FINAL
ENVIRONMENTAL ASSESSMENT

WALLOPS FLIGHT FACILITY
ALTERNATIVE ENERGY PROJECT

Prepared for

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

In cooperation with

U.S. Army Corps of Engineers

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Prepared by

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WALLOPS FLIGHT FACILITY

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

Lead Agency: National Aeronautics and Space Administration

Cooperating Agency: U.S. Army Corps of Engineers

Proposed Action: Alternative Energy Project

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Abstract: This Final Environmental Assessment has been prepared to evaluate the potential environmental impacts from alternative energy sources that would be capable of generating up to 10 gigawatt-hours per year of electricity at Wallops Flight Facility (WFF). The purpose of the proposed Alternative Energy Project is to generate clean, renewable energy at WFF from a technologically proven source to reduce utility costs and meet the requirements of the 2005 Federal Energy Policy Act and Executive Orders 13423 and 13514. The WFF project would also support the National Aeronautics and Space Administration's goal to set an example of leadership in environmental stewardship and accountability by a Federal agency. The Proposed Action, which would involve the installation of solar panels and two residential-scale wind turbines, would have both adverse and beneficial impacts on environmental resources. Adverse impacts would be mitigated to the greatest extent practicable to minimize the effects on resources.

INTRODUCTION

This Final Environmental Assessment (EA) has been prepared to evaluate the potential environmental impacts from alternative energy sources that would be capable of generating up to 10 gigawatt-hours per year (GWh/year) of electricity at National Aeronautics and Space Administration's (NASA's) Wallops Flight Facility (WFF). This EA has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended (42 United States Code [U.S.C.] 4321–4347), the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500–1508), the NASA regulations for implementing NEPA (14 CFR Subpart 1216.3), and the NASA Procedural Requirements (NPR): *Implementing NEPA and Executive Order (EO) 12114* (NPR 8580.1).

The U.S. Army Corps of Engineers (USACE) has served as a Cooperating Agency in the preparation of this EA because they possess regulatory authority over two of the Alternatives considered in this EA. As such, this EA has been developed to also fulfill the USACE's obligations under NEPA. NASA, as the WFF property owner and project proponent, is the Lead Agency and responsible for ensuring overall compliance with applicable environmental statutes, including NEPA.

PURPOSE AND NEED FOR THE ACTION

The purpose of the proposed Alternative Energy Project is to generate clean, renewable energy at WFF from a technologically proven source in order to meet the requirements of the 2005 Federal Energy Policy Act and EOs 13423 and 13514. The WFF project would also support NASA's goal to set an example of leadership in environmental stewardship and accountability by a Federal agency. Additionally, EO 13423 and NASA Policy Directive 8500.1B require revisions to the NASA Environmental Management System (EMS) procedural requirements, NPR 8553.1, to address the implementation of "sustainable practices" through the EMS, including energy/water conservation, reduction of greenhouse gases (GHGs), fleet management, sustainable acquisition, and development of sustainable facilities. The implementation of proven, renewable energy sources such as wind turbines or solar panels at WFF would meet the facility's goal to reduce GHG emissions by reducing the use of fossil fuels to generate electricity, while also reducing WFF's annual operating costs.

PROPOSED ACTION AND ALTERNATIVES

The Proposed Action and Alternatives consist of developing renewable, self-sufficient energy sources at WFF to supplement the electricity currently supplied to WFF by the local electric cooperative. This EA encompasses a 25-year planning horizon, which is based on the expected life span of the proposed wind turbines and solar panels.

Proposed Action

Under the Proposed Action, NASA's preferred alternative, NASA would install a system of solar panels at the Main Base that would be capable of generating 10 GWh/year of power. Additionally, two 2.4 kilowatt (kW) residential-scale wind turbines would be installed.

To produce 10 GWh/year of energy, NASA would install an 8.0 MW system of solar panels. The solar panel system would consist of approximately 38,000 1.4-square-meter (15-square-foot) panels that would equal an area of approximately 6 hectares (15 acres). Panel spacing requirements (to avoid shading and allow maintenance) would increase the overall required land area dedicated to solar panels to approximately 32 hectares (80 acres).

The power generated by the solar panels would be connected via underground transmission lines to a set of switchgear that would be enclosed in a small 5-meter by 6-meter (16-foot by 20-foot) pre-fabricated building. Solar panels would be installed in open, grassy areas or over parking lots at Wallops Main Base. The installation period for the solar panels would be approximately 2 months.

One of the residential-scale 2.4 kW wind turbines would be installed near the WFF Visitors Center, and a second would be installed near the entrance gate/security guard station at the Mainland. The residential-scale wind turbines would be installed with a setback distance of 30 meters (100 feet) from existing towers, buildings, and trees. No transformers or interconnection switchgear would be needed.

The residential-scale turbines would not contribute much to the percent of energy generated from renewable sources at WFF because of their small power output; their primary purpose would be to provide outreach and education to WFF employees and the public about renewable energy.

Alternative One

Under Alternative One, NASA would install one utility-scale wind turbine on Wallops Island that would be capable of generating 5 GWh of electricity per year. The single 2.0 MW wind turbine would be located west of the U.S. Navy V-10/V-20 complex in the location as the southern wind turbine shown on Figure 6. The construction period for the single utility wind turbine would be approximately 4 months. NASA would also install two residential-scale 2.4 kW wind turbines at the Main Base and Mainland as described under the Proposed Action Alternative.

In addition to the wind turbines, NASA would install a system of solar panels at Wallops Main Base that would be capable of generating up to 5 GWh/year (the equivalent of one utility-scale wind turbine). Approximately 19,000 1.4-square-meter (15-square-foot) solar panels, equaling an area of approximately 3 hectares (7.5 acres), would be needed to meet this power generating capability. Panel spacing requirements would increase the overall required land area dedicated to solar panels to approximately 16 hectares (40 acres).

The power generated by the solar panels would be connected via underground transmission lines to a set of switchgear that would be enclosed in a small 5-meter by 6-meter (16-foot by 20-foot) pre-fabricated building. Solar panels would be installed in open, grassy areas or over parking lots at Wallops Main Base. The installation period for the solar panels would be approximately 2 months.

Alternative Two

NASA would install two 2.0 MW utility-scale wind turbines on Wallops Island that would be capable of generating approximately 10 GWh/year of power and two 2.4 kW residential-scale wind turbines at the Main Base and Mainland as described under the Proposed Action Alternative.

The utility-scale wind turbines would be located on Wallops Island west of the U.S. Navy V-10/V-20 complex (Figures 6 and 7). The footprint, work space, and staging areas would be the same as described under Alternative One, but the construction period would be approximately 6 months.

No Action Alternative

Under the No Action Alternative, NASA would not participate in the funding or construction of renewable energy sources at WFF to supplement the current supply of electricity that is provided by the local electric cooperative. The cost of all electricity purchased by WFF would continue to fluctuate based on market conditions, and could be subject to sharp increases, as experienced in recent years. The requirements for the implementation of sustainable practices for energy efficiency and reductions in GHG emissions, and for the use of renewable energy set forth in the Federal regulations, would not be met by WFF.

SUMMARY OF ENVIRONMENTAL IMPACTS

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts on environmental resources. However, there would be no reduction in the use of fossil fuels, which contribute to GHG production and global climate change, during the production of electricity that supplies WFF.

Potential environmental impacts resulting from the Proposed Action and Alternatives are summarized in the Table ES-1 below.

Table ES-1: Summary of Environmental Impacts for the Proposed Action and Alternatives

Resource	Proposed Action	Alternative One	Alternative Two
Topography	No impacts would occur with installation of the residential-scale wind turbines. Long-term minor adverse impacts from solar panel support posts and the trenching for electrical lines.	No impacts from installation of the residential-scale wind turbines. Long-term minor adverse impacts from solar panel support posts and the trenching for electrical lines. Long-term minor adverse impacts from construction of concrete piles to depths of 30 meters (100 feet) and permanent access road to utility-scale wind turbine within wetlands. Changes to natural drainage patterns would be minor.	No impacts from installation of the residential-scale wind turbines. Long-term minor adverse impacts from solar panel support posts and the trenching for electrical lines. Long-term minor adverse impacts from construction of concrete piles to depths of 30 meters (100 feet) and permanent access road to two utility-scale wind turbines within wetlands. Changes to natural drainage patterns would be minor.

Resource	Proposed Action	Alternative One	Alternative Two
Geology and Soils	Spills or leaks of pollutants would have the potential to adversely affect soils. NASA would implement site-specific Best Management Practices (BMPs) for vehicle and equipment fueling and maintenance, and spill prevention and control measures.	Spills or leaks of pollutants would have the potential to adversely affect soils. NASA would implement site-specific BMPs for vehicle and equipment fueling and maintenance, and spill prevention and control measures. Minor long-term impacts on geology immediately around the driven piles.	Spills or leaks of pollutants would have the potential to adversely affect soils. NASA would implement site-specific BMPs for vehicle and equipment fueling and maintenance, and spill prevention and control measures. Minor long-term impacts on geology immediately around the driven piles.
Land Use	Long-term adverse impacts on land use in areas of Main Base where solar panels would be installed.	No changes to or impacts on existing or planned land use at Wallops Island. Long-term adverse impacts on land use in areas of Main Base where solar panels would be installed.	No changes to or impacts on existing or planned land use at Wallops Island.
Surface Waters	Potential adverse impacts from spills or leaks of pollutants during construction. NASA would minimize adverse impacts by acquiring Virginia Stormwater Management Program (VSMP) permits as necessary and implementing BMPs and WFF's Integrated Contingency Plan (ICP).	Potential adverse impacts from spills or leaks of pollutants during construction or operation. NASA would minimize adverse impacts by acquiring VSMP permits as necessary and implementing BMPs and WFF's ICP.	Potential adverse impacts from spills or leaks of pollutants during construction or operation. NASA would minimize adverse impacts by acquiring VSMP permits as necessary and implementing BMPs and WFF's ICP.
Wetlands	No impacts.	Up to 0.17 hectare (0.41 acre) of wetlands would be filled. NASA would obtain necessary permits via the Virginia Marine Resources Commission (VMRC) Joint Permit Application (JPA) process and would implement 0.17 hectare (0.41 acres) of compensatory mitigation at WFF's Mainland.	Up to 0.36 hectare (0.88 acre) of wetlands would be filled. NASA would obtain necessary permits via the VMRC JPA process and would implement 0.362 hectare (0.895 acres) of compensatory mitigation at WFF's Mainland.
Floodplains	No impacts.	The utility-scale wind turbines would be located within the 100-year and 500-year floodplains. Because Wallops Island is	The utility-scale wind turbines would be located within the 100-year and 500-year floodplains. Because Wallops Island is entirely

Resource	Proposed Action	Alternative One	Alternative Two
		entirely within the floodplain, no practicable alternatives exist. The functionality of the floodplain on Wallops Island would not be adversely impacted.	within the floodplain, no practicable alternatives exist. The functionality of the floodplain on Wallops Island would not be adversely impacted.
Coastal Zone Management	All activities occur within Virginia's Coastal Management Area (CMA). NASA has determined that the Proposed Action is consistent with the enforceable policies of the Coastal Zone Management (CZM) Program.	All activities occur within Virginia's CMA. Activities under Alternative One would be conducted in a way that was consistent with the enforceable policies of the CZM Program.	All activities occur within Virginia's CMA. Activities under Alternative Two would be conducted in a way that was consistent with the enforceable policies of the CZM Program.
Air Quality and Climate Change	Long-term beneficial impacts on air quality and climate change with reduction in use of fossil-fuel power sources and greenhouse gas (GHG) emissions.	Long-term beneficial impacts on air quality and climate change with reduction in use of fossil-fuel power sources and GHG emissions.	Long-term beneficial impacts on air quality and climate change with reduction in use of fossil-fuel power sources and GHG emissions.
Radar	The residential scale wind turbines would be sited in an area that would not impact radar systems at WFF. No impacts on radar from solar panels.	The wind turbines would be sited in an area that would not impact radar systems at WFF. No impacts on radar from solar panels.	The wind turbines would be sited in an area that would not impact radar systems at WFF.
Noise	Operation of the residential scale wind turbines would result in highly localized, long-term, minor impacts on the surrounding environment from noise. No impacts on the occupational health of construction workers as a result of construction noise with implementation of BMPs.	Operation of the wind turbines would result in highly localized, long-term, minor impacts on the surrounding environment from noise. Neither the public nor employees and visitors to WFF outside of Wallops Island would be able to hear the utility-scale wind turbines; therefore, no impacts on either of these two groups would occur. No impacts on the occupational health of construction workers as a result of construction noise with implementation of BMPs.	Operation of the wind turbines would result in highly localized, long-term, minor impacts on the surrounding environment from noise. Neither the public nor employees and visitors to WFF outside of Wallops Island would be able to hear the wind turbines; therefore, no impacts on either of these two groups would occur. No impacts on the occupational health of construction workers as a result of construction noise with implementation of BMPs.

Resource	Proposed Action	Alternative One	Alternative Two
Hazardous Materials and Hazardous Waste Management	Construction, maintenance, and decommissioning activities for the residential-scale wind turbines and solar panels would involve hazardous materials and produce hazardous waste. NASA would ensure implementation of WFF's ICP safety procedures, training, and mitigation measures, including spill prevention and response. Therefore, no impacts on human and environmental health due to hazardous materials and wastes are anticipated.	Construction, maintenance, and decommissioning activities for the wind turbines and solar panels would involve hazardous materials and produce hazardous waste. NASA would ensure implementation of WFF's ICP safety procedures, training, and mitigation measures, including spill prevention and response. Therefore, no impacts on human and environmental health due to hazardous materials and wastes are anticipated.	Installation, maintenance, and decommissioning activities for the wind turbines would involve hazardous materials and produce hazardous waste. NASA would ensure implementation of WFF's ICP safety procedures, training, and mitigation measures, including spill prevention and response. Therefore, no impacts on human and environmental health due to hazardous materials and wastes are anticipated.
Munitions and Explosives of Concern (MEC)	Construction personnel working at the Visitor Center area on the residential-scale turbines would be required to attend MEC training to understand the potential MEC at the site. To ensure that excavation equipment does not hit or expose any unknown MEC, digging operations would be surveyed with a magnetometer and cleared and properly disposed by trained personnel.	Construction personnel working at the Visitor Center area on the residential-scale turbines would be required to attend MEC training to understand the potential MEC at the site. To ensure that excavation equipment does not hit or expose any unknown MEC, digging operations would be surveyed with a magnetometer and cleared and properly disposed by trained personnel.	Construction personnel working at the Visitor Center area on the residential-scale turbines would be required to attend MEC training to understand the potential MEC at the site. To ensure that excavation equipment does not hit or expose any unknown MEC, digging operations would be surveyed with a magnetometer and cleared and properly disposed by trained personnel.

Resource	Proposed Action	Alternative One	Alternative Two
Vegetation and Terrestrial Wildlife	Long-term adverse, but highly localized, impacts from the loss of vegetation within the footprint of the support posts for the solar panels and residential-scale wind turbines.	Short-term adverse impacts due to excavation and grading to install the wind turbines, pilings, access roads, and underground cables. Long-term, adverse impacts due to the permanent conversion of 0.17 hectare (0.41 acre) of wetlands to developed land. Long-term adverse, but highly localized, impacts from the loss of vegetation within the footprint of the support posts for the solar panels.	Short-term adverse impacts due to excavation and grading to install the wind turbines, pilings, access roads, and underground cables. Long-term, adverse impacts due to the permanent conversion of 0.36 hectare (0.88 acre) of wetlands to developed land.
Birds and Bats	Because the installation of solar panels at the Main Base would not alter or remove bat habitat, nor would their operation interfere with bird or bat activities, no impacts are anticipated from solar panels. There is a general lack of data on the impacts of residential-scale turbines on avifauna. NASA would implement a post-construction monitoring study as a means of ground truthing the residential-scale wind turbines' risk profile.	Long-term adverse impacts due to the conversion of wetland habitat to developed land and from operation of the wind turbines. Potential avoidance and/or minimization BMPs would be implemented to reduce the potential long-term (direct and indirect) impacts. Because the installation of solar panels at the Main Base would not alter or remove bat habitat, nor would their operation interfere with bird or bat activities, no impacts are anticipated from solar panels. There is a general lack of data on the impacts of residential-scale turbines on avifauna. NASA would implement a post-construction monitoring study as a means of ground truthing the residential-scale wind turbines' risk profile.	Long-term adverse impacts due to the conversion of wetland habitat to developed land and from operation of the wind turbines. Potential avoidance and/or minimization BMPs would be implemented to reduce the potential long-term (direct and indirect) impacts. There is a general lack of data on the impacts of residential-scale turbines on avifauna. NASA would implement a post-construction monitoring study as a means of ground truthing the residential-scale wind turbines' risk profile.

Resource	Proposed Action	Alternative One	Alternative Two
Threatened and Endangered Species	No effect on State or federally listed species in the project area at the Main Base.	NASA determined that the solar panels would have no effect on State or federally listed species in the project area at the Main Base. NASA determined that the installation and operation of a utility-scale wind turbine “may affect, and is likely to adversely affect” the Piping Plover and Red Knot. The project would have “no effect” to federally listed mammals, sea turtles, insects, and plants. NASA submitted a Biological Assessment to USFWS with the Draft EA. However, because the Proposed Action changed between the Draft EA and Final EA, NASA has determined that there would no longer be the potential for effects on federally listed species under the Proposed Action. Accordingly, NASA is no longer consulting with USFWS pursuant to Section 7 of the ESA.	NASA determined that the solar panels would have no effect on State or federally listed species in the project area at the Main Base. NASA determined that the installation and operation of a utility-scale wind turbine “may affect, and is likely to adversely affect” the Piping Plover and Red Knot. The project would have “no effect” to federally listed mammals, sea turtles, insects, and plants. NASA submitted a Biological Assessment to USFWS with the Draft EA. However, because the Proposed Action changed between the Draft EA and Final EA, NASA has determined that there would no longer be the potential for effects on federally listed species under the Proposed Action. Accordingly, NASA is no longer consulting with USFWS pursuant to Section 7 of the ESA.
Essential Fish Habitat (EFH)	No impacts.	Short-term adverse impacts on EFH from filling wetlands for utility-scale turbine footprint, but impacts are not expected to be substantial. Effects on EFH would be offset by compensatory mitigation at WFF’s Mainland.	Short-term adverse impacts on EFH from filling wetlands for utility-scale turbine footprints, but impacts are not expected to be substantial. Effects on EFH would be offset by compensatory mitigation at WFF’s Mainland.
Population, Employment, and Income	Construction activities may temporarily increase local employment opportunities and would benefit local stores and businesses.	Construction activities may temporarily increase local employment opportunities and would benefit local stores and businesses.	Construction activities may temporarily increase local employment opportunities and would benefit local stores and businesses.
Environmental. Justice	No impacts.	No impacts.	No impacts.
Cultural	With the exception of the residential-scale wind	With the exception of the residential-scale wind	With the exception of the residential-scale wind turbine

Resource	Proposed Action	Alternative One	Alternative Two
Resources	turbine to be placed at the WFF Visitor Center, all ground disturbances would be located outside of areas designated as having moderate or high potential for archeological resources. No adverse effects on archaeological resources or aboveground historic properties or viewsheds within or outside WFF are anticipated. Residential-scale turbine construction at the Visitor Center would occur within an area deemed high for archeological sensitivity. Consultation with the Virginia Department of Historic Resources (VDHR) concluded that an archeologist would monitor the site during construction.	turbine to be placed at the WFF Visitor Center, all ground disturbances would be located outside of areas designated as having moderate or high potential for archeological resources. No adverse effects on archaeological resources aboveground historic properties or viewsheds within or outside WFF are anticipated Residential-scale turbine construction at the Visitor Center would occur within an area deemed high for archeological sensitivity. Consultation with VDHR concluded that an archeologist would monitor the site during construction.	to be placed at the WFF Visitor Center, all ground disturbances are located outside of areas designated as having moderate or high potential for archeological resources. No adverse effects on archaeological resources or aboveground historic properties or viewsheds within or outside WFF are anticipated. Residential-scale turbine construction at the Visitor Center would occur within an area deemed high for archeological sensitivity. Consultation with VDHR concluded that an archeologist would monitor the site during construction.
Transportation	No impacts on transportation are anticipated.	Temporary impacts on traffic flow would occur during construction activities. With implementation of mitigation and safety measures related to transportation and traffic closures due to oversize loads, no substantial impacts on transportation are anticipated.	Temporary impacts on traffic flow would occur during construction activities. With implementation of mitigation and safety measures related to transportation and traffic closures due to oversize loads, no substantial impacts on transportation are anticipated.
Aesthetics	No adverse impacts on the public viewshed given the distance of the residential-scale turbines from surrounding communities. Wind turbines would be white to blend in with the sky. Negligible potential adverse impacts on WFF employees and visitors within residential scale turbine shadow due to	No adverse impacts on the public viewshed given the distance of the turbines from surrounding communities. Wind turbines would be white to blend in with the sky. Potential adverse impacts on WFF employees and visitors within turbine shadow due to flickering effect of spinning blades on sunny	No adverse impacts on the public viewshed given the distance of the turbines from surrounding communities. Wind turbines would be white to blend in with the sky. Potential adverse impacts on WFF employees and visitors within turbine shadow due to flickering effect of spinning blades on sunny days.

Resource	Proposed Action	Alternative One	Alternative Two
	flickering effect of spinning blades on sunny days. Implementation of solar panels would result in long-term changes to the viewshed at the Main Base. Because WFF is a highly industrialized setting with numerous antenna arrays and other infrastructure, solar panels should not present a negative impact on the viewshed.	days. Implementation of solar panels would result in long-term changes to the viewshed at the Main Base. Because WFF is a highly industrialized setting with numerous antenna arrays and other infrastructure, solar panels should not present a negative impact on the viewshed.	
Cumulative Effects	There may be adverse cumulative impacts on avifauna from construction and operation of the residential-scale wind turbines. There would be beneficial impacts on air quality from the use of wind turbines and solar panels due to reduced GHG emissions and lowered use of fossil fuels during the production of electricity.	There would be adverse cumulative impacts on avifauna from construction and operation of the utility-scale wind turbines. Cumulative impacts on wetlands would be mitigated. There would be beneficial impacts on air quality from the use of wind turbines and solar panels due to reduced GHG emissions and lowered use of fossil fuels during the production of electricity.	There would be adverse cumulative impacts on avifauna from construction and operation of the utility-scale wind turbines. Cumulative impacts on wetlands would be mitigated. There would be beneficial impacts on air quality due to reduced GHG emissions and lowered use of fossil fuels during the production of electricity.

Appendices

Photographs

Tables

Figures

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ACHP	Advisory Council on Historic Preservation
ACUA	Atlantic County Utilities Authority
amsl	above mean sea level
APE	Area of Potential Effect
APWRA	Altamont Pass Wind Resource Area
ASR	Archive Search Report
AST	aboveground storage tank
AWEA	American Wind Energy Association
BA	Biological Assessment
BBSH	Big brown/Silver-haired bat Guild
BMP	Best Management Practice
BTU	British Thermal Unit
CAA	Clean Air Act
CBC	Christmas Bird Counts
CBRA	Coastal Barrier Resources Act
CBRS	Coastal Barrier Resources System
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	Methane
CMA	Coastal Management Area
CNWR	Chincoteague National Wildlife Refuge
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CRA	Cultural Resources Assessment
CWA	Clean Water Act
CZM	Coastal Zone Management (Program)
dB	Decibel
dBA	decibel weighted to the A-scale
DCR	Virginia Department of Conservation and Recreation
DoD	Department of Defense
DOT	Department of Transportation
E&SC	Erosion and Sediment Control
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJIP	Environmental Justice Implementation Plan
EMS	Environmental Management System
EO	Executive Order
EPA	Environmental Protection Agency
EPAct	Federal Energy Policy Act
ESA	Endangered Species Act

FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
GAO	Government Accountability Office
GHG	greenhouse gas
GPS	Global Positioning System
GSFC	Goddard Space Flight Center
GWh	gigawatt-hours
GWP	global warming potential
HAP	Hazardous Air Pollutant
HVAC	heating, ventilation and air conditioning
IBA	Important Bird Area
ICP	Integrated Contingency Plan
IEC	International Electrotechnical Commission
JD	jurisdictional determination
JPA	Joint Permit Application
kph	kilometers per hour
kW	kilowatt
L_{01}	sound level exceeded 1 percent of the time
L_{10}	sound level exceeded 10 percent of the time
L_{90}	sound level exceeded 90 percent of the time
L_{eq}	time-averaged sound level
lbs	Pounds
LED	Light-emitting diode
LEED	Leadership in Energy & Environmental Design
MARS	Mid-Atlantic Regional Spaceport
MBTA	Migratory Bird Treaty Act
MEC	Munitions and Explosives of Concern
MSDS	Material Safety Data Sheet
MW	Megawatt
MWh	megawatt-hours
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act

NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_X	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NPR	NASA Procedural Requirements
NPS	National Park Service
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
O_3	Ozone
OSHA	Occupational Safety and Health Administration
Pb	Lead
PBS	Plum Brook Station
PM	particulate matter
$PM_{2.5}$	particulate matter less than or equal to 2.5 microns
PM_{10}	particulate matter less than or equal to 10 microns
ppm	parts per million
PTE	potential to emit
PV	Photovoltaic
RBEP	Eastern red bats, Eastern pipistrelles, Evening bats Guild
RCRA	Resource Conservation and Recovery Act
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SO_X	sulfur oxides
SRIPP	Shoreline Restoration and Infrastructure Protection Program
SWPPP	Stormwater Pollution Prevention Plan
TREC	Tom Ridge Environmental Center
UAS	Unmanned Aerial System
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDOE	U.S. Department of Energy
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
UXO	Unexploded Ordnance
VAC	Virginia Administrative Code
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

SECTION ONE: MISSION, PURPOSE AND NEED, BACKGROUND INFORMATION

1.1 INTRODUCTION

This Environmental Assessment (EA) has been prepared to evaluate the potential environmental impacts from alternative energy sources that would be capable of generating up to 10 gigawatt-hours per year (GWh/year) of electricity at the National Aeronautics and Space Administration's (NASA's) Wallops Flight Facility (WFF). This EA has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended (42 United States Code [U.S.C.] 4321–4347), the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500–1508), the NASA regulations for implementing NEPA (14 CFR Subpart 1216.3), and the NASA Procedural Requirements (NPR): *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 in the *Federal Register*.

The U.S. Army Corps of Engineers (USACE) has served as a Cooperating Agency in the preparation of this EA because they possess regulatory authority over two of the Alternatives considered in this EA. Accordingly, this EA has been developed to also fulfill the USACE's obligations under NEPA. NASA, as the WFF property owner and project proponent, is the Lead Agency and responsible for ensuring overall compliance with applicable environmental statutes, including NEPA.

This EA encompasses a 25-year planning horizon, which is based on the expected life span of the proposed wind turbines and solar panels. This EA will be reviewed for adequacy at any time if 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 CHANGES TO THE PROPOSED ACTION BETWEEN THE DRAFT AND FINAL EA

Based on concerns raised by stakeholders regarding potential impacts on birds and bats from the construction of utility-scale wind turbines on Wallops Island, NASA has revised its Proposed Action in this Final EA for the Alternative Energy Project at WFF.

The Proposed Action in this Final EA consists of solar panels and construction of residential-scale wind turbines; no utility-scale turbines are included. Similar to the Draft EA, Alternative One in this Final EA consists of a combination of solar panels, a single utility-scale wind turbine and residential-scale wind turbines. Alternative Two in this Final EA, which was NASA's Proposed Action in the Draft EA, consists of constructing two utility-scale wind turbines and residential-scale wind turbines. Two residential-scale wind turbines are included in all three action alternatives carried forward in this Final EA instead of the five residential-scale turbines proposed in the Draft EA.

1.3 WALLOPS FLIGHT FACILITY

1.3.1 Mission

During its early history, the mission of the NASA Goddard Space Flight Center's (GSFC's) 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 of supporting scientific research through carrier systems (i.e., airplanes, balloons, rockets, and uninhabited aerial systems) and mission services.

NASA is the land owner at WFF, but WFF also consists of multiple NASA tenants and partners, including the U.S. Navy, U.S. Coast Guard, Marine Science Consortium, Mid-Atlantic Regional Spaceport (MARS), and the National Oceanic and Atmospheric Administration (NOAA). Each tenant partially relies on NASA for institutional and programmatic services, but also has its own missions. WFF is a national resource with the facilities, personnel, core competencies, and low cost of operations to provide world-class, end-to-end services for small- to medium-sized missions. It is a fully capable launch range for rockets and balloons, and is also a research airport. In addition, Wallops personnel provide mobile range capabilities, range instrumentation engineering, range safety, flight hardware engineering, and mission operations support.

The strategic vision for WFF is that "Wallops Flight Facility will be a national resource for enabling low-cost aerospace-based science and technology research" (NASA, 2008a).

1.3.2 Environmental Management System

NASA is committed to carrying out its research and projects at WFF in an environmentally sustainable manner. The Wallops Environmental Office (Code 250) ensures that the facility obtains the appropriate environmental permits, prepares documentation for compliance with NEPA and other environmental regulations and EOs, conducts employee and supervisor training, and implements the facility's Environmental Management System (EMS). WFF's EMS is a coherent, integrated approach to environmental management. WFF manages environmental risks through the application of the WFF EMS, which covers such topics as pollution prevention, energy and water management, maintenance of natural (green) infrastructure, and sustainable building practices.

1.3.3 Location

WFF is located in the northeastern portion of Accomack County, VA, on the Delmarva Peninsula, and is comprised of three separate land masses: the Main Base, Wallops Mainland, and Wallops Island (Figure 1). The Main Base comprises 720 hectares (1,800 acres), Wallops Mainland comprises 40.5 hectares (100 acres), and Wallops Island comprises 1,680 hectares (4,600 acres).

The Main Base is located off Virginia Route 175, approximately 3.2 kilometers (2 miles) east of U.S. Route 13. The entrance gate for Wallops Mainland and Wallops Island is approximately 11 kilometers (7 miles) south of the Main Base at the easternmost terminus of County Route 803.

1.4 BACKGROUND

EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (effective January 24, 2007), instructs Federal agencies to "conduct their environmental, transportation, and energy-related activities under the law in support of their respective missions in an environmentally, economically, and fiscally sound, integrated, continuously improving, efficient, and sustainable manner." EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (effective October 8, 2009), sets sustainability goals for Federal agencies and focuses on making improvements in their environmental, energy, and economic performance.

Both EO 13423 and EO 13514 direct Federal agencies to implement sustainable practices for energy efficiency and reductions in greenhouse gas (GHG) emissions, and for the use of renewable energy. Section 3 of EO 13423 states that a Federal agency's EMS objectives shall include the goals identified in Section 2 of EO 13423. EO 13514 requires Federal agencies to set a 2020 GHG emissions reduction target, increase energy efficiency, and reduce fleet petroleum consumption.

The Federal Energy Policy Act (EPAct), effective August 8, 2005, requires Federal agencies to lower electricity consumption and cost, and to increase the use of renewable sources by 3 percent between 2007 and 2009, 5 percent between 2010 and 2012, and by 7.5 percent for 2013 and beyond.

WFF has identified several goals that meet its mission while promoting environmental stewardship and accountability:

- Reducing impacts on the natural environment by consuming energy from a source that provides zero GHG emissions;
- Reducing WFF's annual operating cost by consuming continual, low-cost power from a renewable and sustainable natural resource; and
- Supporting NASA's goal to set an example for responsible stewardship of natural resources by a Federal agency.

1.4.1 Current WFF Energy Sources

WFF currently obtains all of its electricity from the local electric cooperative, which generates electricity primarily from coal and nuclear power. In 2008, the local electric cooperative generated 21.5 percent of its energy from the combustion of coal, 12.4 percent from nuclear power, and 2.6 percent from gas and diesel combined. The remaining 63.5 percent was purchased by the local electric cooperative from a combination of coal and nuclear power sources (ODEC, 2008). WFF also has a backup system of diesel-fired generators for use in the event of a power outage and one large generator that is permitted for load shedding.

Adverse environmental effects result from the production and combustion of coal and the generation of nuclear power. Although new technologies are currently reducing these effects, combustion of coal still results in release of GHGs to the atmosphere, the generation of waste products such as heavy metals and contaminants (fly ash), and destruction of habitat if mountain-top removal methods are used to mine coal. Nuclear power results in the generation of hazardous nuclear waste and uses large quantities of water for cooling compared to wind and solar power sources (AWEA, 2009).

1.4.2 Current Energy Efficiency Improvements at WFF

Through an Energy Savings Performance Contract, NASA has invested $25 million worth of energy efficiency improvements at WFF, the largest of which include: decentralization of the central steam plant and installation of new propane boilers in all facilities at the Main Base; lighting upgrades in all fixtures on the Main Base and all exterior lights on Wallops Island; heating, ventilation and air conditioning (HVAC) system upgrades in 12 buildings; systematically performing a building tune-up program where building energy performance is optimized on a case-by-case basis; and pursuing Leadership in Energy & Environmental Design (LEED) Existing Buildings certification for 3 facilities at the Main Base. Through all of these improvements, WFF anticipates a reduction in energy intensity (measured in British Thermal Units [BTU's] per square foot) by 25 percent compared to 2003, which is the baseline year of the EPAct.

1.5 PURPOSE AND NEED FOR THE PROPOSED ACTION

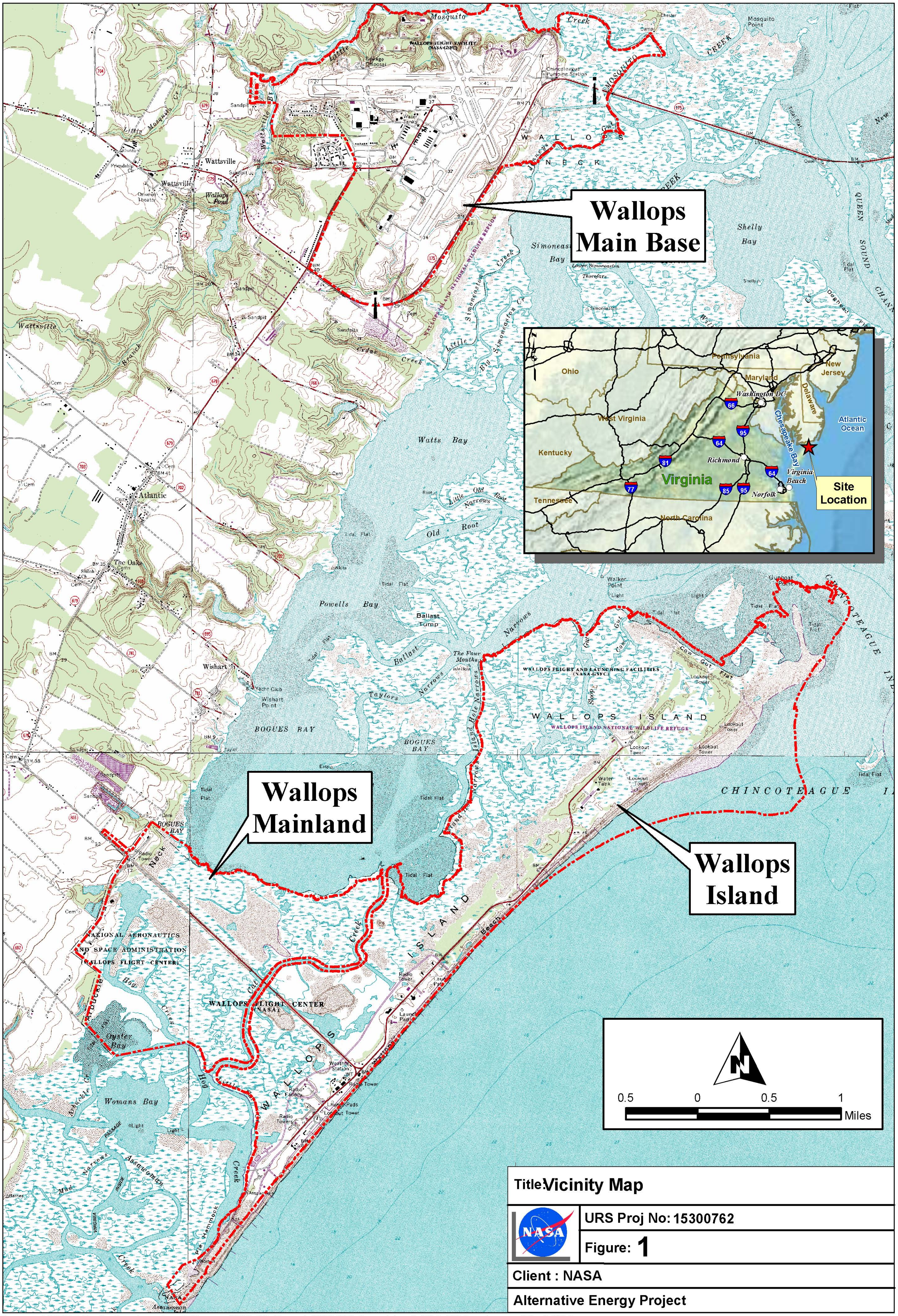
1.5.1 Purpose

The purpose of the proposed Alternative Energy Project is to implement a technologically proven renewable energy source that would enable NASA to meet the requirements of the 2005 EPAct, EO 13423, and EO 13514 while supporting its own goal of setting an example in environmental stewardship by a Federal agency. Additionally, the Alternative Energy Project would provide outreach and education about renewable energy, promote use of renewable energy by the public, and demonstrate NASA's commitment to utilize renewable energy sources.

The project would also stabilize or reduce WFF’s institutional costs. It is expected that as fossil fuels become scarcer, the costs of generating electricity from them would be passed on to the user in the form of higher electricity rates. Having on-site power generation would buffer a portion of WFF’s costs from future increases associated with variables in the electricity market (e.g., tariff adjustments).

1.5.2 Need

The Alternative Energy Project is needed at both an agency and center level to meet the increasing Federal renewable energy requirements. Agency-wide, NASA met the 3 percent target specified by the EPAct in fiscal years 2007 and 2008, generating 3.57 percent and 3.55 percent, respectively, of the agency’s electricity from renewable sources (Smith, pers. comm., 2009). However, NASA did not meet the 3 percent target in fiscal year 2009 (FY09), when 2.2 percent of its electricity was obtained from renewable sources. Although approximately 5 percent of NASA’s electricity was generated from renewable sources in FY10, which met the EPAct target for FY10, WFF did not use renewable electricity during either FY09 or FY10. In 2013, the EPAct requirement will increase to 7.5 percent; NASA must identify additional renewable electricity sources in order to meet this goal.



Title: Vicinity Map

URS Proj No: 15300762

Figure: 1

Client : NASA

Alternative Energy Project

Source: USGS 7.5 min Quadrangles: "Bloxom, VA", "Hallwood, VA", "Wallops Island, VA", "Chincoteague West, VA"

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Recently, other NASA centers have started implementing renewable energy projects. In 2009, NASA's Kennedy Space Center in Merritt Island, Florida, partnered with Florida Power and Light to install a 1 MW solar project on about 2 hectares (5 acres) of land (NASA, 2008d). Additionally, there is the potential for an additional 1 MW solar project on Kennedy Space Center property in the future. Given that all of the energy generated by the project would be used on-site, NASA receives double credit for the project when reporting its EPAct energy metrics. As such, at full build out, it is expected that this project will contribute approximately 0.4 percent to the agency's renewable energy goals.

NASA recently announced that it has begun the planning phase for a proposal to install between 20 and 30 2.5-MW wind turbines on an 810-hectare (2,000-acre) tract of land at its Plum Brook Station (PBS) outside of Sandusky, Ohio (75 FR 52374). Estimates of power output for the project (114 GWh annually) indicate that its implementation would satisfy NASA's agency-level obligations under EPAct. As the power distribution strategy is yet to be defined, the amount of "credit" that NASA would receive toward EPAct goals is still undergoing analysis; however, it is reasonably certain that the PBS project would meet or exceed the agency's minimum requirements for 2013 and beyond. Therefore, if the PBS project is implemented, the WFF project would not be a standalone project to facilitate the agency's meeting the EPAct metric. Rather, it would contribute an additional 1 percent to the renewable energy generation at NASA facilities.

Table 1 shows the contribution of the Proposed Action to the percentage of energy generated from renewable sources for NASA, GSFC, and WFF.

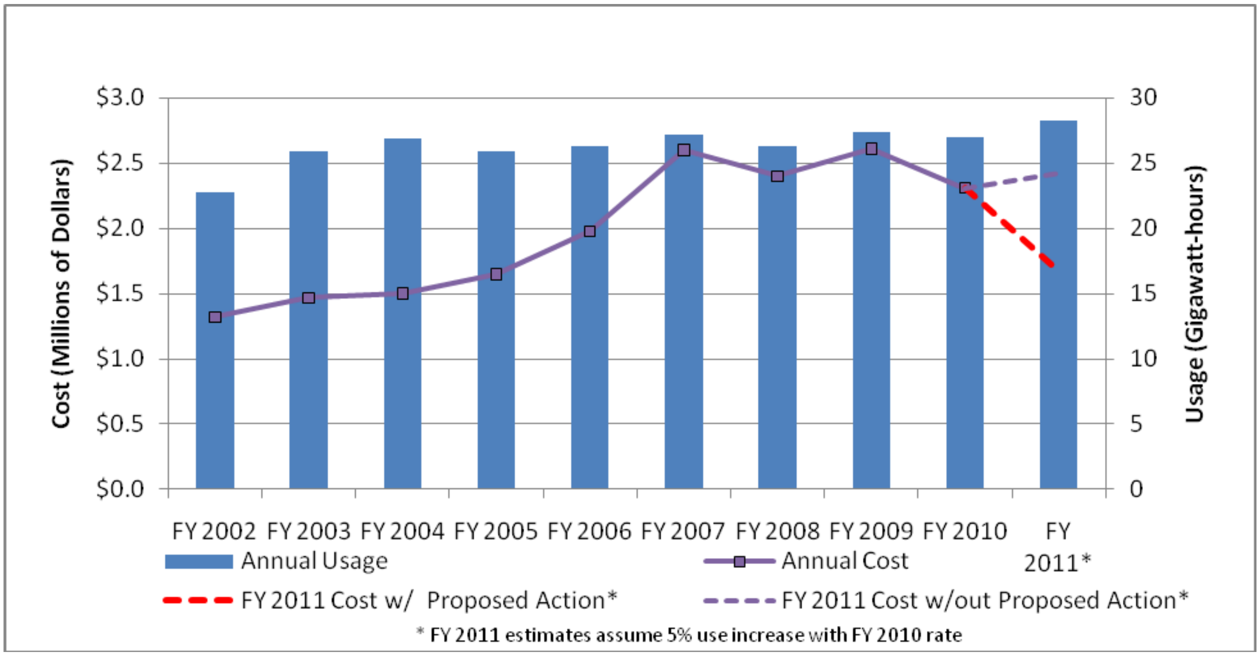
Table 1: Use of Renewable Energy in FY08 and FY09, and Predicted Contribution of Alternative Energy Project in FY12

	% Obtained from Renewable Sources FY08	% Obtained from Renewable Sources FY09	% Obtained from Renewable Sources FY10	Predicted Contribution of Renewable Energy from Alternative Energy Project (%)
NASA	3	2.2	5.34	1
GSFC	3	3	5	13
WFF	0	0	5[1]	66[2]

[1]Obtained by purchase of Renewable Energy Certificates from other renewable energy projects in the United States.
[2]10 GWh/year from the Alternative Energy Project at WFF represents 66 percent of NASA's electricity as it applies to the Federal requirements (two times actual production for on-site generation); however, 10 GWh/year actually represents 33 percent of NASA's electricity consumption from renewable energy sources at WFF.

Additionally, NASA's electricity costs at WFF have increased substantially in recent years. Table 2 shows that since Fiscal Year 2002, NASA's annual electrical expenditures have nearly doubled (an increase of 98 percent), although electrical usage has only increased approximately 20 percent. With WFF's current cost of electricity at 7.5 cents per kilowatt-hour, the proposed project could result in avoided electrical costs of at least $750,000 per year.

Table 2: NASA WFF Annual Electricity Usage and Cost, FY02 to FY11



SECTION TWO: PROPOSED ACTION AND ALTERNATIVES

The need for renewable energy at WFF is limited only by the amount of energy that the facility consumes, which in the previous 5 years has been between 25 and 30 GWh/year. However, to provide a reasonable comparison and analysis of potential projects, NASA standardized each alternative as having to produce approximately 10 GWh/year of electricity based on the initial 2005 investigation into how much energy could be provided by utility-scale wind turbines. The initial investigation approach is described in the paragraph below.

Approach for Standardizing Renewable Energy Alternatives

A study conducted for WFF (James Madison University, 2005) found that a single 1.5 MW wind turbine would produce approximately 15 percent of the electricity required to operate WFF and would easily interconnect to WFF's distribution system. Following this study, NASA performed its own electrical system evaluation and determined that based on its average electrical load, WFF could likely support two of the 1.5 MW wind turbines. Further investigation also led to the conclusion that NASA could obtain 2.0 MW wind turbines for approximately the same cost. WFF estimates that each 2.0 MW wind turbine would generate approximately 5 GWh/year of electricity, for a total of 10 GWh produced annually. Therefore, NASA standardized each alternative as having to produce an equivalent amount of electricity that would be generated by two 2.0 MW wind turbines (10 GWh/year).

CEQ regulations require that an agency "include the alternative of no action" as one of the alternatives it considers (40 CFR 1502.14[d]). The No Action Alternative serves as a baseline against which the impacts of the Proposed Action and Alternatives are compared.

2.1 RANGE OF ALTERNATIVES CONSIDERED FOR RENEWABLE ENERGY

Several sources of renewable energy were considered for the Alternative Energy Project including solar, wind, tidal, wave, and geothermal power.

2.1.1 Solar Power

Solar panels are made up of silicon photovoltaic (PV) cells that convert sunlight into electricity; when sunlight is reduced or absent, such as an overcast day or at night, the conversion process slows down or stops completely. Solar panels by themselves do not constitute a PV system—a system includes structures to hold the arrays and point them toward the sun and components that take the direct-current electricity produced by the modules or arrays and condition the electricity so that it may be utilized. PV cells were first developed in the United States in the 1950s, and solar technology has been constantly improving since then (USDOE, 2005). PV cells are an environmentally low-impact source of energy, as their use generates no air pollution or hazardous wastes, and they do not require fuel. The use of solar power has been expanding at an average rate of 40 percent per year since the year 2000, and solar panels are expected to provide up to 10 percent of the electricity in the United States by the year 2025 (USDOE, 2008).

