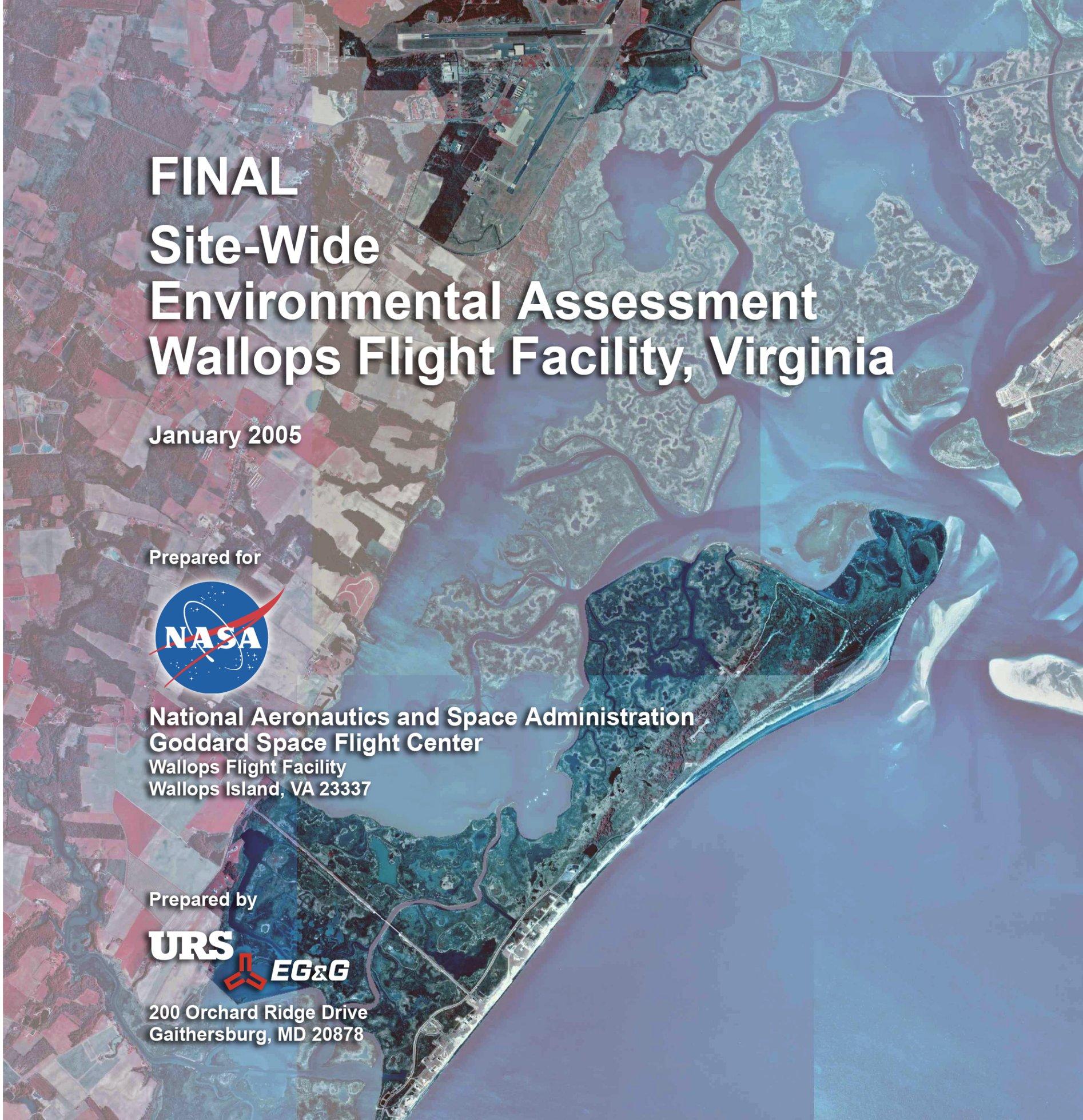

FINAL
Site-Wide Environmental Assessment Wallops Flight Facility, Virginia

January 2005

Prepared for

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

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PREFACE

This *Final Site-Wide Environmental Assessment for Wallops Flight Facility* has been developed by URS Group, Inc. (URS) and EG&G Technical Services (EG&G) for the National Aeronautics and Space Administration's (NASA) Goddard Space Flight Center (GSFC) Wallops Flight Facility (WFF).

URS/EG&G have prepared this report for the exclusive use of WFF in accordance with NASA Procedural Requirements (NPR) 8580.1, *Implementing the National Environmental Policy Act and Executive Order 12114* (NASA, 2001a).

FINAL
SITE-WIDE ENVIRONMENTAL ASSESSMENT
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
Proposed Action:	Recurring and Proposed Future Actions at Wallops Flight Facility
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Date:	January 24, 2005

Abstract

This Site-Wide Environmental Assessment (EA) addresses recurring activities and proposed future actions at the National Aeronautics and Space Administration's (NASA) Goddard Space Flight Center's (GSFC) Wallops Flight Facility (WFF) in Accomack County, Virginia. The recurring activities and proposed future actions at WFF are how WFF achieves its mission of enabling scientific research and aerospace technology; facilitating the commercial development of space; and providing science and technology education, outreach programs, and innovative partnerships.

This Site-Wide EA provides a framework to evaluate typical recurring actions undertaken by NASA and customers at WFF, as well as reasonably foreseeable future actions at WFF. The recurring and future actions covered by this Site-Wide EA have been assessed to ensure that they do not result in any new or substantial environmental or safety concerns.

Executive Summary

This Site-Wide Environmental Assessment (EA) addresses recurring activities and proposed future actions at the National Aeronautics and Space Administration's (NASA) Goddard Space Flight Center's (GSFC) Wallops Flight Facility (WFF) in Accomack County, Virginia. The recurring activities and proposed future actions at WFF are how WFF achieves its mission of enabling scientific research and aerospace technology; facilitating the commercial development of space; and providing science and technology education, outreach programs, and innovative partnerships.

