, Executive Order 11988 goes on to state, "If property used by the general public has suffered flood damage or is located in an identified flood hazard area, the responsible agency shall provide on structures, and other places where appropriate, conspicuous delineation of past and probable flood height in order to enhance public awareness and knowledge about flood hazards." To promote public safety, we recommend that at a minimum, a permit condition be included to require conspicuous delineation of past and probable future flood heights at multiple locations across the project site. These signs should be in place within six months of permit issuance.	All new facilities on Wallops Island are required to include flood mitigation measures such as elevating critical infrastructure (transformers, HVAC units, etc.) above the flood zone, or elevating the first floor above the flood zone (minimum of 10 feet above mean sea level [amsl]) – the first floor of the Horizontal Integration Facility will be elevated to 11 feet amsl. Hazardous materials and wastes would be stored in flood-proof storage containers/facilities or stored above the flood zone (i.e., on the first floor above 10 feet amsl). Because none of the buildings at WFF, existing or proposed, are public facilities, nor can the public access any WFF buildings or get on to Wallops Island without permission from NASA, the delineation of flood height in order to enhance public awareness does not apply. NASA is utilizing the publication of the Draft EA as notification for modification to or occupancy of a floodplain as required under EO 11988. Because Wallops Island is entirely within the floodplain, and facilities related to launch including launch pads and appurtenant structures cannot be moved inland due to the hazard arc/public safety buffer requirements, there are no practicable alternatives to construction within the floodplain of Wallops Island.	The EA has been revised to include more information regarding flood mitigation measures for new construction on Wallops Island.

No.	Commenter	Topic Addressed	Comment/Proposed Revision to Text	Response to Comment	Revision to Text
12.	EPA	Floodplains	In addition, the draft EA states that "NASA and MARS would minimize floodplain impacts and protect and restore the natural and beneficial functions of floodplains to the maximum extent possible." The text should state how NASA and MARS plan to protect and restore the natural and beneficial functions of the floodplains.	There are no practicable ways to restore the floodplain, therefore, the statement referring to protecting and restoring the floodplain has been removed from the EA. Flood mitigation measures have been added to the floodplains section. The functionality of the floodplain on Wallops Island, provided both by the wetlands on the island and the area of the island itself, is not substantially reduced due to the presence of existing or proposed facilities because the footprint of the facilities does not cover a substantial area of the island.	The EA has been revised to include more information regarding flood mitigation measures for new construction on Wallops Island. The statement referring to protecting and restoring the floodplain has been removed from the EA
13.	EPA	Air Quality	Page 98 states, "The conclusion of the workshop, based on evaluation of scientific studies performed in the United States, Europe, and Russia was that the effects of launch vehicle propulsion exhaust emissions on stratospheric ozone depletion, acid rain, toxicity, air quality, and global warming were extremely small compared to other human activities." To make a fair comparison, the types of human activities referenced should be identified.	The reference does not specify the types of human activities; however, human activities that contribute to global warming include the burning of coal, oil, and natural gas, as well as deforestation and various agricultural and industrial practices.	Section 4.2.3.1 Halon of the EA has been revised to include examples of human activities that contribute to global warming. New Section 4.2.3.2, Climate Change, has been added to the EA to discuss the effect of human activities on global warming and air quality.
14.	EPA	Terrestrial Habitat	Page 112 states "Long-term adverse impacts to vegetation would occur due to the loss of forest, shrub, and wetland plant communities due to the construction of the PPF, PFF, and Pad 0-A ramp and road improvement; however, these impacts would be localized and would not present a substantial adverse effect." As with wetlands, the loss of forest and shrub should be quantified and delineated.	Impacts to vegetation including tree removal have been quantified; the construction footprint of the proposed facilities and road improvements delineates the areas where vegetation would be affected.	The EA has been revised to include more information on impacts to vegetation including acreages of area affected.
15.	EPA	Threatened and Endangered Species	Page 116 states, "Therefore, NASA has determined that the once a year static firing related to the Proposed Action also would not result in adverse impacts on the piping plover or its habitat." However, as stated on page 113," ...noise from static fire activities would be of longer duration, but infrequent (not more than two per year)." Clarification of exactly how many static fire activities per year should be documented. Consultation with U.S. Fish and Wildlife Service and Virginia Department of Game and Inland Fisheries is recommended to determine impacts (if any) to the piping plover or its habitat which may result from the static fire activities and open burning of rocket motors.	As described in the proposed action description of Section 2 Alternatives, static fire testing would occur up to two times per year. The statement on page 116 referring to once a year static firing is an error and NASA has corrected that sentence in the EA. NASA provided the USFWS a copy of the Draft EA and has requested their input regarding potential impacts on piping plover from the Proposed Action and cumulative activities at WFF. NASA is currently informally consulting with USFWS regarding impacts on piping plover, seabeach amaranth, and red knot for the proposed action activities. NASA expects to begin formal consultation with USFWS in the near future.	The sentence referring to one static firing per year in Section 4.3.3 Threatened and Endangered Species has been corrected by deleting the reference to one static fire test per year. Additional text describing impacts to state and federally listed species and ongoing consultations with USFWS has been added to the EA.
16.	EPA	Description of Proposed Action	Page 2, Section 1.2.1.3 Federal Aviation Administration, mentions the term reentry activities/operations at least three times. Please	As defined under US Code Title 49, Subtitle IX, Chapter 701, reentry services (sane as activities/operations] means "activities involved in the	Section 1.2.1.3 of the EA has been revised to include definitions for reentry operations and reentry site.