The amount of energy produced by a PV device depends not only on available solar energy (i.e., how many sunny days occur) but on how well the solar cell converts sunlight to useful electrical energy. Today's commercial PV systems can convert from 5 to 15 percent of sunlight into electricity, with recent PV cells achieving percentages of efficiency nearing 20 percent (IMEC, 2009; Mitsubishi, 2009).They are highly reliable and typically last 20 years or longer. Due to loss of sunlight during the nighttime and days with cloud cover, solar energy typically has a capacity factor (the ratio of average production to the rated capability of production) between 15 and 25 percent.

Many sizes and types of modules are commercially available from a number of different companies—NASA is currently considering use of a 200-watt solar panel for WFF. Using a commonly available U.S.-made panel as a representative model, each panel would have a width of 0.84 meter (2.75 feet) and a length of 1.7 meters (5.5 feet), which results in a total surface area of 1.4 square meters (15.13 square feet) per panel (BP Solar, 2009; Table 3). Factory recycling (i.e., the partial reuse of discarded solar panel raw materials), which has been introduced by most manufacturers, can save up to 80 percent of production energy (Earthscan, 2008). As with the silicon cells, the glass and aluminum components can be reused.

Table 3: Basic Data for Representative Solar Panels

Specifications for Representative Solar Panel[1]	
Electricity generation per panel	200 watts
Spacing requirements due to shading and maintenance	4 hectares (10 acres) of space per 1.0 MW of power
Length, single panel	1.7 meters (5.5 feet)
Width, single panel	0.84 meter (2.75 feet)
Capacity factor	15%
Equipment life expectancy	25 years
Annual production at WFF with a 4.0 MW system	5 GWh/year
Number of panels required for 4.0 MW system	19,000

[1]BP Solar, 2009

2.1.1.1 Locations for Solar Panels

Installation of solar panels at Wallops Mainland and Wallops Island was considered but dismissed due to the area required for installation of the amount of solar panels needed to generate 5 or 10 GWh/year of power (equivalent power generated by one and two 2.0 MW wind turbines, respectively). In addition to the space occupied by the solar panels themselves, there are spacing requirements around each solar panel to prevent shading and to allow maintenance. Four hectares (10 acres) are estimated to be needed for each planned MW of power (Caudle, pers. comm.); therefore, a 4.0 MW solar panel system, which would generate 5 GWh/year of power, would require a total area of approximately 16 hectares (40 acres).

This amount of area, or partial amounts of this area (i.e., installation of half of the solar panels) would not be suitable at Wallops Mainland or Wallops Island for several reasons:

1. Most areas of Wallops Mainland and Wallops Island are obligated for existing and planned mission operations; therefore, using 16 hectares (40 acres) to install an amount of solar panels equivalent to the energy output of one 2.0 MW wind turbine is not considered feasible.

2. Based on the siting constraints for mission operations, and because the remaining open areas of Wallops Mainland and Wallops Island are comprised of large areas of wetlands (79 percent of Wallops Island is classified as wetlands), ground disturbance and construction of 16 hectares (40 acres) would create unacceptable adverse impacts on wetlands.
3. The potentially available upland areas of Wallops Mainland and Wallops Island are within the 100-year floodplain and are subject to flooding and the corrosive effects of nearby marine waters, which would result in additional maintenance on the solar panels.
4. An assessment of total rooftop area on NASA buildings on Wallops Mainland and Island indicated that there is only a small amount of area (0.4-hectare [0.9-acre] and 2.5-hectare [6.2-acre], respectively) that could be considered for rooftop panel installation. However, because many of the Mainland and Island facilities directly support mission operations, their rooftops are considered prime areas reserved for mission support equipment, including antennas, cameras, etc. Accordingly, Mainland and Island buildings were dismissed as a primary location for solar panels due to a lack of available area.

Therefore, NASA has determined that the solar panels should be installed at the WFF Main Base. The solar panels would not be expected to interfere with WFF's tracking/telemetry systems. The following Main Base areas were excluded from consideration for installation of solar panels:

- Areas having moderate and high sensitivity for cultural resources;
- Wetland areas;
- Roads;
- Building rooftops (due to limited available area [6.5 hectares (16 acres)], conflicts with existing mission support electronics, rooftop heating/cooling systems, and added complication of roof maintenance);
- Airfield, runways, taxiways;
- Areas within a 174-meter (570-foot) buffer adjacent to runways and taxiways (due to glare and pilot safety);
- Areas planned for future structures; and
- Areas within U.S. Navy and Coast Guard Housing.

Figure 2 shows the potentially suitable areas for installation of solar panels. The total area identified is 70 hectares (174 acres).

2.1.2 Wind Power

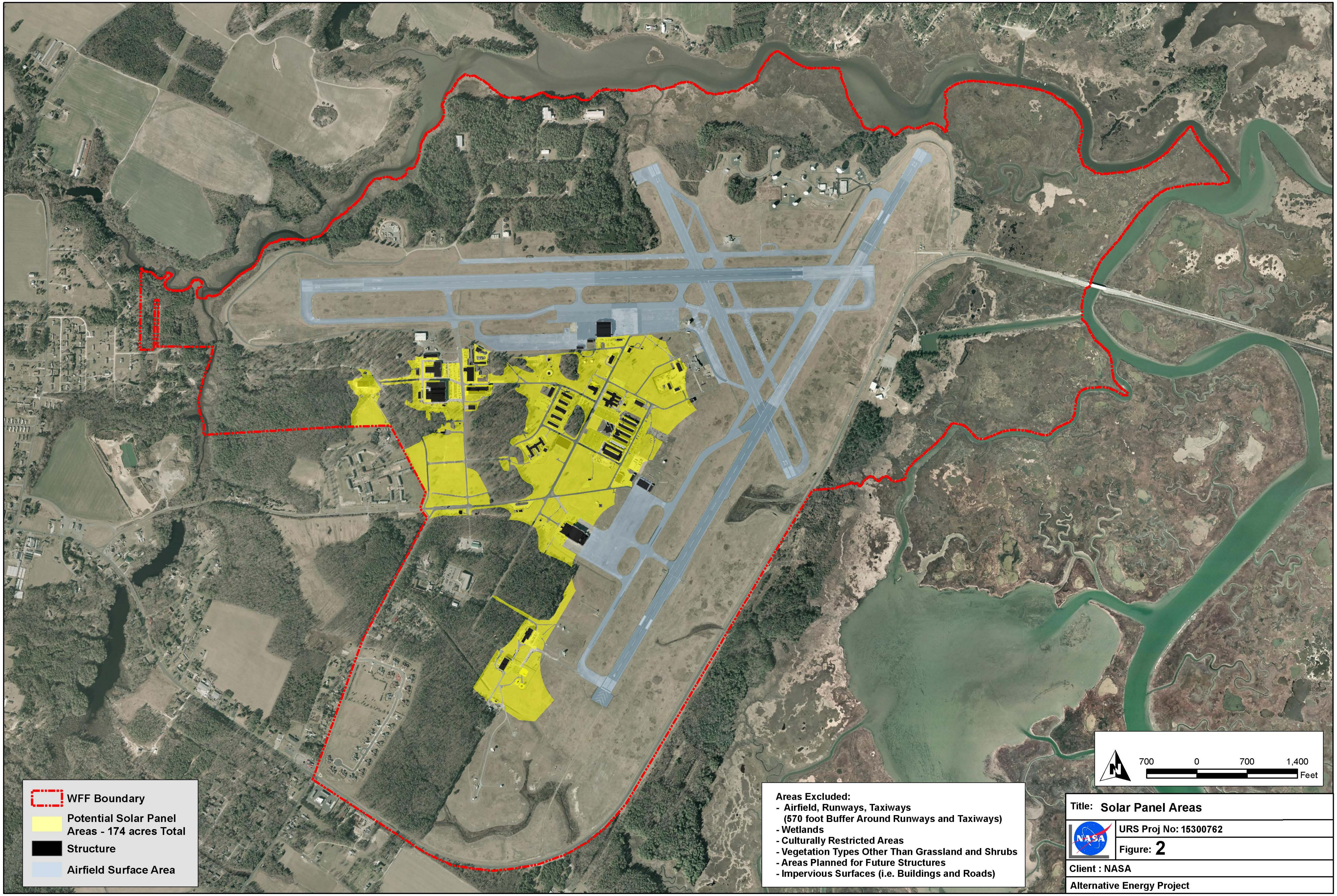
Currently the world's fastest growing renewable power source, wind energy is the transformation of wind into mechanical power through a turbine, which is then converted into electricity through a generator. Generation of electricity by wind energy has the potential to reduce environmental impacts caused by use of fossil fuels to generate electricity because, unlike fossil fuels, wind energy does not generate atmospheric contaminants or thermal pollution.

Figure 3 shows the major components of a typical wind turbine. The nacelle is the housing for the gear box and generator that is mounted on top of the tower. Electronic controls rotate the nacelle to face into the wind, and adjust the angle of the blades to regulate rotor speed.

According to studies performed by James Madison University (JMU, 2005) and Iberdrola Engineering (2009), the average annual wind speed at Wallops Island in the location of the proposed turbines at a height of 48 meters (157 feet) is 6.25 meters (20.5 feet) per second, and the prevailing wind direction is from the south and southwest.

The International Electrotechnical Commission (IEC), an international standards development organization, has developed a classification system for the design conditions of wind turbine systems. There are 3 classes: Class I, II, and III, which specify the design wind speeds for a specific turbine product. The wind resource classification at Wallops Island is Class IIa.

Based on the measured wind speeds and predicted long-term wind speeds, direction of the wind resource, the IEC wind classification (IIa), and other factors such as air density, Iberdrola (2009) determined that Wallops Island has adequate wind resources for operation of utility-scale wind turbines.


WFF Boundary
Potential Solar Panel Areas - 174 acres Total
Structure
Airfield Surface Area
Areas Excluded:
- Airfield, Runways, Taxiways
(570 foot Buffer Around Runways and Taxiways)
- Wetlands
- Culturally Restricted Areas
- Vegetation Types Other Than Grassland and Shrubs
- Areas Planned for Future Structures
- Impervious Surfaces (i.e. Buildings and Roads)
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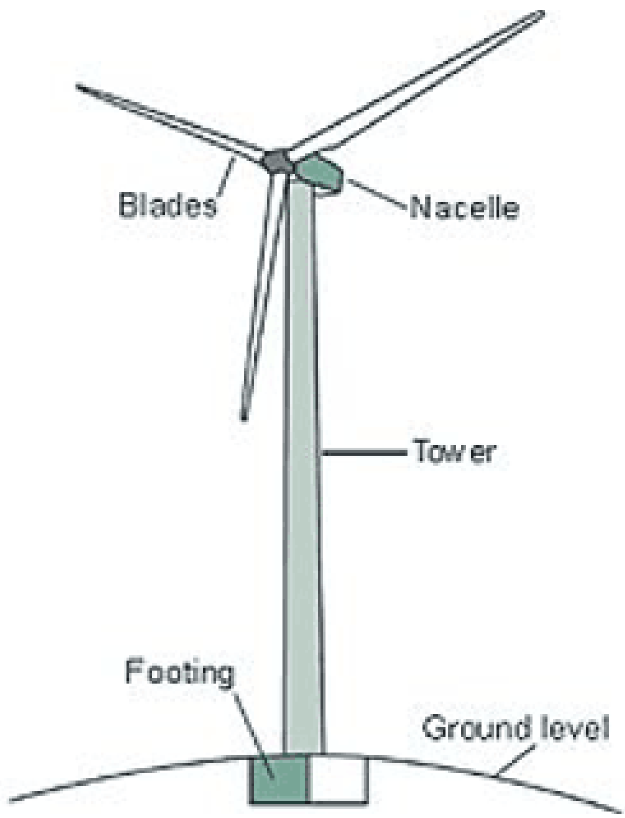

Figure 3: Diagram of Major Wind Turbine Components

Although modern utility-scale wind turbines typically operate 65 to 90 percent of the time, they often run at less than full capacity. Capacity factor, which compares the turbine's actual production over a given period of time with the amount of power the turbine would have produced if it had run at full capacity for the same amount of time, is one element in measuring the productivity of a wind turbine (or any other power production facility). Iberdrola (2009) determined that the capacity factor of potential wind turbines initially evaluated for installation at Wallops Island (based on one 1.5 MW and two 2.0 MW models) was between 25 and 30 percent. Higher power output may be achieved during windy weeks or months.

2.1.2.1 Wind Turbine Specifications

Residential-Scale Turbines

General specifications for the smallest wind turbine commercially available in the United States, a 2.4 kW model, are shown in Table 4. As opposed to the utility-scale wind turbines, these residential-scale turbines would not contribute substantially to the percent of energy generated from renewable sources at WFF because of their small power output. They would help offset power use at individual buildings, but their primary purpose would be to provide outreach and education to WFF employees and the public about wind energy.

Table 4: Basic Data for 2.4 kW Wind Turbine

Representative 2.4 kW Wind Turbine Model[1]	
Rated power	2.4 kW
Cut-in wind speed	3.5 meters (11.5 feet)/second
Rated wind speed	13 meters (43 feet)/second
Blade diameter	3.72 meters (12 feet)
Total height (to tip of blade)	22 meters (72 feet)
Capacity factor	25 to 30%
Equipment life expectancy	25 years
Annual production at WFF, single turbine	6 MWh/year[2]

[1]Southwest Windpower, 2010
[2]MWh = megawatt-hours

Utility-Scale Turbines

Based on the classification the wind resource at WFF (Class IIa) and the appropriate level of electrical generation, either a 1.5 MW or 2.0 MW wind turbine would be suited to WFF's needs (Iberdrola, 2009). NASA initially evaluated both 1.5 MW and 2.0 MW wind turbine models and determined that they were very similar in their design, configuration, and cost—the primary difference being the amount of power generated. Therefore, NASA would install a wind turbine that would produce up to the electrical output of a 2.0 MW wind turbine.

General specifications of a 2.0 MW turbine commonly available in the United States are shown in Table 5 to provide representative information for evaluation of environmental impacts in this EA. Any 2.0 MW wind turbine model NASA would use would have very similar specifications to those shown in Table 5.

Table 5: Basic Data for 2.0 MW Wind Turbine

Representative 2.0 MW Wind Turbine Model[1]	
Rated power, single turbine	2.0 MW
Rated power, 2 turbines	4.0 MW
Cut-in wind speed	3.5 meters (11.5 feet)/second
Cut-out wind speed (10 minutes)	25 meters (82 feet)/second
Rated wind speed	14 meters (46 feet)/second
Wind class	IIa
Blade length	42.5 meters (139.5 feet)
Total height (to tip of blade)	120.5 meters (395.3 feet)
Capacity factor[2]	25 to 30%
Equipment life expectancy	25 years
Annual production at WFF	5 GWh/year

[1]Gamesa, 2009; [2]Iberdrola, 2009

2.1.2.2 Potential Locations for Wind Turbines at Wallops Flight Facility

Residential-Scale Turbines

The residential-scale turbines would not be expected to interfere with WFF's tracking/telemetry systems. The following Main Base areas were excluded from consideration for installation of residential-scale turbines:

- Areas having moderate and high sensitivity for cultural resources
- Wetland areas
- Roads
- Radio frequency hazard areas
- Buildable heights greater than 25 meters (80 feet)
- Areas within 30 meters (100 feet) of forest
- Areas within 30 meters (100 feet) of existing structures
- Areas greater than 150 meters (500 feet) from electrical transformers
- Areas where an 18 meter (60 foot) tower would penetrate the airfield glideslopes

Figure 4 shows the proposed locations of the two residential-scale wind turbines: the entrance gate at WFF Mainland and the WFF Visitors Center. These locations were chosen based on the exclusions above and are within areas having the highest visibility and traffic for WFF employees, visitors, and the public.

Utility-Scale Turbines

Initial Siting Analysis
Proper siting of turbines considers a micro-siting exercise that estimates the wind speed and direction profile at the precise location(s) being evaluated. The total energy produced by a wind turbine during a season is very closely correlated with the wind speeds that prevail during that season. Even slight variations between actual and predicted wind speeds can significantly affect the economics of the project; therefore, wind turbines should be sited within a tract or parcel of land in the locations that bear the highest known wind speeds (Miles, pers. comm., 2010).

The wind map for Virginia depicts a coastal wind resource along both the east and west sides of the Delmarva Peninsula that diminishes quickly moving inland, across the waterfront, and onto the mainland. There is an abrupt reduction in average wind speed by as much as 1 meter per second (2.2 miles per hour) or greater moving inland from the barrier islands to the mainland. For a 1.5 MW wind turbine, a reduction of 1 meter per second (2.2 miles per hour) could reduce the amount of energy produced in a year by 40 percent or more. This would result in a potentially substantial loss of energy produced by wind turbines and would significantly affect the economic benefits that wind can provide at WFF (Miles, pers. comm., 2010). Therefore, for the Alternative Energy Project, the coastal area, including WFF, was the focus of the secondary siting analysis described below.

Siting at WFF

Based on wind studies and compatibility with mission-related activities (JMU, 2005; Iberdrola, 2009), Wallops Island was identified as the preferred location for siting a wind turbine to maximize the wind resource available at WFF.

Other locations at WFF were considered for construction of one or two wind turbines. Wind turbines have the potential to interfere with WFF's active airfields and tracking/telemetry systems; therefore, the area available for their construction is extremely limited.

The entire Wallops Main Base was dismissed due to height restrictions to maintain Federal Aviation Administration (FAA) Part 77 airfield obstruction requirements. The available locations for wind turbine(s) installation at the Main Base would result in a violation of the FAA height restrictions of objects within a specified distance of a public or military runway; therefore, NASA did not consider siting the wind turbines at the Main Base.

The entire Wallops Mainland was dismissed from consideration for siting of wind turbines, due to potential impacts on the performance of radar frequency systems (QinetiQ Inc., 2004). In addition, NASA undertook a rigorous internal siting exercise to identify a location for the proposed wind turbines that would not interfere with existing or planned mission activities on Wallops Island. This exercise was led by the WFF Facility Director with assistance from the Radio Frequency Spectrum Manager, Facilities Management Branch, and Environmental Office. The team evaluated all lines of sight for the NASA telemetry systems and U.S. Navy radar viewsheds. On Wallops Island, all areas north and east of the proposed wind turbine site were dismissed due to impacts on U.S. Navy radar systems (Figure 5). Areas south and west of the proposed wind turbine site were dismissed due to impacts on NASA launch range radars and radar frequency systems (QinetiQ Inc., 2004). The final proposed location of the utility-scale wind turbines at Wallops Island was approved by both the NASA Center Director and the U.S. Navy Surface Combat Systems Center Commanding Officer.

NASA also considered locating wind turbines in the ocean immediately east of Wallops Island. This alternative was dismissed based on the much higher cost of installation and maintenance compared to siting the wind turbines on land, the potential interference of the offshore turbines with radar and NASA's launch range activities such as Unmanned Aerial Systems (UASs), rockets, and drones that are launched over the Atlantic Ocean.

The only available mission-compatible area at WFF for placement of wind turbines is restricted to the "Buildable Area" shown on Figure 5.

2.1.2.3 Hydrokinetic Power

Tidal and wave power generation are in their technological infancy compared to wind and solar power, and numerous operational limitations exist as a result. Some of these limitations include the need to develop equipment and technology that can withstand destructive factors such as heavy storms and corrosion, the cost-benefit of materials and installation versus energy output, and the relatively undocumented effects on ocean life.

Title: Proposed Location of Residential-Scale Wind Turbines

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Figure: 4

Client : NASA

Alternative Energy Project

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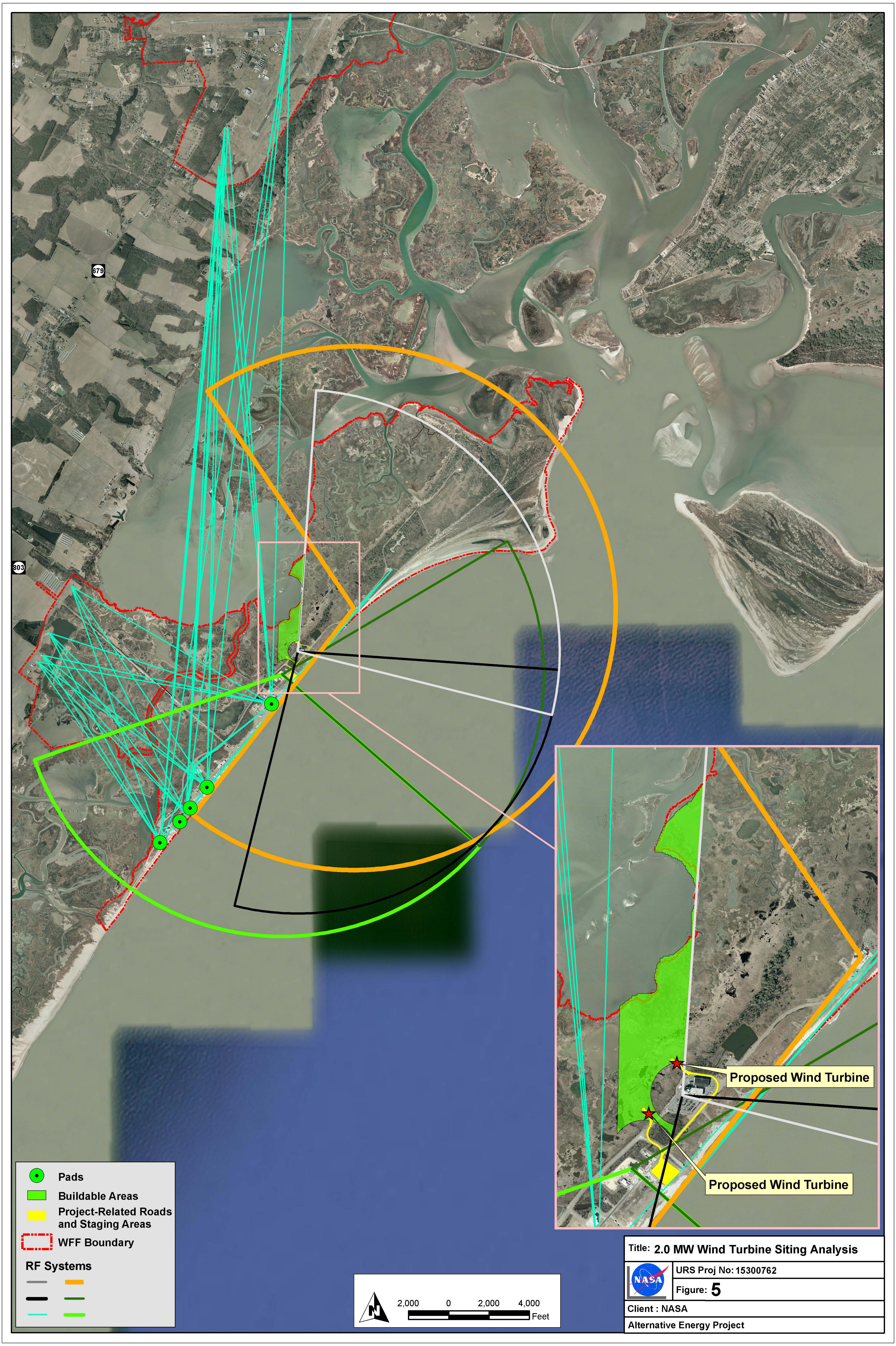
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803
Proposed Wind Turbine
Proposed Wind Turbine
Pads
Buildable Areas
Project-Related Roads and Staging Areas
WFF Boundary
RF Systems
2,000 0 2,000 4,000
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N
Title: 2.0 MW Wind Turbine Siting Analysis
NASA
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Client : NASA
Alternative Energy Project

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Description of Tidal Power

Tidal power utilizes the movement of water caused by tidal currents, and uses equipment similar to wind turbines, which turns like windmills in the current. Water's greater density means fewer and smaller turbines are needed to produce the same amount of electricity as wind turbines. Although tidal power is more predictable than wind and solar power, it is a relatively unproven technology with questionable economic viability on a small scale, which would be the case at WFF.

Description of Wave Power

Wave power differs from tidal power in that electricity generators are placed on the surface of the ocean. Energy output is determined by wave height, wave speed, wave length, and water density. Two of the three basic methods to harness wave power include the buoy method and the hinged contour device, which use a special floating device that rises and falls along with the movement of the waves. The mechanical energy that is created is then converted to electricity using specially designed generators. A third basic method is the oscillating water column method, which is used on shore and must be fixed to the seabed. This method works by using a column of water as a piston to pump air and drive a turbine to generate power. Wave power is a relatively unproven technology with questionable economic viability on a small scale, which would be the case at WFF.

U.S. Licensed or Permitted Tidal and Wave Power Projects

To date there are only a handful of experimental wave generator plants in operation around the world. In December 2007, plans were announced to build the first commercial wave power plant in the United States, located off the coast of northern California (FERC, 2009). A wave energy pilot project off the shore of Washington State obtained the first Federal Energy Regulatory Commission (FERC) license for a hydrokinetic power (includes both wave and tidal power) project in December 2007; however, this license was surrendered in April 2009. FERC issued its first declaratory order for an experimental hydrokinetic demonstration project of the coast of California in March 2010 (FERC, 2011). No FERC licenses for hydrokinetic power have been issued to date.

2.1.2.4 Geothermal Power

Geothermal power, which is energy generated by heat stored beneath the Earth's surface or the collection of absorbed heat in the atmosphere and oceans, is available 24 hours a day, 365 days a year, making it a dependable energy resource. Geothermal reservoirs are most numerous in the Western United States, Alaska, Hawaii, and in the Gulf Coast areas of Texas and Louisiana (USDOE, 2006). Areas in central Texas, Arkansas, the Dakotas, and parts of the East Coast demonstrate moderate geothermal reservoirs as well (USDOE, 2006). Current research is concentrating on discovery methods for other hidden and deeper deposits, as well as better techniques for more efficient and economical extraction (Maryland Energy Administration, 2007). An unknown, but likely low potential, for a geothermal reservoir exists within WFF property due to its geographic location.

2.2 ALTERNATIVES CONSIDERED AND DISMISSED

The tidal, wave, and geothermal power generation alternatives as renewable energy sources for WFF were dismissed because currently they are not practicable or feasible from a technical and/or economic standpoint. However, as these and other renewable energy sources become more technically mature, such sources may be proposed, and their environmental impacts would be addressed in future NEPA documentation.

Siting constraints, as described above, for both the wind turbines and solar panels, limited their placement to the locations described in Section 2.3 below.

2.3 PROPOSED ACTION AND ALTERNATIVES

The Proposed Action and Alternatives consist of developing renewable, self-sufficient energy sources at WFF to supplement the electricity currently supplied to WFF by the local electric cooperative. These alternative energy sources would consist of proven solar and/or wind technologies to assist WFF in meeting its goals of reducing impacts on the natural environment. The solar and wind sources would consume energy from a source that provides zero GHG emissions, reduce WFF’s annual operating costs, and set an example for responsible stewardship of natural resources by a Federal agency.

2.3.1 Proposed Action: 10 GWh/year Solar Panels, Residential-Scale Wind Turbines

Under the Proposed Action, NASA’s preferred alternative, NASA would install a system of solar panels at the Main Base that would be capable of generating 10 GWh/year of power. Additionally, two 2.4 kW residential-scale wind turbines would be installed.

2.3.1.1 Solar Panels

To produce 10 GWh/year of energy, NASA would install an 8.0 MW system of solar panels. The solar panel system would consist of approximately 38,000 1.4-square-meter (15-square-foot) panels that would equal an area of approximately 6 hectares (15 acres). Panel spacing requirements (to avoid shading and allow maintenance) would increase the overall required land area dedicated to solar panels to approximately 32 hectares (80 acres). Figure 2 shows the potentially suitable areas for installation of solar panels.

The power generated by the solar panels would be connected via underground distribution lines to a set of switchgears that would be enclosed in a small 5-meter by 6-meter (16-foot by 20-foot) pre-fabricated building. All solar panels would be installed facing south in open, grassy areas or over parking lots at the Main Base (Figure 2). All solar panels would be located and situated to have no effect on cultural resources, wetlands, or on pilots flying in the WFF Aircraft Operating Area. Shallow (less than 10 feet [3 meter] deep) holes for setting the posts of the support structures for the solar panels and any buried connection lines would be the only ground disturbance required for installation of the panels. The installation period for the solar panels would be approximately 4 months.

Operation, Maintenance, and Decommissioning

Maintenance and operation of solar panels would primarily consist of mirror washing every few weeks or mirror replacement as necessary. Existing WFF maintenance staff would be used to monitor and maintain the solar panels and transmission system; no new staff would be hired for the operation and maintenance of the solar panels.

After the expected 25-year life span of the solar panels, the PV cell systems would be decommissioned. NASA would remove and recycle the solar panels by sending the spent cells to a smelting or refining facility that specializes in reclaiming materials such as glass, aluminum frames, and semiconductor materials.

2.3.1.2 Residential-Scale Turbines

Two 2.4 kW residential-scale wind turbines would be installed under the Proposed Action Alternative. The representative residential-scale wind turbine described in Section 2.1.1.1 and Table 4 would be used. One of the 2.4 kW wind turbines would be installed near the WFF Visitors Center, and a second would be installed near the entrance gate/security guard station on the Mainland (Figure 4).

The wind turbines would be installed with a setback distance of 30 meters (100 feet) from existing towers, buildings, and trees. The finished subsurface footprint of each 2.4 kW wind turbine would be approximately 1 meter (3 feet) in diameter, with a foundation depth of up to 6 meters (20 feet). No transformers or interconnection switchgear would be needed. Standard home electric wiring (10 gauge) would be buried in a trench connecting the wind turbine to the desired facility.

Existing WFF maintenance staff, along with on-call manufacturer maintenance support staff, would be used to maintain the turbines and transmission system; no new staff would be hired for the operation and maintenance of the turbines. Operations and maintenance equipment would be housed in existing NASA facilities.

2.3.2 Alternative One: 5 GWh/year Solar Panels, Residential-Scale Wind Turbines, Utility-Scale Wind Turbine

2.3.2.1 Solar Panels

Under Alternative One, NASA would install a 4.0 MW system of solar panels at Wallops Main Base that would be capable of generating up to 5 GWh/year. Based on the size of the solar panel described in Section 2.1.1.1 of this EA, approximately 19,000 1.4-square-meter (15-square-foot) solar panels equaling an area of approximately 3 hectares (7.5 acres) would be needed to meet the 5 GWh/year power-generating capabilities. Panel spacing requirements would increase the overall required land area dedicated to solar panels to approximately 16 hectares (40 acres).

The power generated by the solar panels would be connected via underground distribution lines to a set of switchgear that would be enclosed in a small 5-meter by 6-meter (16-foot by 20-foot) pre-fabricated building. Solar panels would be installed in open, grassy areas of the Main Base (Figure 2). All solar panels would be installed facing south to maximize their power generating capability. All solar panels would be located and situated to have no effect on cultural resources, wetlands, or on pilots flying in the Aircraft Operating Area. Shallow (less than 10 feet deep) holes for setting the posts of the support structures for the solar panels and any buried connection lines would be the only ground disturbance required for installation of the panels. The installation period for the solar panels would be approximately 2 months.

Operation, maintenance, and decommissioning of solar panels would be the same as described under the Proposed Action Alternative.

2.3.2.2 Residential-Scale Turbines

Two residential-scale (2.4 kW) wind turbines would be installed under Alternative One. The representative residential-scale wind turbine described in Section 2.1.1.1 and Table 4 would be used. One of the 2.4 kW wind turbines would be installed near the WFF Visitor Center, and a second would be installed near the entrance gate/security guard station at the Mainland (Figure 4). Operation, maintenance, and decommissioning for the residential-scale wind turbines would be the same as described under the Proposed Action.

2.3.2.3 Utility-Scale Turbine

Additionally, NASA would install one 2.0 MW utility-scale wind turbine on Wallops Island that would be capable of generating 5 GWh/year of power. The single 2.0 MW wind turbine would be installed west of the U.S. Navy V-10/V-20 complex in the location of the southern wind turbine shown on Figure 6. A depiction of the wind turbine is shown on Figure 7.

The general specifications of a representative 2.0 MW wind turbine (Gamesa, 2009) include:

- Three composite (non-metal) rotor blades
- The diameter of the rotor blades is 87 meters (285 feet)
- A height of 120.5 meters (395 feet) at the top of the blade
- A rotation speed of 9 to 19 revolutions per minute
- Independent pitch control that allows rotor blades to automatically turn to face oncoming wind
- The generator and gearbox are supported by elastomeric elements to minimize noise emissions
- Braking system

The wind turbine would be installed with a setback distance of 150 meters (500 feet) from existing towers and buildings. The finished subsurface footprint of the wind turbine would be approximately 13 meters (42 feet) in diameter, with a 4.6-meter-diameter (15-foot-diameter) surface foundation. The foundation of the turbine would be pre-cast concrete piles installed to a depth of approximately 30 meters (100 feet) below the ground surface.

A corridor 9.7 meters (32 feet) wide would be constructed for an access road to the wind turbine, including approximately 4.9 meters (16 feet) for a permanent gravel road surface and an additional 2.4 meters (8 feet) on each side for road shoulders.

Previously disturbed areas, including the cleared area east of the U.S. Navy V-10/V-20 complex, would be used for staging of equipment and materials, and for construction vehicle parking. The construction period for a single wind turbine would be approximately 4 months.

The workspace radius required around the turbine tower during installation activities would be approximately 45 meters (150 feet). Clearing of existing vegetation beyond the foundation and crane pad footprints would not be required. A crane pad would be installed within the 45-meter

(150-foot) radius of the wind turbine and would be approximately 15 meters (50 feet) by 15 meters (50 feet). The orientation and size of the crane pad could vary depending on the requirements of the wind turbine installation contractor.

Underground power collection lines would be built to interconnect the wind turbine to the existing Wallops Island 12.47-kilovolt electrical distribution system (see Figure 6). These power lines would be installed in conduits via horizontal directional drilling, which is a trenchless method of installing underground pipes, conduits, and cables in a shallow arc along a prescribed bore path, to minimize disturbance. Step-up transformers for the wind turbine would be air-insulated and installed inside the base of the tower. Additionally, interconnection switchgear would be installed inside the tower assembly. All electrical equipment would be installed inside, protected from the weather, to minimize potential corrosion on the equipment.

NASA would utilize data currently collected at various locations/towers on Wallops Island to monitor wind speed and direction, rather than building a new meteorological tower specifically for the utility-scale wind turbine.

Operation, Maintenance, and Decommissioning

Existing WFF maintenance staff, along with on-call manufacturer maintenance support staff, would be used to maintain the turbines and transmission system; no new staff would be hired for the operation and maintenance of the turbines. Operations and maintenance equipment would be housed in existing NASA facilities.

After the approximate 25-year useful life of a wind turbine, it would be decommissioned. Because the wind energy industry is still rather young, there are currently no industry-wide standards for disposing of wind turbine parts. At present, there are three possible options for dismantled wind turbine blades: landfill, incineration, or recycling.

NASA plans on recycling the turbine blades by the best available technology. For incineration, currently the most popular method of disposal, turbine blades must be dismantled and crushed before being transported to incineration plants. After incineration, approximately 60 percent of the blades are left behind as ash, some of which can be recycled as construction materials. Recycling of either the synthetic composite material that makes up the turbine blades or entire parts of the turbine (if the parts are still in good working order) is another option for decommissioned turbine parts. There are several companies (primarily on the west coast, where wind technology has been around the longest) that specialize in rebuilding turbines with refurbished parts (Runyon, 2008; Nexion DG, 2009). Additionally, some of the metal parts may be recycled as scrap metal.

2.3.3 Alternative Two: Utility-Scale Wind Turbines and Residential-Scale Wind Turbines

Under Alternative Two, NASA would install two 2.0 MW utility-scale wind turbines on Wallops Island that would be capable of generating approximately 10 GWh/year of power and two 2.4 kW residential-scale wind turbines at the Main Base and Mainland as described under the Proposed Action Alternative. The specifications for the two 2.0 MW wind turbines would be the same as described for the utility-scale wind turbines in Section 2.1.1.1 and under Alternative One.

The utility-scale wind turbines would be located on Wallops Island west of the U.S. Navy V-10/V-20 complex (Figures 6 and 7). The footprint, work space, and staging areas would be the same as described under Alternative One, but the construction period would be approximately 6 months.

Operation, maintenance, and decommissioning for the utility-scale wind turbine would be the same as described under Alternative One.

2.3.4 Cooperating Agency Action

The USACE is a cooperating Federal agency for this EA. The only suitable location for the utility-scale wind turbine(s) under Alternatives One and Two would result in the filling of wetlands. A USACE permit under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act for dredging and the placement of fill in waters of the U.S. would be required. Therefore, in issuing the permit, the USACE would undertake a “connected action” (40 CFR 1508.25) that is related to, but unique from NASA’s proposed action, the construction of the project.

2.3.5 Comparison of Costs Among Alternatives

Table 6 summarizes the estimated savings or costs that would be realized for each alternative. It includes the initial capital investment, equipment operation and maintenance costs, and environmental mitigation and monitoring costs; however, it does not include costs for the installation of two residential-scale wind turbines because these costs would be the same for each alternative. Because of wind energy’s lower cost and faster payback compared to solar, Alternative Two would be the least expensive of the alternatives.

Table 6: Comparison of Costs among the Alternatives

	No Action	Proposed Action	Alternative One	Alternative Two
Annual energy production at WFF	N/A	10 GWh/year	10 GWh/year	10 GWh/year
Total Installed Cost[1]	N/A	$52.0 million	$31.0 million	$10.1 million
Estimated 25-Year Savings (*or Cost*)[1, 2]	*($27.3 million)*	(*$24.8 million*)	(*$7.1 million*)	$11.1 million

[1]All costs are in 2010 dollars

[2]Assumes $0.075/kWh at year 1 with 3 percent annual escalation

2.3.6 Effects of Project Cost on Implementation

Based on the comparison in Table 6, implementing the Proposed Action (cost of $24.8 million) compared to the No Action Alternative (cost of $27.3 million) would allow NASA to avoid approximately $2.5 million in utility costs over the 25-year analysis term. However, given the high initial investment required for implementing a solar project of this size, it is unlikely that the project would be implemented all at once. It is more likely that solar arrays would be installed using a phased approach and draw from multiple funding sources. The extent of each installation phase is currently unknown; however, final build-out would not exceed that described in this EA. Conversely, implementing one of the utility-scale wind turbine alternatives, with a considerably lower initial cost, would likely allow for all-at-once construction and almost immediate realization of full project benefits.

- Surface Foundation Radius - 7.5 feet
- Subsurface Foundation Radius - 21 feet
- Turbine Workspace Radius - 150 feet
- New Road Width - 30 feet
- Crane Pad - 50 ft x 50 feet
- Staging Area

N

Title:	Proposed Location of 2.0 MW Wind Turbines and Staging Areas
NASA	URS Proj No: 15300762
	Figure: 6
Client : NASA	
Alternative Energy Project	

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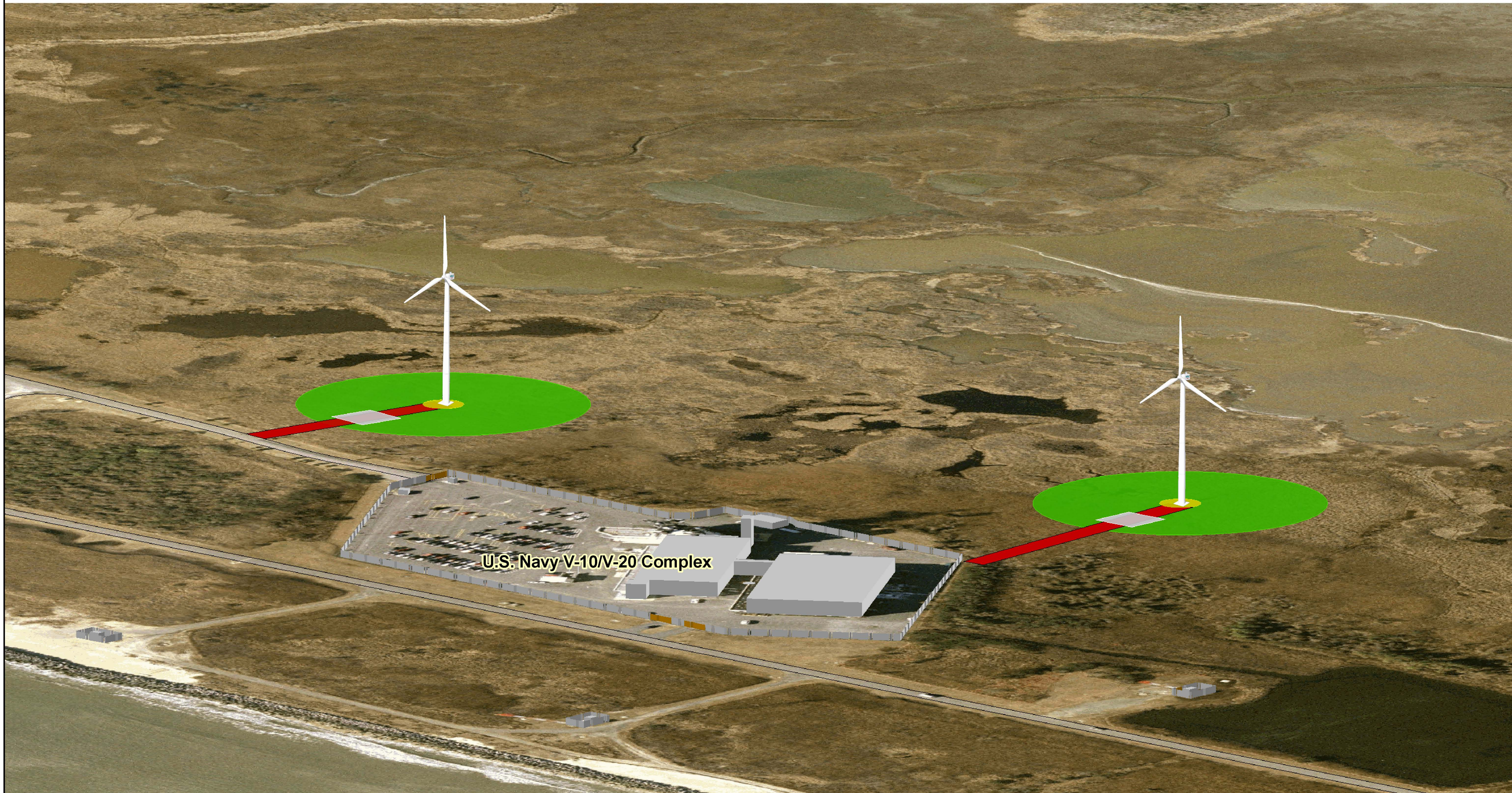

NOT TO SCALE

Legend
Surface Foundation Radius - 7.5 ft
Subsurface Foundation Radius - 21 ft
Turbine Workspace Radius - 150 ft
New Road Width - 30 ft
Crane Pad - 50 ft x 50 ft

Title: Oblique Aerial View of Wallops Island Viewed from the South End of the Island Looking North

URS Proj No: 15300762

Figure: 7

Client : NASA

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2.4 NO ACTION ALTERNATIVE

Under the No Action Alternative, NASA would not fund or install renewable energy sources at WFF to supplement the current supply of electricity that is provided by the local electric cooperative. The requirements for the implementation of sustainable practices for energy efficiency and reductions in GHG emissions, and for the use of renewable energy set forth in the 2005 EPAct, EO 13423, and EO 13514 would not be met by WFF.

WFF would not meet its own goals of reducing GHG emissions and supporting NASA's goal to set an example for environmental stewardship and accountability by a Federal agency. Additionally, WFF would not work toward its goal of reducing annual operating costs by investing in self-sufficient, renewable energy generation. The cost of electricity would continue to depend on the cost of the traditional, non-renewable energy sources used to produce it; as the supply and availability of fossil-fuel burning energy sources decreases, fuel costs are expected to continue to rise and ultimately the cost of electricity to the end user, WFF, would increase.

SECTION THREE: AFFECTED ENVIRONMENT

Section 3 describes existing resources at WFF that may be affected by the proposed alternatives. Resources are discussed under three main categories: Physical Environment, Biological Environment, and Social and Economic Environment.

3.1 PHYSICAL ENVIRONMENT

3.1.1 Land Resources

Information on land resources is taken from the 1994 soil survey for Accomack County, VA (USDA, 1994); the 2005 WFF Site-Wide EA (NASA, 2005); and the 2008 WFF Environmental Resources Document (NASA, 2008a). Land resources include topography and drainage, geology, soil, and land use within the WFF operating area.

3.1.1.1 Topography

The topography at WFF is typical of the Mid-Atlantic coastal region, generally low-lying and near sea level with elevations ranging from sea level to 15 meters (50 feet) above mean sea level (amsl). The majority of the WFF Main Base is located on a high terrace landform (7.6 to 12.2 meters [25 to 40 feet] amsl), with the northern and eastern portions located on low terraces (0 to 7.6 meters [0 to 25 feet] amsl) and tidal marsh. The Wallops Mainland is primarily located on low terrace and tidal marsh.

Wallops Island is a barrier island separated from the Main Base and Wallops Mainland by numerous inlets, marshes, bays, creeks, and tidal estuaries. During storms, flood water from the Atlantic Ocean moves through these inlets and across the marshes to low-lying areas along the coast (NASA, 2005). Wallops Island is approximately 11 kilometers (7 miles) long and 807 meters (2,650 feet) wide. Presently, the highest elevation on Wallops Island is approximately 4.6 meters (15 feet) amsl. Most of the island is below 3.0 meters (10 feet) amsl (NASA, 2005).

3.1.1.2 Geology and Soil

Located within the Atlantic Coastal Plain Physiographic Province, WFF 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 (Commonwealth of Virginia, 1975).