This Site-Wide EA provides a framework to evaluate typical recurring actions undertaken by NASA and customers at WFF, as well as reasonably foreseeable future actions at WFF. The recurring and future actions covered by this Site-Wide EA have been assessed to ensure that they do not result in any new or substantial environmental or safety concerns.

The Proposed Action is to continue existing WFF operations, expand operations, and improve facilities. Facility improvements could include new construction, repair/renovation/relocation of facilities, and demolition. Impacts from as-yet undefined facility improvements are described as generic impacts that could occur from any of the institutional support or operational components. Specific impacts are described when detailed information on an aspect of the Proposed Action is available (for example, the construction of the Project Support Building).

Purpose and Need for the Action

The recurring activities and proposed future actions at WFF are how WFF achieves its mission. The WFF mission drives its programs and projects, which in turn drive its facilities and operations. The purpose and need for the proposed actions is to enable WFF to continue to meet its mission in an efficient and environmentally sound manner.

Alternatives Considered

The Proposed Action is to continue existing WFF operations, expand operations, and improve facilities.

The Proposed Action consists of two categories of actions – Institutional Support and Operational Components. Institutional Support includes construction, demolition of facilities, and routine site activities. Improvements to facilities would include permanent physical improvements to the site that involve buildings and equipment, utilities, other infrastructure, and routine maintenance activities.

Operational Components include rockets, balloons, piloted aircraft, uninhabited aerial vehicles, autonomous underwater vehicles, payloads, tracking and data systems, scientific research programs and facilities, educational programs, the open burn area, rocket boosted projectile testing, and airfield operations. To assess the impacts of current and future operations, a range or "envelope" of activities was identified for each type of operation, and the worst-case scenario for each envelope was evaluated. For example, the largest rocket anticipated to be launched from WFF was used as a model for assessing impacts from rocket launches. Expansion of operations would also include activities that do not require permanent facilities or infrastructure, such as research programs, facility operations, and management practices.

No Action Alternative

The No Action Alternative is defined as maintaining the status quo. Operations and routine assistance activities at WFF would continue at the current level and would not expand or change. Infrastructure would not be constructed or upgraded.

Summary of Environmental Impacts

Potential environmental impacts, including cumulative impacts, of the Proposed Action, are summarized in this section. A more extensive discussion is presented in Chapter 4, Environmental Consequences.

Land Resources

The Institutional Support portion of the Proposed Action would necessarily disturb topography, soils, and possibly drainage patterns in the immediate vicinity of the specific action. NASA would minimize negative impacts by implementing WFF's Storm Water Pollution Prevention Plan and a site-specific Sediment and Erosion Control Plan prior to any intrusive activity. The Operational Components of the Proposed Action are not anticipated to impact topography, soils, or drainage patterns.

No impacts to geology are anticipated from either component of the Proposed Action since no deep excavations are anticipated. NASA would ensure each action is compatible with existing land uses and Master Plans; therefore, no land use impacts are anticipated from either component of the Proposed Action.

No impacts to the Atlantic Ocean substrate are anticipated from the Institutional Support portion of the Proposed Action, since no construction or demolition activities will occur over the ocean. Under the Operational Components of the Proposed Action, operations involving drone targets or rocket motors could potentially impact the Atlantic Ocean substrate when drone targets or rocket motors enter the marine environment. Drone targets used in shipboard weapons tests land on the ocean floor either whole or in pieces. Rocket motors land whole on the ocean floor. However, no significant impacts to the Atlantic Ocean substrate are anticipated, due to the small amount of such materials and the slow degradation of these materials in the deep ocean environment. No other Operational Components are likely to affect the Atlantic Ocean substrate.

Water Resources

Ground disturbing activities associated with the Institutional Support portion of the Proposed Action could affect water resources by causing increased runoff, erosion, and sedimentation. NASA would mitigate any negative impacts by implementing appropriate best management practices for stormwater management and erosion and sediment control, such as installing silt fences, revegetating bare soils, and implementing site-specific Sediment and Erosion Control Plans. Activities that would affect a wetland or waters of the U.S. would be conducted in accordance with Executive Order (EO) 11990 and 14 CFR 1216.2. Activities that would affect the floodplain would be conducted in accordance with EO 11988 and 14 CFR 1216.2. Activities that could affect coastal resources would be consistent with the Coastal Zone Management Act and the Virginia Coastal Resources Management Program.

The Operational Components of the Proposed Action could affect water resources through the accidental release of hazardous materials from operational activities or from a piloted or Uninhabited Aerial Vehicle (UAV) accident. To minimize any potential impacts, NASA would

ensure that all operations occur in strict compliance with the WFF Integrated Contingency Plan (ICP).

Air Quality

The Institutional Support portion of the Proposed Action would cause temporary, short-term impacts to local air quality due to land clearing/grading, ground excavation, construction/demolition of structures, and operation of fossil-fuel burning equipment. Construction vehicles and equipment would be maintained in good working order to minimize pollutant emissions. Construction of the proposed wind turbine on WFF would have a positive impact on air quality by reducing the use of fossil fuels to generate electricity.

The Operational Components of the Proposed Action would have a minor, temporary, negative impact on local air quality through launch vehicle emissions of pollutants or accidental release of toxic gases. WFF would continue to comply with its existing air permits.

Noise

The Institutional Support portion of the Proposed Action would generate temporary, localized increases in noise levels due to heavy equipment operation. New construction may introduce permanent noise sources such as traffic; these impacts, however, would be minor.