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			explain and/or describe reentry activities.	preparation of a reentry vehicle and payload, crew (including crew training), or space flight participant, if any, for reentry; and the conduct of a reentry. NASA has included a definition of reentry in the EA.	
17.	EPA	Description of Proposed Action	Page 9 states, "Pad 0-A is a facility for launch vehicles with up to a 90,909-kg (200,000-lb) maximum load. Originally designed for the Conestoga vehicle, which was launched once in October 1995, Pad 0-A has been inactive; its launch service gantry (a large vertical structure with platforms at different levels used for erecting and servicing expandable launch vehicles [ELVs] before launch) and portions of the existing launch pad were removed in fall 2008, rendering Pad 0-A unusable for launching until a new, gantry is built." Explain why the gantry was removed? Is this a typical activity after so many launches, was this done because it was found to be unsafe, or was the size of the gantry no longer useable?	The old gantry was removed by the Virginia Commercial Space Flight Authority because the structure was dilapidated and no longer useable.	Additional text has been added to Section 1.2.3.1, Launch Complex 0.
18.	EPA	Safety	Page 35 states that, "This western boundary of Wallops Island includes a section of the Virginia Inside Passage, a federally maintained navigational channel frequently used by commercial and recreational boaters alike." What is the notification system used to warn boaters of a launch activity?	The WFF Test Director contacts the following agencies prior to launch dates, in order for the agencies to implement their procedures for warning boaters: • FAA to issue Notices to Airmen (NOTAMS) • Coast Guard to issue Notices to Mariners (NOTMARS) – the Coast Guard is responsible for notification of boaters within the Virginia Inside Passage • Navy to close the Warning Areas of the Virginia Capes Range Complex • International Civil Aviation Organization, European Control Altitude Reservation Function and other foreign countries for overflight comparable to NOTAMS	No revision necessary.
19.	EPA	Safety	Page 102 states, "NASA and MARS personnel and the public would be notified in advance of launch dates and times." The means of notification should be specified.	NASA notifies the public about launch dates through their website and publication in local newspapers. NASA notifies tenants and NASA personnel through e-mail notices, postings, and verbal notification.	No revision necessary.
20.	EPA	Safety	Page 105 states, "If a flight approaches corridor limits, the flight would be destroyed by Range Safety personnel." The text should describe how the flight is destroyed, the impacts, and potential resources that may be threatened.	A flight that approaches the edge of a safety corridor established by Range Safety would be destroyed essentially by a Range Safety Officer activating a remote system from the ground that would cause the rocket to lose thrust and come down within the safety zone area to protect human health and safety. Section 4.4.3 Health and Safety already includes an explanation of how and when flights are terminated by destruction.	Section 4.4.3, Health and Safety, has been revised to include a brief explanation of how Range Safety would destroy a flight.

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				Impacts from flight termination are described in the EA under the various resources topics in Section 4 as necessary.	
21.	EPA	Description of Resource	Page 106 states, "Fueling of ELVs with LOX and RP-1, and pressurized gases would take place at the Liquid Fueling Facility (LFF) adjacent to Pad 0-A." The area surrounding the LFF should be described and potential resources that can be impacted from the hazardous waste and materials identified.	Resources that would be affected by a spill or leak in the area surrounding the LFF are identified, along with potential impacts, under each resource topic such as under surface waters, wetlands, and vegetation.	No revision necessary.
22.	EPA	Safety	Page 106 states, "Payload processing may require limited use of chemicals considered toxic under CERCLA (NASA, 1997)." Describe the type of toxic chemicals used.	Table 24 in the EA contains a list of materials that may be used during payload processing, including toxic chemicals. In addition, hypergolic propellants that would be stored and handled during fueling activities would be considered toxic.	Section 4.2.6 Hazardous Materials and Hazardous Waste Management has been revised to clarify that Table 24 contains payload processing materials which include toxic and hazardous substances under CERCLA.
23.	EPA	Transportation	Page 109 states, "Potential toxic corridors (transportation routes) are defined in mission specific Operations and Safety Directives-further information is provided in the Transportation discussion in Section 4.4.5 of this EA." It is not apparent in Section 4.4.5 that a discussion was provided.	Because transportation routes for transporting toxic/hazardous materials are specific to each mission, the EA states that NASA would comply with all State and Federal regulations for the transport of hazardous materials. The text on page 109 does suggest that Section 4.4.5 Transportation of the EA will include more detail on specific transportation routes/corridors for the transport of toxic/hazardous substances – the text has been revised to remove the reference to toxic corridor routes being provided in Section 4.4.5.	Section 4.2.6 Hazardous Materials and Hazardous Waste Management has been revised to clarify that toxic corridor transportation routes are mission-specific [and therefore no further detailed information is provided in the EA].
24.	EPA	Hazardous Waste	Page 109 states, "In addition, the hazardous waste streams likely to be generated by the Proposed Action are not anticipated to substantially increase the amount of hazardous waste currently generated by WFF." This statement needs to; be explained. "Hazardous waste streams" should be described.	A hazardous waste stream is the generation and transportation of hazardous wastes at WFF. Hazardous wastes generated at WFF and under the proposed action are identified in Section 4.2.6 Hazardous Materials and Hazardous Waste Management of the EA.	No revision necessary.