The Coastal Plain soils of the Eastern Shore are generally very level, and many soil types are considered to be prime farmland by the U.S. Department of Agriculture (USDA). The dominant agricultural soils in the region are high in sand content, which results in a highly leached condition, an acidic pH, and a low natural fertility (USDA, 1994). No prime or unique soils are found on Wallops Island, but some of the areas surrounding WFF, as well as parts of the Main Base, contain soil types that are classified as prime or unique farmland by the Natural Resources Conservation Service (USDA, 1994). Because the WFF is designated for urban and industrial uses by NASA and its partners, the Farmland Protection Policy Act (7 U.S.C. 4201 et seq.) does not apply to the soils within the WFF property boundaries.

3.1.1.3 Land Use

The majority of the Main Base, all of Wallops Mainland and Wallops Island are zoned as agricultural by Accomack County, VA (Figure 8). Parts of the Main Base are also zoned as industrial and residential. The marsh area between Wallops Mainland and Wallops Island is classified as marshland in the County's Comprehensive Plan. Rural farmland and small villages are scattered throughout the surrounding areas.

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. Wallops Mainland consists of 40 hectares (100 acres) and is bordered on the east by extensive marshland, and on the south, west, and north by farmland.

Area businesses include fuel stations, retail stores, markets, and restaurants. Horntown is located 4 kilometers (2.5 miles) north of the Main Base; Wattsville is located 1.6 kilometers (1 mile) to the west of the Main Base; and Atlantic is located 4.4 kilometers (2.75 miles) to the southwest of the Main Base. 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, VA, 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 who visit the public beaches and attend the annual Assateague Island pony swim and roundup. Therefore, hotels and motels, as well as other summer-season tourist businesses, can be found on Chincoteague Island.

The Wallops Island National Wildlife Refuge is located south of the Visitor Information Center and is under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS). This refuge is not open to the general public. South of Wallops Island is Assawoman Island, a 576-hectare (1,424-acre) island managed as part of the Chincoteague National Wildlife Refuge (CNWR) by the USFWS. A string of undeveloped barrier islands, managed by the Nature Conservancy as part of the Virginia Coast Reserve, extends down the coast to the mouth of Chesapeake Bay.

3.1.2 Water Resources

Water resources include surface waters, wetlands, floodplains, coastal zone management, and groundwater.

The southern and eastern portions of Wallops Island are part of the Eastern Lower Delmarva watershed. The western portion of Wallops Island, Wallops Mainland, and the entire Main Base are 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. Bogues Bay forms the northern boundary of Wallops Mainland with Oyster Bay and Woman's Bay to the south, and Hog Creek running through the Mainland. Little Mosquito Creek forms the northwest and northern boundary of the Main Base (Figure 9). A section of the Virginia Inside Passage, a federally maintained navigational channel frequently used by commercial and recreational boaters, is located west of Wallops Island and east of the Main Base. The Atlantic Ocean lies to the east of Wallops Island.

Surface waters in the vicinity of WFF 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. 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.

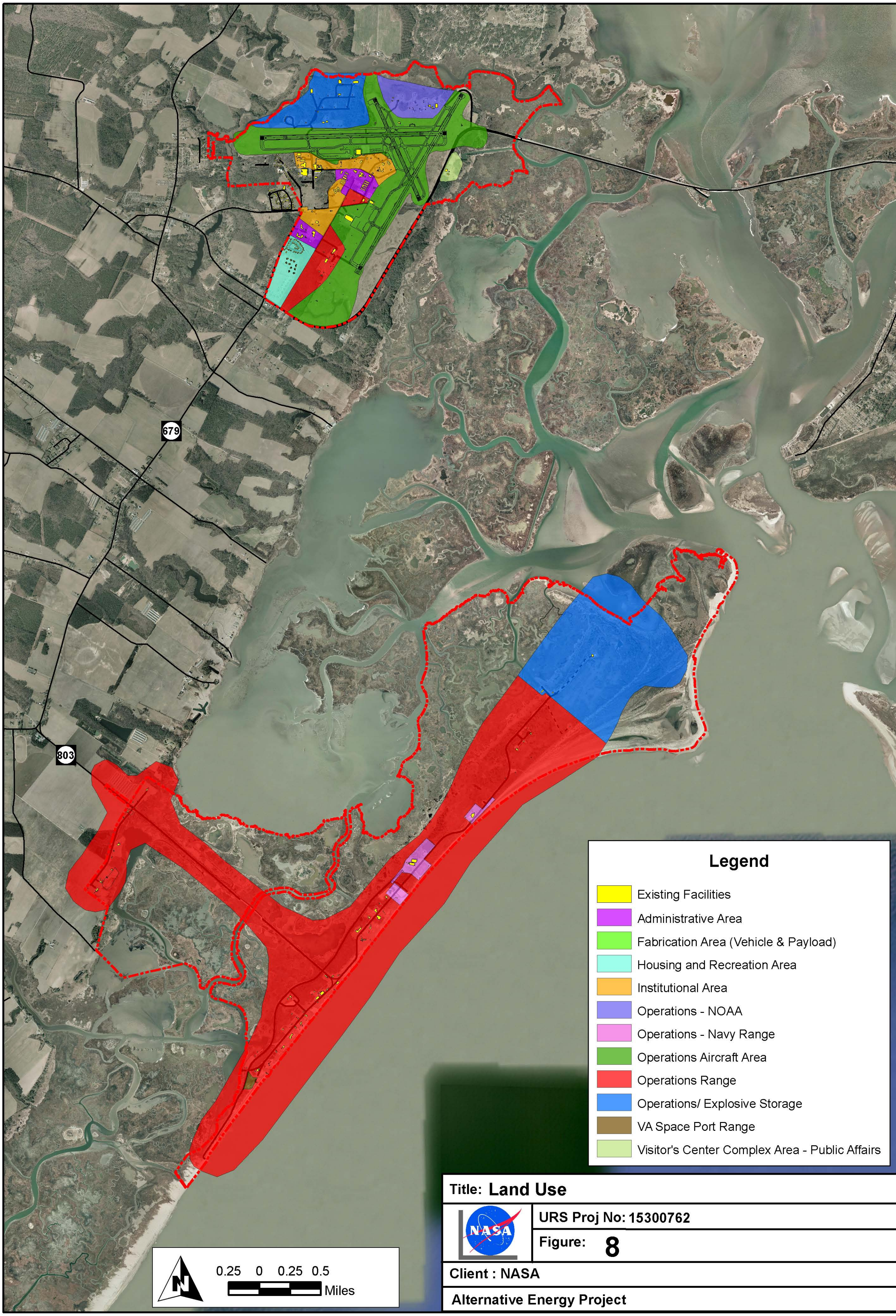
Stormwater

The Main Base has both natural drainage patterns and stormwater swales and drains to intercept and divert flow; all stormwater at WFF eventually flows to the Atlantic Ocean. On the northern portion of the Main Base, stormwater drains to Little Mosquito Creek, the eastern and southeastern portions of the Main Base have a natural drainage pattern that flows to Simoneaston Bay, and the natural drainage pattern on the western and southwestern portions of the Main Base is toward Wattsville Branch and Little Mosquito Creek. With the exception of several cross-culverts, storm drainage at Wallops Mainland is primarily toward Bogues Bay, Hog Creek, and Cat Creek, which all separate Wallops Island from Wallops Mainland.

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

The Clean Water Act (CWA) (33 U.S.C. §1251 et seq.), as amended in 1977, established the basic framework for regulating discharges of pollutants into the waters of the United States.

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 Virginia Pollutant Discharge Elimination System (VPDES) (9 Virginia Administrative Code [VAC] 25-151). NASA maintains a Stormwater Pollution Prevention Plan (SWPPP) to ensure that its operations have minimal impact on stormwater quality.



Title: **Land Use**

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Figure: 8

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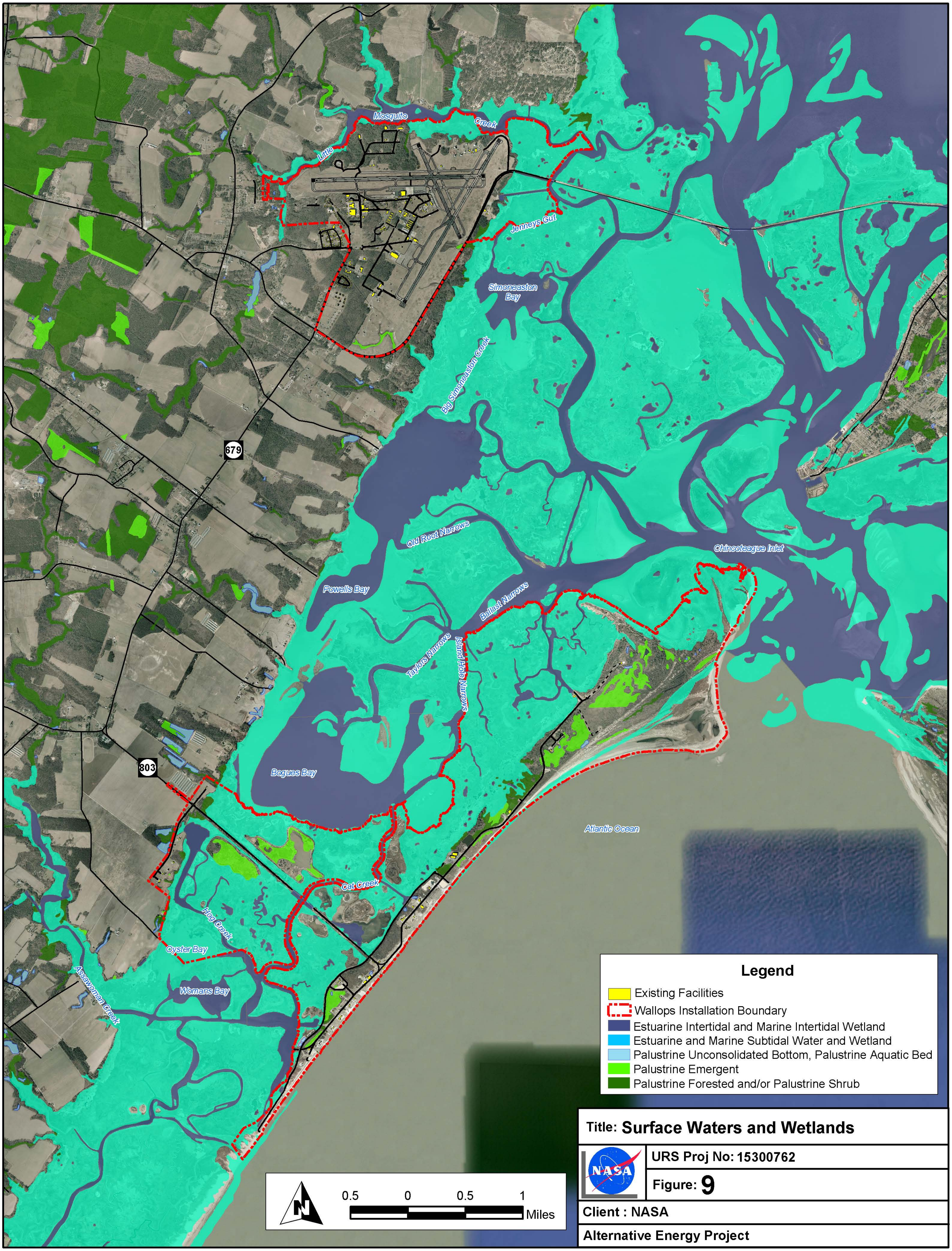
Mosquito
Creek
Little
Jenneys Gut
Simoneaston Bay
Big Simoneaston Creek
679
Old Root Narrows
Chincoteague Inlet
Powells Bay
Ballast Narrows
Taylors Narrows
Island Hole Narrows
Bogues Bay
803
Atlantic Ocean
Cat Creek
Hog Creek
Oyster Bay
Womans Bay
Assawoman Creek
Legend
Existing Facilities
Wallops Installation Boundary
Estuarine Intertidal and Marine Intertidal Wetland
Estuarine and Marine Subtidal Water and Wetland
Palustrine Unconsolidated Bottom, Palustrine Aquatic Bed
Palustrine Emergent
Palustrine Forested and/or Palustrine Shrub
N
0.5 0 0.5 1
Miles
Title: Surface Waters and Wetlands
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Alternative Energy Project

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The Virginia Stormwater Management Program (VSMP) regulations (4 VAC 3-20), administered by the Virginia Department of Conservation and Recreation (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 the Virginia DCR prior to construction. Construction and demolition activities at WFF are subject to VSMP permitting. NASA and its tenants develop SWPPPs and acquire the necessary permits as part of early project planning.

3.1.2.2 Wetlands

EO 11990, *Protection of Wetlands*, 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 CWA, Section 404 permits from the USACE are required for projects at WFF that involve dredging or filling wetlands. 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), the 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.

The Main Base has tidal and nontidal wetlands along its perimeter in association with Little Mosquito Creek, Jenneys Gut, Simoneaston Bay, and Simoneaston Creek. Extensive tidal 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, Hogs Creek, and Bogues Bay. Figure 9 provides further details on the types and locations of wetland communities at WFF.

3.1.2.3 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, 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 510001 0070 B and 510001 0100 C indicate that Wallops Island is located entirely within the 100-year and 500-year floodplains (see Figure 10). The 100-year and 500-year floodplains border the eastern edge of Wallops Mainland along Arbuckle Creek and

Hog Creek. The same FIRM Community Panels show that the 100-year and 500-year floodplains surround the perimeter of the Main Base, and occur along Mosquito Creek, Jenneys Gut, and Simoneaston Creek.

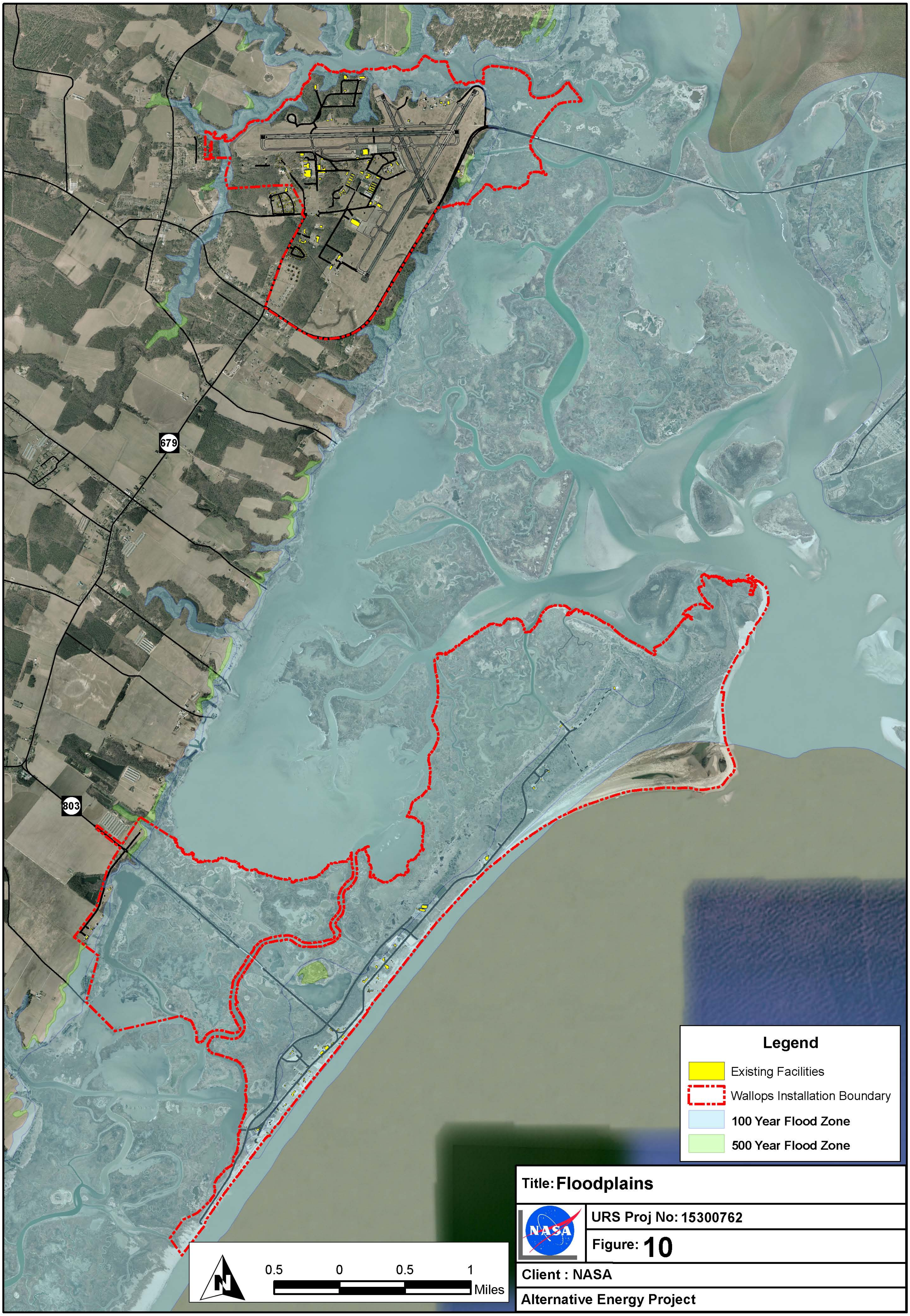
3.1.2.4 Coastal Zone Management

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 recreational resources, important natural habitats for 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 (CBRS). 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 CBRS; 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:

- **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 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 VPDES permit program regulates point source discharges to Virginia's waterways.



Title: Floodplains

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Figure: 10

Client : NASA

Alternative Energy Project

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- **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 WFF is within Virginia's CMA, its activities are subject to the Federal Consistency requirement.

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) for which volatile organic compounds (VOCs) and NO_X are the main precursors, lead (Pb), sulfur dioxide (SO_2) and particulate matter (PM). EPA divides PM into two categories: inhalable coarse particles (i.e., PM less than 10 micrometers [PM_{10}] but larger than 2.5 micrometers) and fine particles (i.e., PM less than or equal to 2.5 micrometer [$PM_{2.5}$]). 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, 2008c; see Table 7).

Table 7: National Ambient Air Quality Standards

Pollutant	Averaging Time	Primary/Secondary NAAQS	NAAQS Violation Determination
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[c]	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, 2008a

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 single facility-wide State operating air permit for stationary emission sources (Permit Number 40909, amended September 8, 2009). Wallops Main Base is also considered a synthetic minor source and has its own facility-wide State operating air permit for stationary sources (Permit Number 40217, amended February 5, 2009). A facility is considered a major source in an attainment area if all of its sources together have a potential to emit (PTE) greater than or equal to 90.7 metric tonnes (100 tons) per year of the criteria pollutants, or greater than or equal to 9.1 metric tonnes (10 tons) per year of a single Hazardous Air Pollutant (HAP) or 23 metric tonnes (25 tons) per year of combined HAPs. Table 8 provides the actual emissions of criteria pollutants for calendar year 2009 at WFF based on the 2009 Annual Update Forms (NASA, 2010c).

Table 8: Calendar Year 2009 Air Emissions at WFF

Pollutant	Main Base Emissions (metric tonnes per year/tons per year)	Mainland/Wallops Island Emissions (metric tonnes per year/tons per year)
VOC	0.54 (0.59)	<0.1 (<0.1)
NO_X	16.60 (18.30)	1.33 (1.47)
SO_2	23.70 (26.13)	2.00 (2.20)
PM_{10}	2.30 (2.54)	<0.1 (<0.1)
Pb	0.49 (0.54)	<0.1 <0.1
CO (Optional)	1.73 (1.91)	0.34 (0.37)
$PM_{2.5}$ (Optional)	N/A	N/A
NH_3 (Optional)	N/A	N/A

[1]VOC = Volatile Organic Compounds

3.1.4 Climate Change

There is scientific evidence 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 GHGs in the atmosphere (NASA, 2010a). By absorbing the radiative energy from the sun and earth, GHGs trap heat in the atmosphere and such accumulation in the atmosphere may be contributing to an increase in the Earth's average surface temperature, which in turn is expected to affect weather patterns and severity of storms/droughts, average sea levels, and increased intrusion of seawater into estuaries. Other effects are changes in precipitation rates, an increase in O_3 levels due in part to changes in atmospheric photochemistry, and decreased water availability and quality (Jones & Stokes, 2007).

GHGs include water vapor, CO_2, methane (CH_4), nitrous oxide (N_2O), O_3, and several hydro- and chlorofluorocarbons. These emissions occur from both natural processes and human activities. Water vapor occurs naturally and accounts for the largest percentage of GHGs, and 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) O_3 and other reactive species. Those compounds then react with GHGs and control the amount of radiation penetrating through the troposphere.

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

Each GHG is assigned a global warming potential (GWP), which is the ability to trap heat, and is standardized to CO_2, which has a GWP value of one. For example, N_2O has a GWP of 310, meaning it has a global warming effect 310 times greater than CO_2 on an equal-mass basis. For simplification, total GHG emissions are often expressed as a CO_2 equivalent (CO_2e). The CO_2e is calculated by multiplying each GHG emission by its GWP and adding the results to produce a combined rate to represent all GHGs.

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 created a Climate Change Steering Committee and GHG 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 such as EO 13514. In 2007, the U.S. Supreme Court determined that the EPA had the regulatory authority to include GHGs as pollutants under the CAA. On October 30, 2009, EPA issued a new rule (Mandatory Reporting of GHGs) that adds substantial additional requirements, such as measurement, monitoring, and reporting for many industries. Most recently, the EPA released a statement on December 7, 2009 announcing that the current levels of GHG threaten public health and the environment, prompting further requests for regulations to reduce GHGs (EPA, 2009).

GHG emissions were calculated for both WFF Mainland/Wallops Island and the Main Base to estimate NASA's contribution in calendar year 2009. These emissions resulting from mobile (government-owned vehicles and rocket launches) and stationary source operations at WFF in 2009 will be referred to as the "baseline" condition for the analysis in this EA.

Table 9 lists the GHG emissions for WFF based on the 2009 Annual Update Forms (NASA, 2009c). Emission factors from the EPA's AP-42 (EPA, 2009) and Environment Canada's National Inventory Report Annex 13 (Environment Canada, 2006) were used in conjunction with the WFF fuel consumption rates to calculate annual GHG emissions for boilers/heating equipment and emergency generators. Total baseline CO_2e emissions for WFF are 9,385 metric tonnes (10,345 tons) per year.

Table 9: Calendar Year 2009 Greenhouse Gas Emissions at WFF by Pollutant

Pollutant	Emissions (metric tonnes per year)/tons per year	
	WFF Main Base	WFF Mainland/Wallops Island
CO_2	8,308/9158	1043/1150
CH_4	24.9/27.4	3.1/3.4
N_2O	5.0/5.5	0.6/0.7
CO_2e	8338/9191	1047/1154

3.1.5 Climate

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, known 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.

3.1.5.1 Wind

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 37 kilometers per hour (kph) (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.

Wind speeds are the strongest during the fall and winter months, with winds exceeding 55 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.

3.1.6 Radar

Radar systems provide space position and/or target characteristic information for a variety of applications, including surveillance, tracking, weather observation, and scientific remote sensing. The radar functions are performed by a variety of ground-based and airborne systems in support of the Wallops Research Range and Earth Science programs. Three surveillance radars and up to seven (three fixed and four mobile) tracking radars provide data for range safety and mission requirements. These systems are located on the Main Base, Wallops Mainland, and Wallops Island. The targets that are tracked include aircraft, balloons, drones, expendable launch vehicles, reusable launch vehicles, satellites, and sounding rockets.

Radar is used to monitor the altitudes that are used for air traffic to prevent airplane collisions. All the objects that are illuminated in the radar field reflect some energy back to the radar. The energy is modified by the reflection process, but radar can use these modifications to differentiate between different types of objects. The motion of wind turbine blades has a similar velocity band as aircraft, so if the blades are visible to the radar then they cannot be distinguished from a moving aircraft. This could cause aircraft near wind turbines to be identified in the wrong position or be lost in the vicinity of the wind turbine(s). As wind turbine technology changes, modifications to radar or turbines and blades are being explored (BWEA, 2008).

3.1.7 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 the policy of the United States is to promote an environment for all Americans free from noise that jeopardizes their health or welfare.

3.1.7.1 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 10). 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 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 on 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 10: 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	

Thresholds/Noise Sources	Sound Level (dBA)	Subjective Evaluation[a]	Possible Effects on Humans[a]
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 11 shows the specific noise limitations by land use as regulated by Accomack County.

Table 11: 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 sources associated with activities at WFF include vehicular and air traffic, and noise at Wallops Island also includes target and rocket launches. In general, vehicular traffic at WFF, and especially Wallops Island, is minimal, and rocket launches are relatively infrequent and of short duration. WFF and U.S. 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.

During a 1992 noise monitoring program at Wallops Island, a wide range of background noise levels was found. 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).

3.1.8 Hazardous Materials and Hazardous Waste

3.1.8.1 Hazardous Materials Management

The WFF Integrated Contingency Plan (ICP), developed to meet the requirements of 40 CFR 112 (Oil Pollution Prevention and Response), 40 CFR 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:

- 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.

3.1.8.2 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.

3.1.8.3 Munitions and Explosives of Concern

The following discussion of Munitions and Explosives of Concern (MEC) is focused on those areas that may be impacted by the Alternative Energy Project and is therefore not a complete discussion of MEC or environmental restoration activities at WFF. Additional MEC and environmental restoration information may be found in the 2008 WFF ERD.

Test Cell/Gun Laboratory Range

A portion of the current Visitor Center property was historically used by the Department of Defense (DoD) as a Test Cell/Gun Laboratory Range from 1946 through 1959. The Test Cell/Gun Laboratory Range was used for ground firing tests evaluate experimental aircraft guns and mechanisms, proof testing of 20 millimeter (mm) and 30 mm (0.8- and 1.2-inch) ammunition, ground fire testing of rocket projectors, and static testing of jet engines used to power guided missiles (USACE, 2005). In addition, 70 mm (2.75-inch) Aircraft Recoilless Rocket Launchers were tested and evaluated at the site (USACE, 2005). Following the property transfer from the DoD to NASA, the Test Cell/Gun Laboratory Range was used by the Chincoteague U.S. Army Reserve unit until 1976, when activities were moved to the current Marine Science Consortium property adjoining the Main Base facility. In 1981, NASA constructed the current Visitor Center.

A 1991 Site Assessment found “a large number of spent 20 mm practice rounds” scattered in the area of one of the former firing-in butts. During a property inspection conducted in April 2005, additional 20 mm (0.8-inch) rounds were identified. In response, NASA conducted clearance activities in February 2006 (NASA, 2006a). The objective of the clearance activities was to locate, identify, and remove MEC from the top 30 cm (1 foot) of soil. Approximately 2,150 items were identified during the surface and intrusive clearance activities:

- 1,106 munitions items (20 mm/30 mm [0.8- and 1.2-inch] fragments and projectiles)
- 7 munitions-related scrap debris items (grenade handle, mortar fins, M-1 clips, 75 mm [3-inch] projectiles, and empty propellant charge canisters)
- 302 scrap metal items (pipe, rebar, etc.)
- 332 unidentified scrap metal items

Items left in place included:

- 3 anomalies associated with an area identified as a probable burn pit containing melted and consolidated metal debris including 20 mm/30 mm (0.8- and 1.2-inch) fragments. This area is covered by 30 cm (1 foot) or more of soil.
- 10 identified scrap metal items too large to move (large metal plates, concrete and rebar).
- 328 unidentified items at depths greater than 30 cm (1 foot).

NASA concluded that the top 30 cm (1 foot) of ground in the area investigated was clear of MEC. This conclusion was based on the fact that no live, fuzed, or explosive-containing items were identified during the investigation. NASA recommended a dig/excavation restriction in the area investigated (approximately 1.6 hectares [4 acres]) in addition to areas adjacent to the perimeter of the investigation area. Any planned soil disturbance or intrusive activities should include qualified Unexploded Ordnance (UXO) Technicians or Specialists and must include UXO avoidance or clearance activities.

Currently the Visitor Center area is an active Formerly Used Defense Site managed by the USACE Baltimore District. A Site-Specific Work Plan summarizing a planned MEC reconnaissance and Munitions Constituents (MC) sampling event was submitted in January 2011 to the EPA, VDEQ, and NASA. Following the finalization of the Work Plan, the USACE would conduct MEC screening and MC sampling activities at the site (currently projected for March-

April 2011). Results of the fieldwork would be presented in a Site Inspection Report and the site would be proposed for either an additional response action or a No DoD Action Indicated designation.

Photograph 1: 1974 Test Cell/Gun Laboratory Range

Photograph 2: Typical MEC at Visitor Center (2005)

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 Vegetation

Wallops Island

Wallops Island is a barrier island that contains various ecological succession stages, including beaches, dunes, swales, maritime forests, and marsh. 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 salt marshes.

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*) (Koltz, 1986). Because of the dynamics of wave action, few plants exist in the subtidal zone, which extends from the lower limit of low tide seaward, and the intertidal zone, a transition zone exposed during low tide and submerged at high tide. On Wallops Island, beaches and dune systems are found on the northern and extreme southern sections of the island only. Plants such as sea rocket and beachgrass 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 central portion of Wallops Island is dominated by common reed, an invasive undesirable species, and maintained lawn areas. 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 dominated by loblolly pine (*Pinus* *taeda*) and cherry trees (*Prunus* spp.), with an understory of northern bayberry, wax myrtle, and groundsel-tree, exists on the central portion of the island. 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.

An area of tidal marsh encompasses 1,130 hectares (2,800 acres) between Wallops Island and Wallops Mainland. As the marshes provide suitable habitat for both foraging and reproduction, these areas are of tremendous importance to marine life and many terrestrial and avian species.

Wallops Mainland and Main Base

The vegetative zones from east to west on Wallops Mainland and Main Base are marsh, thicket, and upland forest. Inland communities such as fresh and brackish marsh, xeric and mesic shrub, patches of open ground, areas completely covered by pine, and pine-deciduous mixed woodlands are often separated from one another by a sharp topographic change. Small rich remnants of upland forests and swamps occur on Wallops Mainland and Main Base. Dominant species in the upland forest include loblolly pine, various oaks (*Quercus* sp.), hickory (*Carya* sp.), tulip-poplar (*Liriodendron tulipifera*), dogwood (*Cornus florida*), sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), and sassafras (*Sassafras albidum*). Black willow (*Salix nigra*) and red maple are dominant species in the swamps. The tidal marsh found on Wallops Mainland and Main Base is similar to the tidal marsh on Wallops Island. Fields, pine forests, lawns, buildings, and pavement are present throughout the Main Base.

3.2.2 Terrestrial Wildlife

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

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. Periwinkle snails (*Littorina irrorata*) and mud snails (*Ilyanassa obsoleta*) are found on the marsh surface.

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 woodhousei*) 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 platirhinos*), snapping turtle (*Chelydra serpentina*), box turtle (*Terrapene carolina*), and northern fence lizard (*Sceloporus undulatus*) can be found in low-lying shrubby areas throughout WFF. 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*), gray squirrel (*Sciurus carolinensis*), white-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), rice rat (*Oryzomys palustris*), Eastern cottontail rabbit (*Sylvilagus floridanus*) and red fox (*Vulpes vulpes*) are plentiful throughout WFF. River otters (*Lontra Canadensis)* have been observed on the marsh/upland interface of Wallops Island. These mammals use the maritime forest and other sections of the island for forage and shelter.

3.2.3 Avifauna

3.2.3.1 Birds

Vaughn (1993) reported in the *Birds of Wallops Island, Virginia 1970–1992* that a total of 244 species have been recorded for Wallops Island and Wallops Mainland. This includes those birds that have been seen over the ocean, saltmarshes, thickets and forests, dunes, and urbanized land habitats associated throughout WFF. Of these, approximately 61 species have been documented breeding since 1970. Vaughn (1993) provides detailed species accounts for the occurrence of all 244 species, including information on the listed species discussed in this report: Bald Eagle, Peregrine Falcon, Piping Plover, Upland Sandpiper, and Wilson's Plover. These species accounts include information on abundance, migratory arrival and departure, breeding status, areas of use and high daily counts. The list of species for WFF is a subset of the 324 species that have been identified as occurring at the CNWR and includes shorebirds, gulls/terns, songbirds, raptors and other groups of birds as discussed below.

During spring and fall migrations, approximately 15 species of shorebirds feed on microscopic plants and animals in the intertidal zone. Abundant among these are the Sanderling (*Calidris alba*), Semi-palmated Plover (*Charadrius semipalmatus*), Red Knot (*Calidris canutus rufa*), 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 Gull (*Larus atricilla*), Herring Gull (*L. argentatus*), and Great Black-backed Gull (*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 sparrow, Red-winged Blackbird (*Agelaius phoeniceus*), Boat-tailed Grackle (*Quiscalus major*), and Fish Crow (*Corvus ossifragus*). Birds common in the shrub zone include the Song Sparrow (*Melopiza melodia*), Gray Catbird (*Dumetella carolinensis*), Common Yellowthroat (*Geothlypis trichas*), and Mourning Dove (*Zenaida macroura*). Resident Canada Geese (*Branta canadensis*) are found year-round in open upland portions of the property.

Numerous songbirds and other avian species can be found on the Main Base and Wallops Mainland. Some of these, such as Barn Swallows (*Hirundo rustica*), are migratory and occur only during the spring, summer, and early fall. Northern Mockingbirds (*Mimus polyglottos*), Robins (*Turdus migratorius*), and Starlings (*Sturnus vulgaris*) are prevalent throughout the year.

Raptors, including 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, and recently another nest was discovered on the northern end of Wallops Island.

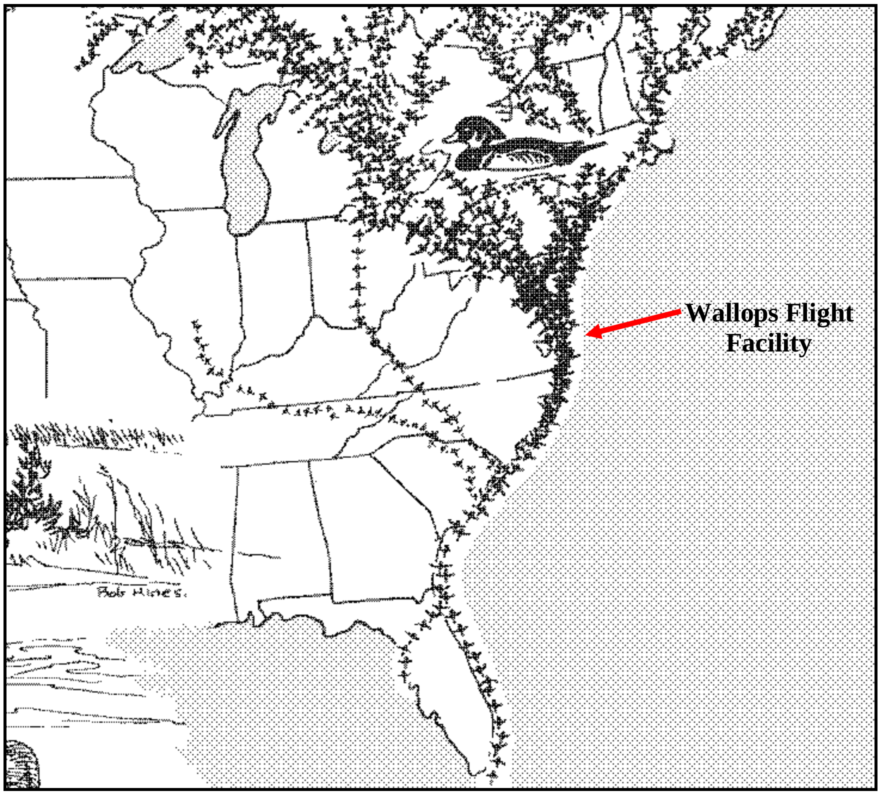
According to the Virginia Department of Game and Inland Fisheries (VDGIF), over 80 percent of Virginia's coastal bird Species of Greatest Conservation Need (SGCN) may occur within the vicinity of Wallops Island (VDGIF, 2005). VDGIF ranks SGCN by 4 tiers, which are defined as:

- Tier I - critical conservation need; faces an extremely high risk of extinction or extirpation;
- Tier II - very high conservation need; has a high risk of extinction or extirpation;
- Tier III - high conservation need; extinction or extirpation is possible; and
- Tier IV - moderate conservation need; the species may be rare in parts of its range, particularly on the periphery (VDGIF, 2005).

Migratory Birds

The Migratory Bird Treaty Act (MBTA, 16 U.S.C. 703-712) was enacted to ensure the protection of shared migratory bird resources. 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 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."

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—several routes converge just north of WFF, resulting in the Eastern Shore of Virginia and parts of Accomack County hosting large migrations of a diversity of bird species (see Figure 11). Waterfowl, other waterbirds, shorebirds, songbirds, and raptors stopover in or migrate through portions of Virginia and Maryland's Eastern Shore along the Atlantic Flyway in numbers that are globally significant. Some species use Wallops Island and Mainland as a stopover point, while others use the island and surrounding habitats as an overwintering area.



Source: USFWS, 2009a

Figure 11: Atlantic Flyway Migration Routes

Wintering Birds

Moderate to large numbers of birds winter successfully in coastal Virginia. The National Audubon Society Christmas Bird Counts (CBCs) are the primary sources of information on birds wintering in and adjacent to Accomack County and the project site. The CBCs are conducted by dozens of birders in Accomack County over a 10-day period in December of each year. Two locations of CBCs contain similar habitat to Wallops Island: the CNWR at Assateague Island and Hog Island, VA, which is a barrier island approximately 29 kilometers (18 miles) south-southwest of Wallops Island (National Audubon Society, 2010). The diversity and number of birds varies between years and sites, but both CBC sites regularly record more than 100 species and in some years report more than 150 species of birds. The reason for the large number of species and individuals found in these CBC sites is related to the diversity of habitats and the presence of excellent winter forage and cover for these species. During the 10-year CBC count period between 1999 and 2009 at CNWR, one Piping Plover was observed in 1999, and one Piping Plover was observed in 2001. One Red Knot, a Federal candidate species, was observed in 2003. No other federally endangered species were observed.

Designated Wildlife Areas in the Vicinity of WFF

Several areas in the vicinity of WFF have been set aside as conservation and/or wildlife management areas, including for use as bird habitat, and when combined, make the Eastern Shore of Virginia a desirable stopover or permanent home for birds.

According to the USFWS, the proposed project is within approximately 4.8 kilometers (3 miles) of the Assawoman Island Division of the CNWR and within approximately 4.8 kilometers (3 miles) of the CNWR. Wallops Island lies within the Virginia Barrier Island Lagoon system, which includes the seaward margin of the lower Delmarva Peninsula from the mouth of the Chesapeake Bay to the Maryland Virginia border, and is a nationally recognized bird migration pathway, a Western Hemisphere Shorebird Reserve, a World Biosphere Reserve, a National Natural Landmark, and an Important Bird Area (IBA).

The CNWR was originally established in 1943 to provide habitat for migratory birds. Currently, this refuge provides habitat for waterfowl, wading birds, shorebirds and songbirds, as well as other species of wildlife and plants. The refuge also supports several threatened and endangered species. According to results from the International Shorebird Surveys east of the Rocky Mountains, CNWR ranks second in species diversity during spring and fall shorebird migrations, and is among the top ten sites with greatest maximum counts. CNWR is part of the barrier island system that constitutes the largest stretch of undeveloped barrier islands on the East Coast of North America, having been preserved through a combination of Federal, State and privately owned (The Nature Conservancy) islands. These barrier islands extend from Assateague Island south to Fisherman Island, and provide habitat for numerous species of birds throughout the year, as well as providing important aquatic habitat for numerous species of finfish and shellfish. These barrier islands in Maryland and Virginia have been designated a Western Hemisphere Shorebird Reserve due to the area’s international importance as shorebird nesting, feeding and resting habitat. Such designation is given where over 100,000 shorebirds use an area on an annual basis. The United Nations has designated these islands and lagoon systems as a World Biosphere Reserve due to their great ecological value. The U.S. Department of the Interior has also designated these barrier islands as a National Natural Landmark due to their outstanding natural values.

The project is also located within the Barrier Island/Lagoon System IBA. The IBA is administered by the National Audubon Society and identifies sites that provide essential habitat to nesting, migrating, or wintering birds. This IBA includes the seaward margin of the lower Delmarva Peninsula from the mouth of the Chesapeake Bay to the Maryland-Virginia border and includes diverse habitats such as barrier beaches, maritime forests, salt marsh, inter-tidal mudflats, and open water. This IBA is identified as the most important bird area in Virginia and supports the highest diversity and density of birds of conservation concern in Virginia.

Other protected areas in the vicinity of the proposed project include the following:

- The Saxis Wildlife Management Area and the Saxis Waterfowl Management Area and Refuge, owned by the Commonwealth of Virginia, is located on the western side of the eastern shore of Virginia, approximately 13 kilometers (8 miles) west of Wallops Island on Pocomoke Sound.
- The Nature Conservancy’s Virginia Coast Reserve, which includes 14 of 18 islands along the entire Virginia coast to the south of Wallops Island.
- The Assateague National Seashore, which is located approximately 17 kilometers (10 miles) northeast of Wallops Island.
- The Pocomoke State Forest in Maryland is located approximately 18 kilometers (11 miles) northwest of Wallops Island.

Phase 1 Avian Risk Assessment

Curry and Kerlinger (2004) prepared a Phase I Avian Risk Assessment for the proposed construction of two utility-scale turbines at WFF. The scope of the assessment included a literature review, interviews with local and regional experts (agency staff, environmental organizations and local birders) and a site visit. These sources of information were used to determine the type and number of birds that are known or suspected to use the project site and the area surrounding that site. The degree of risk to birds, if any, from the proposed project was also determined. Although the siting of one of the turbines on the Mainland changed over the course of the project, the assessment also included a turbine sited on Wallops Island in relatively the same location as is currently proposed under Alternatives 1 and 2.

A summary of conclusions relevant to the turbine proposed for Wallops Island is as follows:

- Risk to state/federal threatened/endangered species is probably minimal because neither will likely use the site to forage or roost. No state or federally listed species is likely to nest on or near the site.
- The birds that nest, migrate and make stopovers in the adjacent habitats (including shorebirds, raptors, waterfowl, etc.), and wintering birds are very diverse and numerous, indicating that the general area is a very important area for birds.
- Risk factors indicate that the Wallops Island turbine site presents relatively high risk to various types of birds.
- Although the number of collision fatalities at the proposed turbines are likely to be greater on a per turbine basis that other wind power sites, the fact that there would only be one or two turbines suggests the absolute number of fatalities would not be high and that the impacts would not be biologically significant (defined as "likely results in the decline at the local, regional or global level").

The Phase I report provides recommendations including the construction- and operation-related mitigation factors discussed in Section 5.

Avian Study at Wallops Island, 2008–2009

NASA conducted an avian field pre-construction study between October 1, 2008, and October 1, 2009 (Appendix A). The overall objective of this study was to assess the potential risk to birds from operation of the two proposed 2.0 MW wind turbines.[1] The specific objectives of the field study were:

- Perform a pre-construction inventory of resident avian species and habitat in the vicinity of the proposed turbine sites.
- Identify pre-construction migratory, nesting, and winter avian use (abundance and behavior) of the project site, including use of migration stopover, resting, or feeding areas in the vicinity of the development site.

[1] The potential risk to birds from the proposed 2.4 kW wind turbines was not assessed as part of this study. See Section 4.3.3 for a qualitative assessment.

- Assess potential risk from wind turbine operation to avian species, primarily through monitoring of avian fatality at existing tall structures on Wallops Island.

To specifically address these objectives, the field study included diurnal avian surveys and fatality searches near existing towers in the general vicinity of the proposed wind turbines. Searcher efficiency and carcass removal tests were also incorporated into the fatality surveys. Radar surveillance was not a component of the avian study.

The pre-construction field study was conducted in accordance with the Avian and Bat Study Plan (Study Plan) (Tetra Tech, 2008). The plan was developed with input from VDGIF, USFWS, the U.S. Navy, the College of William & Mary's Center for Conservation Biology and The Nature Conservancy and designed to address project-specific objectives (i.e., the construction of two turbines). The interim and voluntary USFWS guidelines (2003) available at the time of Study Plan preparation were also considered. The Study Plan was finalized and implemented prior to the release of the Wind Turbines Guidelines Advisory Committee's (WTGAC, 2010) wind turbine recommendations to the Secretary of the Interior. The pre-construction study is generally aligned with Tier 3 (i.e., Field Studies to Document Site Wildlife Conditions and Predict Project Impacts) as outlined in that document.

Methods

Avian Field Observations

The avian field observations included two components: 1) avian observations conducted once per week at two point count locations ("Avian Survey Observation Points" on Figure 12) throughout the 52-week study duration; and 2) avian observations for a period of 15 minutes at least twice per week during migration seasons (September 1–October 31 and April 15–June 15) at the same observation sites.

For the once-per-week observations throughout the 52-week period, biologists visited both observation sites at least once per week for a minimum of 15 minutes per day between 7:00 a.m. and 9:00 a.m. at each location to record avian activity. Data were recorded for birds observed within a 1 kilometer (0.6 mile) radius of the point count locations. Data for each avian observation included: species, number of individuals, and behavior of individuals (to include altitude, flight direction, feeding vs. flying/migrating, resting, etc.).

During migration seasons, the biologists conducted 15-minute avian observations at least twice weekly between 7:00 a.m. and 9:00 a.m. at each location at the same two observation points referenced above. During peak migration days, biologists supplemented these data by conducting observations at the U.S. Navy building mast tower, which offers unobstructed, panoramic views of the Wallops Island air space (including the rotor sweep areas of the proposed turbines). The survey team targeted fall and spring days when weather front movement was conducive to migratory activity and conducted their spot observations during daytime hours (between 9:00 a.m. and 4:00 p.m.). Data collected during migration season surveys included the date and times of observations, species observed, numbers of individuals, and behavior. Behavioral information includes the path where birds were flying in relation to the proposed turbine area(s), height of flight (below, within, or above the rotor height zone), perching behavior, hunting behavior, etc. Local weather data, including temperature, sky conditions, wind direction, and wind speed were also recorded.