The Operational Components of the Proposed Action would generate temporary, intermittent noise from launch activities and aircraft operations; however, no significant impact is anticipated. Sonic booms are permitted to occur only over the ocean, so no negative noise impacts to humans would occur. Ocean-going vessels would be expected to experience sound resembling mild thunder.

Hazardous Materials and Hazardous Waste

The Institutional Support portion of the Proposed Action may increase the use and generation of hazardous materials. However, NASA would follow established procedures for the handling, storage, and disposal of hazardous materials and wastes to ensure that no adverse effects occur. Therefore, no significant impacts are anticipated.

The Operational Components of the Proposed Action would utilize hazardous materials that would be managed with standard procedures, including proper containment, separation of incompatible and reactive chemicals, worker warning and protection systems, handling procedures to ensure safe operations, the WFF ICP, and training. Therefore, no significant impacts are anticipated

Radiation

The Institutional Support portion of the Proposed Action may increase the use of radiation-emitting materials. However, NASA would follow established procedures mandated by GSFC's Radiation Safety Committee for the proper handling, storage, and use of radiation-emitting material and equipment to ensure that no adverse effects occur. Therefore, no significant impacts are anticipated.

Radiation-emitting materials and equipment are used at WFF in space flight research; Earth sciences research; atmospheric research, testing, and integration of space flight hardware; and communications. Radiation-emitting materials and equipment are used and/or stored at WFF

under a comprehensive radiation protection program. GSFC's Radiation Safety Committee provides oversight.

No impacts from the Operational Components of the Proposed Action are anticipated, since environmental radiation safety is and will continue to be maintained by monitoring, inspecting, and maintaining radioactive items and the areas in which these items are located. Therefore, no significant impacts are anticipated

Vegetation

The Institutional Support portion of the Proposed Action would cause limited, permanent loss of some vegetation in areas proposed for construction, demolition, and routine site activities. This loss is not considered significant, since most new construction will occur in developed areas of the facility where vegetated areas are limited and already disturbed. Demolition and routine site activity would have less of an impact because in most cases vegetation would be replanted. No rare, threatened, or endangered vegetation exists at WFF.

Impacts from the Operational Components of the Proposed Action are anticipated to be minor and temporary, since vegetated areas recover after being subjected to rocket exhaust.

Terrestrial Wildlife and Migratory Birds

The Institutional Support portion of the Proposed Action would not significantly impact terrestrial wildlife or migratory birds, because most construction will occur in developed areas of the facility that provide limited habitat. Construction of the wind turbine on Wallops Island is not expected to negatively impact migratory birds because approved impact minimization measures will be applied.

No significant impacts from the Operational Components of the Proposed Action are anticipated because most operations only generate temporary noise on an infrequent basis. Wildlife management activities already occur at WFF to maintain safe airfield operations, so future operations should not cause additional impacts.

Threatened and Endangered Species

Any action that may affect federally listed threatened or endangered species or their critical habitats would need to be coordinated with the U.S. Fish and Wildlife Service, the Virginia Department of Agriculture and Consumer Services, the Virginia Department of Game and Inland Fisheries, and the Virginia Department of Conservation and Recreation, Division of Natural Heritage. The Proposed Action is not anticipated to impact any federally or State threatened or endangered species because of the nature and distance of the proposed activities from protected species and their habitats. WFF adheres to mitigation measures currently in place to protect these species.

Marine Mammals and Fish

Any action that may affect marine mammals or their habitat requires consultation with the National Marine Fisheries Service. No impacts to marine mammals or fish are anticipated under the Institutional Support portion of the Proposed Action, since no construction or demolition activities will occur over the ocean. No impacts to fish in creeks or bays around WFF are anticipated under the Institutional Support portion of the Proposed Action, since no construction or demolition activities would occur in the creeks or bays. It would be the responsibility of the

U.S. Army Corps of Engineers to conduct the environmental review for any dredging activities that have the potential to impact marine mammals or fish. The Operational Components of the Proposed Action would have an adverse effect only if a launch vehicle or payload fell, or a target detonated, on a marine mammal or school of fish – and the risk of such an event occurring is extremely low.

Population

The Proposed Action is not anticipated to have a significant effect on population. The Institutional Support portion of the Proposed Action would have no impact on population. The Operational Components of the Proposed Action could cause a permanent minor increase in the population of the surrounding area if operations expand and require the addition of civil service or contractor personnel at WFF.

Recreation

The Proposed Action is not anticipated to have a significant effect on recreation. The Proposed Action could have minor, temporary effects on the WFF Visitors Center during construction and demolition activities or to surrounding recreational uses during rocket launch and retrieval.

Employment and Income

The Institutional Support portion of the Proposed Action would have temporary beneficial impacts on local employment and income, due to employees and services needed for new construction and demolition. The Operational Components of the Proposed Action could, through increased or new operations, cause small increases in the number of permanent civil service employees and contractors at WFF, which would lead to employment and income increases in the local economy. These impacts are not considered to be significant.

Health and Safety

The Proposed Action could present safety risks to workers and WFF employees during construction and demolition activities, and during WFF operations. NASA complies with guidelines established by the Occupational Safety and Health Administration, various WFF health and safety manuals, and ongoing training to ensure that no significant impacts to health and safety occur.

Cultural Resources

The Proposed Action could potentially affect cultural resources during construction and demolition activities and during WFF operations. For all existing and future actions that impact those cultural resources determined to be eligible for listing in or listed in the National Register, NASA would be responsible for complying with Section 106 and Section 110 of the National Historic Preservation Act. NASA would consult with the Virginia Department of Historic Resources and any other interested parties to identify the area of potential effect, the presence or absence of cultural resources, the effects an action would have on those resources, and the appropriate avoidance or mitigation measures.

Environmental Justice

The WFF Environmental Justice Implementation Plan examined the effects of current Federal actions at WFF and found that these actions do not disproportionately or adversely affect low-

income or minority populations. The Proposed Action would continue and expand existing actions at WFF and is also not anticipated to disproportionately or adversely affect low-income or minority populations.