25.	National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite Data and Information Service		The EA contains several brief references to communications instrumentation (p 9) and groundbased surveillance and radar tracking systems (pp 9 and 11) that will be employed during launch activities. Additionally, the use of radio frequency (RF) telemetry systems and data links between the spacecraft and ground systems is to be expected. The NOAA WCDAS has always been able to coexist with past launches without significant disruption to NOAA activities. However, the text contained in section 2.2.1.7 on p 22 of the EA mentions minor modifications to "communications support, radar, and antenna improvements".	Currently, NASA is unaware of any new or expanded RF systems that would be installed or operated as a result of the Proposed Action. However, if new RF systems or modifications to existing RF systems, such increasing RF power output or changing location or pointing direction, are planned in the future, NASA would coordinate with its tenants via the Wallops Frequency Utilization Management Working Group.	Section 4.2.7 Radiation has been revised to state that currently, NASA is unaware of any new or expanded RF systems that would be installed or operated as a result of the Proposed Action. However, if new RF systems or modifications to existing RF systems, such increasing RF power output or changing location or pointing direction, are planned in the future, NASA would coordinate with its tenants via the Wallops Frequency Utilization Management Working Group.

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			Without specific technical information regarding the proposed modifications and improvements, NOAA is unable to assess any potential impacts to sensitive NOAA receiving systems from changes to said systems. Information required to perform an assessment might include a brief description of the equipment improvements or modifications, along with the technical characteristics of the improved/modified systems (i.e. changes in transmitter power output and/or antenna types/gains, and changes in antenna locations, orientation, or pointing direction, etc).		
26.	NOAA National Environmental Satellite Data and Information Service		The EA contains reference to loss of forest (p 112) due to construction activities. There is evidence from past technical studies that specific stands of the existing natural tree cover, located between the various Wallops Island transmitter systems and the Wallops Flight Facility, provide a degree of radio frequency (RF) isolation (increased propagation loss) to potential interfering signals from high-power transmitters located on Wallops Island and vicinity. This RF isolation currently contributes to allowing the sensitive receiver systems at the WCDAS to generally operate satisfactorily with transmitting systems in the local environment. Without more specific information regarding areas of trees or vegetation that are designated for removal, NOAA is unable to determine if performance degradation to the sensitive WCDAS receiver systems may Increase.	The tree clearing proposed under the preferred alternative would be too far away to change the RF environment around NOAA.	Section 4.2.7 Radiation has been revised to state that tree removal for construction of new facilities would not result in impacts on NOAA radar systems.
27.	NOAA National Marine Fisheries Service (NMFS)		Of particular concern [of the proposed project] for the NMFS is the modifications proposed for the boat dock, specifically the installation of steel sheet piles which will require pile driving. As listed species of sea turtles are likely to occur in the proposed project area, effects to sea turtle species may result from the construction activities. As such, NMFS recommends that NASA initiate consultation pursuant to Section 7 of the Endangered Species Act. NASA should submit a determination of effects along with justification for the determination and a request for concurrence to NMFS.	After publication of the Draft EA, NASA coordinated with NMFS regarding Proposed Action impacts including work at the Wallops Island boat dock. In a letter dated July 8, 2009 NMFS concurred with NASA's determination that the boat dock improvements "may affect, but is unlikely to adversely affect" Kemp's ridley, Loggerhead, and Atlantic Green sea turtles with implementation of mitigation measures. Mitigation will include a visual sweep of the waterways adjacent to the boat basin each day prior to activities, stationing of a trained observer to watch for turtles entering the waterways, and installation of pilings by vibratory techniques rather than hammer methods to the greatest extent practicable.	The EA has been revised to include the mitigation measures that have been agreed upon between NASA and NMFS in a NMFS concurrence letter dated July 8, 2009.
28.	USACE, Robert Cole		In my opinion, with the number of projects NASA is proposing on Wallops Island, there should be a single EIS for the expansion. Although the projects are different the cumulative impacts of the	While having one consolidated NEPA document for all of Wallops Island activities may be administratively preferable, the independent nature/utility of each project, as well as very different	No revision necessary.

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			UAS Airfield, Wind Turbines, Shore Stabilization projects, and this project are piecemeal in nature. The cumulative direct and indirect impacts of all of these projects are significant and warrant greater NEPA attention than a FONSI.	implementation schedules, preclude NASA from taking that approach. Additionally, NASA is addressing cumulative impacts of the projects in the cumulative impacts section of each NEPA document that is prepared (typically an EA with the exception of the Shoreline Restoration and Infrastructure Protection Program, which is an Environmental Impact Statement). Of specific interest to USACE regarding NASA's process of identifying and mitigating cumulative impacts to wetlands, NASA is preparing a wetlands management plan for actions on Wallops Island and Wallops Mainland. NASA is considering the cumulative impacts to wetlands and mitigation and compensation measures on an island-wide scale. NASA would ensure no net loss of wetlands and would also pursue preservation and restoration in addition to creation as mitigation measures. NASA is consulting with other federal agencies, including USACE, on the content of this plan.	
29.	USACE, Robert Cole	Wetlands	As it relates to Waters of the United States, the draft EA confined its scope to Wallops Island; it did not address alternative sites for the project. For example, why can't the launches take place at a different NASA facility (where launches are already taking place) or on the mainland?	The US Congress specifically authorized funding for launch range infrastructure improvements at WFF. The EA explains why no other NASA facilities are under consideration; however, additional information has been added to clarify the Congressional mandate. The launches cannot take place any further inland due to the hazard arcs and safety buffer distances that are required around each launch pad for public safety.	The EA has been revised to include additional explanation regarding Congressional funding specifically for WFF and why the facilities cannot be moved inland to avoid and minimize impacts on waters of the US.