Avian Fatality Searches at Existing Towers

NASA used three existing towers on Wallops Island as surrogates for wind turbines to study avian fatalities. By studying fatalities at these tall structures, an understanding of the nocturnal and diurnal birds that use the airspace above Wallops Island was acquired. One guyed (North Boresight, 47 meters [155 feet] tall) and two unguyed towers (South Boresight, 47 meters [155 feet] tall and South Meteorological Tower, 102 meters [335 feet] tall) were used for observations (see Figure 12).

Fatality searches were conducted as soon as possible after sunrise between October 1, 2008, and September 30, 2009. The intensity of searches was greater during the peak spring (April to early June) and fall (August to October) bird migration seasons. Searches took place three times per week during the migration seasons and one time per week during the remainder of the year; the length of time for each search was not reported. At the North Boresight Tower, the search area extended outward to the full extent of guy wires (approximately 18 meters [60 feet]). At the South Boresight Tower and South Meteorological Tower, which have no guy wires, the search areas extended from the tower base outward to 80 percent of the tower height (approximately 38 meter [125 foot] and 82 meter [268 foot] radii, respectively). The maximum area searched was a rectangle with transects separated by 7 meters (23 feet). All 335 square meters (3,600 square feet) was searched at the North Boresight Tower; a portion of the areas for the South Boresight Tower and the South Meteorological Tower was searched as shown on Figure 4 in Appendix A. All carcasses (i.e., feathers or clumps of feathers with flesh attached or loose tail or primary feathers not expected to come from molt) were recorded as fatalities.

In addition to fatality searches for bird carcasses beneath the existing towers, searcher efficiency and carcass removal trials were also conducted. The Avian Study Final Report (Appendix A) contains more detailed explanation of the searcher efficiency and carcass removal trials.

To estimate how many birds were likely killed at the existing towers, the numbers of carcasses found were multiplied by a factor of four. This factor includes a general searcher efficiency rate of 50 percent and a carcass removal rate of 50 percent. The factor is calculated by multiplying 0.5 by 0.5 for a combined rate of 0.25, the factor of four used to calculate fatality rate. Studies of bird carcasses at communication towers indicate that the factor of four is likely to reflect searcher efficiency and carcass removal at a wide variety of habitats beneath communication towers (Gehring et al., 2009).

Findings

The following is a summary of the data collected during the avian surveys described above; detailed results are presented in the Avian Study Final Report (Appendix A). Although the surveys officially started on October 1, 2008, some data collected prior to this date are included in the report, particularly diurnal point count observations that began on September 12, 2008, and one migration survey on September 22, 2008. Fatality searches began on October 3, 2008, and ended on October 2, 2009.


25 Foot Height at Proposed Turbine Location
Marsh Detector
North Boresight Tower - 155 Foot Height
Marsh Detector
25 Foot Height at Proposed Turbine Location
2 Tower Detectors
South Boresight Tower - 155 Foot Height
South Meteorological Tower - 335 Foot Height
Legend
Bat Echolocation Device
Bat Detector Location
Avian Survey Observation Point
Migration Observation Platform
WFF Boundary
500 0 500 1,000
Feet
Title:
Bat Detector and Avian Observation Locations
NASA
URS Proj No: 15300762
Figure: 12
Client : NASA
Alternative Energy Project

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Avian Field Observations

Species observed during the 79 surveys include almost 100 species of birds typical of the avifauna community expected to occur at Wallops Island (Table 12). With the exception of Snow Goose, which was 72.4 percent of the total number of observations, almost 30 percent of the bird community observed was comprised of native species typically found in Virginia's coastal habitats (e.g., Tree Swallow, Canada Goose, Red-winged Blackbird and Great Egret, in order of frequency of occurrence) as well as a common non-native species (European Starling) that frequently occur in disturbed/urbanized habitats.

Table 12: Species Abundance Summary October 2008–October 2009

Species	Number Observed	Percent of Total With 20,000 Snow Geese Recorded on Single Day	Percent of Total Without 20,000 Snow Geese Recorded on Single Day
Snow Goose	23,321	72.4	27.2
Tree Swallow	1,569	4.8	12.8
European Starling	708	2.2	5.8
Canada Goose	501	1.6	4.1
Red-winged Blackbird	500	1.6	4.1
Great Egret	495	1.5	4.0
All other species	5,132	15.9	42
Total	32,226	100	100

A flock of approximately 20,000 Snow Geese was observed on the far western side of the marsh adjacent to the observation point on one day in November 2008. Table 13 shows the percentage of the total number of birds observed excluding the 20,000-member flock of Snow Geese.

Waterfowl were the dominant class of birds observed (76.8 percent of all observations) (Table 13). Passerines, blackbirds, waders, gulls and terns, raptors, shorebirds and others were much less common, with each less than 9 percent of the total number of birds observed. Excluding the single observation of 20,000 Snow Geese from the total, waterfowl were still the most frequently observed group of birds at 38.9 percent of total individuals. Table 13 shows the percentage of the total number of birds observed excluding the 20,000-member flock of Snow Geese.

Table 13: Avian Observations by Class of Species

Class of Species	Number Observed	Percent of Total With 20,000 Snow Geese Recorded on Single Day	Percent of Total Without 20,000 Snow Geese Recorded on Single Day
Waterfowl[1]	24,759	76.8	38.9
Passerines[2]	2,864	8.9	23.4
Blackbirds[3]	1,554	4.8	12.7
Waders[4]	986	3.1	8.1
Gulls and Terns	951	3.0	7.8
Shorebirds	588	1.8	4.8
Raptors	60	<0.1	<0.1
Other[5]	464	1.4	0.5
Total	32,226	100	100

Notes:
[1] Waterfowl – includes geese, ducks, cormorants, and mergansers.
[2] Passerines – include all songbirds.
[3] Blackbirds – include crows, grackles, blackbirds, starlings, and cowbirds.
[4] Waders – include herons, egrets, and ibis.
[5] Other – includes all other species, including but not limited to, owls, woodpeckers, doves, and pelicans.

The greatest concentrations (i.e., flocks) of birds documented were wintering waterfowl and flocks of certain passerines passing through during migration. Migratory Snow Geese are common and abundant winter residents in the lower Mid-Atlantic States, including Virginia, and were observed multiple times in large flocks numbering up to 20,000. Other large flocks observed were up to 250 Tree Swallows, 100 to 200 Northern Flickers, 120 Brants, and groups of 90 to 120 Yellow-rumped Warblers during the fall migration period. Several other species were observed during migration in concentrations above 50 individuals including waterfowl, passerines, gulls, shorebirds, and wading birds. No large concentrations of raptors were recorded migrating during the survey period.

There is a seasonal component to bird activity at Wallops Island. The observational data for the year-long study indicate that bird activity was highest during fall migration (50 percent higher than spring) and decreased from mid-December through the winter months in January and February (Table 14). Average daily avian observations more than doubled in March and sustained similar levels through June before increasing again approximately 50 percent in July and maintaining similar levels through October 1. The data collected from this study also demonstrate that the winter and summer bird communities vary and some of the migrants that were observed may spend minimal time in the area heading to other geographic areas to winter and/or breed. Finally, the data indicate that the morning bird counts conducted during migration seasons resulted in a 50-percent higher incidence of birds in fall versus spring migration months.

Table 14: Number of Bird Observations by Month and Survey Effort

Month	Number of Surveys	Number of Birds Observed	Average Birds Observed Per Day
September 2008	5	741	148
October 2008	6	2,745	458
November 2008	4	20,665	5,166[2]
December 2008	3	1,833	611
January 2009	5	419	84
February 2009	4	191	48
March 2009	5	543	108
April 2009	12	752	63
May 2009	11	1,070	97
June 2009	7	627	90
July 2009	4	531	133
August 2009	4	682	171
September 2009	8	1,283	160
October 2009	1	154	154

No federally listed endangered or threatened species were observed during the field surveys. Three species listed as threatened by the Commonwealth of Virginia were observed, including 10 Bald Eagles, one Gull-billed Tern, and two Peregrine Falcons. All of the eagles were located west or northwest of the wind turbine sites and the Gull-billed Tern was observed south of the project site. Also documented were 15 Red Knot, a USFWS candidate species and Virginia SGCN Tier IV (moderate conservation need) species, observed on one occasion in September 2009. Other listed species that may occur in the area but were not observed during the surveys include Piping Plover, Wilson's Plover, and Upland Sandpiper.

The number of birds recorded within the wind turbine rotor-sweep zone, which would occur between approximately 43 meters (140 feet) and 120 meters (395 feet) above ground level, was 598 or 1.9 percent of all observed birds. Of these birds, 188 were Tree Swallows (31.4 percent), 130 were Great Egrets (21.7 percent), 57 were European Starlings (9.5 percent) and 50 were Snowy Egrets (8.4 percent). Flight direction was predominantly to the west (65 percent), followed by south (25 percent), east (5 percent) and north (5 percent). The majority of these birds were hunting or feeding (46 percent) or resting (43 percent). These birds were all observed in the August and September fall migration months.

Avian Fatality Study

Carcass searches were conducted on 83 days between October 3, 2008, and October 2, 2009, and resulted in 18 recorded fatalities. Eleven observations were located near the 102-meter (335-foot) tall unguyed South Meteorological Tower. Single/small clumps of feathers of seven individuals

[2] Includes a single daily observation of 20,000 snow geese on November 20, 2008.

were also observed, but not recorded as collision fatalities. Seven dead birds were located near the 47-meter (155--foot) tall guyed North Boresight Tower. Carcasses that could be identified to species include:

- American Robin (MT[1])
- Clapper Rail (MT)
- Common Grackle (NB[2])
- Double Crested Cormorant (NB)
- European Starling (NB, MT)
- Marsh Wren (MT)
- Northern Flicker (MT)
- Red-winged Blackbird (NB, MT)
- Salt Marsh Sharp-tailed Sparrow (NB)
- Tree Swallow (MT)
- Unidentified gull (MT)
- Unidentified sparrow (NB)
- Yellow-rumped Warbler (NB)

[1] MT=Meteorological Tower
[2] NB=North Boresight Tower

Carcasses were recovered during most months of the year.

Few generalizations can be made about what types of birds were most susceptible to colliding with the towers. Both night-flying and diurnal migrant birds were observed, including waterfowl, waterbirds, passerines, and raptors. Three SGCN were identified; the Tier II Salt Marsh Sharp-tailed Sparrow and Tier IV Marsh Wren and Clapper Rail. No State or federally listed endangered or threatened species were among the fatalities. No bird carcasses or remnants were located in the vicinity of the South Boresight Tower; the presence of guy wires may have been responsible for all or nearly all fatalities that were found at the North Boresight Tower.

Searcher efficiency rates for the first half of the study period were approximately 50 percent, but improved to 68 percent during the full searcher efficiency study from March 1, 2009, through October 2, 2009.[3] Searcher efficiency for medium to large birds was 78 percent (21 of 27 birds found) and 76 percent (16 of 21 birds found) for small birds. As for total efficiency rates by tower, 62 percent (16 of 26 carcasses) were found by searchers at the North Boresight Tower and 71 percent (17 of 24 carcasses) were each found at the South Boresight Tower and the South Meteorological Tower.

A total of 28 birds (based on seven carcasses) were estimated as killed at the North Boresight Tower during the 1-year study period when a factor of four was used for the combined carcass removal and searcher efficiency rate. When 11 (the number of fatalities attributed to the tower) and 18 (total number of fatalities plus the number of individuals identified from single feathers/feather clumps) are used to calculate fatalities for the South Meteorological Tower, an estimate of a minimum of 44 and a maximum of 72 birds were killed at the tower during the 1-year period.

Summary of Findings

The following points summarize the findings of the avian study conducted for NASA’s proposed wind turbine project at Wallops Island:

[3] These results include searches for the placed tailless mice (surrogates for bats).

- Avian observations included species that would be expected to occur in this area and included raptors, shorebirds, waterbirds, waterfowl, passerine and non-passerine species. The number of raptors was very low.
- Bird species that were observed in flocks of over 100 individuals within a survey period included Tree Swallow, Flicker, and Yellow-rumped Warbler. By far, the largest numbers of birds observed were flocks of migrating Snow Geese numbering in the hundreds and even thousands.
- Over 81 percent of the recorded flight heights were between 0 and 15 meters (50 feet) above ground, although larger flocks of birds were generally seen at heights over 30 meters (100 feet) above ground or resting in marshes. Less than 2 percent of the observed birds were within the proposed wind turbines' rotor sweep zone; they were generally hunting or feeding and observed in the August/September time period.
- Three State-listed species (Bald Eagle, Gull-billed Tern, and Peregrine Falcon) were observed during the surveys. Red Knot, a USFWS-candidate species, was observed during one survey. No federally listed species were documented during the survey. Piping Plover (federally and State threatened) and Upland Sandpiper (State threatened) are listed species found in the local area but were not observed during the surveys, likely due to lack of habitat in the areas surveyed.
- Documented bird and bat fatalities were greatest at the taller South Meteorological Tower (16) than the shorter, guyed, North Boresight Tower (7). There were no documented fatalities at the unguyed South Boresight Tower.
- Fatality rates of 28 and a range of 44 to 72 per tower per year were calculated for the North Boresight and South Meteorological towers, respectively.

This one-year, multi-seasonal study did not identify any issues that preclude installation of one or two utility-scale turbines at the proposed locations. As such, additional pre-construction study was not warranted. Post-construction avian impact studies would be incorporated into all Action Alternatives as discussed in Section 5.

3.2.3.2 Bats

Fifteen species of bat occur in Virginia, based on their normal geographical range. There are six *Myotis* species in Virginia, including the gray bat (*Myotis grisescens*), little brown bat (*M. lucifugus*), northern long-eared bat (*M. septentrionalis*), Indiana bat (*M. sodalis*), eastern smallfooted bat (*M. leibii*), and southeastern myotis (*M. austroriparius*). Other species include silverhaired bat (*Lasionycteris noctivagans*), eastern pipistrelle (*Perimyotis* [=*Pipistrellus*] *subflavus*), big brown bat (*Eptesicus fuscus*), evening bat (*Nycticeius humeralis*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), seminole bat (*L. seminolus*), Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), and the Virginia big-eared bat (*C. townsendii virginianus*) (VDGIF, 2009).

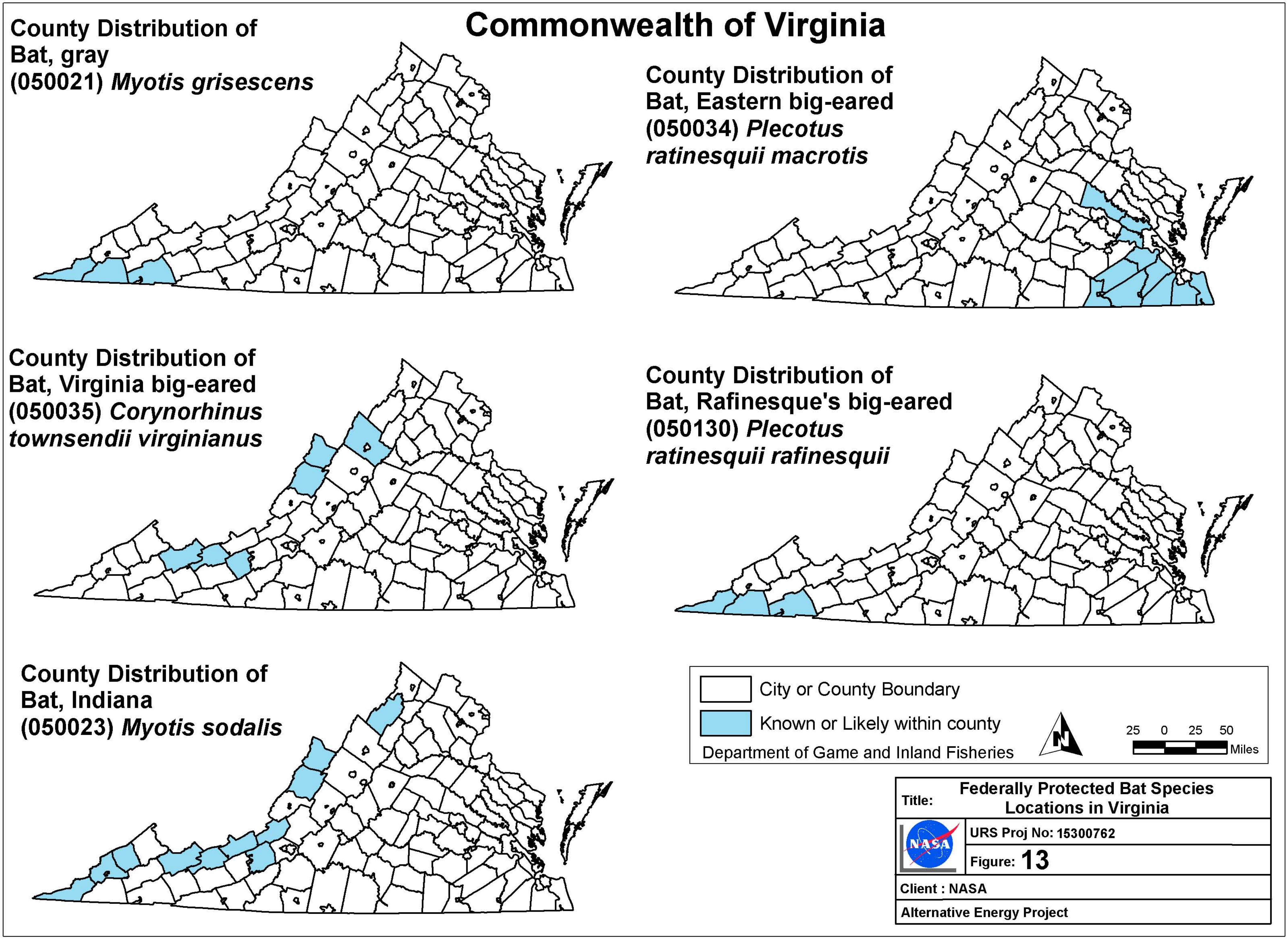
Of these, the Indiana bat, gray bat, and Virginia big-eared bat are listed as federally endangered under the Endangered Species Act (ESA). Rafinesque's big-eared bat is listed as State endangered. According to VDGIF, these protected bat species live in the western and southern parts of Virginia (see Figure 13) and do not likely inhabit or migrate in the vicinity of WFF. There is a current petition to add the eastern-small footed bat and northern long-eared bat to the list of federally threatened or endangered species due to white-nose syndrome and the high likelihood that all cave dwelling bats in the eastern U.S. will be petitioned for listing. Of these two species currently petitioned for listing, the range of the northern long-eared bat includes the project site.

Summer–Fall 2008 Bat Study at Wallops Island

Between July 15 and October 21, 2008, passive acoustic bat surveys were conducted on Wallops Island in the area of the proposed wind turbines to document bat activity and identify species that occur in the area (Appendix B). Four Anabat® acoustic detectors deployed at the proposed wind turbine site (see Figure 12) collected data over 229 nights of recordings. Two detectors were placed in an existing 50 -meter (164 -foot) unguyed tower (the same tower as the "South Boresight Tower" in the previous sections), which is located approximately 425 meters (1,400 feet) south of the proposed wind turbine site, and two were situated on 10 -meter (33 -foot) poles in adjacent marshlands.

A total of 2,140 bat call sequences were recorded during the sampling period. The mean detection rate of all detectors was 9.3 detections per night. The highest detection rate was 15.9 detections per night, and the lowest rate was 2.4 detections per night. Bat calls were identified to the lowest possible taxonomic level, and were then grouped into six guilds based on similarity in call characteristics between some species and the uncertainty in the ability of frequency division detectors to adequately provide information for this differentiation. The six guilds are described below.

- Unknown – All call sequences with too few pulses (less than five) or of poor quality (such as indistinct pulse characteristics or background static).
- Myotid – All bats of the genus *Myotis*. While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat® recordings.
- Eastern red bats, eastern pipistrelles, evening bats (RBEP) – These three species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur.
- Big brown/silver-haired bat (BBSH) – These species' call signatures commonly overlap and were therefore included as one guild.
- Hoary bat – Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats. Hoary bats are easily identified by calls varying in minimum frequency across a sequence.
- Big-eared bat– Known as "whispering bats," this species emits low-intensity calls and listens for insect-generated sounds while foraging close to the ground; detecting calls of these bats is therefore difficult. Calls of big-eared bats are not easily confused with calls of any other species that may coexist on Wallops Island.



Commonwealth of Virginia
County Distribution of
Bat, gray
(050021) Myotis grisescens
County Distribution of
Bat, Eastern big-eared
(050034) Plecotus
ratinesquii macrotis
County Distribution of
Bat, Virginia big-eared
(050035) Corynorhinus
townsendii virginianus
County Distribution of
Bat, Rafinesque's big-eared
(050130) Plecotus
ratinesquii rafinesquii
County Distribution of
Bat, Indiana
(050023) Myotis sodalis
City or County Boundary
Known or Likely within county
Department of Game and Inland Fisheries
N
25 0 25 50
Miles
Title:
Federally Protected Bat Species
Locations in Virginia
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Client : NASA
Alternative Energy Project

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Nightly call volumes varied over the survey period. Call volumes peaked between August 13 and August 16, with the greatest number of sequences (223) recorded on August 15. Sequences within the RBEP, BBSH, unknown, and to a lesser extent hoary bat guilds accounted for these peaks. On August 15, the majority of sequences (46.6 percent) identified to species belonged to eastern red bats. High frequency unknowns likely to be eastern red bats or eastern pipistrelles accounted for 44.4 percent of sequences recorded on August 15.

Over the entire study period, the majority of calls (55.2 percent) were identified as “unknown.” Of these unknown sequences, sequences likely to be eastern red bats or eastern pipistrelles were most common (44.9 percent). The majority of call sequences could not be identified to guild or species, however, due to short call sequences (less than five pulses) or poor call signature formation, which were often a result of bats flying at the edge of the detection zone of the detector or flying away from the microphone.

Of the calls that were identified to species or guild, those of the RBEP guild were the most common (27.9 percent), followed by the species within the BBSH guild (15.7 percent), hoary bat guild (0.8 percent), and Myotid guild (0.3 percent).

Within the RBEP guild, eastern red bats accounted for 25.2 percent of the 2,140 total sequences recorded at Wallops Island, followed by sequences just as likely belonging to red bats *or* eastern pipistrelles (2.5 percent) and eastern pipistrelles (0.1 percent). Within the BBSH guild, sequences just as likely belonging to big brown *or* silver-haired bats accounted for 10.8 percent of the total sequences recorded, followed by those of big brown (4.4 percent) and silver-haired bats (0.5 percent).

Considering the level of bat activity documented at Wallops Island, numbers of recorded bat call sequences are not necessarily correlated with number of bats in an area. Acoustic detectors do not allow for differentiation between a single bat making multiple passes and multiple bats each recorded a single time. Similarly, acoustic interference can make detection of bats in certain areas difficult, lowering the estimate of acoustic activity. Furthermore, calls of some bats are not as detectable as calls of other bats, limiting the inferences that can be made about the presence or absence of species.

3.2.4 Threatened and Endangered Species

Under Section 7 of the ESA, as amended, (U.S.C. 1531–1544) Federal agencies, in consultation with the 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 ESA (29 VAC 29.1-563–570) is administered by the 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 ESA.

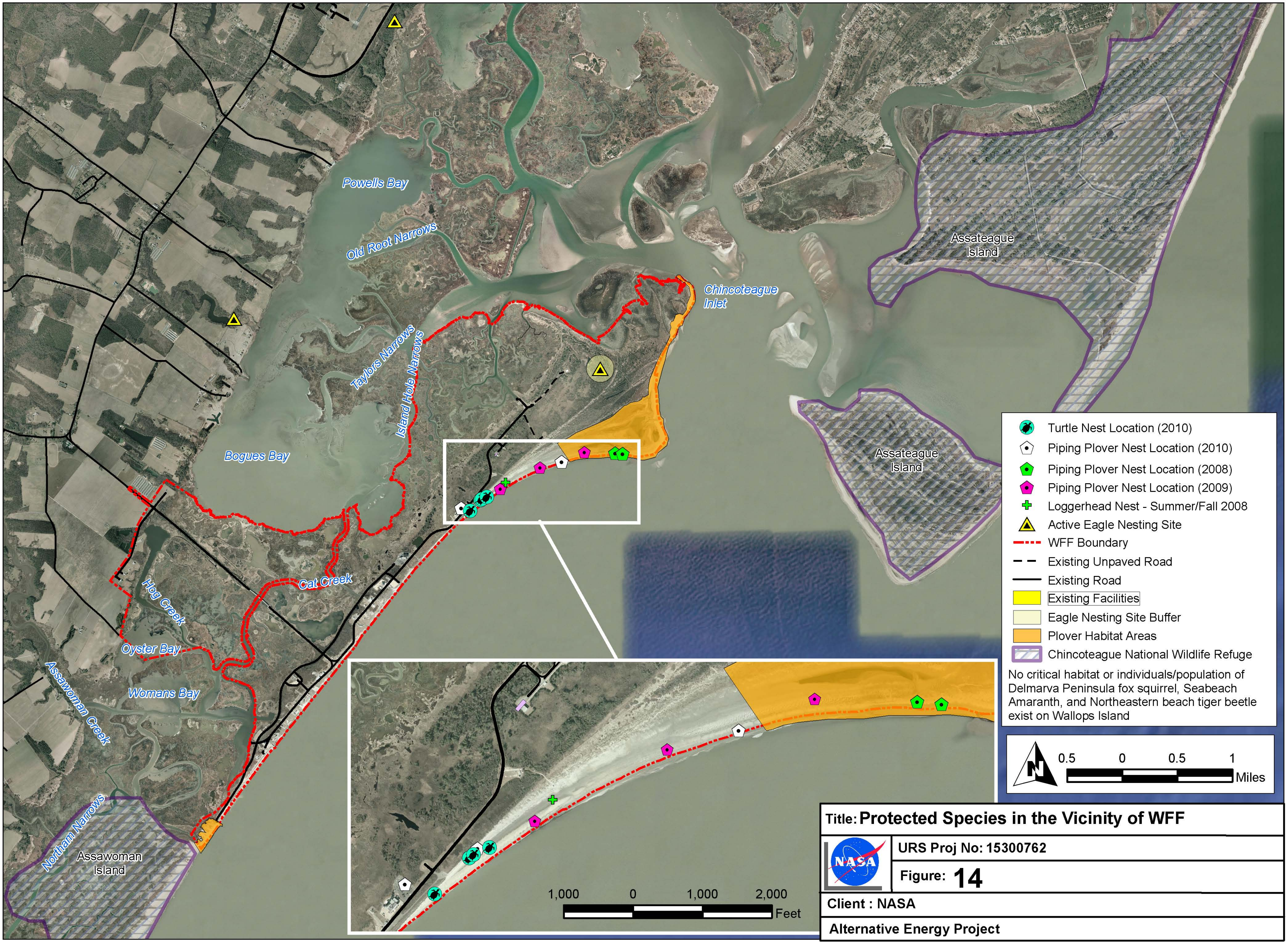
Table 15 shows the State and federally listed threatened or endangered species that may occur in the vicinity of WFF.

Table 15: Threatened and Endangered Species in the Vicinity of WFF

Scientific Name	Common Name	Federal Status	State Status
Birds			
Ammodramus henslowii	Henslow's Sparrow	—[1]	Threatened
Bartramia longicauda	Upland Sandpiper	—	Threatened
Charadrius melodus	Piping Plover	Threatened	Threatened
Charadrius wilsonia	Wilson's Plover	—	Endangered
Calidris canutus	Red Knot	Candidate Species	—
Falco peregrinus	Peregrine Falcon	—	Threatened
Sterna nilotica	Gull-billed Tern	—	Threatened
Haliaeetus leucocephalus	Bald Eagle	—	Threatened
Lanius ludovicianus	Loggerhead Shrike	—	Threatened
Lanius ludovicianus migrans	Migrant Loggerhead Shrike	—	Threatened
Mammals			
Sciurus niger cinereus	Delmarva fox squirrel	Endangered	Endangered
Reptiles			
Dermochelys coriacea	leatherback sea turtle	Endangered	Endangered
Eretmochelys imbricata	hawksbill sea turtle	Endangered	Endangered
Lepidechelys kempi	Kemp's ridley sea turtle	Endangered	Endangered
Caretta caretta	loggerhead sea turtle	Threatened	Threatened
Chelonia mydas	green sea turtle	Threatened	Threatened
Invertebrates			
Cicindela dorsalis dorsalis	northeast beach tiger beetle	Threatened	Threatened
Plants			
Amaranthus pumilus	seabeach amaranth	Threatened	Threatened

[1]Not listed designation

Figure 14 shows the known locations of protected species in the vicinity of WFF. 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. There is no designated critical habitat on WFF.



Title: Protected Species in the Vicinity of WFF

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3.2.4.1 Birds

<u>Shorebirds</u>

Gull-Billed Tern

The Gull-billed Tern is a stout, medium sized, white, blunt-billed bird that feeds in the marshes and adjacent coastal uplands of the southern and Gulf coasts of the United States. Gull-billed Terns migrate to the eastern U.S. breeding areas usually in mid-April and the adults typically depart in late July or early August. They typically nest among other tern species on open, sandy shell beaches, on barrier islands, on dredge-spoil islands, or on overwash fans lacking vegetation. They also nest on elevated-shell ridges along the edges of marsh islands. There are documented occurrences at CNWR and Fisherman Island National Wildlife Refuge and all known breeding colonies in Virginia are located on the barrier islands of the Eastern Shore.

Piping Plover

The Piping Plover is a small shorebird known to breed along the beaches of Wallops Island. 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 winters primarily on the Atlantic Coast from North Carolina to Florida. Piping Plover habitat includes ocean beaches or sand or algal flats in protected bays, expansive sand flats, sandy mudflats, and sandy beaches. Nesting territories are establishing and courtship rituals are conducted beginning in late March or early April. 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.

The Piping Plover is known to nest on Wallops Island, and portions of the island are managed as protected areas by NASA (Figure 14). The northern and southern beaches have been closed to vehicle and human traffic during the Plover’s nesting season (March 15–September 1) since 1986. Biologists from the CNWR monitor Piping Plover nesting activities and advise NASA on protection and management of the species. Biologists from the WFF USDA Wildlife Service Office aid with predator control.

Monitoring was initiated at all CNWR units (including Assateague, Assawoman, and Metompkin) in 1996. Since then, there has been an increasing trend in the number of nesting pairs. However, since 2004, nesting has remained static and decreased at both the hook and overwash areas on Assateague Island, and has increased slightly at Assawoman and north Metompkin. The number of chicks fledged per nesting pair has decreased for all four areas.

Piping Plover nesting habitat has been delineated on Wallops Island dune and overwash areas at the northern and southern reaches of the property. South Wallops Island has experienced substantial erosion of 3.3 meters (11 feet) per year, resulting in a decrease in abundance of suitable habitat. Nesting Plovers have not been observed on South Wallops Island since at least 2000. North Wallops Island has simultaneously been accreting, resulting in additional potential habitat for Plover nesting.

Piping Plovers were observed feeding annually between 1996 and 2008, although exact numbers were not recorded. In 2010, four nests were found on the northern beaches of Wallops Island.

None were found on the southern beach. Of the four nests found, one had a 100 percent fledge rate; four eggs were laid, four hatched, and four fledged. In 2009, four piping plover pairs attempted nests on north Wallops Island. Of these, three were successful and at least seven chicks were fledged. 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. Two nesting pairs were also observed in 2005, but one nest was lost to fox predation and the chicks of the second pair did not survive. In 2004, one nesting pair fledged 3 chicks; one pair is documented as nesting unsuccessfully in 2001 and 1998; in 1996, three pairs nested and two chicks were fledged in total. There were no nests observed in 2003, 2002, 2000, 1999, or 1997.

Wilson’s Plover

Wilson’s Plover is a migratory shorebird. An estimated 25 percent of U.S. populations winter in southern Florida. In Virginia, Wilson’s Plover is an uncommon summer resident from April 24 through September 5 on the Eastern Shore. Its habitat includes coastal sandy and shell beaches, barrier and spoil islands, borders of salt ponds, tidal mudflats, inlets, bays, estuaries, and sometimes sandbars and muddy banks of rivers near the coast. In Virginia, nest habits have been documented on the upper portions of sandy beaches on barrier islands, usually within 30 meters (100 feet) of dune vegetation (but not in dense vegetation) and occasionally on overwash flats behind the dunes. Wilson’s Plover has been documented in Accomack County and Assateague Island, VA.

Red Knot

The Red Knot is a medium-sized shorebird that undertakes an annual 30,000 kilometers (19,000 miles) hemispheric migration, from breeding grounds in the high Arctic to wintering grounds in South America.

Smith et al. (2008) indicates that Virginia’s barrier islands play an important role in the life cycle of the Red Knot (*rufa* subspecies) because it provides important stop-over habitat during migration. Spring migration occurs between late April and mid-June (Cohen, et al. 2009; Smith, et al., 2008); peak counts in mid-May can be several hundred to about 1,000 at WFF (Vaughn, 1993). Cohen et al. (2009) indicates that Red Knot annual census numbers along the Virginia coastline are variable in spring and were 8,332 in 2007. Smith et al. (2008) reports that the total numbers of birds for the six Virginia barrier islands (south of Wallops Island between Wachapreague and Fisherman’s Island) surveyed during spring migration can be more than 12,000. Fall migrating Red Knots arrive again during the second week of July with the peak occurring sometime from late July through the end of August; peaks counts at WFF at this time of the year are 100 to 200 birds (Vaughn 1993).

During the 2009 migration season, flock sizes of 100 to 145 birds were observed on Assateague Island. On May 8, 2009, USFWS observed a flock size of almost 1,300 individuals on north Wallops Island. In late May 2010, flocks of approximately 8 to 230 Red Knots were observed on the beach at North Wallops Island. WFF field personnel did not observe Red Knots on the southern beach during the 2010 monitoring season.

The Red Knot principally uses marine habitats during migration. Coastal habitats providing sandy beaches to forage along the mouths of bays and estuaries are preferred. Red Knots are also known to use tidal flats in more sheltered bays or lagoons in search of benthic invertebrates or horseshoe crab eggs.

Raptors

Peregrine Falcon

The average adult Peregrine Falcon has dark black plumage above, with much graying on the sides, with extensive spotting and barring. Populations nesting in northern latitudes are highly migratory. The Atlantic Coast from New Jersey to South Carolina and the barrier islands of the Texas Gulf Coast are important feeding areas for long-distance migrants. Peregrine Falcons are a diurnal raptor and are active year round. They feed primarily on medium-size birds up to small waterfowl and rarely prey on small mammals, lizards, and fish. Peregrine Falcons are known to occur in Accomack County, VA. A nesting pair with fledglings was documented at WFF in 2005 and 2009.

Bald Eagle

The Bald Eagle is a raptor known for the characteristic white head, white tail, and a large bright yellow bill in adult birds. Bald Eagles migrate widely over most of North America, and most eagles that breed in the northern United States move south for the winter. Special habitat features for Bald Eagles include standing snags and hollow trees. Breeding habitat most commonly includes areas close (within 4 kilometers [2.5 miles]) to coastal areas, bays, rivers, lakes, or other bodies of water that reflect the general availability of primary food sources. Bald Eagles avoid areas with nearby human activity and development. Bald Eagles are documented at the CNWR and environmental scientists discovered a nesting pair of Bald Eagles within the northern section of Wallops Island in July 2009.

Upland Birds

Henslow's Sparrow

Henslow's sparrow is a small bird characterized by a large flat, striped olive-colored head, large gray bill, and short tail. In Virginia, they are rare transient, summer residents and winter visitors in the coastal plain with the only known summer occurrences in Accomack County. This species is believed to breed between May 15 and August 31 in neglected weedy fields commonly dominated by broom sedge, wet meadows, and the along the edges of salt marshes. It occasionally inhabits dry and cultivated uplands, may favor moist lowland habitat and may use areas with widely scattered shrubs. It prefers undisturbed non-maintained areas and breeds in a variety of grassland habitats with tall, dense grass and herbaceous vegetation. The nonbreeding habitat during migration and winter includes moist grassy areas adjacent to open pine or second-growth forests.

Upland Sandpiper

Upland Sandpiper is medium-sized and the most terrestrial of North American shorebirds. Adults are overall scaly-brown in appearance above with a long slender neck, small rounded head, and large eye. Upland Sandpipers arrive in northern breeding areas in April/May and depart by September. Peak spring migration through the U.S. Mid-Atlantic States occurs in April. In

Virginia, they are rarely seen in spring and late fall along the coast, and mostly seen in early fall. The preferred habitat of the Upland Sandpiper consists of large open grasslands, greater than 40.5 hectares (>100 acres), which are not extensively grazed or mowed and include large areas of short grass for feeding and courtship with interspersed or adjacent taller grasses for nesting and brood cover.

Loggerhead Shrike

There are two subspecies of *Lanius ludovicianus*, the Loggerhead Shrike and the Migrant Loggerhead Shrike, which are difficult to differentiate in the field. The major sources of data for Shrike distribution in Virginia do not distinguish the two subspecies, and occurrences listed in Virginia Fish and Wildlife reports may be either subspecies. The Loggerhead Shrike has a hooked, dark bill; bluish-gray head and back; white or grayish-white underparts, very faintly barred in adults; broad black mask extending above the eye and thinly across the top of the bill; gray to whitish rump; black tail with white tip; and large white patches on the black wings.

The Loggerhead Shrike's range includes California, eastern Oregon, eastern Washington, Canada, and south to southern Baja California, throughout Mexico, the Gulf Coast, and southern Florida. Shrikes move southward from the northern half of the breeding range for winter. During Virginia winters, Loggerhead Shrikes may move from pasture to shrub and open forest habitats during periods of cold, wet weather. Loggerhead Shrikes have been historically documented in Accomack County, but there are no recent records for the species on the Eastern Shore of Virginia.

Migrant Loggerhead Shrike

The Migrant Loggerhead Shrike differs from Loggerhead Shrike in that the gray of the upperparts are slightly paler and the underside is less purely white; the bill is also much smaller and the tail is decidedly shorter than the wing. Habitat conditions are the same for the migrant Loggerhead Shrike as for the Loggerhead Shrike. Although the Migrant Loggerhead Shrike has been documented in Accomack County, field identification to subspecies is rarely reported. Therefore, records for Migrant Loggerhead Shrike in Accomack County are likely to be Loggerhead Shrike, and the Migrant Loggerhead Shrike is not likely to occur within the vicinity of WFF.

3.2.4.2 Mammals

Delmarva Fox Squirrel

Delmarva fox squirrel is a large tree squirrel that is a well-marked and distinct subspecies restricted in range to the Delmarva Peninsula. The Delmarva fox squirrel was reintroduced at CNWR and the population there is currently about 180 squirrels. In Virginia, the Delmarva fox squirrel is known to occur in Accomack and Northampton Counties. Habitat for the Delmarva fox squirrel includes mature, open park-like stands of deciduous or mixed deciduous-pine forest, especially near farmland. It is not known to occur on Wallops Island due to the isolation of the island and the lack of suitable habitat for the species.

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3.2.4.3 Sea Turtles

Five federally endangered sea turtle species are transient in the waters off Wallops Island; the Leatherback, Hawksbill, Kemp's Ridley, Loggerhead, and Atlantic green sea turtles, which are known to migrate along east coast beaches. NASA coordinates with CNWR and USDA personnel in monitoring the Wallops Island beaches for sea turtle activity.

Sea turtle crawl tracks, a sign of potential nesting activity, have seldom been found on Wallops Island beaches and according to the USFWS, five nests have been recorded on Wallops Island between 1974 and 2009. One loggerhead sea turtle nest was discovered on north Wallops Island in summer 2008 (Figure 14). Following flood inundation from several fall storms, CNWR personnel recovered approximately 170 eggs from the nest in October 2008. None were viable. According to a 2009 biological memorandum (USFWS), staff did not locate any sea turtle crawl tracks or nesting related activity on CNWR or Wallops Island from June to September 2009. Four nests were found on the north end of Wallops Island in June and July of 2010 (Figure 14), all of which have been confirmed from a single loggerhead female by USFWS.

3.2.4.4 Invertebrates

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, VA, geographic recovery area; however, there are no recorded populations on Wallops Island. The closest documented population is approximately 30 kilometers (20 miles) southwest of Wallops Island (USFWS, 2009c).

3.2.4.5 Plants

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 by USFWS on the southern end of Assateague Island in 2004. In late September 2010, all of Wallops Island beaches were surveyed for seabeach amaranth. No evidence of the plant on was detected on Wallops Island.

3.2.5 Fish

Common fish in the waters near Wallops Island and Mainland include the Atlantic croaker (*Micropogonias undulatus*), sand shark (*Carcharias taurus*), smooth dogfish (*Mustelus canis*), smooth butterfly ray (*Gymnura micrura*), bluefish (*Pomatomus saltatrix*), spot (*Leiostomus xanthurus*), and summer flounder (*Paralichthys dentatus*). 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 Magnuson-Stevens Fishery Conservation and Management Act of 1976 (Magnuson-Stevens Act, 16 U.S.C. 1801 et seq.), as amended, gives the United States exclusive management authority over fisheries, except for highly migratory species of tuna, within a fishery conservation zone of 5 to 320 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.

The tidal marsh areas of Wallops Island and Mainland act as an EFH 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*) (NASA, 2010b).

3.3 SOCIAL AND ECONOMIC ENVIRONMENT

3.3.1 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 2009 median family income of $40,343. 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 2009 was reported to be $22,013, with an estimated 16.3 percent of people below the poverty level (U.S. Census Bureau, 2011). The per capita income in the Commonwealth of Virginia in 2009 was reported to be $31,606, with an estimated 10.1 percent of people below the poverty level statewide (U.S. Census Bureau, 2011).

To ensure compliance with Executive Order 12898, NASA prepared an Environmental Justice Implementation Plan (EJIP) in 1996. NASA evaluated the demographic information in the vicinity of WFF and identified areas that have a higher concentration of minority persons and low-income persons based on Federal guidelines. The EJIP also includes an evaluation of all programs at WFF, including tenant activities that could potentially affect human health and the environment. The EJIP demonstrates that NASA will continue to incorporate environmental justice in all its activities and monitor all programs to determine any potential environmental justice impacts on persons in the area. Figure 15 illustrates the Census Tracts in the vicinity of WFF; Tables 16 and 17 compare the 2000 Census Tract minority and poverty data, respectively, to Accomack County and Commonwealth of Virginia Census data to show how the areas in the vicinity of WFF measure up to these larger-scale benchmarks

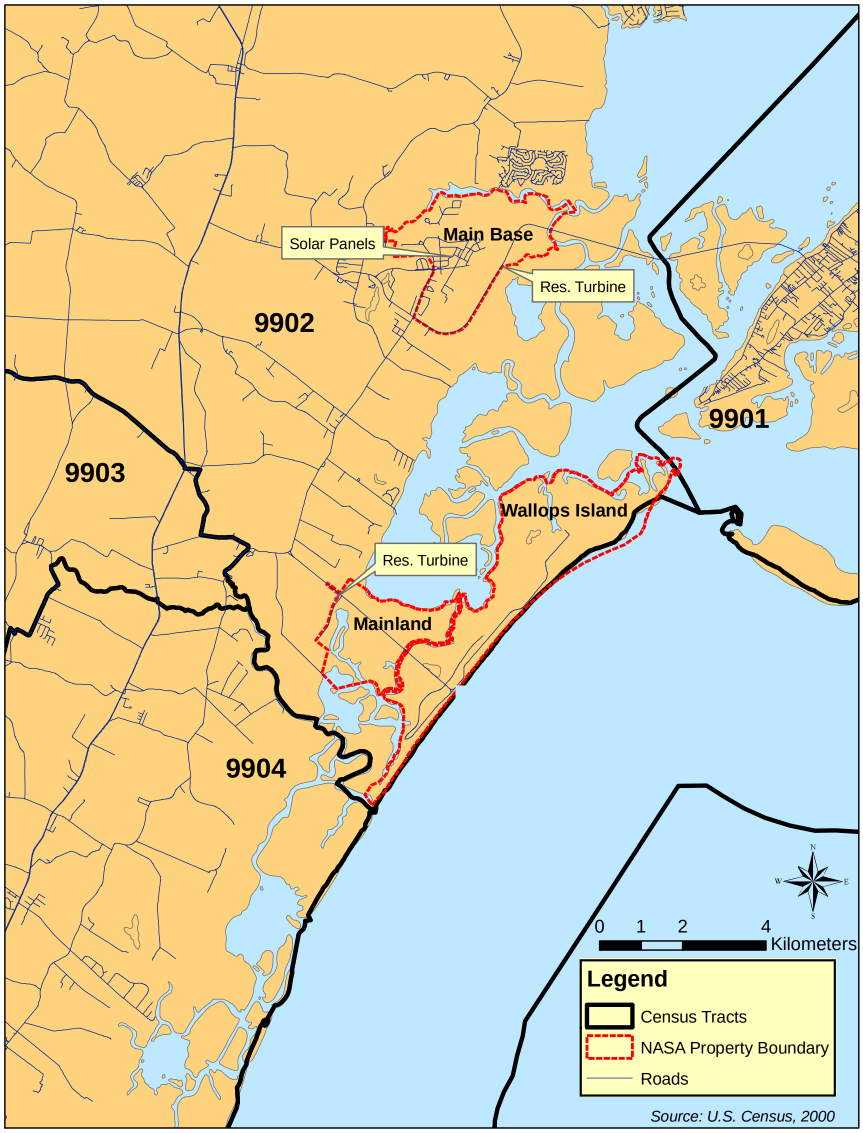


Figure 15: Accomack County Census Tracts in the Vicinity of WFF

Table 16: Minority Population Data – by Census Tract, Accomack County, VA

Tract	Location	Percent Minority, 2000[1]	Compared to Accomack County (39.3%, 2009)[2]	Compared to Virginia (33.7%, 2009)[2]
9901	MD/VA line south including Fisher's Point (includes Chincoteague)	1.97	Lower than County	Lower than State
9902	MD/VA line south including Wallops Island to Assawoman Inlet (includes WFF)	41.75	Higher than County	Higher than State
9903	West of 9902 and 9904, MD/VA line south to Ann's Cove Road	24.66	Lower than County	Lower than State
9904	East of Mears Station Road, South of 9902 south to Horseshoe Lead	59.14	Higher than County	Higher than State

[1]NASA, 2008
[2]U.S. Census Bureau, 2011

Table 17: Poverty Data – by Census Tract, Accomack County, VA

Tract	Location	Percent Poverty, 2000[1]	Compared to Accomack County (20.6%, 2008)[2]	Compared to Virginia (10.2%, 2008)[2]
9901	MD/VA line south including Fisher's Point (includes Chincoteague)	12.80	Lower than County	Higher than State
9902	MD/VA line south including Wallops Island to Assawoman Inlet (includes WFF)	16.38	Lower than County	Higher than State
9903	West of 9902 and 9904, MD/VA line south to Ann's Cove Road	19.28	Lower than County	Higher than State
9904	East of Mears Station Road, South of 9902 south to Horseshoe Lead	27.14	Higher than County	Higher than State

[1]NASA, 2008
[2]U.S. Census Bureau, 2011

The WFF Main Base is located in Accomack County Census Tract 9902. This Census Tract has a 2.27 percent and 7.87 percent higher minority population than Accomack County and Virginia, respectively. The Tract also demonstrates a 4.22 percent lower and 6.18 percent higher population below the poverty level when compared to the County and the State, respectively. Accordingly, NASA considers this tract to contain populations needing Environmental Justice consideration during project planning.