Transportation

The Proposed Action would not have a significant effect on transportation. Construction and demolition activities could temporarily disrupt local traffic patterns, but this is not considered a significant impact.

Cumulative Effects

In accordance with NEPA and to the extent reasonable and practical, this Site-Wide EA considers the overall cumulative impact of the Proposed Action and other actions (both on and off WFF) that are related in terms of time or proximity. According to CEQ regulations, cumulative impacts represent the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7)."

No impacts resulting from the cumulative effects of current NASA actions or reasonably foreseeable action were identified.

Summary

The Proposed Action is not anticipated to have significant impacts on any resource area. Any adverse impacts would be minimized and mitigation measures would be implemented as necessary.

TABLE OF CONTENTS

Executive Summary i

Acronyms and Abbreviations xiv

Section 1 Mission, Purpose and Need, Background Information 1

1.1 Wallops Flight Facility Mission 1
1.2 Background 1
1.2.1 Tenants and other On-Site Organizations 7
1.3 Purpose and Need 10
1.4 Scope of the Site-Wide Environmental Assessment 10
1.5 Related Environmental Documentation 11

Section 2 Actions Covered by this Site-Wide Environmental Assessment 12

2.1 Institutional Support 24
2.1.1 Construction Program 24
2.1.2 Demolition Program 29
2.1.3 Routine Site Activities 34
2.2 Operational Components 39
2.2.1 Rocket Operations 40
2.2.2 Balloons 40
2.2.3 Piloted Aircraft 40
2.2.4 Uninhabited Aerial Vehicles (UAV) 40
2.2.5 Autonomous Underwater Vehicles (AUV) 40
2.2.6 Payloads 40
2.2.7 Tracking and Data Systems 40
2.2.8 Scientific Research Programs and Facilities 40
2.2.9 Educational Programs 40
2.2.10 Open Burn Area 40
2.2.11 Rocket Boosted Projectile Testing 40
2.2.12 Airfield Operations 40
2.3 No Action Alternative 40

Section 3 Affected Environment 40

3.1 Introduction 40
3.2 Physical Environment 40
3.2.1 Land Resources 40
3.2.2 Water Resources 40
3.2.3 Air Quality 40
3.2.4 Noise 40
3.2.5 Hazardous Materials and Hazardous Waste 40
3.2.6 Radiation 40
3.3 Biological Environment 40
3.3.1 Vegetation 40
3.3.2 Terrestrial Wildlife and Migratory Birds 40
3.3.3 Threatened and Endangered Species 40
3.3.4 Marine Mammals and Fish 40
3.4 Social and Economic Environment 40

3.4.1 Population 40
3.4.2 Recreation 40
3.4.3 Employment and Income 40
3.4.4 Health and Safety 40
3.4.5 Cultural Resources 40
3.4.6 Environmental Justice 40
3.4.7 Transportation 40

Section 4 Environmental Consequences 40

4.1 Introduction 40
4.2 Physical Environment 40
4.2.1 Land Resources 40
4.2.2 Water Resources 40
4.2.3 Air Quality 40
4.2.4 Noise 40
4.2.5 Hazardous Materials and Hazardous Waste 40
4.2.6 Radiation 40
4.3 Biological Environment 40
4.3.1 Vegetation 40
4.3.2 Terrestrial Wildlife and Migratory Birds 40
4.3.3 Threatened and Endangered Species 40
4.3.4 Marine Mammals and Fish 40
4.4 Social and Economic Environment 40
4.4.1 Population 40
4.4.2 Recreation 40
4.4.3 Employment and Income 40
4.4.4 Health and Safety 40
4.4.5 Cultural Resources 40
4.4.6 Environmental Justice 40
4.4.7 Transportation 40
4.5 Cumulative Effects 40

Section 5 List of Preparers 40

Section 6 List of Agencies, Organizations, and Persons to Whom Copies of the Assessment Are Sent 40

Section 7 Public Participation 40

Section 8 References 40

Appendix A NASA Wallops Flight Facility Site-Wide EA NEPA Checklist

Appendix B Agency Coordination

Appendix C U.S. Fish and Wildlife Coordination on Piping Plover Habitat on Wallops Island

Appendix D National Marine Fisheries Service Coordination on Marine Mammals

Appendix E Cultural Resources Assessment

Appendix F Historic Resources Survey and Eligibility Report

Tables

Table 2-1 Summary of the Proposed Action
Table 2-2 Specific Anticipated Construction Projects
Table 2-3 Property Scheduled for Demolition through FY 2009
Table 2-4 List of Rockets and Associated Motors and Propellants
Table 2-5 Typical UAVs Operating at WFF
Table 2-6 Laboratory Names and Functions
Table 2-7 Summary of OB Operations
Table 3-1 Predominant Soil Types at Wallops Flight Facility
Table 3-2 Outfalls Associated with VPDES Permit Number VA0024457
Table 3-3 Flood Hazard Zone Definitions
Table 3-4 Commonwealth of Virginia Ambient Air Quality Standards
Table 3-5 Local Climatological Data
Table 3-6 2001 Point Source Criteria Pollutant Emissions
Table 3-7 Air Quality Guidelines for Exposure to Rocket Exhaust
Table 3-8 Summary of OB Area Operations
Table 3-9 Summary of Emissions from Paint Spray Booths for Exempt Non-Criteria Air Pollutants
Table 3-10 Summary of Emissions from Paint Spray Booths for Regulated Non-Criteria Air Pollutants
Table 3-11 Maximum Permissible Noise Exposures
Table 3-12 Aircraft Noise Levels
Table 3-13 Threshold for Noise Interference and Noise Abatement Criteria
Table 3-14 Wallops Flight Facility Noise Levels
Table 3-15 Satellite Accumulation Areas
Table 3-16 Properties with Hazardous Materials or Waste Concerns
Table 3-17 Threatened and Endangered Species in the WFF Area
Table 3-18 Marine Mammals in the VACAPES OPAREA
Table 3-19 Species with Designated Essential Fish Habitat in the Proposed Project Area
Table 3-20 County Population and Density
Table 3-21 Town Population and Housing Units
Table 3-22 Geographic Distribution by County of Residence