30.	USACE, Robert Cole		The EA did not mention avoidance and minimization of impacts to waters or provide a mitigation proposal. These items will be required in the JPA, and may result in substantial changes in your plans for this project. Your proposed impacts, 5.7 acres, are significant in nature and require more detail than provided in the draft EA.	NASA is currently completing wetland delineations for the areas that would be affected by the proposed action and are far enough along in design to establish areas of disturbance. As design plans are completed and areas of disturbance are known, NASA will complete wetland delineations for all construction that would potentially impact wetlands. NASA will submit a JPA for review and approval by USACE, DEQ and local agencies and would obtain the necessary permits (potentially permits under Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act, and Virginia Water Protection permit). NASA will avoid and minimize potential impacts to wetlands to the maximum extent practicable and will fully comply with mitigation measures that are determined through the JPA process. Also, NASA's wetlands management plan serves as a mitigation measure, directing NASA to pursue preservation and restoration in addition to the practice of no net loss of wetlands through wetland creation.	No revision necessary.

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31.	Virginia Department of Historic Resources		The Wallops Coast Guard Station and associated tower (001-0027-0100 and 001-0027-0101 respectively) are referenced in the Draft Environmental Assessment (EA). These resources have been determined Eligible for listing in the National Register of Historic Places (NRHP). Currently there is an agreement under development with DHR to address the adverse effects to these resources, DHR File No. 2004-0147. What is the status of the agreement? The last correspondence we have concerning the agreement is dated December, 2008. Please provide a status update of the MOA including any relocation plans currently in development.	NASA provided VDHR additional information regarding the status of the Coast Guard Station MOA in an informal consultation letter after publication of the Draft EA. In a letter dated July 15, 2009 VDHR concurred with NASA's determination that the proposed action would not adversely affect any historic properties. Additionally, as the new alternative would impact existing structures on WFF that had not previously been evaluating for historical eligibility, WFF submitted a letter report to VDHR on August 13, 2009. In a letter dated August 24, 2009, VDHR concurred with WFF's determination that Buildings V-45, V-50, and V-55 were not eligible for listing in the NRHP and that no historic resources would be affected by the proposed action, including construction of the HIF.	The EA and has been revised to include VDHR's determination of no adverse affects to cultural resources.
32.	Virginia Department of Historic Resources		We recommend that you request the comments of the National Park Service (NPS) Assateague Island National Seashore regarding indirect effects to the NRHP-listed Assateague Beach Lifeboat Station. According to the NPS directory. Trish Kicklighter is Superintendent and Carl Zimmerman is the Resource Management Specialist. These comments will allow us to better comment on the effects of the proposed undertaking.	In response to VDHR's request to request comments NPS Assateague Island National Seashore regarding indirect effects to the NRHP-listed Assateague Beach Lifeboat Station, NASA contacted Assateague Island National Seashore and requested their input on the Draft EA. Responses to Assateague Island National Seashore' comments have been included in this comment and response matrix.	Text has been added to Section 4.4.4, Cultural Resources, to describe consultation with NPS.
33.	Virginia Marine Resources Commission	Regulatory	[This] project will not be in the Commission's jurisdiction, therefore, no authorization would be required from the Marine Resources Commission. However, if any portion of the proposed project extends channelward of mean low water or falls within the Coastal Primary Sand Dunes/Beaches of Accomack County, authorization may be required from the Marine Resources Commission.	Comment noted. If any portion of the Proposed Action would extend channel-ward of mean low water or would fall within the Coastal Primary Sand Dunes/Beaches of Accomack County, NASA will consult with the Marine Resources Commission.	No revision necessary.
34.	Adrianna Ortiz	Wetlands	We understand that due to the need of the expansion and the specific details therein, there is only one alternative action mentioned. However, we feel that there needs to be alternatives listed in detail for various pieces such as possible locations for roads and possible sites for wetland mitigation. The destruction to wetlands is not clearly explained. Acreage is given, but the specific locations and wetland type are missing. We recommend that further details be given on wetland destruction as well as mitigation, along with possible locations of roads to the proposed buildings.	NASA added a new alternative to EA in order to provide an alternative that will minimize the construction of new facilities. NASA is currently completing wetland delineations for the wetlands that would be affected by the proposed action. NASA will submit a JPA for review and approval by USACE, DEQ and local agencies and would obtain the necessary permits (potentially permits under Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act, and Virginia Water Protection permit). NASA will avoid and minimize potential impacts to wetlands to the maximum extent practicable and will fully comply	NASA added an additional proposed action alternative to the EA. The EA has been revised to include additional explanation regarding why no other NASA facilities are under consideration for the proposed action as well as to why the proposed action must occur on Wallops Island. The proposed action figures have been updated to show the footprints of all site improvements.

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				with mitigation measures that are determined through the JPA process. The proposed action figures have been updated to include footprints of all site improvements, including locations of new and modified roads.	
35.	Adrianna Ortiz	Proposed Action Description	It is unclear from Figure 5 if the revised launch pad will have a new building associated with it. We recommend that the figure [5] include a drawing of the building if applicable.	While there is a small facility that may be considered a building located underneath the launch ramp (which can be seen on Figure 5 although it is not labeled) that would house equipment (including telecom and electrical) there is no stand-alone building that will be constructed near the launch pad.	No revision necessary.
36.	Adrianna Ortiz	Floodplain	We also recommend that forethought in engineering include mitigating the risk of storm overwash by elevating structures off the ground, and/or enclosing the various tanks (gases and oils) to shield them from the salt water preserving their integrity.	All new facilities on Wallops Island are required to include flood mitigation measures such as elevating critical infrastructure (transformers, HVAC units, etc.) above the flood zone, or elevating the first floor above the flood zone (minimum of 10 feet above mean sea level [amsl]) – the first floor of the Horizontal Integration Facility will be elevated to 11 feet amsl.	The EA has been revised to include more information regarding flood mitigation measures for new construction on Wallops Island.