A key component of NASA's Environmental Justice program is its continuing outreach activities. During project planning, NASA regularly holds public meetings and issues announcements to ensure that members of the public are aware of upcoming activities. These announcements are published through a variety of outlets including the internet, local radio, local newspapers, and local town hall meetings. This outreach effectively ensures that people of all income and ethnicities have the opportunity to provide input on NASA's activities.

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 and are greater than 3 kilometers (2 miles) from the project site.

3.3.2 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 properties and promote historic preservation in cooperation with other nations, Tribal governments, States, and local governments. The NHPA established the National Register of Historic Places (NRHP) and designated the State Historic Preservation Office (SHPO) as the individual responsible for administering State-level programs. The NHPA also created the Advisory Council on Historic Preservation (ACHP), the Federal agency responsible for overseeing the Section 106 process and providing commentary on Federal activities, programs, and policies that affect historic properties.

Section 106 of the NHPA and its implementing regulations (36 CFR 800) outlines the procedures for Federal agencies to follow to take into account their actions on historic properties. The Section 106 process applies to any Federal undertaking that has the potential to affect historic properties, defined in the NHPA as those properties that are listing in or eligible for listing in the NRHP. Under Section 106, Federal agencies are responsible for identifying historic properties within the Area of Potential Effects (APE) for an undertaking, assessing the effects of the undertaking on those historic properties, if present, and considering ways to avoid, minimize, and mitigate any adverse effects. Because Section 106 of the NHPA is a process by which the Federal government assesses the effects of its undertakings on historic properties, it is the primary regulatory framework that is utilized in the NEPA process to determine impacts on cultural resources.

Section 110 of the NHPA calls for Federal agencies to establish historic preservation programs to ensure the identification, protection, and use of historic properties. To that end, in November 2003 NASA WFF 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, 2003a). The study focused on aboveground resources at WFF that were constructed prior to 1955. Additionally, the CRA established a predictive model for understanding the archaeological potential over the entire WFF property.

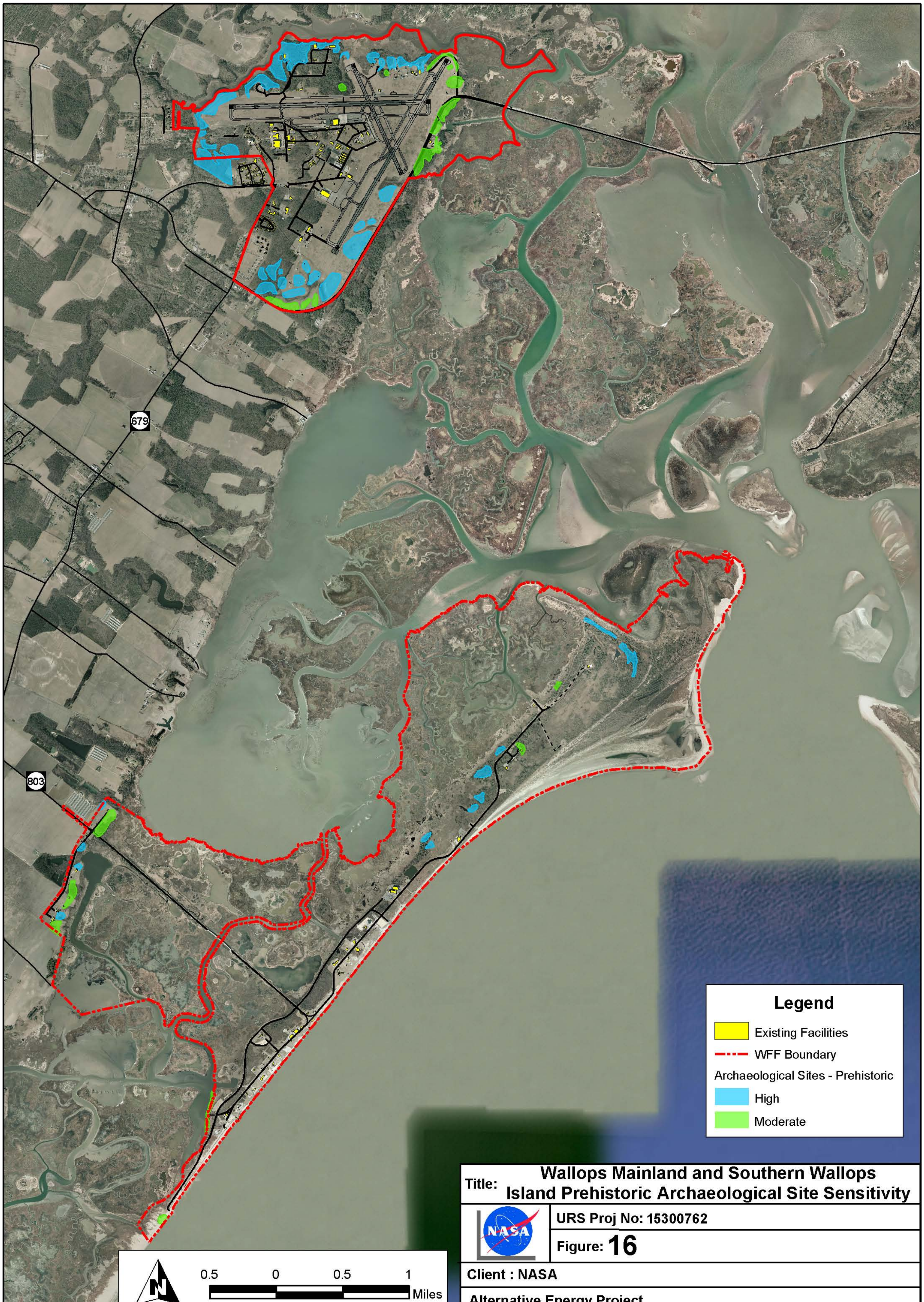
Among the cultural resources identified at WFF in the CRA are six archaeological sites, two of which are historic sites on Wallops Island (Figure 16 and Figure 17) and a total of 166 buildings and structures that were at the time of the study at least 55 years old, 25 of which are located on Wallops Island. Comments from the SHPO (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 2003 CRA, an intensive-level survey and NRHP evaluation of 124 buildings and structures at WFF constructed prior to 1956 was conducted, and an historic context for these resources prepared. The findings were presented in the *Historic Resources Survey and Eligibility Report for Wallops Flight Facility* (NASA, 2004). 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 eligible for listing in the NRHP because they lacked the historical significance or integrity necessary to convey their significance.

In a letter dated November 4, 2004, VDHR concurred with the findings and determinations in the *Historic Resources Survey and Eligibility Report*, agreeing that the Wallops Coast Guard Lifesaving Station was 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, removal, or adaptive reuse in a different location on WFF 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 adverse effects of the proposed move.

The CRA briefly discussed the recordation and discovery of Site 44AC0089, described as a probable Revolutionary War fort. Because no development was planned for the north end of Wallops Island in 2003, Site 44AC0089 was not investigated at that time. Further examination of the north end of Wallops Island led NASA to perform both Phase I and II archaeological survey of Site 44AC0089. In a letter dated November 22, 2010, VDHR concurred with NASA’s determination that the Revolutionary War Earthworks is eligible for listing in the NRHP. NASA has established, with VDHR’s concurrence, a plan to protect the Earthworks.

NASA is currently undertaking an effort to survey more than 90 additional aboveground resources. The 2011 survey updates currently underway at WFF may reveal aboveground historic properties not identified in the 2004 report, including properties that have achieved 50 years of age since 2006 and properties that are less than 50 years of age that meet NRHP Criteria Consideration G, which states that properties may be eligible for listing in the NRHP if they possess exceptional importance.



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

URS Proj No: 15300762

Figure: 16

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Alternative Energy Project

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

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Figure: 17

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3.3.3 Transportation

The Eastern Shore of Virginia is connected to the rest of the Commonwealth 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.

3.3.3.1 Aviation Safety Requirements

FAA regulates structures that may pose a threat to aviation safety. A sponsor proposing any type of construction or alteration of a structure that may affect the National Airspace System is required under the provisions of 14 CFR 77 to notify the FAA by completing the Notice of Proposed Construction or Alteration form (FAA Form 7460-1). The form should be sent to the Obstruction Evaluation service.

Any temporary or permanent structure, including all equipment, that exceeds an overall height of 60 meters (200 feet) above ground level or exceeds any obstruction standard contained in 14 CFR 77, should normally be marked and/or lighted. However, an object may present such an extraordinary hazard potential that higher standards may be recommended for increased visibility to ensure safety to aircraft. FAA Advisory Circular AC 70/7460-1K provides requirements for obstruction (wind turbines are included in the “obstruction” category) marking and lighting (FAA, 2007).

3.3.4 Aesthetics

Aesthetics is the study of sensory or sensory emotional values, and as a result is subjective by nature. There are no State or Federal regulations for aesthetics.

In order to assess aesthetics, a viewshed, which is the area that is visible from a fixed vantage point, must be defined. The viewshed from areas surrounding WFF is generally consistent due to the flat topography of the region. The aesthetic character of the area is that of a rural and small-town landscape with little to moderate urban development. The horizon is typically defined by trees or water when a view of the ocean or estuaries is available. The foreground of a viewshed is typically the main focal point; beyond a few hundred feet, objects in the background tend to fade into the viewshed background, which around WFF is the open sky due to the absence of tall buildings or other elements that rise above the tree line.

Typical viewsheds from within WFF include a mix of buildings, roads, and other infrastructure such as towers, open grassy areas that are maintained in the summer by mowing, and forest. WFF’s Wallops Island property contains more natural areas than the Main Base, and the viewsheds from Wallops Island generally include one or more of the following in addition to buildings and infrastructure: wetland vegetation, maritime scrub-shrub forest vegetation, or the rock seawall and the ocean beyond.

Because of the development and infrastructure at WFF, man-made lighting results in some light pollution. NASA's policies for lighting at WFF are based on FAA, OSHA, and NASA health and safety requirements. To the extent possible, NASA strives to reduce light pollution while still meeting laws and safety regulations regarding lighting.

Photograph 3 shows a typical view at the Main Base and Photograph 4 shows a typical view at Wallops Island. Photograph 5 shows the viewshed from a vantage point west of WFF looking northeast toward Wallops Island. Photograph 6 and Figure 18 are aerial views of the Main Base and Wallops Island, respectively, for context.

Photograph 3: Viewshed from the Main Base looking south toward the cafeteria building.

Photograph 4: Viewshed from Launch Pad 2 on South Wallops Island looking north.

Photograph 5: Viewshed from a vantage point west of WFF approximately 3.7 kilometers (2.3 miles) southwest of the bridge that links Wallops Mainland to Wallops Island looking northeast toward the bridge.

Photograph 6: Aerial overview of the Main Base looking east.

Title:	Oblique Aerial View of Wallops Island Viewed from the South End of the Island Looking North
	URS Proj No: 15300762
	Figure: 18
Client : NASA	
Alternative Energy Project	

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SECTION FOUR: ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

Section 4 presents the potential impacts on existing resources described in Section 3 that may result from the alternatives described in Section 2. This chapter contains discussions on potential impacts on resources under the three main categories of Physical Environment, Biological Environment, and Social and Economic Environment. Following an initial evaluation of potential impacts on all resources, NASA determined that there would be no impacts on groundwater, or health and safety; therefore, these resources are not discussed in this EA.

Section 4 focuses on addressing the type, context, intensity, and duration of the project-related environmental impacts for each resource area included in this EA. The impacts can be described in different ways, including:

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

The levels of 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).

Mitigation measures that would reduce the potential for an impact are identified in Section 5.

4.2 PHYSICAL ENVIRONMENT

4.2.1 Land Resources

4.2.1.1 Topography

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts on topography would occur.

Proposed Action

Solar panels installed in the open areas of Wallops Main Base would not alter topography. No changes in topography would occur with installation of the residential-scale wind turbines. The area of permanent ground disturbance would be limited to support posts holding the solar panels, the 1 meter (3 foot) surface foundation for the residential-scale turbines, and the trenching for electrical lines; therefore, permanent ground disturbances would be localized and minor.

Alternative One

Solar panels installed in the open areas of Wallops Main Base would not alter topography. No changes in topography would occur with installation of the residential-scale wind turbines. The area of permanent ground disturbance would be limited to support posts holding the solar panels, the 1 meter (3 foot) surface foundation for the residential-scale turbines, and the trenching for electrical lines; therefore, permanent ground disturbances would be localized and minor.

Construction activities (e.g., land grading and excavation) and infrastructure installation (e.g., access road, wind turbine footprint, crane pad, and underground cables) for the utility-scale wind turbine would have long-term, localized impacts on topography. Under Alternative One, total permanent ground disturbance at the proposed utility-scale wind turbine site would be approximately 870 square meters (9,400 square feet), which equals 0.09 hectare (0.22 acre). This includes 620 square meters (6,700 square feet) for new roads, 17.5 square meters (180 square feet) for foundations, and 225 square meters (2,500 square feet) for the crane pad. In addition to permanent disturbance, approximately 130 square meters (1,385 square feet) would be temporarily disturbed during installation subsurface foundations for the turbines.

To minimize the impacts, previously disturbed areas such as the cleared area east of the U.S. Navy V-10/V-20 complex would be used for staging of equipment of materials and for construction vehicle parking (Figure 6). The foundation for the wind turbine and access road would require filling of wetlands, resulting in permanently elevated areas of soil within the wetland, which would result in long-term adverse impacts on the topography in the areas immediately around the turbine footprint.

Alternative Two

The types of impacts described for installation of one utility-scale wind turbine under Alternative One are applicable for Alternative Two; however, there would be more ground disturbance because two utility-scale wind turbines would be installed. Under Alternative Two, total permanent ground disturbance for construction of the utility-scale wind turbines would be approximately 2,580 square meters (28,000 square feet) which equals 0.26 hectare (0.64 acre). This includes 2,100 square meters (22,650 square feet) for new roads, 33 square meters (350 square feet) for foundations, and 450 square meters (5,000 square feet) for the crane pads. In addition to permanent disturbance, approximately 260 square meters (2,800 square feet) would be temporarily disturbed during installation subsurface foundations for the turbines.

To minimize the impacts, previously disturbed areas such as the cleared area east of the U.S. Navy V-10/V-20 complex would be used for staging of equipment of materials and for construction vehicle parking (Figure 6). The foundation for the wind turbines and access roads would require filling of wetlands, resulting in permanently elevated areas of soil within the wetland, which would result in long-term adverse impacts on the topography in the areas immediately around the turbine footprints.

No changes in topography would occur with installation of the residential-scale wind turbines. The area of permanent ground disturbance would be limited to the 1 meter (3 foot) surface foundation and trenching for electrical lines; therefore, permanent ground disturbances would be localized and minor.

4.2.1.2 Geology and Soils

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts on geology and soils would occur.

Proposed Action

The installation of solar panels would result in disturbance of soils including clearing, grading, and digging holes for the support posts, but impacts would only be minor and short-term. The staging areas for the solar panels would be either existing gravel or paved areas, or existing mowed areas. Because installation of solar panels would require only shallow excavation activities, no impacts on geology are anticipated. NASA would minimize adverse impacts on soils by acquiring VSMP permits as necessary, and developing and implementing site-specific SWPPPs and Erosion and Sediment Control (E&SC) plans prior to ground disturbing activities. NASA would revegetate bare soils when construction is complete.

The subsurface foundations of the residential-scale turbines would be installed to a maximum depth of 6 meters (20 feet), which would be entirely within the geologic layer of surficial coastal deposits at any of the potential Main Base or Mainland locations; therefore, no impacts on geology are anticipated from installation of the residential-scale wind turbines.

Accidental release of contaminants, such as an accidental release of pollutants from vehicles or equipment to a permeable surface, could also occur. Any accidental release of contaminants or liquid fuels would be addressed in accordance with the WFF ICP. The impacts of an accidental release could be adverse, although the likelihood of an accidental release would be low due to vehicle and equipment maintenance as well as spill prevention and containment measures. With implementation of mitigation measures, only short-term minor impacts on soils would occur under the Proposed Action.

Alternative One

The types of impacts from solar panel installation described under the Proposed Action Alternative would be the same for Alternative One, but the area of soil disturbance would be smaller due to installation of half the amount of solar panels. Impacts on geology and soils for construction of the residential-scale wind turbines would be the same as described under the Proposed Action.

Construction activities for the utility-scale wind turbines, including grading, clearing, filling, and excavation, would result in disturbance of the ground surface and would have the potential to cause soil erosion. The staging areas for the utility-scale wind turbines would be either existing dirt or paved areas and would not require new grading or ground disturbance. Potential impacts from staging would be short-term and minimal. Utility-scale wind turbines need deep foundations and firmly packed soils to maintain their horizontal stability. Construction of the pile foundation to support the wind turbine infrastructure would require driving precast concrete piles to depths of 30 meters (100 feet) below ground surface. The piles are expected to penetrate the surficial coastal deposits and terminate in the uppermost geologic layer, the Yorktown Formation, which occurs at a depth of 18 to 45 meters (60 to 140 feet) below the ground surface. Although the driven piles would create long-term changes to the subsurface geology immediately around the piles, the changes would be limited in extent and are considered negligible. Therefore, minor, long-term, and highly localized impacts would occur on geology.

NASA would minimize impacts on soils by acquiring VSMP permits as necessary, and developing and implementing site-specific SWPPPs and E&SC Plans prior to ground disturbing activities. NASA would revegetate bare soils and incorporate landscaping measures in areas to be left as pervious surfaces (not paved) when construction is complete.

Accidental release of contaminants, such as hydraulic and lubricating oils or cooling fluids into the soil could also occur from routine maintenance of the utility-scale turbines or an accidental release of pollutants from vehicles or equipment to a permeable surface. Any accidental release of contaminants or liquid fuels would be addressed in accordance with the WFF ICP. The impacts of an accidental release could be adverse, although the likelihood of an accidental release would be low due to vehicle and equipment maintenance as well as spill prevention and containment measures. With implementation of mitigation measures, only short-term minor impacts on soils would occur under Alternative One.

Alternative Two

Impacts on geology and soils for construction of the utility-scale wind turbines would be the same as described under the Proposed Action and Alternative One, but to a greater extent since two utility-scale wind turbines would be installed under Alternative Two. Impacts on geology and soils for construction of the residential-scale wind turbines would be the same as described under the Proposed Action.

4.2.1.3 Land Use

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts on land use would occur.

Proposed Action

Installation of the solar panels in open areas at the Main Base would result in up to 32 hectares (80 acres) of land unavailable for future uses. Approximately 120 hectares (300 acres) at the Main Base are currently occupied by buildings, roads, runways, and other infrastructure and 150 hectares (380 acres) are occupied by forest, leaving approximately 520 hectares (1,280 acres), or 66 percent of the Main Base unoccupied. The 32 hectares (80 acres) of land the solar panels would occupy is about 6 percent of the currently unoccupied land. This would result in long-term adverse impacts on land use in those specific areas. However, impacts on land use would not be permanent because, if needed, the panels could be removed, returning the land use to open space.

The area where the proposed residential-scale wind turbines would be located is zoned agricultural by Accomack County and would be located in areas on WFF property that have no existing plans for future uses that would conflict with placement of the turbines. The installation of the proposed wind turbines would result in long-term changes to land use – open space would be converted to an area occupied by a relatively permanent structure.

Alternative One

Installation of the solar panels in open areas at the Main Base would result in up to 16 hectares (40 acres) of land unavailable for future use. The 16 hectares (40 acres) of land the solar panels would occupy is about 3 percent of the currently unoccupied land. This would result in long-term adverse impacts on land use in those specific areas. However, impacts on land use would not be permanent because, if needed, the panels could be removed, returning the land use to open space.

The area where the proposed residential-scale and utility-scale wind turbines would be located is zoned agricultural by Accomack County and would be located in areas on WFF property that have no existing plans for future uses that would conflict with placement of the turbines. The installation of the proposed wind turbines would result in long-term changes to land use – open space would be converted to an area occupied by a relatively permanent structure.

Alternative Two

Impacts on land use under Alternative Two would be the same as described under Alternative One for wind turbine construction and operation.

4.2.2 Water Resources

4.2.2.1 Surface Waters

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts on surface water within the project area would occur.

Proposed Action

Installation of solar panels and residential-scale wind turbines would not restrict stormwater flow but would result in disturbance to soils that would have the potential to cause soil erosion and the subsequent transport of sediment into waterways via stormwater. NASA would minimize impacts on surface waters during construction by acquiring VSMP permits and by developing and implementing a site-specific SWPPP and E&SC plans prior to land disturbing activities. Short-term minor impacts on surface water quality may occur during construction, but with implementation of mitigation measures for construction activities and stormwater flow, no long-term or adverse impacts on surface waters would occur.

Other possible impacts on surface waters during construction include spills or leaks of fuel or oil from vehicles or equipment. The site-specific SWPPP would include Best Management Practices (BMPs) for vehicle and equipment fueling and maintenance, and spill prevention and control measures would be implemented to reduce potential impacts on soils during construction and continued operation and maintenance of the two wind turbines. Any accidental release of contaminants or liquid fuels would be addressed in accordance with the existing WFF ICP.

Alternative One

The types of impacts from solar panel and residential-scale wind turbine installation described under the Proposed Action Alternative would be the same for Alternative One, but the area of soil disturbance related to installation of the solar panels would be smaller. NASA would minimize impacts on surface waters during construction by acquiring VSMP permits and by developing and implementing a site-specific SWPPP and E&SC plans prior to land disturbing activities. Short-term minor impacts on surface water quality may occur during construction, but with implementation of mitigation measures for construction activities and stormwater flow, no long-term or adverse impacts on surface waters would occur.

Construction activities for the utility-scale wind turbine 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. The utility-scale wind turbine would be located in an area where stormwater primarily drains to the west toward Bogues Bay. Short-term minor impacts on surface water quality could occur during construction, but with implementation of mitigation measures for construction activities and stormwater flow, no long-term or adverse impacts on surface waters would occur. NASA would minimize impacts on surface waters by acquiring VSMP permits and by developing and implementing a site-specific SWPPP and E&SC plans prior to land disturbing activities.

Any accidental release of contaminants during maintenance of the utility-scale turbines would be addressed in accordance with the WFF ICP. The impacts of an accidental release could be adverse, although the likelihood of an accidental release would be low due BMPs.

Alternative Two

The types of impacts on surface water would the same as those described under Alternative One for the construction wind turbines; however, because two utility-scale wind turbines would be installed, there would be more land disturbance and greater potential for a leak or spill due to more construction activity. Short-term minor impacts on surface water quality could occur during construction, but with implementation of mitigation measures for construction activities and stormwater flow, no long-term or adverse impacts on surface waters would occur. NASA would minimize impacts on surface waters by acquiring VSMP permits and by developing and implementing a site-specific SWPPP and E&SC plans prior to land disturbing activities.

Any accidental release of contaminants or liquid fuels during the maintenance of the utility-scale turbines would be addressed in accordance with the WFF ICP. The impacts of an accidental release could be adverse, although the likelihood of an accidental release would be low due to BMPs.

4.2.2.2 Wetlands

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts on wetlands at WFF would occur.

Proposed Action

The potential areas identified for the residential-scale wind turbines and solar panels were selected to exclude wetlands; therefore, no impacts on wetlands would occur under the Proposed Action Alternative.

Alternative One

Installation of solar panels and the residential-scale wind turbines would not affect wetlands.

Due to siting constraints, including finding available land and areas that would not interfere with WFF's active airfields and tracking/telemetry systems, NASA determined that there are no practicable alternatives for the location of the utility-scale wind turbine.

NASA completed a wetland delineation 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 affected by the construction of a utility-scale wind turbine and access road. The delineation determined that both tidal and non-tidal wetlands are present within the project site (NASA, 2009a). Up to 0.17 hectare (0.41 acre) of tidal wetlands would be permanently impacted for construction of the southern wind turbine.

The potentially affected wetlands are considered jurisdictional under Section 404 of the CWA and are regulated by the USACE. NASA completed a *Final Wetland Delineation for Alternative Energy Project* report which was sent to the USACE along with a request for preliminary jurisdictional determination (JD); the USACE responded in a letter dated April 30, 2009, with a preliminary JD. Prior to construction, NASA 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 on wetlands by VMRC through the JPA process. NASA would obtain necessary permits including CWA Section 404, Section 10, and Section 401 Water Quality Certification/Virginia Water Protection permits. NASA would implement wetland mitigation measures agreed upon through the JPA consultation process to offset the impacts from this project. Specifically, NASA would implement 0.181 hectare (0.448 acre) of wetland compensation at the Mainland (Figure 19). The mitigation area would be within the estuarine intertidal emergent persistent (E2EM1) or palustrine scrub shrub (PSS) wetland areas identified for compensation on Figure 19.

Alternative Two

Under Alternative Two, both utility-scale wind turbines would be installed. Due to siting constraints, including finding available land and areas that would not interfere with WFF's active airfields and tracking/telemetry systems, NASA determined that there are no practicable alternatives for the location of the two utility-scale wind turbines.

Up to 0.36 hectare (0.88 acre) of wetlands would be filled for construction of the utility-scale wind turbine pads, underground cables, and access roads: 0.29 hectare (0.71 acre) of estuarine intertidal emergent wetlands; 0.06 hectare (0.14 acre) of palustrine emergent wetlands; and 0.01 hectare (0.03 acre) of palustrine scrub-shrub wetlands (Table 18).

Table 18: Wetland Impacts from Construction of Utility-Scale Wind Turbines

Wind Turbine Site	Permanent Impacts hectare (acre)
Southern turbine	0.17 (0.41)
Northern turbine	0.19 (0.47)
Total	**0.36 (0.88)**

Source: NASA, 2009a

The agency consultation process and public notification described under Alternative One would be the same for Alternative Two. NASA would implement 0.362 hectare (0.895 acre) of wetland compensation at the Mainland (Figure 19). The mitigation area would be within the estuarine intertidal emergent persistent (E2EM1) or palustrine scrub shrub (PSS) wetland areas identified for compensation on Figure 19.

4.2.2.3 Floodplains

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts on floodplains would occur.

Proposed Action

The areas of the Main Base where solar panels would be installed are not within the floodplain.

The residential-scale wind turbine proposed at the Visitor's Center would be located within the 500-year floodplain; however, its very small footprint would not measurably alter floodplain functions. The residential-scale wind turbine proposed at the Mainland gate would not be within the 100- or 500-year floodplain. NASA would ensure that construction activities comply with EO 11988 and 14 CFR 1216.2 to the maximum extent possible. Because the Proposed Action would involve federally funded and authorized construction in the 500-year floodplain, this EA also serves as NASA's means for facilitating public review as required by EO 11988.

Alternative One

The areas of the Main Base where solar panels would be installed and the residential-scale turbine at the Mainland gate are not within the floodplain. The residential-scale wind turbine proposed at the Visitor's Center would be located within the 500-year floodplain.

The single utility-scale wind turbine proposed on Wallops Island would be located within the 100-year and 500-year floodplains. Because of the siting constraints for placement of the utility-scale wind turbine, no practicable alternatives to placement of the utility-scale wind turbine on Wallops Island exist. The functionality of the floodplain on Wallops Island and Mainland, provided both by the wetlands and the area of the island/Mainland itself, would not be substantially reduced due to the presence of the proposed facilities because the footprint of the facilities does not cover a substantial area of the island. Electrical cables would be buried in conduit underground, and any aboveground water-sensitive equipment (i.e., switchgear, electrical components) would be elevated above the base flood elevation, which is 3.4 meters (11 feet) amsl at both the Mainland and on Wallops Island.

NASA would ensure that construction activities comply with EO 11988 and 14 CFR 1216.2 to the maximum extent possible.

Alternative Two

The residential-scale wind turbine proposed at the Visitor's Center would be located within the 500-year floodplain. The residential-scale wind turbine proposed at the Mainland gate would not be within the 100- or 500-year floodplain.

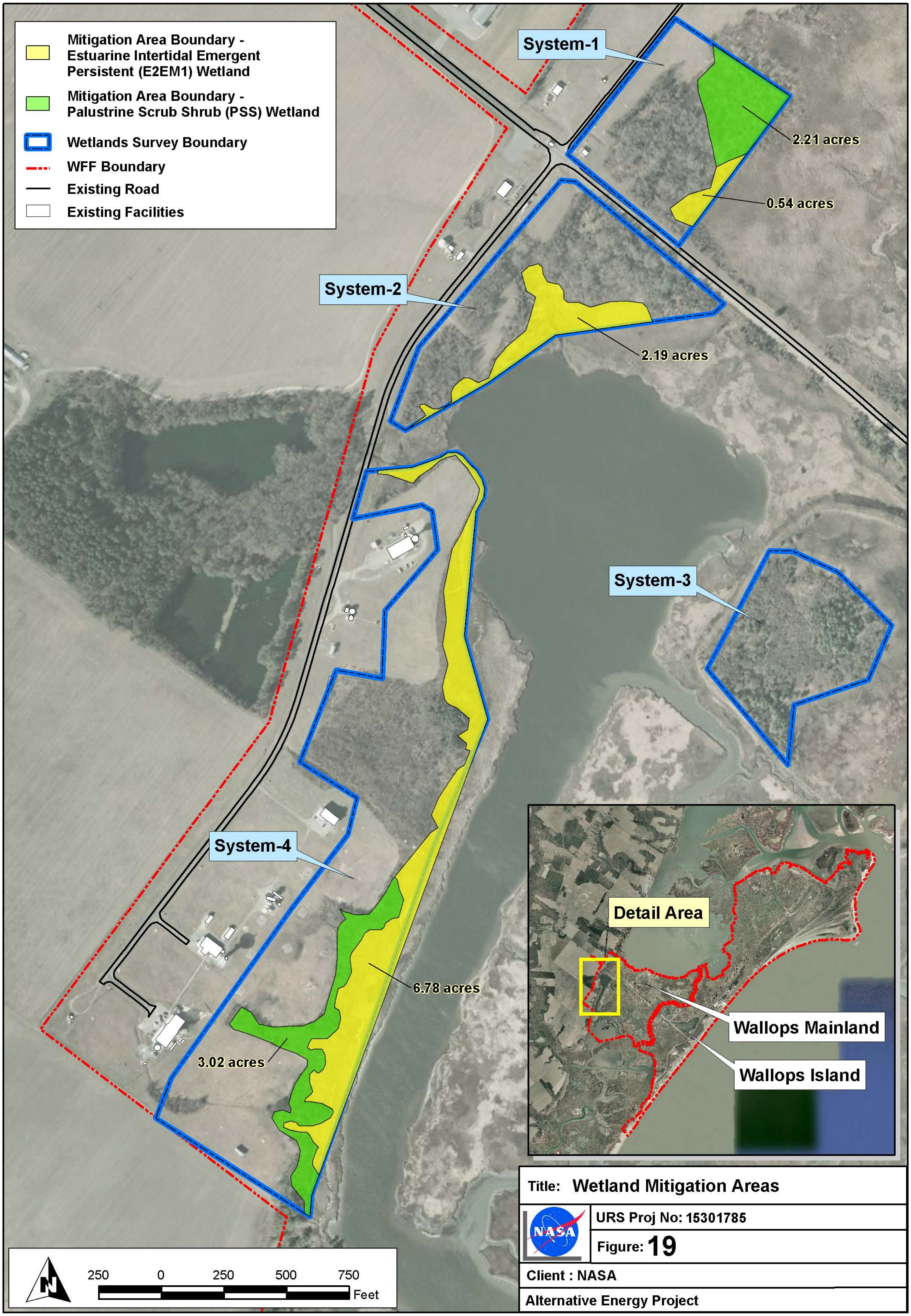
Mitigation Area Boundary - Estuarine Intertidal Emergent Persistent (E2EM1) Wetland
Mitigation Area Boundary - Palustrine Scrub Shrub (PSS) Wetland
Wetlands Survey Boundary
WFF Boundary
Existing Road
Existing Facilities
System-1
2.21 acres
0.54 acres
System-2
2.19 acres
System-3
System-4
6.78 acres
3.02 acres
Detail Area
Wallops Mainland
Wallops Island
250 0 250 500 750
Feet
Title: Wetland Mitigation Areas
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Figure: 19
Client : NASA
Alternative Energy Project

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The utility-scale wind turbines on Wallops Island would be located within the 100-year and 500-year floodplains. Because of the siting constraints for placement of the wind turbines on WFF, no practicable alternatives to placement on Wallops Island, which is entirely within the floodplain, exist. The types of impacts on the floodplain would the same as those described under Alternative One for the construction of the wind turbines; however, there would be more construction in the floodplain under Alternative Two.

NASA would ensure that construction activities comply with EO 11988 (Floodplain Management) and 14 CFR 1216.2 (NASA regulations on Floodplain and Wetland Management) to the maximum extent possible.

4.2.2.4 Coastal Zone Management

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts on the coastal zone would occur.

Proposed Action, Alternative One, Alternative Two

All activities under the Proposed Action and Alternatives One and Two occur within Virginia's CMA as designated by Virginia's CZM Program. NASA has determined that the construction of solar panels, residential-scale wind turbines, and up to two utility-scale wind turbines is consistent with enforceable policies of the CZM Program. Based on the information and analysis in this EA and the Federal Consistency Determination (Appendix C), NASA determined that the Proposed Action is consistent to the maximum extent practicable with the enforceable policies of the CZM Program. VDEQ concurred with NASA's determination in a letter dated April 29, 2010.

4.2.3 Air Quality and Climate Change

No Action Alternative

Under the No Action Alternative, development of the Alternative Energy Project would not occur; therefore, emissions would remain at present levels as described in Section 3.1.3 (calendar year 2009 summary table for WFF emissions). There would be no reduction in emissions resulting from the use of fossil fuels during the production of electricity at the source of the electric power generation that supplies WFF.

Proposed Action

The proposed locations for installation of 32 hectares (80 acres) of solar panels and two residential-scale wind turbines would be in an attainment area for all criteria pollutants; therefore, NASA is not required to perform a general conformity review for the Proposed Action.

Construction equipment and construction worker's vehicles used during the construction activities (i.e., solar panel placement, land clearing, access road, and wind turbine construction) would produce emissions resulting from the use of diesel engines. The use of diesel-or gasoline-powered emergency generators is not anticipated during the construction phase. Due to the operation of fossil-fuel burning equipment, there would be the potential to cause temporary, short-term air quality impacts. To help minimize such impacts and emissions, vehicles and equipment used for construction would be maintained in good working order. Effective since June 2010, the non-road diesel engines are required by law to utilize ultra-low-sulfur diesel, which must meet a 15 parts per million (ppm) sulfur maximum. Idling of construction equipment would be prohibited when feasible.

The amount of disturbed area would be minimized by utilizing previously disturbed areas for the staging of equipment and materials, and for construction vehicle parking. However, depending on weather conditions, there would be fugitive particulate (i.e., dust) emissions emitted during the construction activities, such as clearing and grading. Additionally, 10 percent of the land needed for solar panel placement would be graded to anchor the panels in place. Although the following BMPs were not taken into consideration to estimate worst case emissions, NASA does require the inclusion of specific contract language to require contractors to implement dust suppression procedures (e.g., application of water) when necessary. Additionally, aggregate materials (permanent gravel road surface) would be used on surface access roads and on-site roads.

Based on the quantification of emissions, using EPA-approved emission factors and conservative assumptions where possible (i.e., not accounting for BMPs), the construction activity emissions for the Proposed Action would be minimal (see Table 19). For example, it was assumed that the construction crew would drive to the work site every day in personally owned vehicles (e.g., light-duty trucks), conservatively assuming that each person would drive their own vehicle. Construction timeframes were doubled.

Operational phase activities include power generation and any associated maintenance activities that would require vehicular access and heavy equipment operation when large components would be replaced. There would be no direct air emissions from operation of the solar panels or wind turbines. However, routine activities during the operational phase to produce power, and regular monitoring and maintenance activities to ensure safe and consistent operation could cause some emissions. Potentially, minor VOC emissions may occur during routine maintenance activities (e.g., mirror washing every few weeks or mirror replacement). Also during the operations phase, vehicular traffic would produce fugitive dust and tailpipe emissions, such as from the maintenance of access roads, but these types of emissions would be infrequent and negligible. Additionally, maintaining the vegetation around the solar panels would be negligible and no different from the current mowing operations at the Main Base.

Table 19: Proposed Action Construction Emissions for WFF Mainland/Wallops Island

Emission Sources	Emissions[1] in tons per year					Emissions in metric tonnes per year			
	CO	NO_X	VOC	PM	SO_X[2]	CO_2	N_2O	CH_4	CO_2e
Site Preparation	-	-	-	<1	-	-	-	-	-
Personal Vehicles (Light-duty Diesel Trucks)	<1	<1	<1	<1	<1	11.6	<1	<1	11.8
Construction Equipment	1.8	3.3	<1	<1	<1	202.3	<1	<1	207.1
TOTAL	**2.5**	**3.9**	**<1**	**<1**	**<1**	**213.9**	**<1**	**<1**	**218.9**

[1] Construction emissions were quantified for the duration of the project.
[2]SO_X = sulfur oxides *Source: URS, 2009*

There would be no long-term adverse impacts on air quality for the Proposed Action. Based on the negligible criteria pollutant emissions that would be expected, NASA has concluded that project-related emissions would not have an impact on the area's compliance with the NAAQS. The short-term impact of constructing the solar panels and wind turbines would be negligible compared to the long-term benefits of supplementing WFF's energy needs with fossil fuel-free power. Potentially, a beneficial impact would be a regional reduction in criteria pollutant and GHG emissions resulting from the reduction in electricity production at the source(s) of electric power generation that currently supplies WFF.

Although there are no formally adopted NEPA thresholds of significance for GHG emissions, there are a multitude of various state and regional regulatory programs requiring GHG emissions reductions. However, due to the absence of GHG thresholds, it is difficult to determine the level of proposed emissions that may significantly contribute to global climate change.

Given the absence of science-based or adopted NEPA significance thresholds for GHGs, the CO_2e emissions from the Proposed Action are compared to the EPA GHG baseline inventory of 2007 for the United States to determine the relative increase in proposed GHG emissions. Table 20 summarizes the annual GHG emissions from the Proposed Action and the most recent U.S. annual baseline GHG emissions. This data shows the CO_2e emissions from this alternative would amount to approximately 3.06×10^{-6} percent of the total GHG emissions generated across the United States; therefore, impacts on global climate change would not be substantial.

Table 20: Proposed Action GHG Construction Emissions for WFF Mainland/Wallops Island

Scenario/Activity	Emissions
Proposed Action (metric tonnes/tons per year)	218.9 (241.3)
U.S. 2007 Baseline Emissions (10^6 metric tonnes/tons per year)	7,150 (7,880)
Proposed Action Emissions as a Percent of U.S. Emissions	3.06×10^{-6}
Source: EPA, 2009	

It is likely that the solar panels would reduce an equivalent amount of GHG emissions as calculated for the utility-scale wind turbines (see discussion under Alternatives One and Two below) because they would generate a similar amount of energy. In addition, one residential-scale turbine is estimated to annually reduce the GHG emissions by 3.0 tonnes (3.3 tons) of CO_2 (USDOE, 2001).

Alternative One

Similar to the Proposed Action, reviews for general conformity would not be necessary. The same BMPs described under the Proposed Action to reduce construction emissions would reduce air quality impacts from the construction/installation activities of two residential-scale wind turbines and one utility-scale wind turbine at Wallops Island and 16 hectares (40 acres) of solar panels at the Main Base.

Construction activities would be the same as described for the Proposed Action; however, the graded area required would be greater than under the Proposed Action due to the construction of one utility-scale wind turbine. As under the Proposed Action, 10 percent of the land needed for solar panel placement would be graded to anchor the panels in place.

Calculations were performed using EPA-approved emission factors and conservative assumptions. Similar to the Proposed Action, there would be beneficial impacts on regional air quality as a result of the operation of the wind turbines and solar panels. Based on the quantification of criteria pollutant emissions (see Table 21), these emissions would not have an impact on the area's compliance with the NAAQS. GHG emissions would be minimal compared to the reduction that would be achieved by using the alternative energy sources. Compared to the amount of GHGs emitted during the construction activity, the amount of GHGs offset by the operation of the utility-scale wind turbines at WFF would be considerable. One 2.0 MW wind turbine is estimated to reduce the following quantities of GHG emissions per year: 2,470 tonnes (2,720 tons) of CO_2 and 36.6 kg (85.2 lbs) of N_2O (USDOE, 2001).

Table 21: Alternative One Construction Emissions for WFF Mainland/Wallops Island

Emission Sources	Emissions[1] in tons per year					Emissions in metric tonnes per year			
	CO	NO_X	VOC	PM	SO_X	CO_2	N_2O	CH_4	CO_2e
Site Preparation	-	-	-	<1	-	-	-	-	-
Personal Vehicles (Light-duty Diesel Trucks)	<1	<1	<1	<1	<1	9.7	<1	<1	9.8
Construction Equipment	1.4	2.5	<1	<1	<1	145.0	<1	<1	148.5
TOTAL	**1.9**	**2.9**	**<1**	**<1**	**<1**	**154.7**	**<1**	**<1**	**158.3**

[1]Construction emissions were quantified for the duration of the project.
Source: URS, 2009

Alternative Two

As this alternative does not include solar panels, only emissions for land clearing operations for the two residential-scale and two utility-scale wind turbines were calculated. Personally owned vehicle emissions and construction equipment were calculated for an installation period of 14 weeks.

Similar to the Proposed Action and Alternative One, reviews for general conformity would not be necessary under Alternative Two. The same BMPs described under the Proposed Action to reduce construction emissions for the construction of the wind turbines would apply.

There would be no direct air emissions from operation of either type of wind turbine. However, similar to the Proposed Action, routine activities during the operational phase to produce power, and regular monitoring and maintenance activities to ensure safe and consistent operation could cause negligible emissions.

Based on the quantification of criteria pollutant emissions (see Table 22), these emissions would not have an impact on the area's compliance with the NAAQS. GHG emissions would be minimal compared to the reduction that would be achieved by using the alternative energy sources. Compared to the amount of GHGs emitted during the construction activity, the amount of GHGs offset by the operation of the two residential-scale and two utility-scale wind turbines at WFF would be even greater than Alternative One or the Proposed Action (i.e., a reduction of 2,470 tonnes [2,720 tons] of CO_2 for each 2.0-MW wind turbine and 3.0 tonnes [3.3 tons] of CO_2 for each residential-scale turbine).

Table 22: Alternative Two Construction Emissions for WFF Main Base

Emission Sources	Emissions in tons per year					Emissions in metric tonnes per year			
	CO	**NO_X**	**VOC**	**PM**	**SO_X**	**CO_2**	**N_2O**	**CH_4**	**CO_2e**
Site Preparation	-	-	-	<1	-	-	-	-	-
Personal Vehicles (Light-duty Diesel Trucks)	<1	<1	<1	<1	<1	5.0	<1	<1	5.1
Construction Equipment	<1	<1	<1	<1	<1	89.9	<1	<1	92.2
TOTAL	**1.1**	**1.8**	**<1**	**<1**	**<1**	**94.9**	**<1**	**<1**	**97.3**

Source: URS, 2009

4.2.4 Radar

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts radar systems in the area would occur.

Proposed Action

Solar panels would not affect radar systems. To determine potentially suitable areas for installation of the residential-scale turbines, areas that could potentially affect radar systems were excluded. Therefore, no impacts on radar would occur with installation of any of the 2.4 kW wind turbines.

Alternative One

Solar panels would not affect radar systems. To determine potentially suitable areas for installation of the residential-scale turbines, areas that could potentially affect radar systems were excluded. Therefore, no impacts on radar would occur with installation of any of the 2.4 kW wind turbines.

Since the motion of utility-scale wind turbine blades would have a similar velocity band as aircraft, the 2.0 MW wind turbine(s) was sited to prevent a negative impact upon radar systems at WFF. A study of the radar systems currently in use at WFF was conducted to assist NASA in identification of acceptable sites for the wind turbines (QinetiQ Inc., 2004). Figure 5 shows the acceptable locations for siting the utility-scale wind turbine(s), and illustrates the constraints placed on the siting to prevent interference with radar. Because the utility-scale wind turbine would be located within an area that would not affect existing radar systems, no impacts on radar would occur under Alternative One.

Alternative Two

The site selection process for the utility-scale wind turbines was the same as described under Alternative One. Neither the residential-scale wind turbines nor the solar panels would affect radar systems, so no impacts on radar would occur under Alternative Two.

4.2.5 Noise

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, there would be no additional increase in noise levels at WFF so no new impacts on humans or wildlife from noise would occur.

Proposed Action

Installation activities for the solar panels and the residential-scale wind turbines have the potential to generate temporary increases in noise levels around the Main Base and at the entrance gate to the Mainland from heavy equipment operations. NASA would comply with local noise ordinances and State and Federal standards and guidelines for potential impacts on humans caused by construction activities. OSHA limits noise exposure for workers to 115 dBA for a period of no longer than 15 minutes in an 8-hour work shift and to 90 dBA for an entire 8-hour shift. Workers near activities producing unsafe noise levels, both during installation and during maintenance or repair operations after the solar panels and residential-scale wind turbines are operational, would be required to wear hearing protection equipment. Therefore, impacts on the occupational health of construction workers as a result of construction noise are not expected.