Table 3-23 Labor Force and Unemployment
Table 3-24 County Employee Distribution
Table 3-25 Full-Time WFF NASA Employees
Table 3-26 WFF Employee Distribution
Table 3-27 Staffing Changes at WFF
Table 3-28 Total WFF Labor Force
Table 3-29 Income and Poverty
Table 3-30 Civil Service Employee Income
Table 3-31 Environmental Justice Concerns – by Census Tract, Accomack County, VA
Table 4-1 Impact Summary Matrix
Table 4-2 Major Exhaust Products from Propellant Systems
Table 4-3 Estimated Peak Concentrations of HCl from an Athena-3(8)
Table 4-4 Estimated Peak Concentrations of Al_20_3 from an Athena-3(8)
Table 4-5 Weighted Average Emissions per Type of Flight Event
Table 4-6 Expected Employment Growth
Table 4-7 New Employees to Reside in Accomack County
Table 4-8 Additional Population of Accomack County
Table 4-9 Expected Construction Employment
Table 4-10 Construction Impacts
Table 4-11 Expected Annual Demolition Projects
Table 4-12 Expected Annual Demolition Project Costs
Table 4-13 Expected Demolition Employment
Table 4-14 Demolition Impacts
Table 4-15 Employment Impacts – First Five Years of Operations Growth
Table 4-16 Total Output and Value Added for First Five Years of Operational Growth

Figures

Figure 1 Vicinity Map
Figure 2 Wallops Main Base Facilities
Figure 3a Wallops Mainland and Southern Wallops Island Facilities
Figure 3b Northern Wallops Island Facilities
Figure 4 VACAPES OPAREA

Figure 5a	Main Base Land Use Strategy
Figure 5b	Wallops Mainland and Wallops Island Land Use Strategy
Figure 6a	Main Base Areas of Increased Sensitivity
Figure 6b	Wallops Mainland and Southern Wallops Island Areas of Increased Sensitivity
Figure 6c	Northern Wallops Island Areas of Increased Sensitivity
Figure 7	Conceptual Plan – Campus Core Area
Figure 8	Location of M-Area Control Building
Figure 9a	Demolition Plan – Main Base
Figure 9b	Demolition Plan – North Island
Figure 9c	Demolition Plan – South Island
Figure 10	Soil Types
Figure 11	Wallops Flight Facility Land Uses
Figure 12	Wetlands
Figure 13	Floodplain Zones
Figure 14	Known Locations of Endangered Species
Figure 15	Main Base Prehistoric Archaeological Site Sensitivity
Figure 16	Main Base Historic Archaeological Site Sensitivity
Figure 17	Wallops Mainland and Southern Wallops Island Prehistoric Archaeological Site Sensitivity
Figure 18	Wallops Mainland and Southern Wallops Island Historic Archaeological Site Sensitivity
Figure 19	Northern Wallops Island Prehistoric Archaeological Site Sensitivity
Figure 20	Northern Wallops Island Historic Archaeological Site Sensitivity
Figure 21	Main Base Historic Resources Survey Sites
Figure 22	Wallops Island Historic Resources Survey Sites

°C	Degrees Celsius
°F	Degrees Fahrenheit
µ/m3	Micrograms per cubic meter
ACBM	Asbestos-containing Building Materials
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
ACS	Attitude Control System
Al	Aluminum
Al_2O_3	Aluminum oxide
ALSE	Aviation Life Support Equipment
amsl	Above mean sea level
AOA	Aircraft Operating Area
AOC	Area of Concern
AOL3	Airborne Oceanographic LIDAR
AP	Ammonium perchlorate
APHIS	Animal and Plant Health Inspection Service
APLIC	Avian Power Line Interaction Committee
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASO	Aviation Safety Officer
ASROC	Antisubmarine Rocket
ASRS	Aviation Safety Reporting System
AST	Above ground Storage Tank
ATM	Airborne Terrain Mapper
AUV	Autonomous Underwater Vehicle
BACT	Best Available Control Technology
BFE	Base Flood Elevation
BMP	Best Management Practice
C	Celsius
CAA	Clean Air Act
CAS	Chemical Abstract System
CBRA	Coastal Barrier Resources Act
CDAS	Command and Data Acquisition Station
CDC	Centers for Disease Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Cl	Chlorine
ClO	Chlorine monoxide
CMA	Coastal Management Area
CO	Carbon monoxide
CO_2	Carbon dioxide

COBE	Cosmic Background Explorer
CODAR	Coastal radar
CTPB	Carboxyl-terminated polybutadiene
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dB	Decibel
dBA	Decibel weighted to the A-scale
DCR	Department of Conservation and Recreation
DEQ	Department of Environmental Quality
DMR	Discharge Monitoring Report
DNL	Day-Night Level
DoD	Department of Defense
DOE	Determination of Eligibility
EA	Environmental Assessment
EAV	Experimental Aerospace Vehicle
ECC	Electrochemical Concentration Cell
EFH	Essential Fish Habitat
EG&G	EG&G Technical Services
EIS	Environmental Impact Statement
EJCC	Environmental Justice Coordination Committee
EJIP	Environmental Justice Implementation Plan
ELV	Expendable Launch Vehicle
EMS	Environmental Management System
EO	Executive Order
EPA	Environmental Protection Agency
EPNdB	Effective Perceived Noise Level
ERD	Environmental Resources Document
ERP	Environmental Restoration Program
ESA	Endangered Species Act
ESVEDC	Eastern Shore of Virginia Economic Development Commission
F	Fahrenheit
FAA	Federal Aviation Administration
FACSFAC VACAPES	Fleet Area Control and Surveillance Facility, Virginia Capes
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMP	Fisheries Management Plan
FUDS	Formerly Used Defense Sites
FYI	Fiscal Year
GEM	Graphite Epoxy Motor