37.	Adrianna Ortiz	Threatened and Endangered Species	Modifications to the boat dock on the northern end of Wallops are listed, but are lacking detail. The draft EA does not mention the importance to wildlife of the waters surrounding this boat dock, although it does mention the essential fish habitat (EFH) near pad 0-A. We recommend that more detail be given for which part of the boat dock area will be hardened and by what means. An additional figure would be very helpful to support the text. Also we recommend that the National Marine Fisheries Services be consulted to ensure that the marsh adjacent to the boat dock is not classified as EFH.	NASA coordinated with NMFS Protected Resource Division regarding Proposed Action impacts including work at the Wallops Island boat dock. In a letter dated July 8, 2009 NMFS concurred with NASA's determination that the boat dock improvements "may affect, but is unlikely to adversely affect" Kemp's ridley, Loggerhead, and Atlantic Green sea turtles with implementation of mitigation measures. Mitigation will include a visual sweep of the waterways adjacent to the boat basin each day prior to activities, stationing of a trained observer to watch for turtles entering the waterways, and installation of pilings by vibratory techniques rather than hammer methods to the greatest extent practicable. Additionally, NASA consulted with NMFS Habitat Conservation Division regarding impacts to EFH. In an email response dated August 11, 2009, NMFS concurred that the proposed bulkhead construction will not result in substantial adverse effects to EFH, managed species or their prey species.	The EA has been revised to describe NMFS consultations and responses.
38.	Adrianna Ortiz	Groundwater	The increase of water usage due to the proposed action was not considered significant since the total usage was still within the constraints of the current permit. We would like to reiterate that the expected monthly increase of 44% and expected annual increase of 25% would still increase the demand to the sole source aquifer. We recommend that the water be conserved as much as possible to ensure future water supplies to Wallops Island.	*NASA and MARS will implement water conservation practices in facility design to the maximum extent practicable.*	No revision necessary.

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39.	Adrianna Ortiz	Water Quality	From the description given, the deluge basin will be completely filled prior to each launch. After the launch the pH levels of the water within will be tested before being released into an unlined containment pond. From there the water will drain into the surrounding ecosystem until completely drained from the basin. We would like to mention that the surrounding water is very shallow and has a low turnover rate. By introducing large amounts of nitrogen sources this water is likely to undergo eutrophication, leading to other water quality problems such as low oxygen levels (Ryther and Dunstan 1971). Since this area has been labeled as EFH, it is reasonable to assume that degraded water quality will greatly impact the fish community (Kemp et al. 2005). We recommend that other water quality parameters such as total nitrogen or other possible contaminants be tested for before release to the secondary containment pond. We also recommend that potential impacts to water quality be further investigated and minimized where possible.	NASA will coordinate with DEQ regarding permitting of discharges from the deluge basin under the VPDES program. Based on experience at other NASA facilities, no other contaminants (such as nitrogen) would be expected. Other regulators (equivalent to DEQ) have required testing and set guidelines for temperature, total suspended solids, and oil/grease. DEQ will likely require testing of the discharge water including but not limited to pH. NASA will obtain a VPDES permit and following testing and discharge requirements outline in the permit. Air quality modeling discussed in the EA shows that the reaction of the exhaust gas with the deluge water produces the following constituents: water, carbon dioxide, oxygen, hydroxide, carbon monoxide, dioxygen, hydrogen, and perhydroxyl radical (HO_2). The amount of gas versus liquid is not specified in these constituents. As stated in the EA, weak carbonic acid also may be formed. Total nitrogen is not anticipated to be in the deluge water above background levels in the groundwater.	No revision necessary.
40.	Adrianna Ortiz	Threatened and Endangered Species	Section '4.2.4 Noise', discusses the potential noises from construction, transportation, and launches. Piping plovers are mentioned as a potential receptor and more details are given later. Under the subheading 'sonic booms', it states that noise impacts to wildlife will be discussed below. However, this subject is not brought up until '4.3.2 Terrestrial Wildlife and Migratory Birds, and even there the information given is vague.	NASA is currently informally consulting with USFWS regarding impacts on piping plover, seabeach amaranth, and red knot for the proposed action activities. Although, some adverse impacts are anticipated, they are not expected to be substantial. NASA expects to enter formal consultation with USFWS in the near future.	Section 4.3.3, Threatened and Endangered Species, has been revised to describe additional analysis performed during NASA's current consultation with USFWS.
41.	Adriannia Ortiz	Threatened and Endangered Species	The proposed payload fueling facility building is near the known peregrine falcon (listed by Virginia as threatened (VDGIF 2009)) nest on Wallops Island, VA. We recommend that the potential impact from noise disturbances be further evaluated for other wildlife, especially the peregrine falcon.	NASA has included the species that DEQ recommended adding to Table 16 of the Environmental Assessment (EA), including the peregrine falcon, and any necessary additional impacts discussion in Section 4.	Table 16 of the EA (Threatened and Endangered Species in the WFF Area) has been revised to include additional species, and Section 4 of the EA has been revised to include impacts to the additional species as necessary.
42.	Adriannia Ortiz	Safety	Laser use is brought up and some background information on the various classes of lasers is described. For this specific proposal the class of lasers is not mentioned, nor are the potential impacts to wildlife. We recommend that details be given to better characterize the use and potential risks of lasers.	Because the types of lasers that would be used on spacecraft for specific missions is not known at this time, NASA cannot provide further information or details regarding what types of lasers would be utilized. The range of laser classes that could be utilized on spacecraft is described in the EA.	No revision necessary.