The operation of solar panels would not create any noise. Employees and visitors to the two locations of the residential-scale wind turbines (the Visitor Center and the Mainland guard station) would hear the turbines while they were outside of the buildings, but they would not hear the turbines from inside the buildings. The noise from the residential-scale turbines, on windy days, may sound like a faint “whoosh.” However, most of the time the residential-scale turbines would not be heard by people standing outside of the Visitor Center or Mainland guard station, so the impacts on those employees and visitors would be minor.

Alternative One

The types of noise impacts and mitigation for installation and operation of solar panels and residential-scale wind turbines would be the same as described under the Proposed Action Alternative. However the duration of the noise related to installation of the solar panels would last approximately half as long because half the amount solar panels would be installed.

Modern utility-scale wind turbines are generally quiet in operation, and compared to the noise of road traffic, trains, aircraft and construction activities, to name but a few, the noise from wind turbines is very low (The Working Group on Wind Turbine Noise, 1996). Outside of homes that are at least 300 meters (980 feet) away from large wind turbines, the sound of a wind turbine generating electricity is likely to be about the same level as noise from a flowing stream about 50 to 100 meters (160 to 330 feet) away or the noise of leaves rustling in a gentle breeze. The noise level from a single wind turbine creates a sound pressure level of 50 to 60 dBA at a distance of 40 meters (130 feet) from the turbine, which is about the same level as conversational speech. At a house 500 meters (1,640 feet) away, the equivalent sound pressure level would be 25 to 35 dBA when the wind is blowing from the turbine towards the house (The Working Group on Wind Turbine Noise, 1996). Additionally, the proposed 2.0 MW wind turbine would use a generator and gearbox with elements that minimize noise.

The closest facility occupied by personnel to the utility-scale wind turbine would be the U.S. Navy V-10/V-20 Complex, which is approximately 120 meters (400 feet) northeast of the proposed wind turbine location. Neither the public nor employees and visitors to WFF outside of Wallops Island would be able to hear the utility-scale wind turbine; therefore, there would be no impacts on either of these two groups from operation of the wind turbines. Operation of the utility-scale wind turbine would result in highly localized, long-term, minor impacts on the surrounding environment from noise.

Alternative Two

The construction-related noise impacts and mitigation would be the same as described under the Proposed Action for construction of residential-scale wind turbines. The discussion of noise generated by the utility-scale wind turbines would be the same as described under Alternative One however, there would be more noise generated because two utility-scale wind turbines would be operated.

4.2.6 Hazardous Materials, Hazardous Waste, and MEC

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, there would be no impact from hazardous materials and generation of hazardous waste.

Proposed Action

Solar Panels

Construction activities would include the use of hazardous materials and hazardous waste generation (i.e., solvents, hydraulic fluid, oil, and antifreeze) from the construction equipment. 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 would require a site-specific SWPPP containing BMPs related to spill prevention and cleanup procedures for hazardous materials and wastes to be developed before starting construction activities.

Maintenance of the solar panels, which primarily involves periodic cleaning, would involve the use of soap concentrates and water, which are not hazardous. Although small amounts of harmful toxins like arsenic and cadmium compounds are present inside the solar cells, they cannot cause adverse effects unless they enter the human body in high doses, which would not occur during normal installation, operation, and maintenance. At ambient temperature and pressure conditions, there would be no vapors or dust generated by the normal operation of PV systems (Markvart and Castaner, 2003). The only conceivable situation in which the substances contained within PV cells could become a threat to human health and safety would be if a fire were to engulf the panels and firefighters or others nearby were to inhale contaminants released into the air (UCS, 1992). At the proposed solar panel locations, the risk of fire is negligible.

After the expected 25-year life span of the solar panels, the PV cell systems would be decommissioned. NASA would recycle the solar panels by sending the spent cells to a smelting or refining facility that specializes in reclaiming materials such as glass, aluminum frames, and semiconductor materials. Currently, many manufacturers accept decommissioned solar panels. The following procedures for reprocessing waste materials and recycled silicon are representative of existing practices:

- Modules that can be recovered and repaired into working modules would be recovered.
- Modules that cannot be repaired into working modules would undergo a de-manufacturing process to recover aluminum frame material, and where possible, recoverable materials. Specialized recyclers would then recycle materials appropriately.
- The remaining non-recoverable parts of the modules would be crushed and disposed of according to all Federal, State, and local requirements in controlled landfill sites.

With the implementation of WFF's ICP and proper procedures for the handling, storage, and disposal of hazardous materials and wastes, no impacts on human and environmental health due to hazardous materials and wastes are anticipated for this alternative.

Residential-Scale Wind Turbines

Construction equipment used to erect the residential-scale turbines would likely contain small quantities of hazardous materials, including diesel fuel, gasoline, and petroleum-based lubricants. To mitigate potential risks to human health or the environment, WFF would require all workers to adhere to the WFF ICP, which prescribes means for preventing or responding to an unintentional release of hazardous materials. The residential-scale turbines do not contain hazardous fluids and would not require any scheduled maintenance other than replacing blades after 20 years of service; therefore, maintenance would not expected to generate any hazardous materials or waste.

Additionally, NASA would ensure implementation of WFF's ICP safety procedures, training, and mitigation measures, including spill prevention and response. Therefore, no impacts on human and environmental health due to hazardous materials and wastes are anticipated.

Due to the presence of MEC at the Visitor Center, construction personnel working in this area would be required to attend MEC training to understand the characteristics and volume of potential MEC at the site. To ensure that excavation equipment does not hit or expose any unknown MEC, digging operations would be surveyed with a magnetometer and cleared using the following process:

- A magnetometer survey of the first 30 cm (1 foot) of soil would be completed, prior to excavating those soils.
- The second 30 cm (1 foot) of subsoil would be re-surveyed, then excavated.
- This process would continue to the depth of the residential-scale turbine foundation.
- All MEC found would be inspected and handled by trained UXO personnel and properly disposed.

Alternative One

The types of impacts and mitigation measures would be the same as those described for solar panels under the Proposed Action Alternative; however, less hazardous materials and wastes related to the solar panels would be handled and generated compared to the Proposed Action.

The types of construction and maintenance impacts for the residential-scale wind turbines described under the Proposed Action Alternative would be the same for both the residential-scale turbines under Alternative One.

The construction, operation, and maintenance of the utility-scale wind turbine would result in the use of hazardous materials (i.e., solvents, hydraulic fluid, oil, and paint) and generation of hazardous wastes for maintenance of the turbine engine and parts. Each turbine model has different specifications for lubricating oil and hydraulic fluid quantities. There are three main types of fluid in a wind turbine: cooling fluid for the generator (a mix of glycol and water, similar to that used in automobile radiators), lubricating oil for the gearbox (typically a synthetic lubricating oil), and hydraulic oil for operating the blade pitch system, yaw mechanism, and brakes.

Based on the limited quantities of fluids contained in the wind turbine generators and the leak detection and containment systems engineered into their design, the potential for an accidental spill from a wind turbine generator malfunction is extremely limited. Furthermore, any accidental gear oil or other fluid leaks from the wind turbine would be contained inside the turbine tower, which would be sealed around the base.

The wind turbine generator fluids would be checked periodically and would be replenished or replaced infrequently (generally less than once per year and sometimes only once every 5 years). The turbine would be equipped with fluid catch basin and containment systems to prevent accidental releases from leaving the nacelle. When replacing these fluids, operations staff would climb up to the nacelle and remove the fluids in small (typically 19 liter [5 gallon]) containers and lower them to the ground using a small maintenance crane built into the nacelle itself. The containers would be transferred to a vehicle for transport to a facility for temporary storage (typically less than one month) before being picked up by a licensed transporter for recycling. Replacement fluids are added the same way, only in reverse. Small quantities of replacement fluids, typically no more than a few 208 liter (55 gallon) drums of lubricating oil and hydraulic oil may be stored in existing facilities for replenishing and replacing spent fluids. These fluids would be stored indoors in appropriate containment. All operations staff would be trained in appropriate handling and spill prevention techniques to avoid accidental spills. Because only small quantities of fluids would be transported, added, or removed at any one time and would be stored for short periods of time, the potential for an accidental spill during routine maintenance would be extremely limited.

Moreover, the utility-scale wind turbine generator would be equipped with sensors to automatically detect loss in fluid pressure and increases in temperature and would shut it down in case of a fluid leak.

With the implementation of WFF's ICP and proper procedures for the handling, storage, and disposal of hazardous materials, wastes, and MEC, no adverse impacts on human and environmental health due to hazardous materials and wastes are anticipated for this alternative.

Alternative Two

The types of construction and maintenance impacts for the residential-scale wind turbines described under the Proposed Action Alternative would be the same for both residential-scale turbines under Alternative Two. Impacts from the utility-scale turbine would be similar to Alternative One; however, because construction would take longer, construction-related hazardous materials would be onsite longer. Additionally, because there would be two turbines instead of one, Alternative Two would have approximately twice the maintenance requirements (and associated hazardous materials and waste).

With the implementation of WFF's ICP and proper procedures for the handling, storage, and disposal of hazardous materials, wastes, and MEC, no adverse impacts on human and environmental health due to hazardous materials and wastes are anticipated for this alternative.

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Vegetation

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts on vegetation would occur.

Proposed Action

Installation of solar panels would result in the permanent loss of vegetation within the footprint of the support posts; however, they would be placed in areas where high levels of human activity occur, including foot traffic and regular mowing. Impacts on vegetation would be long-term and adverse but localized. The staging areas for the solar panels would be existing gravel or paved areas, or areas that are maintained by mowing. No currently unmaintained vegetated areas would be used; therefore, no trees would be removed, vegetation denuded, or wetlands affected during staging. Potential impacts during staging would be short-term and minimal.

Short-term adverse impacts on vegetation are anticipated due to excavation and grading to install the residential-scale wind turbines including the surface foundation and trenches for underground wire. NASA would minimize adverse impacts on vegetation during construction by minimizing the areas of disturbance to the extent practicable, using existing un-vegetated areas for staging, acquiring VSMP permits as necessary, and developing and implementing site-specific SWPPPs and E&SC Plans prior to ground-disturbing activities. NASA would revegetate bare areas after soil disturbing activities.

Alternative One

The types of impacts would be the same as those described for solar panels and residential-scale wind turbines under the Proposed Action Alternative; however, a smaller area would be affected due to half the area of solar panels compared to the Proposed Action.

Short-term adverse impacts on vegetation are anticipated due to excavation and grading to install the utility-scale wind turbine and construct the access road, entrance and exit boreholes of directional drilling operations on Wallops Island, and trenches for underground wire. The staging areas for the wind turbines would be existing dirt or paved areas and would not require new grading or ground disturbance. No currently unmaintained vegetated areas would be used; therefore, no trees would be removed, vegetation denuded, or wetlands affected during staging. Potential impacts during staging would be short-term and minimal.

There would also be long-term adverse impacts on vegetation at Wallops Island from construction of one utility-scale wind turbine due to the permanent conversion of 0.17 hectare (0.41 acre) of tidal wetlands to developed land. NASA would implement wetland mitigation measures agreed upon through the JPA consultation process to offset the impacts. Impacts would be localized to the area within the utility-scale wind turbine construction footprint shown on Figure 6.

NASA would minimize adverse impacts on vegetation during construction by minimizing the areas of disturbance to the extent practicable, using existing un-vegetated areas for staging (see Figure 6), acquiring VSMP permits as necessary, and developing and implementing site-specific SWPPPs and E&SC Plans prior to ground-disturbing activities. NASA would revegetate bare areas after soil disturbing activities, and incorporate landscaping measures in areas that would be left as pervious surfaces (not paved) when the project is complete.

Alternative Two

The types of impacts for construction of residential-scale wind turbines would be the same as those described under the Proposed Action Alternative.

Short-term adverse impacts on vegetation are anticipated due to excavation and grading to install the utility-scale wind turbines, and construct access roads, entrance and exit boreholes of directional drilling operations on Wallops Island, and trenches for underground wire. There would be long-term, adverse impacts on vegetation at Wallops Island due to the permanent conversion of 0.36 hectare (0.88 acre) of wetlands to developed land: 0.29 hectare (0.71 acre) of estuarine intertidal emergent wetlands; 0.06 hectare (0.14 acre) of palustrine emergent wetlands; and 0.01 hectare (0.03 acre) of palustrine scrub-shrub wetlands. NASA would implement wetland mitigation measures agreed upon through the JPA consultation process to offset the impacts. Impacts would be localized to the area within the utility-scale wind turbine installation footprint shown on Figure 6.

4.3.2 Terrestrial Wildlife

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts on terrestrial wildlife would occur.

Proposed Action

There would be short-term adverse impacts on wildlife during all construction activities due to temporary noise disturbances. However, this would be similar to disruptions from existing daily operations at WFF.

The solar panels and residential-scale wind turbines would be installed in developed areas that are marginally suitable as wildlife habitat. Solar panels installed within open areas would result in loss of foraging areas for some terrestrial wildlife (i.e., squirrels, raccoons, frogs, etc.). This would result in long-term adverse impacts on terrestrial wildlife from installation of the solar panels and residential-scale wind turbines, although the impacts would be localized to the footprint of the support posts and foundations.

Shadow flicker from the residential scale turbines, although expected to be very minor, is one factor that may affect wildlife and its use of available habitat. The few studies that have been conducted focused on utility-scale turbines and generally observe changes in wildlife behavior in response to wind turbines without attempting to distinguish the effects of verticality, noise, motion, or flicker. Species of birds and small mammals that require open grasslands and are often preyed upon by raptors may be most affected by flicker. In such an environment, a rapidly moving shadow can indicate the presence of a bird of prey. Whether a constantly repeated shadow is tolerated, or elevates levels of stress in prey species, or even potentially results in habitat exclusion, is unknown (Illinois DNR, 2007).

Alternative One

There would be short-term adverse impacts on wildlife during all construction activities due to temporary noise disturbances. However, this would be similar to disruptions from existing daily operations at WFF. Long-term impacts on terrestrial wildlife from solar panels and residential-scale wind turbines would be the same as those described under the Proposed Action.

Additionally, there would be long-term adverse impacts on terrestrial wildlife due to the permanent conversion of 0.17 hectare (0.41 acre) of wetland habitat at Wallops Island for the single utility-scale wind turbine foundation and access road, which would permanently displace the terrestrial wildlife from using the affected area. NASA would implement wetland mitigation measures agreed upon through the JPA consultation process to offset the impacts. The potential for shadow flicker would be greater than the Proposed Action due to the much larger blades on the utility-scale turbine.

Alternative Two

There would be short-term adverse impacts on wildlife during wind turbine construction activities due to temporary noise disturbances. However, this would be similar to disruptions from existing daily operations at WFF. There would be long-term adverse impacts on terrestrial wildlife due to the permanent conversion of 0.36 hectare (0.88 acre) of the wetland habitat at Wallops Island to developed land for the utility-scale wind turbine foundations and access roads, which would permanently displace the terrestrial wildlife from the affected area. NASA would implement wetland mitigation measures agreed upon through the JPA consultation process to offset the impacts. The potential for shadow flicker would be the greatest compared to the other alternatives due to there being two utility-scale turbines.

4.3.3 Avifauna – Birds

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, there would be no impacts on avifauna.

Proposed Action

Because the installation of solar panels at the Main Base would occur within marginally suitable bird habitat, and their operation would not interfere with bird activities, no measurable impacts on birds are anticipated from solar panels from the Proposed Action. In fact, the areas around the Main Base runways are managed specifically to discourage bird use due to the potential for an aircraft strike hazard. Minimal adverse impacts are expected for the installation and operation of two 2.4 kW turbines as discussed in the following sections.

Construction Impacts for Residential-Scale (2.4 kW) Wind Turbines

Limited temporary short-term impacts on bird nesting from the construction of two 2.4 kW turbines are anticipated as a result of wind turbine construction activities. These temporary impacts would be minimal because: 1) the total amount of habitat disturbance is minimal; 2) large areas of similar habitat exist nearby; 3) the species nesting in the area are generally common species; 4) construction period is short-term (6 months); 5) birds are mobile and can avoid construction activities; and 6) birds are acclimated to other nearby towers, buildings, and site operations.

Operational Impacts for Residential-Scale (2.4 kW) Wind Turbines

A qualitative evaluation of the potential for risk to birds from residential-scale turbines is provided in the absence of site-specific information. The general assumption is that small, residential-scale wind projects have minimal impacts on birds and less impact than the larger utility-scale turbines. For example, the American Wind Energy Association (AWEA) says that "anecdotal evidence indicates that birds occasionally collide with small wind turbines as they do with any other type of structure. However, such events are rare and very unlikely to have any impact on bird populations. Large, utility-scale wind turbines account for less than 0.003% of all human-caused bird deaths, and small wind turbines have even less of an impact."

Further, Southwest Windpower, Inc., the manufacturer of 2.4 kW turbines, states in their Residential Wind and Birds fact sheet that "although no formal studies have been conducted with residential wind generators like those produced by Southwest Windpower, Inc., bird strikes are even rarer. This is due in part to their shorter towers [9 to 30 meters (30 to 110 feet)], and relatively small blades [1 to 3 meters (3 to 12 feet) in diameter]. Also, residential wind generators are typically installed over a more dispersed area, further reducing the chance of bird collision." Neither AWEA nor Southwest Windpower, Inc. track avian mortality at residential-scale windfarms and, therefore, project-specific information was sought during a literature review.

A review of relevant literature and discussions with industry experts were conducted to determine if there were post-construction monitoring results for projects similar to WFF that would be instructive in assessing the potential for avian risk from the 2.4 kW turbines. Post-construction monitoring to assess avian mortality rates generally has been conducted at the larger utility-scale projects and not on the smaller turbines projects like the 2.4 kW turbines proposed at WFF. In a review of avian mortality data for 33 wind turbine sites in the United States and Canada, Barclay, et al. (2007) determined that that the height of turbines had no effect on bird mortality rate (corrected mortality rates ranged between zero and nine per turbine per year). With the exception of two sites, data included in this analysis were from 31 sites with turbine heights between 30 and 94 meters (98 to 308 feet) tall.

Two sites were included that have turbines less than 24.4 meters (80 feet) tall (San Gorgonio wind farm and Altamont Pass Wind Resource Area [APWRA], both in California). However, these projects are not appropriate for assessing risk to birds in Virginia. The APWRA in California has more than 1,500 24-meter (79-foot) tall turbines (Barclay, et al., 2007) and there is a lack of similarities between the large wind farms in inland California and the residential-scale turbines at WFF's coastal Virginia location. Therefore, the avian mortality research conducted in California is not particularly instructive in assessing impacts on birds from much smaller turbine groupings sited in the northeastern United States (Kerlinger, 1996), and the APWRA data are not provided for comparison.

While there is a general lack of data for these smaller turbines in the peer reviewed literature, two relevant projects were identified for which there are avian monitoring data. Projects at Eastern Neck National Wildlife Refuge (NWR) and Presque Isle State Park were recently built and have a number of similarities to the WFF project. Both projects are described below. The

USFWS is also considering installation of 7.52 meter (24.7 foot) vertical axis turbines at Izembek NWR in Alaska. The USFWS indicated in its March 2, 2010, FONSI (USFWS, 2010) that there would be “little or no impact to existing bird use” based on a qualitative assessment; pre-construction avian monitoring was not conducted. Post-construction surveys are planned.

In 2002, Eastern Neck NWR near Rock Hall, MD, installed a single 18-meter (60-foot) tall, unguyed 10 kW wind turbine (7-meter [23-foot] radius blades) about 40 meters (130 feet) from the former refuge office. The turbine site has a number of similarities to the proposed 2.4 kW turbine sites at WFF including the following: the turbine at Eastern Neck NWR is in a coastal location (Chesapeake Bay), is sited on elevated land that is regularly maintained, is an important stopover location in the Atlantic Flyway, and is adjacent to the building the generated electricity is meant to primarily serve. The woodland fringing the turbine at Eastern Neck NWR is more than 100 meters (330 feet) away, which may be slightly farther than woodland areas from the 2.4 kW turbines at WFF. The Eastern Neck NWR supports saltmarsh, forest, and agricultural fields, and the bird community is similar to that occurring at WFF and includes passerines, waterfowl, raptors, waterbirds, and shorebirds. A Bald Eagle nest is located approximately 0.4 kilometer (0.25 mile) from the Eastern Neck NWR wind turbine.

Pre- and post-construction monitoring activities for birds were conducted for 3.5 years at Eastern Neck NWR to determine local bird community and use, determine scavenger species and rate, evaluate carcass searcher efficiency, and document mortality (Willis, no date). The turbine site was visited 478 times over 3.5 years (average of approximately one visit per 3 days); fewer visits occurred during the summer months when the turbine was less likely to be operational due to light winds. There were no more than 7 days between visits. The results of the survey indicated that 20 bird carcasses were recovered in the search area beneath the turbine. Seventeen of these carcasses were European Starlings (*Sturnus vulgaris*), which nested in the cowling of the turbine. The Starlings returned to nest in the cowling even after routine maintenance activities were conducted to remove the nesting material and the birds were observed flying into the nest even when the blades were turning. Carcasses of a Bank Swallow (*Riparia riparia*) and a Gray Catbird (*Dumtella carolinensis*) were also recovered. A third bird was scavenged prior to confirming its species. Over the course of the study period, Willis (no date) reported the corrected mortality rate as 18.4 birds per year. Given that nesting European Starlings comprised a majority of the observed mortality, the mortality rate drops to 2.8 birds per year. This is lower than the rate of seven/turbine/year for the eastern United States (Kerlinger et al., 2009) and is lower than the rate reported for the WFF’s utility-scale turbines’ pre-construction study.

In 2007, Presque Isle State Park near Erie, PA, installed a single 36-meter (118-foot) tall, unguyed 10 kW wind turbine 11 meters (35 feet) from the Tom Ridge Environmental Center (TREC). The turbine site is located near the entrance to the State park on a bluff near Lake Erie. Like the Eastern Neck NWR turbine project, there are similarities between the TREC project and the 2.4 kW turbine proposed sites at WFF. The turbine at TREC was sited adjacent to the TREC building and is adjacent to developed and more naturalized areas. Natural and planted vegetation and a 2.8 hectare (7 acre) parking lot surround the turbine site. The turbine site is a former outdoor movie theater on maintained lawn. McWilliams and Brauning (1999) indicate that more than 250 species of birds have been observed at the State park.

Pre-construction monitoring activities for birds at the TREC site were conducted to determine local bird community and use through direct observation and recordings of nighttime calls between October 2006 and the date the turbine was erected in May 2007 (Anderson, 2009).

During the year-long pre-construction study, 83 species were observed including raptors, gulls, waterfowl, waterbirds, and numerous types of passerines. Shorebirds were not documented. A post-construction study was conducted between May 2007 and July 2008 to observe bird use and conduct carcass searches, nocturnal surveys, and scavenger surveys using site-specific methodology. During the 14-month post-construction monitoring, no bird (or bat) carcasses were recovered at the turbine site despite the documentation of use by a variety of birds. The study authors suggest that mortality may have occurred but were not observed due to undocumented scavenger activity. Nevertheless, the authors conclude that their results confirm low mortality rates for smaller turbines such as the one at TREC.

The Eastern Neck NWR and Presque Isle State Park turbine studies discussed in this section suggest that mortality at WFF would also be low given the similarities between sites and projects, and likely lower than the utility-scale turbines. The proposed residential-scale turbine sites at WFF are adjacent to existing buildings and/or site operations, including the Visitor Center and Mainland guard station, where birds have already acclimated to these features and related site activities. Most individuals would habituate to the presence of the turbines and would avoid the turbines. The two studies available for review also suggest that there would be no impacts on foraging or breeding activities or migratory patterns.

NASA acknowledges that there is a limited amount of knowledge relating potential wildlife impacts to shadow flicker caused by wind turbines. Flicker is one factor which may affect wildlife and its use of available habitat. Those few studies which have been conducted generally observe changes in wildlife behavior in response to wind turbines without attempting to distinguish the effects of verticality, noise, motion, or flicker. Species of birds and small mammals which require open grasslands and are often preyed upon by raptors may be most affected by flicker. In such an environment, a rapidly moving shadow can indicate the presence of a bird of prey. Whether a constantly repeated shadow is tolerated, or elevates levels of stress in prey species, or even potentially results in habitat exclusion, is unknown.

NASA would implement a post-construction monitoring study as a means of ground truthing the residential-scale wind turbines' risk profile. Details of the post-construction study can be found in Chapter 5 of this EA.

Alternative One

As with the Proposed Action, because the installation of solar panels at the Main Base would not alter or remove bird habitat, nor would their operation interfere with bird activities, no impacts on bird are anticipated from solar panels under Alternative One. The impacts on birds from the two 2.4 kW turbines as discussed above are expected to be the same as the Proposed Action.

Construction Impacts

The proposed utility-scale turbine project site is considered suitable nesting habitat for a number of SGCN bird species, including the Tier I Black Rail (*Laterallus jamaicensis*), Tier II Salt Marsh Sharp-Tailed Sparrow (*Ammodramus caudacutus*), and the Tier IV Virginia and Clapper Rails (*Rallus limicola* and *longirostris*), respectively. Adverse impacts on marsh dwelling waterbirds from the construction of one 2.0 MW turbine are anticipated, and could include startling nesting species, thereby exposing nests to greater risk of predation or cooling, inadvertent crushing of eggs by construction equipment. Impacts from construction activities could also reduce available prey base, which includes small crabs, mussels, fish, and insects.

Long-term construction-related impacts for the one 2.0 MW turbine on birds would be anticipated from the conversion of estuarine and marine wetland habitat to developed land Impacts would include loss of available foraging and nesting 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.

Operational Impacts

The impacts evaluated for Alternative One include direct impacts (i.e., fatalities resulting from collisions with the 2.0 MW wind turbine rotors and monopoles) and indirect impacts (i.e., disruptions of foraging behavior, breeding activities, and migratory patterns resulting from alterations on landscapes used by nocturnally active birds [Kunz et al., 2007]). Based on the findings of the pre-construction study, avian fatalities would be expected from the operation of the 2.0 MW wind turbine.

The total number of fatalities based upon corrected observations (e.g., scavenger, searcher efficiency) at WFF's existing towers (up to 68 per year at the South Meteorological Tower) is proportionally very small in comparison to the number of birds that resided in and/or migrated through this region over the same span of time. The WFF site is located in an area of Virginia within the Atlantic flyway where waterfowl, other waterbirds, shorebirds, songbirds, and raptors stopover or migrate through in numbers that are globally important. While the magnitude of this coastal region of Virginia as a bird migration corridor cannot be understated, data from the 2008–2009 WFF avian study (NASA, 2009d) indicates that the vast majority of birds flew around the existing towers. Nevertheless, given that coastal Virginia hosts a robust fall bird migration, the potential for risk for collision with the proposed turbine at WFF would likely be higher at that time of year due to the large number of birds flying through.

The proposed turbine site is contiguous with (within 150 meters [500 feet]) WFF's existing developed lands and, therefore, from a regional perspective, operation of the turbines would only minimally reduce the area of preferred habitat and minimally increase the amount of developed area that would largely be avoided by birds. There is abundant habitat for most birds in the adjacent uplands and salt marshes where there is minimal disturbance from site operations. While there would be some loss of habitat for nesting and or foraging for turbine installation, local, regional, and flyway migratory patterns are not likely to shift in response to operation of the turbines.

Low post-construction fatality rates are expected because most birds were observed flying below, or are known to migrate flying above, the rotor sweep zone. Flight heights of the vast majority of birds observed during the day time were between ground level and 15 meters (50 feet), well below the rotor sweep zone at 43 meters (140 feet). The less than 2 percent of birds observed within the height range of the wind turbine rotor sweep zone were not directly over the proposed wind turbine sites but rather spread out throughout the survey area. The potential for risk to nocturnal migrating birds is expected to be similarly low given that they generally fly above the height of most wind turbines. Fog or other inclement weather conditions, however, increases the level of risk to migrating birds since visibility can be greatly reduced. Communication towers, in comparison, exhibit much higher levels of fatality (one to two orders of magnitude) simply because their height (typically 150 meters [500 feet] and taller) is within the preferred zone of migration, their guy wires create additional collision hazards, and steady-burning lights serve as an attractant (Kerlinger et al., 2009, in review).

The level of mortality documented for the WFF site is higher than the mortality rate reported at other wind projects. The number of fatalities for the WFF 2008–2009 avian study was estimated to be 28 fatalities per year at the guyed North Boresight Tower and 44 to 68 fatalities at the unguyed South Meteorological Tower. In a review of data from 30 wind farms in North America, Kerlinger et al. (2009) reported a rate of approximately seven carcasses per turbine per year for the eastern United States. These data aren't entirely comparable to WFF given differences in calculation of mortality rate (Kerlinger et al.'s rates are corrected for scavenging and searcher efficiency; a conservative factor of four was used to determine fatality rate in the WFF avian study). The lack of multi-bird fatality events (greater than three carcasses per tower on a single evening) in the WFF avian study is, however, comparable to the data reported by Kerlinger et al. (2009). Unlike communication towers for which a number of large-scale multi-bird mortality events have been documented, multi-bird mortality events at a single wind turbine are rarely observed (four times in approximately 25,000 turbine searches at 30 wind farms) (Kerlinger et al., 2009). These findings from Kerlinger et al.'s (2009) data review, in combination with the WFF avian study findings, suggest that the probability of large scale mortality events occurring at the WFF project would be low. So while there may be mortality at the individual level for a variety of birds, there is sufficient evidence to conclude that population level effects are very unlikely.

The mortality study component indicates that risk for collision with the proposed turbine is based on each species' population status. That is, risk may be highest for abundant and common species and lowest for State or federally listed avian species. Most of the species of carcasses recovered in the avian study are categorized by CNWR (USGS, 2006) as abundant or common during most seasons of the year (migratory species may be "uncommon," "occasional," or "rare" during some seasons. Abundant species are defined as "very numerous" and common species are "likely to be seen or heard in suitable habitat." Only one species (the Tier IV SGCN Marsh Wren – uncommon) was categorized as uncommon, occasional, rare, or accidental.

NASA has been monitoring the post-construction wildlife studies that have been conducted by the New Jersey Audubon Society at the Jersey Atlantic Wind, LLC/Atlantic County Utilities Authority (ACUA) five-turbine project in Atlantic City, NJ (Photograph 7). This facility was built in 2005 and post-construction monitoring of impacts on birds has been ongoing since August 2007. The Atlantic Ocean coastal setting is similar to the Wallops Island environment and supports similar avian species composition. These similarities provide an opportunity to determine the type of impacts that might occur at the proposed WFF project site.

Source: ACUA, 2005

Photograph 7: Jersey Atlantic Wind, LLC/Atlantic County Utilities Authority Wind Farm

Results of site-specific bird mortality studies that took place between August 2007 and August 2009 (ACUA, 2009) have been published, and during this period, carcasses of 40 birds (25 species; 2 were not related to collisions) were discovered near the operating wind turbines. Laughing Gull, which is an abundant breeder in southern coastal New Jersey, and passerines (perching birds) were the most frequently encountered during collision event searches. Carcasses of raptors, waterfowl, and shorebirds were infrequently observed. One carcass of a Peregrine Falcon, a New Jersey endangered species, was recovered in August 2007. Four State threatened osprey but no federally listed species were documented. Although a final report is not yet available, a preliminary corrected mortality rate for the first two years of study was estimated to be approximately 30 birds/turbine/year; this rate is within the range estimated from pre-construction monitoring at WFF (28 to 72 birds/turbine/year). According to the VDGIF, this mortality rate is the highest documented for any single wind energy project in the United States (Fernald, pers. comm., 2010). The results of the avian and bat mortality monitoring at the ACUA five-turbine project lend strong support to the potential for the Wallops Island 2.0 MW-turbine project to cause an equivalent level of risk to coastal avian resources, given similarity in the actual mortality rate at ACUA and the estimated rate at WFF.

Alternative Two

The types of impacts on birds as a result of wind turbine construction would be the same as described for the Alternative One; however, more impacts are anticipated because the surface area disturbance, and therefore amount of habitat disturbance, would be about double compared to the Alternative One, and the construction period would be longer. Avian mortality from the operation of two utility scale turbines would most likely increase accordingly. The impacts on birds from the two 2.4 kW turbines as discussed in the Proposed Action are expected to be the same.

4.3.4 Avifauna – Bats

As discussed in Section 3, 15 species of bat occur in Virginia; of these, the Indiana bat, gray bat, and Virginia big-eared bats are listed as federally endangered under Section 7 of the ESA. Rafinesque's big-eared bat is listed as State endangered. These protected species live in the western and southern parts of Virginia (see Figure 13) and do not likely inhabit or migrate in the vicinity of WFF.

The central portion of Wallops Island, the eastern portion of Wallops Mainland, and the edges of the Main Base are primarily marsh (dominated by common reed) and maintained lawn with limited amounts of forest habitat. The small amount of forest habitat may limit the amount of local resident bats that use the areas of WFF for seasonal roosting activities. Local resident bats may roost farther inland and mainly utilize the estuarine and marine wetland habitat (marsh vegetation) for foraging purposes. Additionally, non-resident bats may forage in the marshes while passing through on their annual seasonal migration. This situation is illustrated by the peak in activity observed in mid-August during the acoustical monitoring bat survey for this project—call volumes peaked between August 13 and August 16, with the greatest number of call sequences recorded on August 15 (Tetra Tech, 2008).

No Action Alternative

Under the No Action Alternative, no solar panels or wind turbines would be installed and there would be no impacts on bats.

Proposed Action

Because the installation of solar panels at the Main Base would not alter or remove bat habitat, nor would their operation interfere with bat activities, no impacts on bats are anticipated from solar panels under the Proposed Action Alternative.

Little to no data exists on the impacts of residential-scale wind turbines on bat mortality. Therefore, it is assumed that the types of potential impacts (collision or other forms of turbine-induced mortality) discussed below for utility-scale wind turbines would be similar for residential-scale units, however on a substantially smaller scale. To illustrate the difference in size (and potential mortality risk), the rotor-swept area of a residential-scale turbine (approximately 11 square meters [118 square feet]) is approximately 0.19 percent of that of a utility-scale turbine (5,675 square meters [61,085 square feet]). A post-construction monitoring study would be implemented to ground truth the risk profile to bats from the construction and operation of two residential-scale wind turbines. Details of the post-construction study can be found in Chapter 5 of this EA.

Alternative One

Because the installation of solar panels at the Main Base would not alter or remove bat habitat, nor would their operation interfere with bat activities, no impacts on bats are anticipated from solar panels under Alternative One.

Regarding utility-scale turbines, in 2005, the U.S. Government Accountability Office (GAO) completed a report titled *Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife* (GAO, 2005). The GAO report states that there is a "lack of complete and definitive information on the interaction of bats with wind turbines. As previously noted, bats have collided with wind turbines in significant numbers in some parts of the United States, but scientists do not have a complete understanding regarding why these collisions occur."

The GAO report states that bats are known to have the ability to echolocate to avoid collision with objects; however, their collision with wind turbines remains a mystery. The few studies that have been conducted show that most of the bat mortality has occurred during the migratory season (July through September), which suggests that migrating bats are involved in most of the fatalities. In addition, one study showed that lower wind speeds were associated with higher fatality rates. The report also states: "However, experts admit that much remains unknown about why bats are attracted to and killed by turbines and about what conditions increase the chances that bats will be killed."

Although the 2005 GAO report is relatively old in the context of the emerging wind energy field, there are still few studies on bats to date that provide useful information relevant to the proposed wind turbine project at WFF. Several investigations of avian activity at Wallops Island and the surrounding vicinity (e.g., Chincoteague Island, Assateague Island) have been conducted, including a 2004 Phase I Avian Risk Assessment at WFF for installation of a utility-scale wind turbine on Wallops Island (Curry & Kerlinger, 2004), but very little information on bats at WFF or in the surrounding areas has been collected.

Background research on bats conducted in 2008 for an acoustic bat survey at WFF (Appendix B) stated that despite the recent increase in general bat studies resulting from the growing wind-energy industry, most of the questions regarding risk to bats from wind turbines remain unanswered (Tetra Tech, 2008).

Mortality of eight bat species has been documented at utility-scale wind energy facilities in the eastern United States (Kunz et al., 2007a), with most fatalities occurring during what is generally considered the fall migration period. Species documented in the vicinity of utility-scale wind turbines in the eastern United States include little brown myotis, northern myotis, eastern pipistrelle, seminole, hoary, silver-haired, red, and big brown bats. With the exception of eastern pipistrelles, the species affected most frequently—hoary, red, and silver-haired bat—are long-distance migrants, traveling dramatically greater migration distances than other North American species (Cryan, 2003; Cryan et al., 2004; Cryan and Brown, 2007).

Very little is understood about the behavior of migrating bats and the reasons behind their apparent susceptibility to collision with wind turbines. Among the scientific community, a variety of hypotheses have been proposed to explain this ecological concern. Several of these hypotheses suggest attraction of bats to wind turbines due to: (1) creation of linear habitat and/or potential roosts; (2) placement of wind turbines in habitats or areas with conditions favorable for foraging and high insect abundance; and, (3) attraction through auditory cues. Other hypotheses suggest that turbines create an electromagnetic disorientation, or postulate that bats are unable to accurately determine wind turbine blade speed through echolocation. Further, it is unknown whether bats echolocate while migrating, and whether failure to echolocate could cause collision mortality, as bats are clearly able to avoid objects and maneuver rapidly while foraging (Kunz et al., 2007a).

Although there have been some studies in the past several years conducted on bat mortalities and wind turbines, most of these studies have been conducted in landscapes that are different from the WFF coastal environment—such as California, West Virginia, and Kentucky. The most relevant study to the WFF environment to date was conducted in New Jersey in 2007 and 2008 at the Jersey Atlantic Wind, LLC/ACUA utility-scale wind power facility (ACUA, 2009).

The results are preliminary and the numbers of carcasses reported were uncorrected for observer efficiency or scavenger removal. Correcting for these and other biases will likely increase the estimates of collision mortality. Preliminary results of post-construction wildlife monitoring reported that 53 bat carcasses were found in the study area around the utility-scale wind turbines between the start of the project (in August 2007) and December 2008. To date, only two species have been documented: Eastern red bat (*Lasiurus borealis*) and hoary bat (*Lasiurus cinereus*). During the searches, more than three times as many red bats as hoary bats were found and the data suggest that 85 percent of all bat collision events occurred during August and September (ACUA, 2009).

Construction Impacts

Temporary impacts on bats as a result of foraging disruptions caused by the wind turbine construction activities are anticipated. However, these temporary impacts would be minimal because: 1) no known or suspected roosting habitat is being impacted; 2) the total amount of foraging habitat disrupted is minimal; 3) plenty of other foraging areas exist nearby; 4) the construction activities are not being performed at night during bat foraging activities; and 5) the construction period is short term (4 months for the single utility-scale wind turbine). Additionally, the scheduling of construction activities can be done so as to minimize these temporary impacts by disrupting only one migration of the bat's annual migration cycle during the approximate 4-month construction period for the utility-scale wind turbine.

Because Alternative One would result in the removal of 0.17 hectare (0.41 acre) of wetlands, there would be long-term adverse impacts on bats due to the conversion of estuarine and marine wetland habitat to developed land. The long-term impacts on bats would be minimal for the same reasons discussed above under temporary impacts. Implementation of mitigation measures as agreed upon through the JPA consultation process, such as restoration of wetlands on Wallops Mainland, would minimize the impacts from loss of habitat.

Operational Impacts

The relatively low bat mortality at the ACUA five-turbine project over the monitoring period lends strong support to the potential for the installation of a 2.0 MW-turbine at Wallops Island to cause low risk to a similar coastal avian community. However, under Alternative One, there would be long-term adverse impacts on bats from the operation of a utility-scale wind turbine and possibly from operation of the two residential-scale wind turbines.

These impacts fall into two categories: direct and indirect impacts. Direct impacts refer to fatalities resulting from collisions with the wind turbine rotors and monopoles. Indirect impacts refer to disruptions of foraging behavior, breeding activities, and migratory patterns resulting from alterations of landscapes used by bats (Kunz et al., 2007a). Bat fatalities due to the operation of the utility-scale wind turbines are anticipated; however, because the factors that cause bat fatalities are unknown, the number of fatalities and whether they pose a substantial impact is difficult to determine. A few potential reasons bats may be attracted to wind turbines (resulting in fatalities) are listed below; however, the significance of each is unknown (Kunz et al., 2007a):

- Attraction to the wind turbines for roosting purposes during migration
- Attraction to the sounds wind turbines make
- Attraction to the complex electromagnetic fields they produce
- Attraction of the insects, and thus the bats to feed, due to thermal inversions associated with the weather

Research is ongoing regarding wind energy projects and how to avoid and minimize potential impacts, and many BMPs have yet to be developed or proven. The following BMPs could be implemented:

- Post-construction fatality monitoring studies utilizing the most proven up-to-date protocol, which may include visual, acoustic, radio tracking, mist-net, thermal imaging, and other monitoring techniques at the residential-scale and utility-scale turbine sites.
- Modified operation of either scale wind-energy facilities (either changing turbine cut-in speed or temporarily stopping wind turbines) to reduce bat fatalities. Seasonal low wind shutdowns during predictable nights or periods of high bat kills could reduce fatalities considerably. Current studies suggest that bat fatalities occur primarily on low wind nights (BWEC, 2008).
- Ultrasonic deterrents that use high amplitude sonar “jamming” sounds as a potential method of deterring bats from wind turbine facilities (BWEC, 2008).

Alternative Two

The types of impacts on bats as a result of wind turbine construction under Alternative Two would be the same as described for Alternative One; however, there would be more impacts because: 1) the surface area disturbance to install two utility-scale wind turbines would be about double the area required for one; 2) the amount of wetland impacts, 0.36 hectare (0.88 acre), is larger; and 3) there would be two utility-scale turbines that could result in direct impacts on bats. Because the amount of habitat disturbance would be greater and the construction period would be longer (6 months for two utility-scale wind turbines) compared to Alternative One, Alternative Two would have a greater potential for short-term adverse impacts on bats. Additionally, more bats would be directly affected by a second utility-scale wind turbine under Alternative Two compared to the single utility-scale turbine in Alternative One. Potential Mitigation and monitoring described under Alternative One would apply under Alternative Two.

4.3.5 Threatened and Endangered Species

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts on State or federally listed threatened or endangered species or federally designated critical habitat would occur.

Proposed Action

Because the proposed solar panel installation would be in a highly developed area of the Main Base, installation and operation of the solar panels would not disturb or affect State or federally listed species or their habitat.

Although the Visitor Center site for the residential-scale wind turbine is approximately 30 meters (100 feet) of forested habitat, both that area and the guard station at Wallops Mainland are developed sites close to existing infrastructure, vegetation is maintained by mowing, and there is human activity on a daily basis. Neither of these areas contain optimum habitat for State or federally protected species. No protected bat species is known or likely to occur in Accomack County. Because of the proximity of the site to the Main Base airfield, which has suitable habitat for grassland birds, including Henslow's Sparrow, Upland Sandpiper, and Loggerhead Shrike, the remote possibility exists for adverse effects on birds due to collision with turbine blades. However, given the rarity of these species in Virginia, coupled with the small rotor-swept area of the residential-scale turbine and the nearby human disturbances from the Visitor's Center and Route 175, effects are unlikely. Because the residential-scale turbine at the Wallops Island Main Gate would be in a small area of mowed grass adjacent to large fields of row crops, the lack of habitat suggests that collision with turbine blades would be improbable.

Regarding shorebirds, all construction activities would take place outside of the beach and lagoon environments where the Federally-listed species (Piping Plover) and candidate species (Red Knot) would typically stopover and/or feed. No construction is planned for areas within or near known Piping Plover nesting habitat; the residential-scale wind turbine at the Mainland would be installed on the west side of the Mainland, away from preferred habitat and historical Piping Plover nesting sites on Wallops Island. Therefore, installation and operation of the two residential-scale wind turbines would have no effect on the Piping Plover and the Red Knot. The nearest Bald Eagle or Peregrine Falcon nest is several miles away from the proposed turbine sites, and accordingly, impacts would not be expected.

Alternatives One and Two

Table 23 lists the federally endangered, threatened, and candidate species of concern in the vicinity of WFF that may be affected by the utility-scale wind turbines in Alternatives One and Two, and lists NASA's determination of effects under Section 7 of the ESA. Based on the proposed location of the utility-scale wind turbines and the likelihood that Wallops Island may provide suitable habitat for listed avian species, birds may be affected by the utility-scale wind turbines. Impacts from the residential-scale turbines would be the same as under the Proposed Action.

The area of effect for the construction of the wind turbines includes the footprint, access road infrastructure, work space for construction, and staging areas (Figure 6). The operational area of effect of the wind turbines would include the overall height of the tower and top of the blades, the diameter of the blades, and the rotational area of the blades. Effects on State-listed species with respect to the utility-scale wind turbines under Alternatives One and Two are discussed below.

Table 23: Determination of Effects on Federally Listed Threatened and Endangered Species

Scientific Name	Common Name	Determination of Effect
Birds		
Charadrius melodus	Piping Plover	May affect, likely to adversely affect
Calidris canutus	Red Knot	May affect, likely to adversely affect
Mammals		
Sciurus niger cinereus	Delmarva fox squirrel	No effect
Reptiles		
Dermochelys coriaces	leatherback sea turtle	No effect
Eretmochelys imbricate	hawksbill sea turtle	No effect
Lepidechelys kempi	Kemp's ridley sea turtle	No effect
Caretta caretta	loggerhead sea turtle	No effect
Chelonia mydas	green sea turtle	No effect
Invertebrates		
Cicindela dorsalis dorsalis	northeast beach tiger beetle	No effect
Plants		
Amaranthus pumilus	seabeach amaranth	No effect

While a collision with a turbine by a State or federally listed species could occur since these birds exist in the area, the potential impact would be much lower and not substantial compared to more common and abundant species. Listed species were infrequently observed during the surveys, but no carcasses were recovered during the fatality study. The lack of observations of Piping Plover, Wilson's Plover, and Upland Sandpiper during the 12-month survey, combined with the lack of viable habitat in the proposed wind turbine area for these species, indicates the risk to these species should be very low. Only Peregrine Falcons have been documented to nest in the marshes near the proposed turbine sites; however, whether the individuals observed nest in the area or are part of a migratory population is unknown. Bald Eagles and Gull-Billed Terns would not likely nest in the vicinity of the turbines because there is little or no suitable habitat. However, these birds will forage in the general vicinity.