GFO	Geosat Follow On
GLAS	Geoscience Laser Altimeter System
GRACE	Gravity Recovery and Climate Experiment
GSFC	Goddard Space Flight Center
GVSITE	Synthetic Vision Integrated Test and Evaluation
H	Hydrogen
He	Helium
H_2O	Water
HAP	Hazardous Air Pollutant
HAZCOM	Hazard Communication
HAZMAT	Hazardous Material
HAZWOPER	Hazardous Waste Operation and Emergency Response
HCl	Hydrogen chloride
HTPB	Hydroxyl-terminated polybutadiene
ICP	Integrated Contingency Plan
ICRMP	Integrated Cultural Resources Management Plan
IEEE	Institute of Electrical and Electronic Engineers
IPA	Isopropyl alcohol
KSC	Kennedy Space Center
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
$L_{eq}(1)$	Time-averaged sound level for 1 hour
L_{dn}	Day-night average sound level
LEO	Low Earth Orbit
LFF	Liquid Fueling Facility
LOx	Liquid Oxygen
LN_2	Liquid Nitrogen
MAFMC	Mid-Atlantic Fisheries Management Council
MARS	Mid-Atlantic Regional Spaceport
MBTA	Migratory Bird Treaty Act
MEC	Management Education Center
MGD	Million gallons per day
mg/m^3	Milligrams per cubic meter
MMH	Mono-methyl hydrazine
MMPA	Marine Mammal Protection Act
MPE	Maximum Exposure Level
MRFSS	Marine Recreational Fisheries Statistics Survey
MSC	Marine Science Consortium
MSDS	Material Safety Data Sheet

N_2	Nitrogen gas
N_2H_4	Anhydrous hydrazine
NAAQS	National Ambient Air Quality Standards
NACA	National Advisory Committee for Aeronautics
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications System
NAWC/AD	Naval Air Warfare Center/Aircraft Division
NC	Nitrocellulose
NCA	Noise Control Act
NEPA	National Environmental Policy Act
NESDIS	National Environmental Satellite Data Information Service Command
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFSAM	Nuclear Flight Safety Assurance Manager
NG	Nitroglycerin
NHPA	National Historic Preservation Act, as amended (1966)
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
nm	Nanometer
NMHC	Nonmethane hydrocarbons
NMFS	National Marine Fisheries Service
NO_2	Nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOTAMS	Notice to Airmen
NOTMARS	Notice to Mariners
NPDES	National Pollutant Discharge Elimination System
NPOL	NASA Polarimetric
NPR	NASA Procedural Requirements
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NTO	Nitrogen tetroxide
NWCC	National Wind Coordinating Committee
NWS	National Weather Service
O_3	Ozone
OB	Open Burn
OLP	Oceanographic LIDAR Project
OPR	Office of Protected Resources
OSHA	Occupational Safety and Health Administration
Pb	Lead
PCB	Polychlorinated biphenyl
PM_{10}	Particulate matter less than or equal to 10 microns
PPF	Payload Processing Facility
ppm	Parts per million

ppt	Parts per thousand
QuikSCAT	Quick Scatterometer
RCRA	Resource Conservation and Recovery Act
REC	Record of Environmental Consideration
REEDM	Rocket Exhaust Effluent Diffusion Model
RISO	Rocket Impacts of Stratospheric Ozone
RLV	Reusbale Launch Vehicle
RMR	Radioactive Materials Report
RPC	Regional Purchase Coefficient
rpm	Revolutions per minute
RSM	Range Safety Manual
SCS	Soil Conservation Service
SEAWIFS	Sea-Viewing Wide Field-of-View Sensor
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SMA	Safety and Mission Assurance
SO_2	Sulfur dioxide
SOP	Standard Operating Procedure
SPCCP	Spill Prevention, Control, and Countermeasures Plan
SPEGL	Short-Term Public Emergency Guidance Level
SRP	Sounding Rocket Program
STEL	Short-term exposure limits
SVITE	Synthetic Vision Integrated Test and Evaluation Program
SWPPP	Stormwater Pollution Prevention Plan
TLV	Threshold Limit Values
TMA	Trimethyl aluminum
TOTS	Transportable Orbital Tracking Station
TRACE	Transition Region and Coronal Explorer
TSCA	Toxic Substance Control Act
TSDF	Treatment, Storage, and Disposal Facility
TTS	Temporary Threshold Shift
TWA	Time-Weighted Averages
UAV	Uninhabited Aerial Vehicle
URS	URS Group, Inc.
USACE	U.S. Army Corps of Engineers
USAEHA	U.S. Army Environmental Hygiene Agency
USC	United States Code
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service

UST	Underground Storage Tank
UV	Ultraviolet
VAC	Virginia Administrative Code
VACAPES OPAREA	Virginia Capes Operating Area
VCRMP	Virginia Coastal Resources Management Program
VDHR	Virginia Department of Historic Resources
VDOT	Virginia Department of Transportation
VM&P	Varnish Maker's and Painter's
VMRC	Virginia Marine Resources Commission
VOC	Volatile organic compound
VPDES	Virginia Pollutant Discharge Elimination System
WEMA	Wallops Employee Morale Association
WFF	Wallops Flight Facility
WOTS	Wallops Orbital Tracking System
WRA	Wind Resource Area
WS	Wildlife Services

1.1 WALLOPS FLIGHT FACILITY MISSION

During its early history, the mission of the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) Wallops Flight Facility (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 vehicles) and mission services. Under Wallops Mission 2005, WFF plans to rebalance its mission, continuing its strong operation and technology support for the science community, while renewing its emphasis on support to NASA's aerospace transportation goals (NASA, 2002b). This rebalancing will provide for a more effective utilization of WFF capabilities, lead to lower program costs, and provide support for currently underutilized resources. The WFF Mission 2005 "… was developed with the goals of leveraging the unique capabilities of WFF and providing high value to NASA's enterprises, while ensuring stability and a bright future for the facility and its workforce" (NASA, 2002b).