43.	Adriannia Ortiz	Assateague Island Closure	In section '4.3.2 Terrestrial Wildlife and Migratory Birds', under 'launch activities', there is confusion about the closures of Assateague during the	The southern portion of Assateague Island is closed (closures are closely coordinated with the Chincoteague National Wildlife Refuge [CNWR])	Section 4.3.2 Text has been revised to clarify that public launch viewing occurs on northern CNWR.

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			launches. First it states that all launches from Pad 0-B require the closure of the southern end of Assateague Island. It then contradicts by stating that Assateague has become a popular observation location for viewing the launches.	during launches; however, the northern portion of Assateague Island and the CNWR remain open during launches and the public is allowed to view launches from designated areas of Assateague Island.	
44.	Adriannia Ortiz	Assateague Island Closure	The last portion of ['4.3.2 Terrestrial Wildlife and Migratory Birds'] digresses as it begins to talk about the inputs of educational resources NASA has brought to the community. We recommend that the role of Assateague during launches be clarified and the information regarding education be placed in the appropriate section, '4.4.1 Population, Employment and Income'.	Section 4.4.1 Population, Employment and Income already contains the same paragraph discussing the opportunities for education (including CNWR) as Section 4.3.2. NASA agrees that the educational paragraph does not belong under Section 4.3.2 and therefore has removed that paragraph from the section while retaining the paragraph discussing educational opportunities under Section 4.4.1.	The sentences discussing educational opportunities for surrounding areas including CNWR has been deleted from the subheading "Launch Activities" under Section 4.3.2 Terrestrial Wildlife and Migratory Birds.
45.	Adriannia Ortiz	Section 4(f) Lands	Section '3.4 Department of Transportation Section 4(F) Lands' discusses regulations concerning the conversion of publicly owned parks, recreational areas, wildlife and waterfowl refuges, and public or private historical sites to non-recreational lands. Section '3.4.2 Public Lands and Refuges', mentions the validity of these regulations not only to public land holdings, but also to 'Federal lands'. It is our understanding that the incorporation of 'federal lands' in this section is an error. We recommend its removal or clarification if applicable.	NASA agrees that the wording in Section 3.3.8.2 Public Lands and Refuges is confusing and the placement of the words "Federal lands" should be revised to properly imply the intent of the regulations.	The text in Section 3.3.8.2 of the EA has been revised to the following: "Section 4(f) prohibits park and recreation lands, and wildlife and waterfowl refuges from being converted to non-recreational use on Federal lands or other public land holdings (e.g., State forests)…"
46.	Adriannia Ortiz	References	Last we have noticed that approximately one whole page from the reference section ('Section Eight References') was from a NASA source. We recommend that outside sources be integrated into the document to support in-house research effort findings.	NASA utilized many non-NASA references and information as necessary, and these are listed in Section 8. Several NASA documents (WFF and non-WFF) contained pertinent information for this EA, so the list in Section 8 for NASA related references is large.	No revision necessary.
47.	Virginia Department of Environmental Quality (DEQ) – Tidewater Regional Office (TRO)	Water Quality and Wetlands	According to the DEQ TRO, it appears that the existing Virginia Pollutant Discharge Elimination System (VPDES) permit for Wallops Island may require modification to address any new discharges of process wastewater and industrial stormwater. If the quench water used during rocket launches will require an adjustment to its pH, the discharge of this treated wastewater will require a permit under the VPDES program.	NASA will coordinate with DEQ TRO to obtain a VPDES permit and DEQ requirements for discharge of the deluge water.	The EA has been revised to include a reference to the need for a VPDES permit for the discharge of the deluge water after launches and static fire tests.
48.	DEQ TRO	Water Quality	The DEQ TRO will evaluate whether stormwater runoff from the rocket launch pads should be covered in the [VPDES] permit. The existing VPDES permit for the NASA Wallops Island facility is currently being reviewed by DEQ for reissuance. Therefore, any additional discharges will be included in DEQ's permit evaluation.	NASA will coordinate with DEQ regarding permitting requirements for stormwater runoff from Launch Pad 0-A and inclusion of any new discharges associated with the Proposed Action in the reissued VDPES permit.	No revision necessary.

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49.	DEQ TRO	Groundwater	DEQ TRO notes that the proposed deluge system will use 100,000 gallons of potable groundwater for each launch or static fire. DEQ TRO believes that this is not the best use of potable water from the Eastern Shore confined aquifer system. DEQ TRO recommends that NASA investigate the feasibility of constructing a shallow water table well for the sole purpose of filling the storage tank for the deluge system, provided a reusable source of water is not available. The deluge system water that would be discharged to the concrete-lined retention basin should be recycled back to the storage tank even if some treatment is necessary. Groundwater would only be needed to make up for water loss after the initial filling of the storage tank.	Alternative systems to groundwater were evaluated including the idea of using saltwater; however, the use of saltwater would drastically increase the degradation of the concrete launch pad structure and the water system as a whole. A shallow water table well would likely contain high concentrations of salt, so based on the reasons above, it was also dismissed. The construction of a dedicated water supply and distribution system from Wallops Mainland to the launch pad would be cost prohibitive. The option of reclaiming the water used during launch from the deluge basin would only be feasible to provide a small fraction of the required water due to evaporation and conversion to steam during engine firing.	No revision necessary.
50.	DEQ TRO	Stream and Wetland Impacts	DEQ recommends that stream and wetlands impacts be avoided to the maximum extent practicable. To minimize unavoidable impacts, DEQ recommends [following standard best management practices].	NASA would avoid and minimize impacts to streams and wetlands to maximum extent practicable under any alternative.	No revision necessary.