Shorebirds

Gull-Billed Tern

The utility-scale wind turbines would be installed and access roads constructed within potentially suitable habitat for the Gull-Billed Tern. Avian mortality has been documented as an adverse effect of birds colliding with the rotating blades of wind turbines. Nesting habitat would not be affected by the project. Because Gull-Billed Terns may utilize marsh habitat when foraging for crabs, marine worms, clams, and small fish, Alternatives One and Two may result in adverse impacts on the Gull-Billed Tern.

Piping Plover

The utility-scale wind turbines would be installed and access roads constructed on the opposite side of Wallops Island from preferred habitat and historical nesting sites of the Piping Plover, presenting a reduced risk of avian mortality associated with wind turbine collision. Residential-scale wind turbines would not be constructed on Wallops Island. No construction is planned for areas within known Piping Plover nesting habitat. Noise from construction activities would be of short duration and would likely present minor, if any, startle reactions.

Although suitable habitat would not be affected by the project, avian mortality has been documented as an adverse effect of birds colliding with the rotating blades of wind turbines and cannot be discounted. As such, Alternatives One and Two may affect, and are likely to adversely affect, the Piping Plover.

Wilson's Plover

The utility-scale wind turbines would be installed and access roads constructed on the opposite side of the island from the preferred habitat of Wilson's Plover, presenting a reduced risk of avian mortality associated with wind turbine collision. No construction is planned for areas within potential nesting habitats or areas of the beach and lagoon environments within which the species would typically stopover, nest, or feed. Noise from the construction activities would be of short duration and would likely present minor, if any, startle reactions. Alternatives One and Two may result in adverse impacts on the Wilson's Plover.

Red Knot

All construction activities would take place outside of the beach and lagoon environments within which the species would typically stopover or feed. Red Knots would be expected in areas suitable for Piping Plover nesting during similar times of year. Although the Red Knot has been observed in Accomack County, the construction of utility-scale wind turbines would occur on the opposite side of Wallops Island from the Red Knot's preferred habitat of tidal flats and sandy or pebbly beaches (i.e., on the sound side). However, because Red Knots may also utilize marsh habitat and potential effects cannot be discounted, Alternatives One and Two may affect, and are likely to adversely affect, the Red Knot.

Raptors

Peregrine Falcon

The utility-scale wind turbines would be installed and access roads constructed within potentially suitable habitat for the Peregrine Falcon. Avian mortality has been documented as an adverse effect of birds colliding with the rotating blades of wind turbines. Nesting habitat would not be directly affected by the project, as the species nests on artificial structures, including towers and bridges. Several potential nesting sites (wooden hacking towers) are within a 3.2 km (2 mi) radius of the project site. Of these, one tower has been actively used by nesting Peregrines in recent years. Because Peregrine Falcons may utilize marsh habitat while hunting for prey (which could include shorebirds, ducks, and other waterbirds), Alternatives One and Two may result in adverse impacts on the Peregrine Falcon.

Bald Eagle

The active Bald Eagle nest identified in the northern section of Wallops Island is located atop a large loblolly pine tree approximately 6.4 kilometers (4 miles) from each of the residential-scale wind turbine locations, 3.97 kilometers (2.5 miles) away from the northern utility-scale wind turbine, and 3.88 kilometers (2.4 miles) away from the nearest point of the access road for the northern utility-scale wind turbine. The utility-scale wind turbines would be installed and access roads constructed within potentially suitable habitat for this species. However, the proposed access roads would be constructed through habitat that is dominated by common reed and is unlikely to produce substantial amounts of carrion that would attract Bald Eagles. Furthermore, vehicle strikes associated with access roads are unlikely due to the low speed of traffic; the posted speed limit is 25 miles per hour on North Bypass Road, the main paved road adjacent to the utility-scale wind turbine access roads.

The greatest potential impacts from construction and operation of the utility-scale wind turbines on Bald Eagles would be associated with fatal avian collisions with turbine towers or spinning blades, a documented adverse effect. No activity for this project would occur within 200 meters (660 feet) of the known nest site.

Any use of the proposed wind turbine sites would most likely be by transitory Eagles. There are no known roosts in the area directly affected by Alternatives One and Two. Because Bald Eagles may utilize marsh habitat when hunting for fish, birds, and other small mammals, Alternatives One and Two may result in adverse impacts on the Bald Eagle.

Upland Birds

Henslow's Sparrow, Upland Sandpiper, and Loggerhead Shrike

All three species are rare in Virginia and typically found in larger tracts (greater than 40 hectares [100 acres]) of early successional habitat characterized by a ground cover of grasses and forbs interspersed with shrubs or scattered trees. These habitat conditions are common in pastures and meadows (Paxton and Wilson, 2009). Accordingly, the utility-scale wind turbines on Wallops Island would not be installed within or adjacent to prime habitat; however, the remote potential for a collision with a utility-scale turbine blade could exist.

Mammals

Delmarva Fox Squirrel

No effects are anticipated to the Delmarva fox squirrel because the site of the wind turbines lacks essential habitat elements for the species. Their preferred habitat is old-growth loblolly pine forests; deep, deciduous swamps; or backwoods adjacent to pine woods. Alternatives One and Two are anticipated to have no effect on the Delmarva fox squirrel.

Other Wildlife and Plants

Sea Turtles

The wind turbine sites lack essential habitat elements for the loggerhead sea turtle, green sea turtle, leatherback sea turtle, hawksbill sea turtle, and Kemp's ridley sea turtle. Alternatives One and Two are anticipated to have no effects on federally listed sea turtles.

Northeastern Beach Tiger Beetle

The wind turbine sites lack essential habitat elements for the northeast beach tiger beetle because there are no beaches within the project study limits or near the proposed construction activity. No effect on this species is anticipated due to the lack of habitat in the area of the proposed wind turbines.

Seabeach Amaranth

The wind turbine sites lack essential habitat elements for the seabeach amaranth because there are no beaches within the project study limits or near the proposed construction activity. No effect on the seabeach amaranth is anticipated due to the lack of habitat in the area of the proposed wind turbines.

Agency Consultation

NASA prepared a Biological Assessment (BA) with determinations of effects to the federally listed species presented in Table 23 for the Draft EA Proposed Action, which was installation of two 2.0 MW utility-scale wind turbines and up to five 2.4 kW residential-scale wind turbines. The BA was submitted to USFWS with the Draft EA. However, because the Proposed Action has changed, NASA has determined that there would no longer be the potential for effects on federally listed species. Accordingly, NASA is no longer consulting with USFWS pursuant to Section 7 of the ESA.

4.3.6 Essential Fish Habitat

No Action Alternative

Under the No Action Alternative, the Alternative Energy Project would not be implemented; therefore, no impacts on EFH would occur.

Proposed Action

Because the areas identified as potentially suitable for residential-scale wind turbines and solar panels are all located on upland (exclusively at the Main Base for solar panels), no EFH is located near the proposed sites. Therefore, NASA has determined that the construction of the two proposed residential-scale wind turbines and installation and operation of solar panels at the Main Base would have no effect on EFH.

Alternative One

The types of impacts on EFH would be the same as those described for solar panels and residential-scale wind turbines under the Proposed Action Alternative.

Because EFH occurs in the wetlands that would be affected by construction of one utility-scale wind turbine, NASA completed an EFH Checklist to determine what, if any, impacts Alternative One may have on EFH. Based on the EFH Checklist, NASA has determined that Alternative One would result in adverse effects on EFH, but they would not be substantial. Effects on EFH would be offset by compensatory mitigation at WFF's Mainland.

Alternative Two

The types of impacts on EFH would be the same as those described for solar panels and residential-scale wind turbines under the Proposed Action Alternative.

Because EFH occurs in the wetlands that would be affected by the construction of two proposed utility-scale wind turbines, NASA completed an EFH Checklist to determine what, if any, impacts Alternative Two may have on EFH. Based on the EFH Checklist, NASA has determined that Alternative Two would result in adverse effects on EFH, but they would not be substantial. Effects on EFH would be offset by 0.362 hectare (0.895 acre) of compensatory mitigation at WFF's Mainland.

4.4 SOCIAL AND ECONOMIC ENVIRONMENT

4.4.1 Environmental Justice

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, there would be no disproportionately high or adverse impacts on low-income or minority populations.

Proposed Action

NASA complies with EO 12898 by incorporating Environmental Justice into its mission. As a result, NASA has prepared an EJIP (NASA, 1996) that examines whether its programs and actions may disproportionately and adversely affect minority and low-income populations around WFF. Minority and low-income communities are located in Accomack County adjacent to WFF property. The type and intensity of effects on minority or low-income persons from the Proposed Action would the same as those affecting persons of all other ethnicities or income. These effects are discussed in detail in each resource area's section in this EA. In summary, any effects on minority or low-income populations would not be disproportionately high.

To ensure that members of the public are involved in planning for this project, NASA published Notices of Availability of the Draft EA in two local newspapers, one of which is a free weekly publication. Additionally, NASA has posted copies of the Draft and Final EA on the Internet. Additionally, to increase public awareness of the project and update the public on the project's status, NASA held a public meeting at the WFF Visitor Center on April 1, 2010. The announcement of the public meeting was published in the same newspapers as the Draft EA and on the Internet. Therefore, no impacts are predicted for environmental justice populations.

Alternatives One and Two

The environmental justice impacts for Alternatives One and Two would be the same as described under the Proposed Action. Visual impacts from the utility-scale wind turbines on all populations in the communities surrounding WFF would be greater, however distributed equally among residents and are discussed more in Section 4.4.4, Aesthetics. Therefore, no impacts are expected for populations requiring environmental justice consideration.

4.4.2 Cultural Resources

Section 106 of the NHPA requires that Federal agencies take into consideration the effects of their undertakings on historic properties and to allow the ACHP the opportunity to comment on such undertakings. As defined in the Act, "historic properties" are one of five resource types—buildings, structures, objects, 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 comply 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 by an undertaking.

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 Section 3.3.2, serves as the baseline for the identification of the aboveground historic properties at WFF, while the archaeological sensitivity model presented in the CRA (NASA, 2003a) serves as the baseline for identifying potential archaeological resources. Together these studies, discussed in the Integrated Cultural Resources Management Plan (ICRMP) for WFF, likely account for many of the historic properties present at WFF, and as such, allow an assessment of the potential for an undertaking to affect historic properties.

In December 2009, NASA WFF initiated Section 106 consultation with VDHR for the Alternative Energy Project. To facilitate the consultation, NASA WFF submitted to VDHR the *National Historic Preservation Act Section 106 Assessment of Alternative Energy Project,* a Section 106 effects analysis of the utility-scale wind turbine component of the Alternative Energy Project, prepared by URS, on the grounds that this was the component of the project most likely to have adverse effects on historic properties (NASA, 2009b).

Since initiation of the Section 106 process, NASA has revised its alternatives so that construction of utility-scale wind turbines is no longer the Proposed Action, and all alternatives now include a residential-scale wind turbine component. NASA has completed consultation with the VDHR regarding installation of the residential-scale wind turbines.

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, there would be no impacts on cultural resources.

Proposed Action

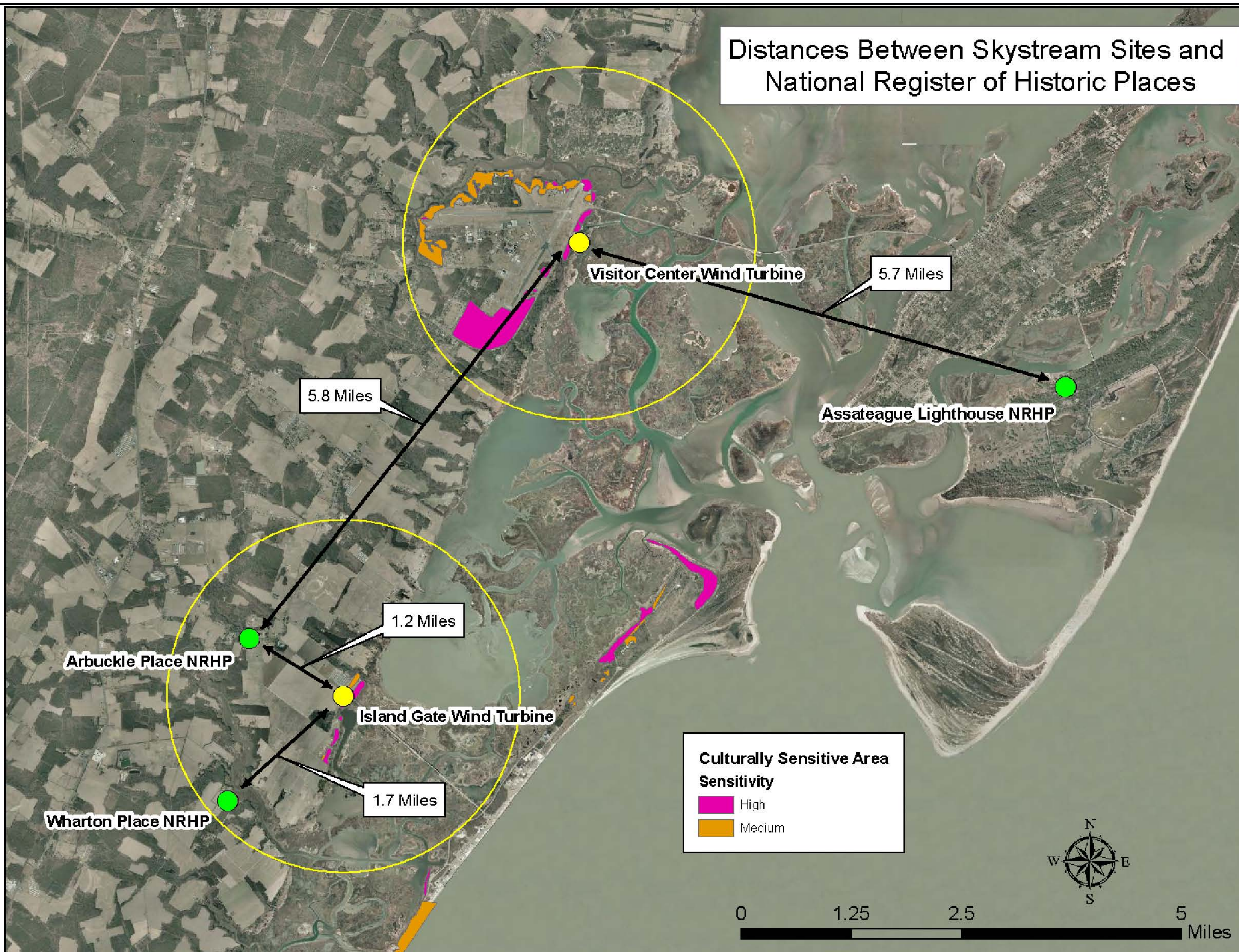
Aboveground Resources

Solar panels: Since the publishing the Draft EA, NASA has narrowed down the potential sites for the solar arrays by eliminating such factors as the presence of existing Navy and Coast Guard housing, NASA's active runways, and the potential effect to historic properties, as well as the need to locate the panels in open areas that would provide the largest benefit from the sun. Based upon the determinations of eligibility in the *Historic Resources Survey and Eligibility Report for Wallops Flight Facility, Accomack County, Virginia* (NASA, 2004), structures on the Main Base were found to be eligible for listing in the NRHP. Because all solar arrays would be located in areas on the Main Base, the installation of solar panels would have no adverse effect on aboveground historic properties within the boundaries of the WFF property. The Wallops Main Base is characterized by numerous buildings, towers, and antennas from various periods of construction. Given this context, the construction of the solar arrays is unlikely to have an adverse indirect visual effect to historic properties outside of the WFF Main.

Residential-scale turbines: One of the residential-scale wind turbines is proposed to be installed near the WFF Visitor Center, and a second residential-scale wind turbine is proposed near the entrance gate/security guard station at the Mainland (Figure 4). The residential-scale wind turbines would be installed with a setback distance of 30 meters (100 feet) from existing towers, buildings, and trees. The finished subsurface footprint of each residential-scale wind turbine would be approximately 1 meter (3 feet) in diameter, with a foundation depth of 6 meters (20 feet). No transformers or interconnection switchgear would be needed. Standard home electric wiring (10-gauge) would be buried in a trench from the wind turbine to the desired facility.

NASA determined the above-ground APE to be a 3.2-kilometer (2-mile) radius for each residential-scale turbine to account for potential visual effects on historic properties, if present (Figure 20). NASA identified two historic properties within the APE for the Mainland wind turbine. Arbuckle Place, which is individually listed in the NRHP, is located approximately 1.9 kilometers (1.2 miles) northwest of the Mainland wind turbine. Wharton Place, which is also individually listed in the NRHP, is located approximately 2.7 kilometers (1.7 miles) southwest of the Mainland wind turbine. No previously identified historic properties are known to exist within the APE of the Visitor Center wind turbine.

Given the nature of the WFF facility, it is not likely that the residential-scale wind turbines would have an indirect adverse effect on unidentified historic properties located within the boundaries of WFF, should they be present. As discussed in Section 3.3.2, the resources within WFF—with the exception of the Wallops Lifesaving Station and Observation Tower, which are not in the APE for the residential-scale turbines—are all associated with the U.S. Navy, National Advisory Committee for Aeronautics, or NASA development of the area after 1942 and are utilitarian in nature. WFF is characterized by numerous towers, test stands, and antennas from various periods of construction.



Title:	APE Residential-Scale Turbines
	URS Proj No: 15300762
	Figure: 20
Client : NASA	
Alternative Energy Project	

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Determination: Upon consideration of the above, NASA has determined that the Proposed Action would have no adverse effect on aboveground historic properties.

Archaeological Resources

Solar panels:
NASA used the CRA to narrow down potential sites for the installation of the solar arrays by eliminating areas with increased sensitivity for the presence of archaeological resources.

Residential-scale turbines: The proposed location for the Mainland residential-scale wind turbine is in an area identified as low archaeological sensitivity (Figure 21). The proposed Visitor Center wind turbine is located within an area of high archeological sensitivity as identified in the 2003 CRA (NASA, 2003a; Figure 22).

Determination:

As the Visitor Center turbine would be located with an area of elevated archaeological sensitivity, NASA would employ the following mitigation measures:

- Hand digging of the foundations for the residential scale turbine at the Visitor Center would be overseen by a professional archaeologist who would stop work immediately if artifacts of archaeological or historic significance are identified.
- The access road to the residential scale turbine at the Visitor Center would be constructed to the minimum width possible. No ground disturbance would be required as NASA would spread a gravel base or crusher run over existing grade to form the access road.

With the inclusion of the above mitigation measures, it is determined that the Proposed Action would have no effect on archaeological resources.

Alternative One

Aboveground Resources

Solar panels: Based on the analysis of impacts from the installation of solar panels (described under the Proposed Action), NASA determined that the installation of solar panels at the Main Base would not have an adverse effect on aboveground historic properties, either identified or yet-to-be identified, within or outside the boundaries of the WFF property.

Residential-scale turbines: Based on the analysis of impacts from the construction of the two residential-scale turbines (described under the Proposed Action), NASA has determined that the proposed residential-scale turbines would have no adverse effect on historic properties within the APE. Given the nature of the WFF facility, it is not likely that the residential-scale wind turbines would have an indirect adverse effect on as-yet unidentified historic properties within or outside the boundaries of WFF, if present.

Utility-scale turbines: Because specific guidelines for Section 106 review of wind turbine projects have not yet been developed in Virginia, the VDHR Section 106 guidance on cell towers was used to determine the APE. This guidance recommends an APE for cell towers of 60 meters (200 feet) or more in height that extends 3.2 kilometers (2 miles) from the cell tower to account primarily for indirect visual effects. Because wind turbines are similar to cell towers in terms of their potential for visual impact, this 3.2-kilometer (2-mile) APE was used to determine effects on historic properties for the utility-scale wind turbine.

No identified historic properties within the APE would be directly affected by construction of a utility-scale turbine under Alternative One. The utility-scale turbine would have indirect visual effects on the two NRHP-eligible resources identified within the APE—the Wallops Coast Guard Lifesaving Station and its associated Coast Guard Observation Tower (Figure 23).

A digital rendering of the projected viewshed from the historic properties toward the utility-scale turbine indicates that, although the wind turbine would be approximately 2.7 kilometers (1.7 miles) away, it would still be partially visible from the Wallops Coast Guard Lifesaving Station. However, the visual impact would be minimal. Since the 1940s, the setting and feeling of the Wallops Coast Guard Lifesaving Station and Observation Tower have been compromised by the construction of numerous utilitarian buildings and structures associated with the Navy, the National Advisory Committee for Aeronautics, and NASA development. Among these is the Navy's ASR-8 Radar, a 24-meter (79-foot) structure located immediately adjacent to the Wallops Coast Guard Lifesaving Station. Given this context, the construction of the utility-scale turbine 2.7 kilometers (1.7 miles) from the Wallops Coast Guard Lifesaving Station and Observation Tower would not have an adverse effect on these historic properties.

Eighty unevaluated resources exist within the APE, 13 of which are over 50 years of age. Some of these 13 may be found to be eligible for listing in the NRHP once they are evaluated; if so, construction of the proposed wind turbine would have an indirect visual effect on them. However, these unevaluated resources are also associated with the Navy, the National Advisory Committee for Aeronautics, or the NASA development of the area after 1942 and are utilitarian in nature. The portions of the APE in which the built resources are located are currently characterized by numerous towers, test stands, and antennae from various periods of construction. Given this context, the construction of the utility-scale turbine is not likely to have an adverse effect on the setting or feeling of any yet-to-be identified NRHP-eligible resources, if present, in the APE.

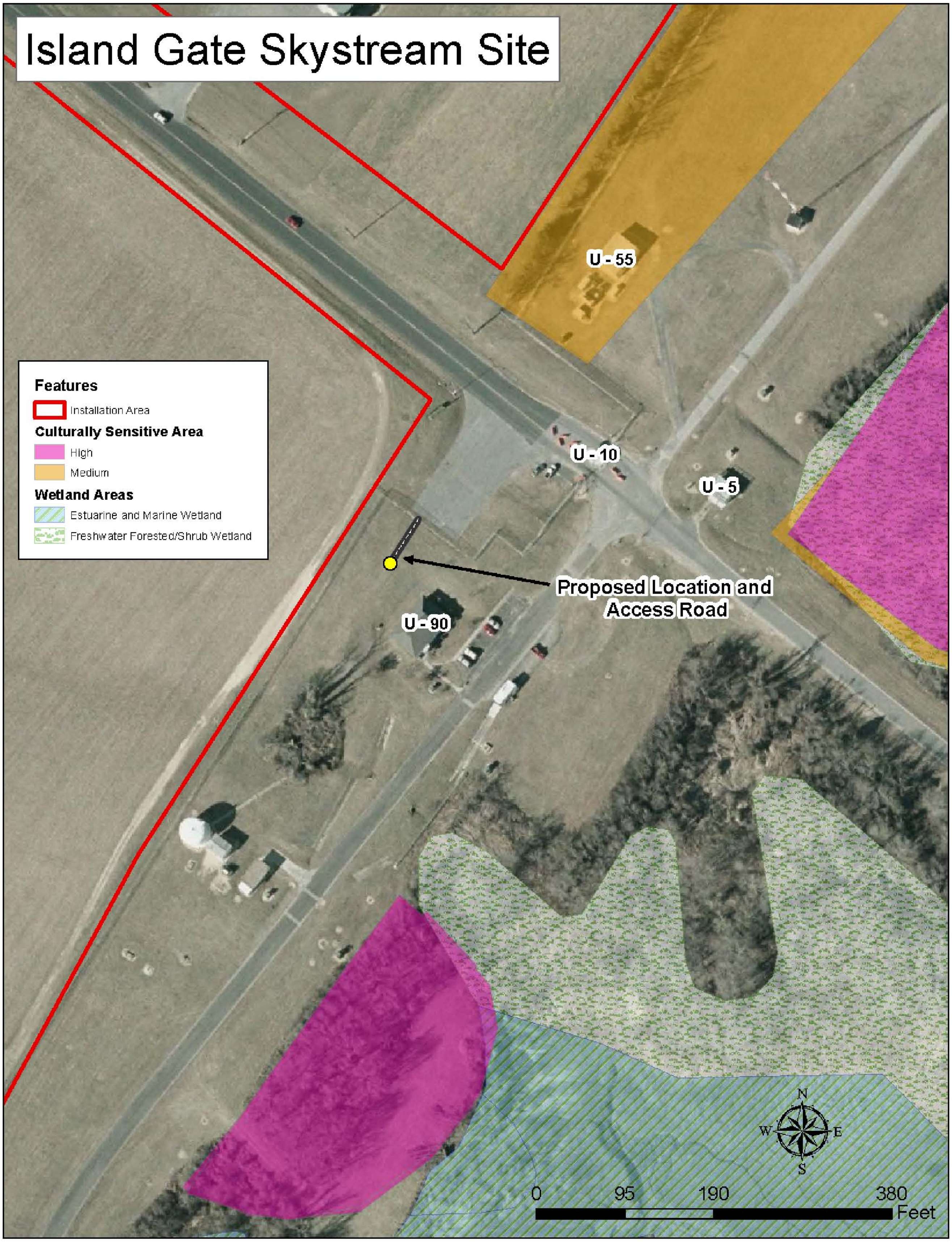
The utility-scale wind turbine component of Alternative One is anticipated to have no adverse effect on historic properties outside of WFF, should they be present, given the nature of the existing viewshed to WFF. The majority of the facilities at WFF exhibit rooftop radar antennas, beacons, HVAC systems, cooling towers, and other industrial equipment, and the presence at WFF of numerous towers, including elevated water storage tanks, boresight, meteorological, and radio equipment platforms.

Determination: NASA has determined that the Alternative One would have no adverse effect on aboveground historic properties.

Archaeological Resources

Solar panels and Residential-scale turbines. Impacts to archaeological resources from solar panels and residential-scale wind turbines under Alternative One would be identical to those under the Proposed Action.

Utility-scale turbines. According to the mapping produced for the 2003 CRA, the proposed location for the utility-scale turbine on Wallops Island is in an area determined to be low archaeological sensitivity.



Title: Archaeological Sensitive Area - Mainland Gate Turbine

URS Proj No: 15300762

Figure: 21

Client : NASA

Alternative Energy Project

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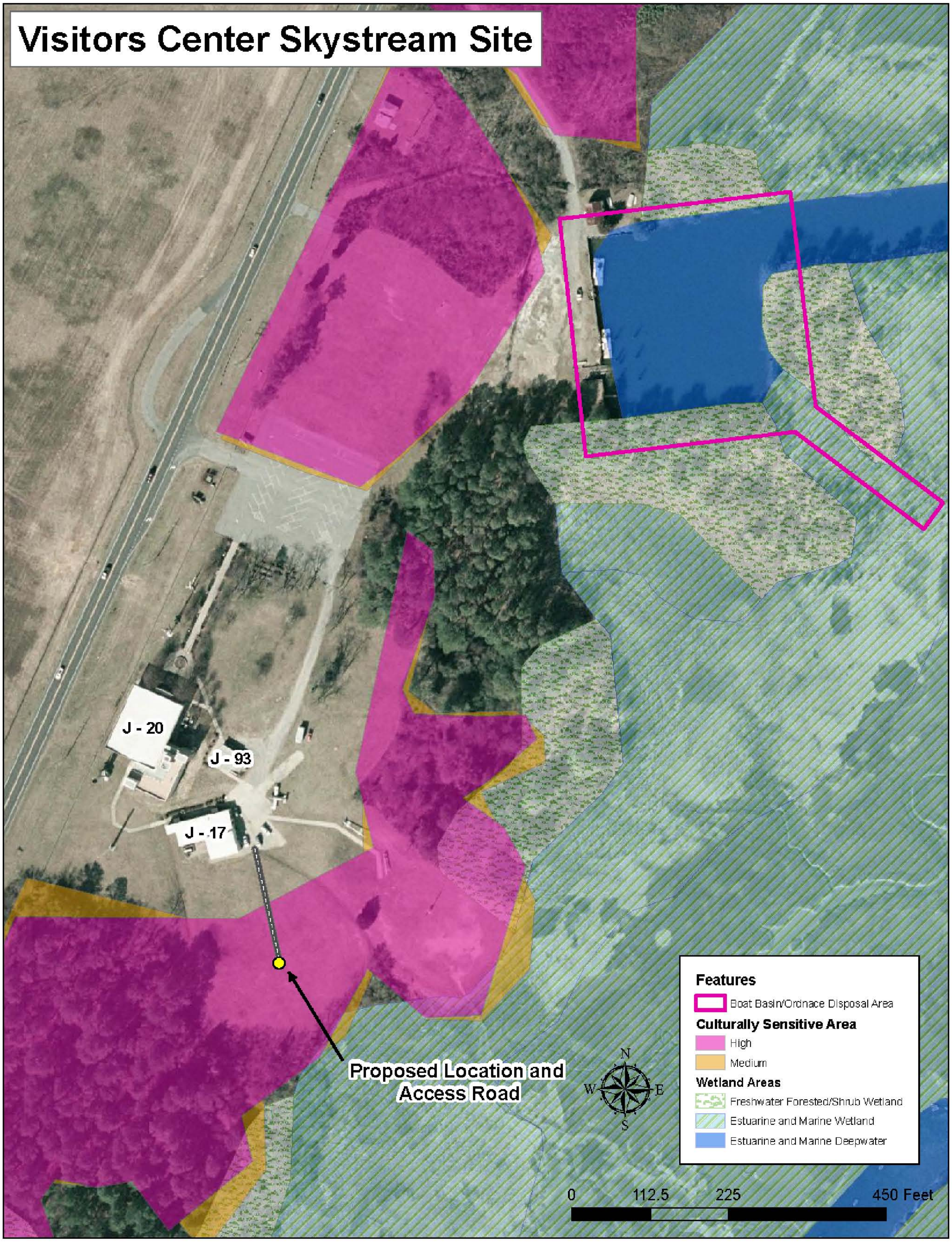

Title: Archaeological Sensitive Area - Visitor Center Turbine

URS Proj No: 15300762

Figure: 22

Client : NASA

Alternative Energy Project

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303
V-065
Coast Guard
Lifesaving Station
V-070
Coast Guard
Observation Tower
V-80
V-65
60 0 60 120
Feet
Utility-Scale Turbine Location
Above-Ground National Register-eligible Resource Location
2-Mile APE for Each Wind Turbine
APE for Alternative One (Wind Turbines)
WFF Boundary
1,500 0 1,500 3,000
Feet
N
Title: National Register-Eligible Resource Locations
NASA
URS Proj No: 15300762
Figure: 23
Client : NASA
Alternative Energy Project

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Determination: To avoid adverse effects to archaeological historic properties, should they be present, and in response to VDHR's request, NASA would ensure that archaeological monitoring occurs in areas of moderate and high probability including the WFF Visitor Center location.

Alternative Two

Aboveground Resources

Residential-scale turbines: Based on the analysis of impacts from the construction of the two residential-scale turbines (described under the Proposed Action), NASA has determined that the proposed residential-scale turbines will have no adverse effect on historic properties within or outside the APE.

Utility-scale turbines: Based on the analysis of effects from the construction of the utility-scale turbines (described under Alternative One), NASA determined that the construction of two utility-scale turbines on Wallops Island is not likely to have an adverse effect on aboveground historic properties within the 3.2-kilometer (2-mile) APE.

Determination: NASA has determined that the Alternative One would have no adverse effect on aboveground historic properties.

Archaeological Resources

Residential-scale turbines: The proposed location for the Mainland residential-scale wind turbine is in an area identified as low archaeological sensitivity (Figure 21). The proposed Visitor Center wind turbine is located within an area of high archeological sensitivity as identified in the 2003 CRA (NASA, 2003a; Figure 22). VDHR recommended archeological monitoring during construction in areas of archaeological sensitivity in a letter to NASA dated March 2, 2011 (Appendix D).

Utility-scale turbines: According to the mapping produced for the 2003 CRA, the proposed location for the utility-scale turbine on Wallops Island is in an area determined to be low archaeological sensitivity.

Determination: To avoid adverse effects to archaeological historic properties, should they be present, and in response to VDHR's request, NASA would ensure that archaeological monitoring occurs in areas of moderate and high probability including the WFF Visitor Center location.

Section 106 Consultation

NASA determined that the proposed construction of two utility-scale turbines on Wallops Island or the installation of solar panels at the Main Base would not have an adverse effect on aboveground historic properties within the 3.2-kilometer (2-mile) APE or to archaeological resources within the area of ground disturbance associated with those actions.

In December 2009, NASA submitted the *Section 106 Assessment of Alternative Energy Project, Wallops Flight Facility, Wallops Island, Virginia* (NASA, 2009b) report along with a determination letter requesting concurrence to VDHR. In a letter dated January 25, 2010, VDHR stated that they were unable to make an informed decision concerning the effects of the proposed undertaking (Appendix D). VDHR stated that they did not have enough information to adequately evaluate the effects of the undertaking, specifically the lack of exact location and configuration of the solar panel component. VDHR requested NASA to seek comments of the

National Park Service (NPS), specifically the Assateague Island National Seashore. No comments were received.

On March 1, 2010, WFF sent the Draft EA to VDHR, which proposed up to 5 residential-scale wind turbines under all alternatives (2 of them in the locations proposed under all alternatives in this Final EA, 3 locations undetermined at the time of the Draft EA). In the Draft EA, NASA determined that all 5 proposed residential-scale turbines would have no adverse effect on historic properties, and requested VDHR's review and comment. In a letter dated March 31, 2010, VDHR responded to the Draft EA and stated that they were unable to make an informed decision concerning all aspects of the proposed undertaking (Appendix D). VDHR concurred with NASA's determination that the proposed utility-scale wind turbines will have no direct effects to historic properties. VDHR also concurred with NASA's determination that the proposed utility-scale wind turbines will have an indirect effect on the NRHP-eligible Coast Guard Life Saving Station and associated Observation Tower. VDHR requested a detailed description of what alternatives NASA has explored to avoid and/or minimize the effects to aboveground historic properties. VDHR also noted that the APE for the proposed residential-scale wind turbines was not identified and recommended continued consultation to identify and assess the effects of the residential-scale wind turbine component of the proposed undertaking. VDHR also requested information on NASA's consultation efforts with Native American Tribes.

NASA responded to VDHR in a letter dated April 16, 2010, and with an APE map for the two residential-scale turbines proposed in this Final EA, as requested. NASA further responded that there were no federally recognized Indian Tribes in Virginia, nor did the Virginia Council of Indians (VCI) identify any state-recognized Indian Tribes in Accomack County, and that no consultation had been initiated with Native Americans with respect to this undertaking. VDHR responded in a letter dated May 12, 2010, and stated that they were unable to make an informed decision concerning the effects of the proposed residential-scale wind turbine component of the undertaking. VDHR requested that "a professional archaeologist monitor the hand digging in the culturally sensitive areas," (Appendix D). VDHR also requested that NASA contact the VCI directly to identify Indian Tribes regarding the undertaking. NASA contacted VCI by email on May 26, 2010, requesting Native American Tribes with interest in the Eastern Shore of Virginia, specifically WFF and the surrounding area. VCI responded by email on May 27, 2010, and stated that at this time no concerns have been raised by any Virginia tribe regarding viewshed disturbance by wind turbines, either offshore or on land.

NASA responded in a letter dated January 31, 2011, informing VDHR of the results of the consultation with VCI and that NASA had determined potential locations for the solar arrays, reduced the number of residential-scale turbines to 2, and identified sites for these 2 turbines. The letter stated that potential sites for the solar arrays were narrowed down by eliminating such factors as the presence of existing Navy and Coast Guard housing, NASA's active runways, and the potential effect to historic properties, as well as the need to locate the panels in open areas that would provide the largest benefit from the sun. NASA requested a conclusion to the Section 106 consultation with VDHR regarding the Alternative Energy Project and requested concurrence with NASA's determination of no-adverse effect to historic properties concerning this future undertaking. VDHR responded in a letter on March 2, 2011, concurring with NASA's determination of no adverse effect to historic properties provided that NASA WFF ensured that the following conditions are met:

- Hand digging of the foundations for the residential scale turbine at the Visitor Center overseen by a certified archaeologist who would stop work immediately if artifacts of archaeological or historic significance are identified.
- The access road to the residential scale turbine at the Visitor Center would be constructed to the minimum width possible. No ground disturbance would be required as NASA would spread a gravel base or crusher run over existing grade to form the access road.

4.4.3 Transportation

No Action Alternative

Under the No Action Alternative, implementation of the Alternative Energy Project would not occur; therefore, no impacts on transportation would occur.

Proposed Action

Negligible temporary impacts on traffic flow would occur during delivery of the solar panels and during construction activities due to an increase in the volume of construction-related traffic at roads in the immediate vicinity of WFF. Traffic lanes within WFF may be temporarily closed or rerouted during delivery and construction. Delivery and installation of the residential-scale turbines would likely have no measurable effect on transportation. NASA would coordinate all transportation activities that would have the potential to affect public roads, including closures, traffic control, safety issues, etc. with Accomack County and the Virginia Department of Transportation (DOT) Accomack Residency Office.

Alternative One

The transportation impacts for installation of solar panels and residential-scale wind turbines under Alternative One are the same as those described under the Proposed Action. NASA would coordinate all transportation activities that would have the potential to affect public roads, including closures, traffic control, safety issues, etc. with Accomack County and the Virginia DOT Accomack Residency Office.

Temporary impacts on traffic flow would occur during construction of the utility-scale wind turbine due to an increase in the volume of construction-related traffic at roads in the immediate vicinity of Wallops Island and the transportation of wind turbine parts and equipment. Traffic lanes may be temporarily closed or rerouted during construction, and construction equipment and staging could interfere with typical vehicle flow. NASA 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 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

The utility-scale wind turbine's tower and blades would be delivered to WFF via truck over public roads and would be characterized as an oversize load by the U.S. DOT. The transport of an oversize load would require a permit from the Virginia Department of Motor Vehicles. Oversize items that are trucked to Wallops Island (i.e., via Route 679 and 803) may require temporary closure of roadways. The closure would likely last a maximum of 2 hours and would occur in the middle of the night if possible for minimal impact on traffic. NASA would coordinate the closure with Accomack County, the Virginia State Police, and the Virginia DOT Accomack Residency Office.

Alternative Two

Delivery and construction of the two residential-scale wind turbines would not result in impacts on traffic. Impacts on traffic and the mitigation measures outlined for construction of the utility-scale wind turbines would be the same as described under Alternative One. However, impacts would be greater due to there being two turbines instead of one. NASA would coordinate all transportation activities that would have the potential to affect public roads, including closures, traffic control, safety issues, etc. with Accomack County and the Virginia DOT Accomack Residency Office.

4.4.4 Aesthetics

No Action Alternative

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

Proposed Action

Installation of solar panels would result in long-term changes to the viewshed at the Main Base. Visual impacts would affect WFF employees and visitors at the Main Base, but the solar panels would not be visible to the public in the area. The solar panels would not substantially alter the characteristics of the viewshed at the Main Base because they would be installed adjacent to highly developed areas (roads, buildings, towers, lighting, etc.). Although aesthetics are subjective, because the Main Base is a highly industrialized setting with numerous antenna arrays and other infrastructure, solar panels should not have a negative impact on the viewshed.

The landscape surrounding the proposed residential-scale turbine sites already contains infrastructure such as buildings, roads, power lines, towers, and artificial lighting. Installation of the residential-scale turbines at the WFF Visitor Center or the entrance gate to the Mainland would not substantially alter the viewshed at either location. The turbines would be painted white to blend with the sky to reduce visual impacts.

Because aesthetics are dependent on people's perceptions of whether the wind turbines are a negative or positive impact on the landscape, NASA would provide educational tours about wind energy, and educational information on the benefits of the residential-scale wind turbines via newsletters and public announcements to the surrounding communities. NASA would likely establish a public viewing area at the WFF Visitor Center, and the wind turbine there could potentially become a popular public attraction.

Operation of the residential-scale wind turbines would create intermittent shadows cast by the moving blades. For the residential-scale wind turbines, shadow flickering would occur within about 75 meters (250 feet) of the wind turbines (based on methodology from Meridian Energy, 2005). However, due to overcast days when no shadow flickering would occur and the sun angle changing the location of the shadow flicker throughout the day, the timing, position, and size of the shadow flickering will change constantly. The amount of shadow flicker would depend on the angle in which the sun hits the turbine blades. Shadow flickering would be seen by people at nearby facilities, including the guard station at the entrance gate to the Mainland and at the WFF Visitor Center.

Alternative One

The aesthetic impacts from the solar panels for Alternative One would be the same as those described under the Proposed Action; however, there would be fewer impacts because half the number of solar panels would be used as the Proposed Action.

In 2008, NASA conducted an aesthetics study to determine what impacts, if any, the construction of one or two wind turbines on Wallops Island would have on the local viewshed. Figure 24 shows the locations of five vantage points that were used in the study. The vantage points were chosen because they represented viewsheds of the turbines from rural residences west of Wallops Island, from the town of Chincoteague to the north, and from Assateague Island National Seashore northeast of Wallops Island.

Because CNWR and Assateague Island National Seashore are visited by thousands of people each year to enjoy their undeveloped nature and seaside views, these two areas would be key vantage points from a public perspective when looking back toward the viewshed that includes WFF. The character of WFF and the surrounding region is generally considered highly aesthetic by those that come to participate in recreational, cultural, and other leisure activities. The five viewshed vantage points are summarized in Table 24 below.

Table 24: Aesthetics Analysis Vantage Points

Vantage Point No.	Description of Vantage Point	Vantage Point Location	Distance and Direction from Proposed Wind Turbine Site
1	Harbor of Refuge	Southern tip of Chincoteague Island	7.7 kilometers (4.8 miles) northeast
2	Queen Sound Boat Ramp	Between Mainland and Chincoteague Island	10 kilometers (6.2 miles) northeast
3	Watts Bay Residential Subdivision	Mainland	6.3 kilometers (3.9 miles) north
4	Mount Wharton Residential Subdivision	Mainland	3.1 kilometers (1.9 miles) northwest
5	Arbuckle Neck Road	Mainland	3.7 kilometers (2.3 miles) southwest

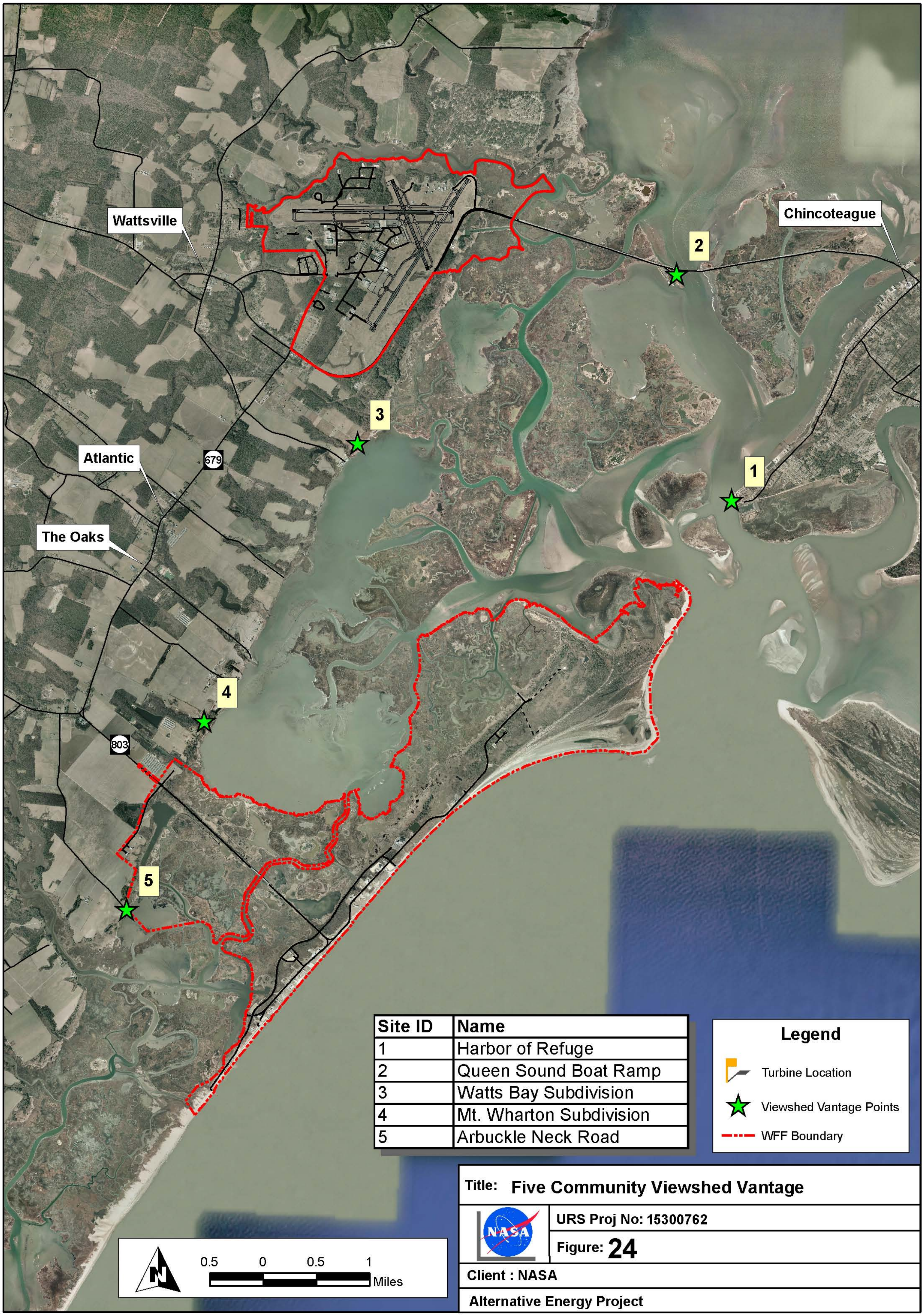
Digital photographs taken from each vantage point were modified to include a simulation of the two wind turbines in their proposed location on Wallops Island (Appendix E). Photograph 8 below shows an example of the viewshed from Arbuckle Neck Road, including the simulation of the wind turbines, which is the same view as shown without wind turbines in Photograph 3. The simulated wind turbines in Photographs 1, 2, and 3 of Appendix E are barely visible; therefore, the wind turbine(s) would not result in a substantial change to the viewshed from recreational areas along Chincoteague Island, Assateague Island, and Watts Bay Subdivision.