The strategic vision for WFF—"Wallops Flight Facility will be a national resource for enabling low-cost aerospace-based science and technology research"—has three primary mission themes that align with and support NASA's goals at WFF (NASA, 2002b). These mission themes, listed below, continue to expand existing WFF activities.

Mission Theme 1 - Enable Scientific Research

This mission theme supports the Earth and Space Science Programs by providing low-cost, highly capable suborbital and orbital carriers, mission management, and mission services to enable and conduct Earth and space science research.

Mission Theme 2 - Enable Aerospace Technology and Facilitate the Commercial Development of Space

This mission theme supports the Aerospace Technology and Human Exploration and Development of Space Programs by providing advanced aerospace technology development, testing, operational support, and facilitation of the commercial launch industry to enable frequent, safe, and low-cost access to space.

Mission Theme 3 - Enable Education, Outreach, and Innovative Partnerships

This mission theme supports other NASA goals and objectives by providing science and technology education and outreach programs, including innovative partnerships with academia, other government agencies, and industry.

1.2 BACKGROUND

WFF is a NASA facility under the management of GSFC. NASA is the land owner with multiple tenants, including the U.S. Navy, U.S. Coast Guard (USCG), Mid-Atlantic Regional Spaceport (MARS), and 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 located in the northeastern portion of Accomack County, Virginia, on the Delmarva Peninsula, and is comprised of the Main Base, Wallops Mainland, and Wallops Island (Figure 1).

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.

The Main Base at WFF includes management and administration buildings, engineering and design laboratories, research laboratories, the airfield and associated support infrastructure, radar, and U.S. Navy and USCG Housing (Figure 2). The Wallops Mainland facilities include radar antennas and transmitter systems and associated buildings (Figure 3a). Southern Wallops Island includes the open burn area, the launch complexes, and associated structures (Figure 3a). Northern Wallops Island includes rocket storage facilities, and the Navy's Aegis and Ship Self Defense System Facilities (Figure 3b).

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 a research airport. In addition, Wallops personnel provide mobile range capabilities, range instrumentation engineering, range safety, flight hardware engineering, and mission operations support.

A partnership with the U.S. Navy provides additional state-of-the-art range capabilities that can be employed in a joint operational manner, making the WFF range potentially the most capable in the world. Its partnership with MARS provides additional capabilities and offers attractive commercial benefits that include non-NASA capital investments, free trade zones, and other benefits that will ultimately enable the commercial development of space.

The carrier systems that are an integral part of the Wallops mission – airplanes, balloons, sounding rockets, and small payload carriers for the Space Shuttle – enable NASA to meet many of its goals in scientific research, technology, and instrument development. Missions flown on these carriers provide training for many young scientists and engineers who later become involved in larger orbital programs. This same fleet of carriers is a valuable resource for meeting NASA's educational outreach goals.

WFF provides resources and expertise to the aerospace, scientific, and technology communities. WFF uses its research airfield, fixed and mobile launch range, and orbital tracking facilities to provide cost-effective and quick response flight opportunities and data collection. The project management, design, and fabrication capabilities; research and testing abilities; and operations expertise of the WFF workforce and its partners enable NASA, other government agencies, and industry to meet prescribed objectives. These objectives include supporting the development of new technologies to increase the capabilities of launch platforms.

Figure 1 – Vicinity Map (USGS Quad) (11 x 17 color)

Figures 2 – Wallops Main Base Facilities (11 x 17 color)

Insert Figure 3a –Wallops Mainland and Southern Wallops Island Facilities (11x 17 color)

Insert Figure 3b – Northern Wallops Island Facilities (11x17 color)

NASA is committed to carrying out 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 the National Environmental Policy Act (NEPA) and other environmental regulations and Executive Orders (EO), conducts employee and supervisor training, and implements the facility's Environmental Management System (EMS). EMS is a coherent, integrated approach to environmental management. 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, WFF manages environmental risks.

1.2.1 Tenants and Other On-Site Organizations

U.S. Navy Surface Combat Systems Center

The U.S. Navy Surface Combat Systems Center is WFF's largest partner. Wallops Island is home to the unique replica of an Aegis cruiser and its destroyer combat systems. These systems are used to train naval officers and enlisted personnel in the operation and maintenance of sophisticated equipment used by the fleet onboard their Aegis cruisers and destroyers. The systems are also used to test concepts and solve operational problems. Other technical missions include Lifetime Support Engineering, In-Service Engineering, Systems Level operations, and maintenance training. The Surface Combat Systems Center supports the Aegis Training Unit by providing equipment on which replacement crew training is held. The U.S. Navy Ship Self Defense System Facility on Wallops Island conducts research, development, testing, and evaluation elements of shipboard systems, integration, and demonstrations of new shipboard systems. WFF also provides missile launch support for the U.S. Navy. Drone vehicles are used for target tracking and are engaged by both the Aegis facility and operational naval forces.