51.	DEQ TRO	Stream and Wetland Impacts	NASA must prepare and submit a Joint Permit Application (JPA) for review by DEQ TRO for anticipated project impacts to surface waters and wetlands.	NASA is currently completing wetland delineations for the wetlands that would be affected by the proposed action. NASA will submit a JPA for review and approval by USACE, DEQ and local agencies and would obtain the necessary permits (potentially permits under Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act, and Virginia Water Protection permit). NASA will avoid and minimize potential impacts to wetlands to the maximum extent practicable and will fully comply with mitigation measures that are determined through the JPA process.	No revision necessary.
52.	Virginia Department of Conservation and Recreation (DCR)	Stormwater	NASA must prepare and implement an erosion and sediment control plan to ensure compliance with state law and regulations. NASA is ultimately responsible for achieving project compliance through oversight of onsite contractors, regular field inspection, prompt action against non-compliant sites, and other mechanisms consistent with agency policy.	Prior to construction, NASA and/or MARS will apply for a General Permit for Discharges of Stormwater from Construction Activities and develop a project-specific stormwater pollution prevention plan (SWPPP) that would include an erosion and sediment control plan. NASA would oversee the implementation of the SWPPP and acknowledges that it is ultimately responsible for compliance with state law and the General Permit.	No revision necessary.
53.	Virginia DCR	Stormwater	[NASA] is required to register for coverage under the General Permit for Discharges of Stormwater from Construction Activities and develop a project-specific SWPPP.	Prior to construction, NASA and/or MARS will apply for a General Permit for Discharges of Stormwater from Construction Activities and develop a project-specific SWPPP that would include an erosion and sediment control plan.	No revision necessary.

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54.	DEQ Air Quality Division	Air Quality	NASA should take all reasonable precautions to limit emissions of volatile organic compounds and oxides of nitrogen, principally by controlling or limiting the burning of fossil fuels.	NASA will limit emissions by controlling or limiting the burning of fossil fuels to the maximum extent practicable	No revision necessary.
55.	DEQ Air Quality Division	Air Quality	During construction, fugitive dust must be kept to a minimum by using control methods outlined in 9 VAC 5-50-60 et seq. of the Regulations for the Control and Abatement of Air Pollution.	NASA will implement dust control best management practices to keep fugitive dust to a minimum utilizing applicable methods outlined in 9 VAC 5-50-60 et seq. of the Regulations for the Control and Abatement of Air Pollution.	No revision necessary.
56.	DEQ Air Quality Division	Air Quality	On May 8, 2009 Wallops Flight Facility submitted a permit application for this project under Article 6 (Minor New Source Review). TRO is currently in the process of determining permit applicability for this project.	Comment noted.	The EA has been revised to state that NASA's permit application for this project under the state's Minor New Source Review program is being reviewed by DEQ.
57.	DEQ Waste Division	Hazardous and Solid Waste	DEQ encourages all construction projects and facilities to implement pollution prevention principles including the reduction, reuse, and recycling of all solid wastes generated. All generation of hazardous wastes should be minimized and handled appropriately.	NASA and MARS will implement pollution prevention measures including reduction, reuse, and recycling of solid waste, and will handle hazardous waste according to applicable state and federal regulation. The generation of hazardous waste will be kept to the minimum necessary.	No revision necessary.
58.	DEQ TRO	Storage Tanks	NASA must comply with the requirements of the DEQ Storage Tank Program.	NASA will fully comply with the DEQ Storage Tank Program requirements.	No revision necessary.
59.	DEQ	Herbicides and Pesticides	DEQ recommends that the use of herbicides or pesticides for construction or landscape maintenance should be in accordance with the principles of integrated pest management. The least toxic pesticides that are effective in controlling the target species should be used.	NASA and MARS will utilize integrated pest management practices and the least toxic pesticides that are effective when using herbicides and pesticides for construction or landscape maintenance.	No revision necessary.
60.	DEQ Department of Conservation and Recreation (DCR)	Natural Heritage Resources	DCR concurs with the finding attributed to the USFWS in the EA (page 66) that negative impacts to the piping plover from the proposed action are unlikely.	Comment noted.	No revision necessary.
61.	DEQ DCR-Department of Natural Heritage (DNH)	Threatened and Endangered Species	DCR-DNH recommends that NASA continue to monitor piping plover populations, continue coordinating with USFWS and DGIF, and contact DCR-DNH for an update on natural heritage information if a significant amount of time passes before the project is initiated.	NASA will continue to monitor piping plover populations and coordinating with USFWS and DGIF. NASA will contact DEQ, including DCR-DNH, if the proposed action changes or a significant amount of time has passed before the proposed action is implemented.	No revision necessary.
62.	Virginia Department of Game and Inland Fisheries (DGIF)	Threatened and Endangered Species	DGIF recommends that the following information and analysis be included in the final EA: fully address impact associated with the proposed expansion upon the habitat requirements of avian species.	Section 4 of the EA (Environmental Consequences) has been updated as necessary to include more information on protected avian species.	Section 4 of the EA (Environmental Consequences) has been updated as necessary to include more information on protected avian species
63.	DGIF	Threatened and Endangered Species	DGIF recommends that the following information and analysis be included in the final EA: update Section 3.2.3 Table 16 to reflect the state status	Table 16 in Section 3.2.3 Threatened and Endangered Species of the EA has been revised to include the species that DEQ recommended and updated to reflect	Table 16 in Section 3.2.3 Threatened and Endangered Species of the EA has been revised to include the species that

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			species [with the information provided in the DEQ comment letter dated 6/18/09].	the state status of some species.	DEQ recommended and updated to reflect the state status of some species.