As shown by the simulation of Photographs 4 and 5 in Appendix E, the wind turbine(s) would be visible from the closest residential community, Mount Wharton subdivision, and from Arbuckle Neck Road (also shown in Photograph 8 below).

As shown in all the simulated photographs, the landscape surrounding the proposed turbine site already contains radio towers, the U.S. Navy V-10/V-20 Complex, and the bridge that links Wallops Mainland with Wallops Island. The turbines would be painted white to reduce visual impacts. Because of the height of the turbines (approximately 120 meters [395 feet] at the top of the blade), it is not possible to site them in a location or manner completely invisible to the public and WFF workers and visitors.

Photograph 8: Simulated utility-scale wind turbine viewshed from a vantage point located approximately 3.7 kilometers (2.3 miles) southwest of the bridge that links Wallops Mainland to Wallops Island looking northeast toward the bridge.

Because aesthetics are dependent on people's perceptions of whether the wind turbines are a negative or positive impact on the landscape, NASA would provide educational information to the surrounding communities regarding the benefits of the wind turbines via newsletters and public announcements. In addition, the wind turbines could potentially become a popular public attraction, which is what happened at the ACUA wind farm. Although the ACUA wind farm is at an industrial facility and therefore not open to the public, ACUA established a public viewing area and a frequently visited Web site that shows the wind turbines via webcam 24 hours a day. NASA would likely establish a public viewing area at the WFF Visitor Center and give pre-arranged educational tours for outreach and education about wind energy.



Site ID	Name
1	Harbor of Refuge
2	Queen Sound Boat Ramp
3	Watts Bay Subdivision
4	Mt. Wharton Subdivision
5	Arbuckle Neck Road

Title: **Five Community Viewshed Vantage**

URS Proj No: 15300762

Figure: 24

Client : NASA

Alternative Energy Project

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As discussed under the Proposed Action Alternative, operation of wind turbines would create a shadow flickering effect. Based on methodology that uses 10 times the rotor diameter for estimating the maximum distance of shadow flicker (Meridian Energy, 2005), NASA estimates that shadow flickering would occur at a distance of no more than about 850 meters (2,800 feet) away from the utility-scale wind turbine. For the residential-scale wind turbines, shadow flickering would occur no more than about 75 meters (250 feet) from the wind turbines.

The amount of shadow flicker would depend on the angle in which the sun hits the turbine blades. Shadow flickering would be seen by people at nearby facilities, including the U.S. Navy V-10/V-20 Complex for the utility-scale turbine, and the WFF Visitor Center and guard station for the residential-scale wind turbines. Because some people could be bothered by the flickering effect, the wind turbines may result in long-term adverse impacts within the shadow of the wind turbines; however, these effects would be most likely to bother people who occupy these facilities long-term, such as permanent employees.

Another operational impact would be the potential distraction from the lights on the utility scale wind turbine. FAA regulations stipulate that all wind turbines over 60 meters (200 feet) include lights to warn pilots of their presence. A single red flashing light-emitting diode (LED) light would be placed on top of the wind turbine. Since all structures at Wallops over 60 meters (200 feet) include FAA lighting, this would not result in any noticeable changes to the lighting that already exists on Wallops Island. Due to the distance of the surrounding communities, the lights on the wind turbine would be nearly impossible to see from residences and businesses, and therefore would not result in visual impacts on the public. NASA's policies for lighting of facilities at WFF are based on FAA, OSHA, and NASA health and safety requirements. To the extent possible, NASA strives to reduce light pollution while still meeting laws and safety regulations regarding lighting.

Alternative Two

The aesthetic impacts from the residential-scale wind turbines under Alternative Two would be to the same as those described under the Proposed Action. The types of aesthetic impacts from the utility-scale wind turbine described under Alternative One would be the same for Alternative Two; however, with two utility-scale wind turbines instead of one, the impacts would be greater. NASA would likely establish a public viewing area at the WFF Visitor Center for the utility-scale wind turbines on Wallops Island, and would give pre-arranged educational tours for outreach and education about wind energy.

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). Sections 4.2 – 4.4 of this EA describe the potential impacts from the Proposed Action evaluated for the Alternative Energy Project. Past, present, and reasonably foreseeable future actions that may result in cumulative effects when combined with this Proposed Action are described below in Section 4.7.1.

Cumulative effects can result from actions that overlap spatially and temporally. The spatial extent of each analysis is presented within each resource area. The temporal scope of all analyses begins at the point at which the WFF landmasses were developed, which is generally the mid-

1940s or 1950s, depending on which landmass is under consideration. Future activities are defined as those that may be reasonably foreseen to affect resources of concern during the 25-year service life of the solar panels and residential-scale turbines.

4.5.1 Past and Present Activities

4.5.1.1 Wallops Main Base

From colonization to World War II, the area of the Main Base had been farm and woodlands. During World War II, the Navy took over the property and established the Chincoteague Naval Auxiliary Air Station, primarily as a training field for naval aviation. NASA acquired the facility in June 1959, and has expanded facilities since then. Currently, the Main Base comprises 720 hectares (1,800 acres), approximately 240 hectares (600 acres) of which are impervious surfaces covered by offices; laboratories; radar antennas, maintenance and service facilities; an airport with air traffic control facilities, hangars, runways, aircraft maintenance, and ground support buildings; and tenant administration buildings and housing (NASA, 2005). Roads, parking areas, airfield, and the water and sewage treatment plants, are interconnected with storm drainage systems. Over time, all of these activities have impacted the topography, drainage, land use, wetlands, surface water, and biological resources of the Main Base area.

Current activities at the Main Base can be generally classified as administrative in nature with the exception of those functions that directly support WFF’s active research airfield. WFF’s three runways regularly support military training exercises, almost on a daily basis, when the runways are not reserved for NASA flights.

4.5.1.2 Wallops Research Park

Located on over 80 hectares (200 acres) of land just west of the WFF Main base, the Wallops Research Park (WRP) would consist of a multi-use development created for non-retail commercial, government space, science research, educational facilities, and public recreation areas. The goal of the WRP project is to create an integrated business park for aerospace research and development programs, scientific research, commercial space industries, and educational centers. Development of the WRP is taking place over an expected 20-year period; limited development (one building built on several acres) has occurred thus far, with the majority of the Proposed Action not yet constructed. Please refer to the 2008 WRP EA for more information (NASA, 2008b).

4.5.1.3 Residential Developments

Since the mid-1940s, when the WFF Main Base began serving as a Naval Air Station, small clusters of private residences and businesses have been constructed. The majority of construction has taken place west of the Main Base and is predominately single-family home sites. A GIS-based analysis of Accomack County tax parcel data indicates that approximately 250 buildable lots are located within a 1.5 km (0.9 mi) westerly radius of the WFF main entrance. The most notable development to the north is Trails End, a 2,500-lot year round campground located on approximately 300 ha (750 ac).

At the present time, several residential developments are being constructed within Accomack County. The closest development to the proposed Alternative Energy Project is an 81 hectare

(201 acre), 99-lot subdivision called Olde Mill Pointe that is located on the north side of Little Mosquito Creek to the northwest of the Main Base.

4.5.1.4 Wallops Mainland

Prior to NASA's presence, which began in the early 1960s, Wallops Mainland primarily consisted of open farm fields and woodlands. As WFF became a more active aerospace test site, radar antennas, cameras, transmitter systems, and associated buildings were constructed in upland areas. The eastern portion of the Mainland also provided a substantial amount of fill material for the Wallops Island causeway. Over the approximately 50 years that NASA has occupied the Mainland, the land uses have not changed substantially. Current activities primarily consist of radio frequency system operation and maintenance. The only land-based entrance for accessing the Mainland and Wallops Island landmasses is located here.

4.5.1.5 Wallops Island

Activities have occurred at WFF since development of Wallops Island by the government in the 1930s. The majority of WFF has been subject to continuous change and development since its founding in the 1940s. Changes to the island include frequent construction, infrastructure upgrades, and removal of structures and facilities driven by technological developments and advances in rocket science and related fields. Since 1945, NASA has launched more than 16,000 rockets.

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, 18 from orbital rocket missions at Pad 0-B and 30 from Navy missiles and drones. In support of these operations, NASA and MARS are also in the process of constructing new launch support infrastructure on mid and south Wallops Island (NASA, 2009e).

4.5.2 Reasonably Foreseeable Future Activities and Projects

4.5.2.1 Future Projects

Reconfiguration of the WFF Main Base Main Entrance

NASA is currently in the planning stage for a project to reconfigure the WFF Main Entrance. Recent increases in personnel, visitor, and truck traffic to WFF's Main Base have resulted in multiple substantial safety, security, and logistical risks associated with the continued use of the main entrance in its current configuration. To separate vehicles, trucks, and people and thereby increase personnel safety and decrease congestion at the main entrance to the Main Base of WFF, NASA is proposing to reconfigure the Main Base main entrance. Improvements would include a new badge office, security personnel and visitor parking areas, truck inspection lanes, enhancements to the guard building, a new combined shipping and receiving building outside of WFF's fence, and a traffic roundabout where Mill Dam and Atlantic Roads intersect. Additional information about this project may be found in the Draft EA, published March 2011 (NASA, 2011).

4.5.3 Potential Cumulative Effects by Resource

Below is a description of the potential cumulative impacts for each resource area that could be affected by the Alternative Energy Project when combined with the potential impacts from past actions and the present and reasonably foreseeable projects and activities described in Section 4.5.1 and 4.5.2 above.

4.5.3.1 Water Quality

The geographic scope of the water quality cumulative impacts analysis includes all waters within Little Mosquito Creek, Jenneys Gut, and Simoneaston Bay, which are directly north and east of the WFF Main Base, respectively. Waters adjacent to Wallops Mainland are not included as the land disturbance from construction of the one residential-scale turbine would be negligible.

Effects on water quality from installation of solar panels would be very minor, and accordingly the additive effects would also be minor. Other existing and future activities, including agricultural runoff and construction and maintenance of commercial and residential areas, would contribute to water quality degradation by sedimentation and storm water runoff. Effects of these larger-scale activities include burial of shellfish from sediment runoff and an increased risk of harmful algal blooms from excess nutrients, which can eventually lead to a reduction in dissolved oxygen content. However, in recent years, Accomack County passed the Chesapeake Bay Protection Act buffer restrictions on the Atlantic Ocean side of the Eastern Shore which will require setbacks, reductions in vegetation clearing, and will provide long-term benefits to water quality.

NASA would minimize impacts on water quality by acquiring construction and industrial VSMP permits and by developing and implementing a site-specific SWPPP and E&SC plans prior to land disturbing activities. NASA would follow VSMP requirements for proper sizing and planning for stormwater conveyance from new infrastructure.

4.5.3.2 Air Quality

In accordance with 9 VAC 5 Chapter 20, the Northeastern Virginia Intrastate Air Quality Control Region (Region 4) consists of the territorial area encompassed by geographical boundaries of various county jurisdictions, which includes Accomack County. These Air Quality Control Regions form the geographic basis for the legal applicability of the regulations and air quality programs. Region 4 is designated as being in attainment with the NAAQS for all criteria pollutants.

Construction-related and operational activities that would occur under the Proposed Action for the Alternative Energy Project and the other projects that are reasonable and foreseeable at WFF would occur at different locations and at different times over a period of several years. Table 25 shows the estimated emissions from the current and planned WFF projects (listed above in Section 4.5) using conservative assumptions to create worst case total project emissions. Therefore, BMPs were not accounted for which, when implemented, would decrease project emissions.

Site preparation (i.e., earth moving and soil disturbance) and wind erosion for the projects would result in various amounts of fugitive particulate (i.e., dust) emissions (PM_{10} and $PM_{2.5}$). The amount of fugitive dust emissions would depend on numerous factors, such as: the degree of vehicular traffic; amount of exposed soil; soil moisture content; and wind speed. Construction activities would create combustion product (tailpipe) emissions (mostly PM, NO_X, and CO) from vehicles (e.g., contractor personally owned vehicles, delivery trucks, heavy construction equipment), and temporary non-road equipment. Criteria pollutant emissions from mobile sources associated with the WFF projects listed in Table 25 would be short-term, negligible, and localized.

BMPs (e.g., dust suppression, temporarily halt construction work during high wind speeds, establishment of lower speed limits in construction areas) and legal requirements (i.e., use of ultra-low sulfur fuel, anti-idling regulations) would be implemented during each project to minimize and mitigate those emissions to the maximum extent practicable.

The operational phases of these projects would produce similar criteria pollutant emissions on an annual basis, although only the first year of operational emissions was estimated. Pollution prevention initiatives (e.g., use of alternative fueled vehicles, decentralizing the Central Boiler Plant) implemented together with the installation of the proposed fossil fuel-free power would help minimize criteria pollutant emissions locally over the long-term. In addition, a positive impact in a regional reduction in criteria pollutant emissions could result from the decreased use of fossil fuels during the production of electricity at the electric power generation plant that currently supplies WFF.

Table 25: WFF Cumulative Project Criteria Pollutant Emissions in Tons

Project	CO	NO_X	VOC	PM_{10}	SO_X
Wallops Research Park	Data Unavailable[1]				
Residential Development	Data Unavailable[1]				
UAS Airstrip		62	12	66.1	6
Reconfiguration of Main Base Main Entrance	<0.1	0	0.1	3.0	0
Alternative Energy Project	2.5	3.9	<1.0	<1.0	<1.0
SRIPP	106.6	751.4	28.2	24.5	18.4
Expansion of WFF Launch Range – Alternative One	7.7	20.5	2.1	1.8	25.7
WFF Launch Range Activities[2]	1.9	19.2	1.6	2.5	28.7
Total	**149.7**	**857.0**	**45.0**	**98.9**	**79.8**

[1]Quantitative air analysis not performed for this project.

[2]Based on 2008 WFF baseline emissions.

Cumulative emissions from the Alternative Energy Project, Expansion of the WFF Launch Range, and the SRIPP 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 and operational activities are anticipated without significant effects on local or regional air quality.

Although cumulative impacts from all construction related and operational activities are anticipated to be minimal, WFF is already in the process of decentralizing the Central Boiler Plant/steam system with individual propane-fired boilers. Table 26 provides the estimated emissions reduction resulting from this action.

Table 26: Emissions Reduction Resulting from Central Boiler Plant Decentralization in Tons

Pollutant	2007 Emissions	Proposed Emissions After Decentralization	Percent Change
CO	1.86	2.6	39% increase
NO_X	17.8	4.55	74% reduction
PM	1.2	0.25	79% reduction
SO_X	27	<1	99% reduction

4.5.3.2 Climate Change

The potential effects of proposed GHG emissions are by nature global and cumulative since individual sources are not large enough alone to have an appreciable effect on the climate. Such an impact on global climate change would only occur when GHG emissions from anthropogenic sources and sinks combine with proposed GHG emissions on a global scale.

Overall, compared to nationwide annual GHG emissions, there would be minimal GHG emissions released to the atmosphere during the site preparation and construction phases of the projects shown in Table 27. However, the dredging operations for the SRIPP would produce considerably more GHG emissions compared to the other WFF projects. The operational phases of the WFF projects would also create GHG emissions on an annual basis (except for the Proposed Action whereby there would be a reduction of GHG emissions), although only the first year of operational emissions was estimated. When the Alternative Energy Project Proposed Action is implemented there would potentially be a beneficial impact to regional GHG emissions as described in Section 4.2.3 if there is a reduction in electricity production at the source(s) of power generation that currently supplies WFF. It has been documented that the three largest GHG emission sources in Virginia are transportation, non-utility uses of fuel in commercial industrial and residential facilities, and electricity generation (Bryant, 2008).

Given the absence of science-based or adopted NEPA significance thresholds for GHGs, all of the CO_2e emissions presented in Table 27 from the year with the highest (worst) emissions are compared to the EPA 2007 GHG baseline inventory to determine the relative increase in proposed GHG emissions from WFF.

Table 27: WFF Cumulative Project Greenhouse Gas Emissions in Metric Tonnes

Project	CO_2e Emissions[1]
Wallops Research Park	Data Unavailable[2]
Residential Development	Data Unavailable[2]
Reconfiguration of Main Base Main Entrance	7,265
UAS Airstrip	17,390
Alternative Energy Project	218
SRIPP	37,250
Expansion of WFF Launch Range – Alternative One	445
WFF Launch Range Activities[3]	1,400
Total	**63,986**

[1]Only CO_2e emissions are included as this is a representation of all GHG emissions.
[2]Quantitative air analysis not performed for this project.
[3]Based on 2008 WFF baseline emissions.

Although the Alternative Energy Project Proposed Action and other proposed projects would not cause substantial cumulative impacts associated with global climate change, there are several measures currently in place at WFF, which together with the Proposed Action, would reduce energy consumption and thereby, reduce GHG emissions. WFF has replaced already almost 50 percent of its entire light-duty government-owned fleet (30 out of 70 vehicles) with newer, more fuel-efficient vehicles, as well as switched all of its diesel vehicles to using 20-percent biodiesel. It is anticipated that alternative fuel vehicles will continue to be added to be fleet in the future. In addition, the aforementioned decentralization of the Central Boiler Plant/steam system with individual propane-fired boilers would result in an estimated emissions reduction of approximately 4,400 metric tonnes (4,850 tons) per year of CO_2.

4.5.3.3 Vegetation and Terrestrial Wildlife

The geographic scope of cumulative effects for vegetation and terrestrial wildlife is the WFF Main Base and immediately adjacent areas bound by Wattsville Branch to the west, Little Mosquito Creek to the North, Simoneaston Bay to the east, and Route 175 to the south. The Wallops Mainland is not included as any impacts on these resource areas from the single residential-scale turbine would be negligible.

Over time, nearby developments have reduced the available vegetation and associated habitats for terrestrial wildlife, including white-tailed deer, gray squirrel, opossum, red fox, and various rodents. Additionally, the near-permanent human presence exposes wildlife to repeated disturbances (primarily noise) both day and night. Occasional mortality also occurs due to interactions with motorized vehicles, particularly along Route 175.

The Proposed Action would result in the loss of vegetation (grasses) within the footprint of the support posts for solar panels and the footprint of the residential scale wind turbines. Additionally, existing vegetation under/behind the panels would likely convert to more shade tolerant species. These very minor effects when considered in conjunction with other actions would produce short- and long-term cumulative effects.

All infrastructure under the Proposed Action would be installed in lower-value areas that are subject to regular disturbance (e.g., mowing, aircraft overflight) and are specifically managed to deter terrestrial wildlife from taking residence near the active WFF airfield. Additionally, after the project is constructed, large areas of open grassland would remain for affected species to seek refuge. Adjacent to the WFF Main Base are agricultural fields, forests, and (most specifically) the USFWS-managed Wallops Island National Wildlife Refuge, all of which provide an abundance of habitat available for feeding and reproduction. Accordingly, no substantial cumulative impacts on vegetation or terrestrial wildlife are anticipated.

4.5.3.4 Birds and Bats

The geographic scope of analysis for analysis of cumulative effects on birds and bats is the same area described under 4.5.3.3, Vegetation and Terrestrial Wildlife. Based on recent studies at the Eastern Neck National Wildlife Refuge in MD and the Tom Ridge Environmental Center in PA, minimal risk to wildlife occurs from wind turbines similar in size to the proposed residential-scale wind turbines. Results from multi-year post-construction studies at these sites indicate that despite their location within areas that have frequent use by local wildlife, there were few interactions with the turbines. Long term impacts, then, are not expected given the very low level of mortality (bird and bat) documented.

The proposed locations for the two residential-scale turbines are near heavily used areas and the turbines are not expected to have long-term impacts on the nesting or foraging habitats of local birds and bats. Both the Visitor Center site and the Mainland site are subject to almost constant human-induced disturbances, particularly resulting from vehicular traffic. Other less frequent noise-related disturbances include rocket launches from Wallops Island; wildlife-deterring pyrotechnics employed as part of the Aviation Safety Program at the Main Base airfield, and aircraft overflights. The most likely effects of these disturbances include causing species to roost, nest/reproduce, and forage elsewhere. This synergistic interaction would further reduce the risk of turbine caused mortality at the proposed sites.

When combined with past, present, and future developments within the analysis area, the most pronounced long-term effects have likely been the permanent loss of suitable nesting/reproductive/foraging habitat, which would force species to take residence elsewhere. As evidenced by the pre-construction avian mortality study conducted for this project (that used existing towers as utility-scale turbine surrogates), direct avian mortality can be expected from the various towers and buildings that support WFF’s missions. This would present an adverse cumulative effect, however it would be expected to be minor.

In summary, the proposed Alternative Energy Project would produce minor additive adverse cumulative impacts on birds and bats when combined with other past, present, and future actions. However, since large areas of habitat would remain on the WFF Main Base, the Wallops Island National Wildlife Refuge, Wallops Mainland, and the surrounding areas, the results are expected to be minimal.

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.

- VSMP Permits, Virginia DCR

SECTION FIVE: MITIGATION AND MONITORING

5.1 MITIGATION

CEQ regulations (40 CFR 1508.20) define mitigation to include: (1) avoiding the impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the lifetime of the action; and (5) compensating for the impact by replacing or providing substitute resources or environments. Described below are NASA's proposed mitigation measures for wind turbines under the WFF Alternative Energy Project. Mitigation measures are described by resource area.

MEC

NASA would provide pre-construction MEC awareness training to all persons supporting the installation of the residential-scale turbine at the Visitor Center.

Prior to disturbing soil, all areas that would be affected by residential-scale turbine installation at the Visitor Center would be surveyed with a magnetometer and cleared. The excavation process would involve using the magnetometer to survey the first foot of soil, then digging out the first foot of soil, then re-surveying the second foot of subsoil until final depth is reached to ensure that the boring/digging equipment does not hit or expose any unknown MEC. All potential MEC encountered would be inspected and handled by a trained specialist and properly disposed.

Cultural Resources

In accordance with Section 106 consultation with VDHR, a professional archaeologist would be on site during installation of the residential-scale wind at the Visitor Center. If a potential resource is identified, work would be halted, and the WFF Historic Preservation Officer would contact VDHR.

5.2 MONITORING

Under NEPA, a Federal agency has a continuing duty to gather and evaluate new information relevant to the environmental impact of its actions. Below is a summary of NASA's proposed monitoring plan for the implementation of the two utility-scale wind turbines on Wallops Island. The focus of the monitoring plans would be to track the effects of the project on birds and bats.

5.2.1 Post-Construction Residential-Scale Wind Turbine Avian Fatality Monitoring

A proposed monitoring study approach focused solely on documenting avian and bat fatalities from the residential-scale wind turbines is described below. NASA proposes to conduct a minimum of two years of post-construction fatality surveys at the residential-scale wind turbines. Surveys would include carcass searches, searcher efficiency trials, scavenger removal trials, and estimation of searchable area. These trials would be used to estimate overall avian and bat collision fatalities. Surveys would be conducted from March 1 through November 1. The first year of surveys would take place after each turbine is fully operational. More detail regarding the proposed monitoring plan is provided below.

5.2.1.1 *Fatality Searches*

Bird and bat carcass searches would be conducted at each wind turbine within the rectangular area depicted in Figure 25. Search plots would be centered at the base of the turbine tower and the area would be searched along transects no more than 5 to 6 meters (16 to 20 feet) apart. Searches would be made every three days throughout the study period.

Field surveyors would likely be NASA biologists and/or technicians trained in the search protocol. Transects at each of the turbines would be walked slowly to visually locate bird and bat carcasses, including portions of carcasses. Search intervals would vary (i.e., approximately one to two hours per turbine location) depending upon specific ground conditions.

A standardized data sheet would be used for each search. The data sheet would include detailed weather observations, time, date, and observer name and carcass species identification. The data collected would also include:

- Digital photographs of each carcass, including:
  1. The posture and habitat in which it was found;
  2. The dorsal and ventral sides;
  3. Photographs that indicate the gender and reproductive condition of bats (if possible); and
  4. Any identifying characteristics such as bill, foot, wing or tail shape, and plumage coloration for birds.
- Additionally, data collection would include:
  1. Turbine number;
  2. Location of carcass;
  3. Estimated distance and direction from turbine;
  4. Distance and bearing from transect from which it was first spotted;
  5. Condition of carcass (whole or partial, extent of injury and some measure of decomposition to estimate time of death);
  6. Preliminary estimate of days since death;
  7. Position of carcass (face-up/down, sprawled, balled up, etc.);
  8. Species, age and sex, if determinable; and
  9. Substrate conditions when found (marsh/water, short/long grass, dense fragmite cover).

Searches would begin as close to sunrise as practicable and optimally on every working day. However, to ensure personnel safety, searches not occur in high wind, extreme heat, rain, or foggy conditions. Carcasses found during the survey effort would be cataloged and stored in a freezer. If observers cannot determine species type because partial bird or bat carcasses were found, USFWS, VDGIF, or other expert biologists would be contacted to assist in species identification efforts. Where individual feathers, as opposed to carcasses or clumps of feathers (including feather tracts) are found, observers would note these but they would not be considered wind turbine fatalities. Any larger than expected fatality events or evidence of rare, threatened, or endangered species would be reported to USFWS and VDGIF staff within 48 hours of the discovery.

Weather conditions from the night (for night migrants) and day (for other birds) prior to the surveys will be collected from local and national weather databases, or from personal observation at or near the site. If carcasses are found, descriptions of visibility conditions the night prior to the fatality surveys would be investigated and reported, particularly information concerning percent cloud cover and the presence of fog or low cloud ceilings.

5.2.1.2 Carcass Removal Trials

Carcass removal by scavengers would be monitored using no less than 30 specimens per year and would be performed periodically throughout the survey season. Planted carcasses would include an equal assortment of small birds, large birds and bats (or tailless mice, as bat surrogates). Carcasses would be fresh, inconspicuously marked, and would be placed in various ground cover types and at different turbine locations. Carcasses would be monitored daily (during the first week) for removal and thereafter weekly until the carcass disappears. During carcass checks, the location and condition of the carcass would be recorded on standardized data sheets to document the degree of scavenging (e.g., wing missing, tail missing, head missing, breast eaten, etc.) over time. Incidental signs such as tracks or scat adjacent to the carcasses would also be identified and documented.

5.2.1.3 Searcher Efficiency Trials

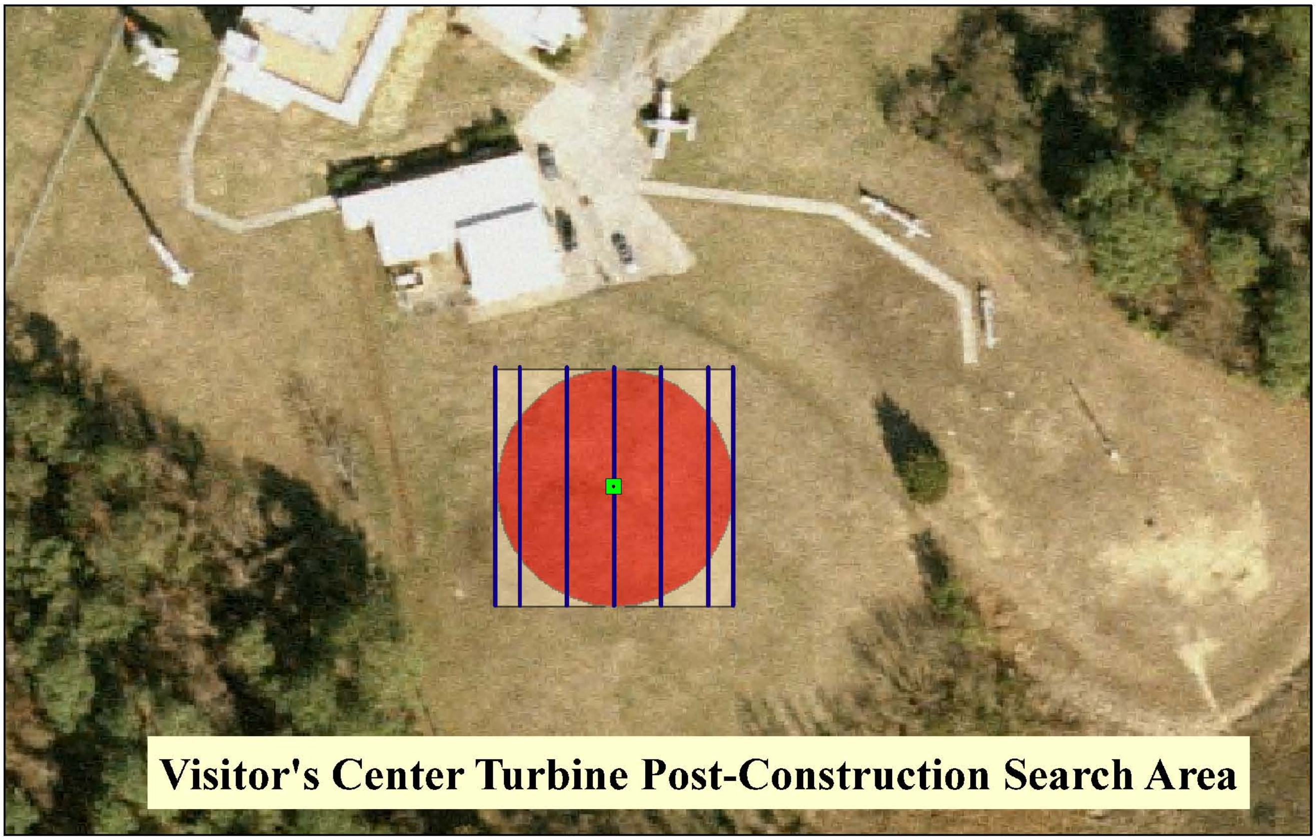
Individual searcher efficiency trials would be conducted periodically during the survey period. Marked carcasses of various sizes, taxa, and species will be placed without prior knowledge of the searcher at various locations and in various ground cover types. A record of how many days it took for a carcass to be found would be noted.

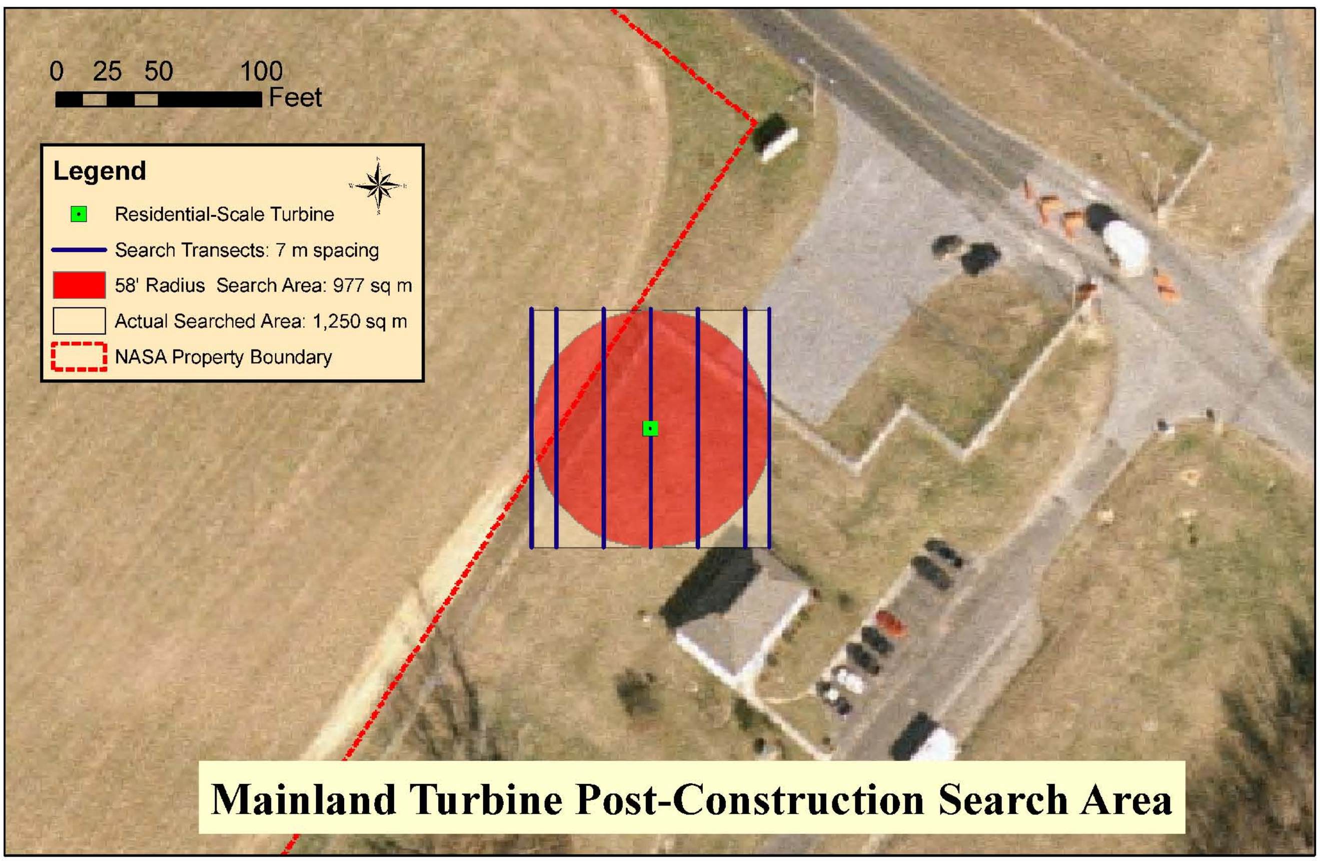
5.2.1.4 Searchable Area

Bird and bat fatalities are expected to be found within a circle centered on the turbine, with a radius of 80 percent of the turbine height. To facilitate searches along transects, the fatality area would be defined as a square that circumscribes this circle. As a result of brushy vegetation, water, or other conditions, the fatality area around the turbines may not be entirely searchable. To adjust for carcasses that may not be found because of this potential bias, those areas that cannot be searched would be measured via GPS. The estimate of birds or bats that may have actually been present within the unsearchable areas would be extrapolated from the numbers of fatalities found in the searchable area.

5.2.1.5 Calculation of Adjusted Fatality Estimates

Using searcher efficiency, carcass removal, and searchable area estimates determined empirically, an overall estimate of bird and bat fatalities would be calculated. The resulting estimates would be larger than the numbers of carcasses found for both birds and bats.





Title: Residential-Scale Wind Turbine Avian Fatality Monitoring Search Plots

URS Proj No: 15300762

Figure: 25

Client : NASA

Alternative Energy Project

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5.2.1.6 Survey Report

After the completion of each annual fatality survey a report of findings would be prepared. A summary of the results of the fatality searches would include recorded data for each carcass found, including the variables described above. Results of the carcass removal and searcher efficiency studies would also be presented. An estimated fatality rate would be calculated as presented above. A discussion of the species of carcasses discovered during the fatality search would also be presented. Recommendations for any modifications to subsequent post-construction avian and bat fatality studies at the project site would also be presented. This report would be distributed to interested stakeholders including USFWS and VDGIF.

5.3 ADAPTIVE MANAGEMENT

Adaptive management is a tool to help agencies and organizations make better decisions in a context of uncertainty as more information becomes available. Adaptive management utilizes ongoing, data collection and analysis to assess and if necessary, to modify existing processes.

For example, NASA may consider adding more post-construction avian study time, adjusting its survey methodology, or modifying the frequency of searches. Before modifying the study plan, NASA would consult with interested stakeholders including USFWS and VDGIF.

Similarly, considerable uncertainty exists regarding the effectiveness of various wind turbine mitigation strategies in reducing impacts on birds and bats. This is especially true with respect to residential-scale wind turbines, which based upon the projects reviewed by NASA, have not needed such measures due their low risk to avian resources. However, based upon results of the proposed monitoring and the technological maturity of future mitigation strategies, NASA may consider implementing, augmenting, or replacing these methods as circumstances warrant. NASA would consult with interested stakeholders including USFWS and VDGIF prior to implementing or modifying mitigation measures.

SECTION SIX: LIST OF PREPARERS

Name	Title	Areas of Responsibility in EA
URS (Contractor to NASA)		
Shari Silbert	Environmental Scientist, Wallops Environmental Office	WFF Onsite Project Manager, Document Development and Review
Jeffrey Reidenauer	Principal Environmental Scientist	Project Management, Document Review
Suzanne Richert	Principal Environmental Scientist	Project Management, NEPA Compliance, Social and Economic Environment Sections, Viewshed, Noise
Ashley Kurzweil	Environmental Scientist	Physical Environment, Alternative Energy Information
Charles Benton	Senior Wetland Scientist	Wetlands
Tom Page	Senior Biologist	Bats
Katie Eberhart	Senior Ecologist	Birds
Richard Podolsky	Principal Ecologist	Birds
Douglas Kibbe	Certified Wildlife Biologist	Birds
Angela Chaisson	Principal Biologist	Independent Technical Reviewer
Larry Poole	Senior Project Manager	Community Viewshed
Mike Kendall	Principal Air Quality Scientist	Air Quality
Sally Atkins	Senior Air Quality Scientist	Air Quality
Bethany Lambright	Staff Air Quality Scientist	Air Quality
Varna Boyd	Principal Archaeologist	Cultural Resources - Archaeology
Chris Polglase	Principal Archaeologist	Cultural Resources - Archaeology
Jeremy Lazelle	Senior Archaeologist	Cultural Resources - Archaeology
Carrie Albee	Senior Principal Historian	Cultural Resources - Aboveground
Linda Mackey	Architectural Historian	Cultural Resources - Aboveground
Sarah Cleary	Architectural Historian	Cultural Resources - Aboveground
Lee-Ann Lyons	Graphics Specialist	Cultural Resources - Aboveground
Christopher Ditton	Geographical Information Systems Specialist	Figures
Amy Siegel	Internal Technical Editor	Editing
Ivy Porpotage	Internal Technical Editor	Editing
NASA		
Philip Smith	WFF Project Manager	Alternatives, Document Review
Joshua Bundick	WFF NEPA Program Manager	NEPA Compliance, Alternatives, Project Management, Document Review, Cumulative Effects
Joel Mitchell	WFF Natural Resources Program Manager	Biology and Wetlands, Monitoring Plan, Document Review
USACE		
Robert Cole	Environmental Scientist	Document Review

SECTION SEVEN: AGENCIES AND PERSONS CONSULTED

7.1 INTRODUCTION

NEPA states that "There shall be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to the proposed action." NASA has engaged stakeholders and the general public in planning the Alternative Energy Project and preparing this EA. Stakeholders include Federal and State agencies, local governments, business interests, landowners, residents, and environmental organizations.

7.2 SCOPING PROCESS

During the Alternative Energy Project planning process, NASA provided several opportunities for public and stakeholder involvement. Scoping letters were sent to targeted stakeholders and agencies in April 2008. NASA also held several meetings with various stakeholders during the planning of this project. The meetings are summarized below:

- In February 2008, NASA met with members of the Accomack County Board of Supervisors to introduce and discuss the proposed project.
- In March 2008, NASA met with A&N Electric Cooperative to introduce the project and to discuss interconnection requirements for installing alternative energy sources at WFF.
- In April 2008, NASA hosted six stakeholder groups including Federal and State regulatory agencies and local environmental organizations at the Chincoteague National Wildlife Refuge's Herb Bateman Center. This meeting was held to discuss NASA's proposed Avian and Bat Study Plan. In spring and summer 2008, Draft and Final copies of the Plan were sent to each participant for review and comment.
- In August 2009, NASA held a Trust Resources Meeting with six Federal and State regulatory agencies. During this meeting, NASA consulted with the other agencies on potential impacts to wetlands and protected species.

NASA formally invited the USACE to participate as a cooperating agency in the EA process. The USACE accepted this request and has assisted NASA in the preparation of this EA.

7.3 DRAFT EA

NASA considered information obtained during scoping in preparing the Draft EA. The public was notified of the opportunity to review and comment on the Draft EA by e-mail, announcements in local newspapers, and direct mailings. Comments on the Draft EA were originally requested by April 5, 2010. On April 1, 2010, NASA held a public meeting to discuss the Draft EA. Because this meeting was so close to the original April 5th deadline for comments on the Draft EA, NASA extended the public comment period to April 12, 2010.

The Draft EA was available for public review between March 3, 2010 and April 12, 2010 on the WFF Environmental Office Web site at http://sites.wff.nasa.gov/code250/AltEnergy_DEA.html and 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.	**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.
Eastern Shore 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.	**Northampton Free Library** 7745 Seaside Rd Nassawadox, Virginia, 23413 (757) 442-2839 Monday, Tuesday, Wednesday, Friday: 9 am - 6 pm Thursday: 9 am - 9 pm Friday: 9 am - 6 pm Saturday: 9 am - 1 pm

NASA held a stakeholder meeting to discuss the Draft EA, mitigation and monitoring, and other concerns regarding potential impacts on avian resources at the CNWR on June 23, 2010. Based on the concerns expressed in the comments on the Draft EA and in the June 23rd meeting, NASA decided to change the Proposed Action of the Alternative Energy Project from installation of two 2.0 MW utility-scale wind turbines and up to five 2.4 kW residential-scale wind turbines to installation of 10 GWh/year of solar panels and two 2.4 kW residential-scale wind turbines. Public comments on the Draft EA are included in Appendix F and NASA's responses to the public comments are included in Appendix G this Final EA.

7.4 SUMMARY

In summary, NASA solicited public and agency review and comment on the environmental impacts of the Alternative Energy Project through:

1. Publication of a notice of availability of this Draft EA in the Federal Register and local newspapers;
2. Publication of the Draft EA on the WFF Environmental Office Web site;
3. Public and stakeholder meetings;
4. Consultations with local, State, and Federal agencies; and
5. Direct mailing of the Draft EA to interested parties.

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

Joshua A. Bundick
NEPA Program Manager
Wallops Flight Facility, Code 250.W
Wallops Island, VA 23337
Phone: (757) 824-2319
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Below in Table 28 is a list of the agencies and persons consulted during the NEPA process.

Table 28: Agencies and Persons Consulted

Name	Organization	Participated in Scoping	Sent a Copy of Draft EA
Federal Agencies			
Ms. Barbara Rudnick	EPA	X	X
Mr. Michael Blaich	FAA	X	X
Ms. Julie Crocker	NMFS, Protected Resources Division		X
Mr. David O'Brien	NMFS, Habitat Conservation Division	X	X
Ms Trish Kicklighter	NPS, Assateague Island National Seashore		X
Mr. Doug Crawford	NOAA, Command and Data Acquisition Station		X
Mr. Robert Cole	USACE, Norfolk District	X	X
Mr. Bryan Connor	U.S. Department of Energy		X
Dr. Marilyn Ailes	U.S. Navy, Surface Combat Systems Center	X	X
CAPT J.M. Hinson	U.S. Navy, Fleet Forces Command		X
CDR John Keegan	U.S. Navy, Surface Combat Systems Center		X
Mr. Louis Hinds, III	USFWS, Chincoteague National Wildlife Refuge	X	X
LT Mark Merriman	U.S. Coast Guard		X
Ms. Cindy Schulz	USFWS, Virginia Field Office	X	X
State Agencies			
Mr. Richard Baldwin	Mid-Atlantic Regional Spaceport		X
Mr. Frank Daniel	VDEQ, Tidewater Regional Office		X
Ms. Ellie Irons	VDEQ, Office of Environmental Impact Review		X
Ms. Ruth Boettcher	VDGIF, Wildlife Diversity Division	X	X
Mr. Ron Grayson	VDHR	X	X
Mr. George Badger, III	VMRC, Habitat Division	X	X

Name	Organization	Participated in Scoping	Sent a Copy of Draft EA
Mr. Tommy Oliver	Virginia State Corporation Commission	X	X
Local Government			
Mr. Steven Miner	Accomack County Administration		X
Mr. Grayson Chesser	Accomack County Board of Supervisors		X
Ms. Laura Belle Gordy	Accomack County Board of Supervisors		X
Ms. Wanda Thornton	Accomack County Board of Supervisors	X	X
Mr. Ronald Wolff	Accomack County Board of Supervisors	X	X
Mr. David Fluhart	Accomack County Building and Zoning	X	X
Mr. Robert Ritter	Town of Chincoteague, Virginia		X
Mayor John Tarr	Town of Chincoteague, Virginia		X
Other Organizations & Individuals			
Mr. Vernon Brinkley	A & N Electric Cooperative	X	X
Mr. George Stricker	Accomack Wind Energy Project	X	X
Ms. Kathy Phillips	Assateague Coastal Trust		X
Mr. Charlie Smith	Audubon Society	X	X
Ms. Mary Elfner	National Audubon Society		
Mr. Nick Olmstead	BaySys Technologies, Inc.		X
Dr. Adam Duerr	College of William and Mary Center for Conservation Biology	X	X
Dr. Bryan Watts	College of William and Mary Center for Conservation Biology	X	X
Ms. Suzanne Taylor	Chincoteague, Virginia Chamber of Commerce		X
Mr. Denard Spady	Citizens for a Better Eastern Shore		X
Mr. Jim Rapp	Delmarva Low Impact Tourism Experiences		X
Mr. Jeff Davis	Eastern Shore Chamber of Commerce		X
Mr. Steven Habeger	Eastern Shore Defense Alliance		X

Name	Organization	Participated in Scoping	Sent a Copy of Draft EA
Ms. Donna Bozza	Eastern Shore of Virginia Tourism Commission		X
Dr. Jonathan Miles	James Madison University	X	X
Ms. Amber Parker	Marine Science Consortium		X
Ms. Judy Dunscomb	The Nature Conservancy, Charlottesville	X	X
Mr. Stephen Parker	The Nature Conservancy, Virginia Coast Reserve		X
Mr. Barry Truitt	The Nature Conservancy, Virginia Coast Reserve	X	X
Mr. Randy Fox	Trails End Campground		X
Dr. Karen J. McGlathery	Virginia Coast Reserve Long-Term Ecological Research Project		X
Mr. Patrick Wilson	Virginia Wind Energy Collaborative		X
Mr. David Burden	Virginia Eastern ShoreKeeper		X
State Elected Officials			
Honorable Mr. Lynwood Lewis, Jr.	Virginia House of Delegates		X
Honorable Mr. Ralph Northam	Virginia Senate		X

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