64.	DGIF	Threatened and Endangered Species	DGIF recommends that the following information and analysis be included in the final EA: fully evaluate the additional species [state-listed bald eagle, sperm whale, sei whale, blue whale, Florida manatee] for impacts associated with the launch and reentry of rockets from MARS in addition to any other activities associated with the proposed upgrades to the facility.	Table 16 in Section 3.2.3 Threatened and Endangered Species of the EA has been revised to include the species that DEQ recommended and updated to reflect the state status of some species; Section 4 of the EA (Environmental Consequences) has been updated as necessary to include the species added to Table 16.	Table 16 in Section 3.2.3 Threatened and Endangered Species of the EA has been revised to include the species that DEQ recommended and updated to reflect the state status of some species; Section 4 of the EA (Environmental Consequences) has been updated as necessary to include the species added to Table 16.
65.	DGIF	Threatened and Endangered Species	DGIF recommends that the following information and analysis be included in the final EA: include the red knot in Section 3.2.3 Table 16	Table 16 in Section 3.2.3 Threatened and Endangered Species of the EA has been revised to include the red knot per DEQ's recommendation; Section 4 of the EA (Environmental Consequences) has been updated as necessary to include the species added to Table 16.	Table 16 in Section 3.2.3 Threatened and Endangered Species of the EA has been revised to include the red knot per DEQ's recommendation; Section 4 of the EA (Environmental Consequences) has been updated as necessary to include the species added to Table 16.
66.	DGIF	Threatened and Endangered Species	DGIF recommends that the following information and analysis be included in the final EA: address the impact s of increased rocket launches on wildlife resources and provide alternatives for operations at MARS that may avoid, minimize or mitigate such impacts (this may include options such as a reduced number of launches during the breeding season).	Additional analysis regarding impacts to both state and federally listed species has been added. NASA has been consulting with USFWS during the preparation of this EA and will adhere to all mitigation and monitoring measures developed during the consultation	Section 4.3.3 Threatened and Endangered Species of the EA has been revised to include additional analysis and details of the ongoing consultation with USFWS.
67.	DGIF	Threatened and Endangered Species	DGIF recommends that the following information and analysis be included in the final EA: detail the number of planned launches from MARS and the effect that an increase in the number of launches, if proposed, may have on nearby wildlife resources (this should also include a detailed discussion about cumulative impacts).	Additional analysis regarding impacts to wildlife including state and federally listed species has been added to the EA.	Sections 4.3.2 Terrestrial Wildlife and Migratory Birds and 4.3.3 Threatened and Endangered Species of the EA have been revised to include additional analysis.
68.	Virginia Department of Forestry (VDOF)	Forest Resources	VDOF finds that the proposed project would have no significant impact on the forest resources of the Commonwealth.	Comment noted.	No revision necessary.
69.	Virginia Department of Mines, Minerals, and Energy (DMME)	Geologic and Mineral Resources	DMME anticipates that the proposed action would have no significant impact to mineral resources.	Comment noted.	No revision necessary.
70.	Virginia Department of Transportation (VDOT)	Transportation	VDOT concludes that any additional traffic or traffic disruptions related to the proposed action would be negligible. Any VDOT land use requirements, lane closures, traffic control or work zone safety issues should be closely coordinated with the Accomack County and the VDOT Accomac Residency Office.	As stated in the EA, NASA would notify and coordinate with the VDOT Accomac Residency Office and Accomack County for any lane closures, traffic control, traffic disruptions, or work zone safety issues.	No revision necessary.

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71.	Accomack County Administrators Office	Proposed Action	The Accomack County Administrators Office fully supports the proposed action.	Comment noted.	No revision necessary.
72.	DEQ Office of Pollution Prevention	Pollution Prevention	DEQ has several pollution prevention recommendations that may be helpful in the construction of the project and operation of the facility [listed in letter dated 6/18/09].	NASA and MARS would implement the pollution prevention measures during construction as appropriate, including the recommendations provided by DEQ.	No revision necessary.
73.	DEQ DMME	Energy Conservation	The proposed facility should be planned and designed to comply with state and federal guidelines industry standards for energy conservation and efficiency.	NASA and MARS would design and implement energy conservation and efficiency measures into building and facility design as appropriate, and would comply with all state and federal guidelines and industry standards.	No revision necessary.
74.	DEQ	Water Conservation	DEQ provides several recommendations that will result in reduced water use associated with the operation of the facility [listed in letter dated 6/18/09].	NASA and MARS would implement the water conservation measures into building and facility design as appropriate.	No revision necessary.
75.	DEQ	Federal Consistency Determination	DEQ concurs that this proposal is consistent with the Virginia Coastal Resources Management Program.	Comment noted.	No revision necessary.
76.	National Park Service Assateague Island National Seashore		We concur with [NASA's] assessment that the proposed action will not result in adverse indirect effects on the cultural landscape and vistas associated with the Assateague Beach Coast Guard Station located on Assateague Island, VA. As you noted, the existing viewshed from the perspective of the Coast Guard Station looking towards Wallops Island has been significantly altered by the previous development of facilities supporting the WFF mission. As such, the proposed new infrastructure will not appreciably alter the existing visual characteristics of the area.	Comment noted.	Text has been added to Section 4.4.4, Cultural Resources, to describe consultation with NPS.
77.	National Park Service Assateague Island National Seashore		Should there be a need to mitigate the impacts of whatever disposition is ultimately selected [regarding the future of the Wallops Station], [NPS] would ask that [NASA] consider the Assateague Beach Station as a potential mitigation option.	Comment noted.	No revision necessary.