The Virginia Capes Operating Area (VACAPES OPAREA) is a surface and subsurface operating area off the Virginia and North Carolina coasts (Figure 4). It includes the area covered by Warning Areas (W) -386, W-387, W-72, W-50, W-108, W-110, R-6606, and the Submarine Transit Lanes. The VACAPES OPAREA is used for various surface, subsurface, and air-to-surface exercises. VACAPES OPAREA is managed by the Fleet Area Control and Surveillance Facility, Virginia Capes (FACSFAC VACAPES), located in Virginia Beach, Virginia. As a designated air traffic control facility, it is required to provide air traffic separation consistent with the guidelines used by the Federal Aviation Administration's (FAA) controllers, and provide for the safe, efficient and expeditious flow of air traffic.

Warning Area 386 (W-386) is special-use airspace over VACAPES OPAREA – Areas 1-12 off the coast of Maryland located approximately 96 kilometers (60 miles) east of the Naval Air Station Patuxent River, Channel 1231. W-386 extends from the surface to unlimited altitude, except that portion of the area west of 75° 30'W which is surface to, but not including, 2000-feet MSL. R-6604, located west of W-386, is part of WFF. Air-to-air, air-to-surface, surface-to-air, and surface-to-surface missile, gunnery, and rocket exercises using conventional ordnance are authorized. Antisubmarine Rocket (ASROC) exercises may be scheduled in W-386E.

National Oceanic and Atmospheric Administration (NOAA)

The NOAA National Environmental Satellite Data Information Service Command (NESDIS) operates environmental satellites, which collect information on atmospheric, oceanic, and

terrestrial environmental conditions. This data is distributed to various organizations to prepare short-term and long-range meteorological forecasts, monitor important environmental parameters, provide information critical to aviation and maritime safety, aid search and rescue missions, and assist in national defense and security. NESDIS satellites track the movement of storms, volcanic ash, and icebergs; measure cloud cover; measure temperature profiles in the atmosphere and temperature of the ocean surface; collect infrared and visual information; and measure atmospheric ozone levels. The Wallops Command and Data Acquisition Station (CDAS), an 11.7-hectare (29-acre) facility operated by NESDIS, gathers the data from the satellites via radio downlinks from 12 receiving antennas and controls satellites via transmission of radio signals through 5 transmitting antennas.

U. S. Coast Guard

The U.S. Coast Guard maintains housing units on 2.8 hectares (7 acres) south of the Main Base Entrance for personnel assigned to the Chincoteague Station.

Mid-Atlantic Regional Spaceport (MARS)

The Virginia Space Flight Authority is responsible for the development and operation of the MARS, a Federal Aviation Administration (FAA)-licensed commercial spaceport on Wallops Island. MARS operates the orbital Launch Complex 0, which includes both Pad 0-A and 0-B, and provides facilities and services for commercial launches of payloads into space. Activities include launch vehicle and payload preparation, integration and testing, pre-launch operations, launch range integration, and launch and post-launch operations.

Marine Science Consortium (MSC)

The MSC was founded in 1968 by a consortium of three colleges, although it was known by a different name at that time. This Consortium established a list of objectives that included the establishment and maintenance of a marine field station, promoting and encouraging learning and research in the marine and environmental sciences, and promoting activities that will create a broader understanding of the marine and environmental sciences. Fifteen academic institutions now comprise the MSC, whose main campus, the Wallops Island Marine Science Center, is located adjacent to the WFF Main Base and consists of over 23 hectares (57 acres) containing classrooms, wet and dry laboratories, a computer laboratory, residence buildings, faculty and staff residences, a cafeteria, library, recreational facilities, and an administrative building. Students from MSC frequently launch boats behind the WFF Visitors Center and conduct research in the nearby marshes.

Insert Figure 4 – VACAPES OPAREA (8.5 x 11 color)

1.3 PURPOSE AND NEED

The recurring activities and proposed future actions at WFF are how WFF achieves its mission. The WFF mission drives its programs and projects, which in turn drive its facilities and operations. The purpose and need for the proposed actions is to enable WFF to continue to meet its mission in an efficient and environmentally sound manner. This Site-Wide Environmental Assessment (EA) will facilitate WFF's compliance with the National Environmental Policy Act (NEPA) of 1969 in achieving its mission goals.

1.4 SCOPE OF THE SITE-WIDE ENVIRONMENTAL ASSESSMENT

NASA, in compliance with the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 *et seq*.), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Parts 1500-1508), and NASA policy and procedures (14 CFR 1216), has prepared this Site-Wide EA for recurring activities and proposed future actions at WFF. NASA has decided to analyze and address the potential impacts of current and future activities at the WFF site in one NEPA document in an effort to create a more integrated review and analysis. This document will provide a more comprehensive look at the potential impacts of activities at WFF and give the public a better overall understanding of WFF operations.

This Site-Wide EA evaluates typical recurring actions undertaken by NASA and NASA customers, as well as reasonably foreseeable future actions at WFF. At WFF, NASA supports its own operations and facilities, other NASA organizations and facilities, other government organizations, commercial industry, and academia through flight projects, mission operations, and use of facilities, people, and equipment. Tenant missions and supporting activities, such as development of non-NASA facilities and non-NASA programmatic activities, are not covered by this Site-Wide EA except to the degree that NASA activities play a meaningful role in those activities, such as launching tenant rockets or allowing tenants to use the NASA airfield. This document will facilitate NASA's compliance with NEPA at WFF by providing a framework to address the impacts of actions typically occurring and proposed at WFF.

When NASA has determined that NEPA analysis is required for a specific action at WFF, the action will be evaluated for coverage under this Site-Wide EA. The NASA WFF Site-Wide EA NEPA Checklist will be completed for proposed NASA actions at WFF to determine if the actions are covered under this Site-Wide EA (Appendix A). If the action is accurately and adequately covered under this Site-Wide EA (as determined by this checklist) and all applicable sections have been completed, a Record of Environmental Consideration (REC) will be prepared documenting the determination, and no further NEPA documentation will be required. If the checklist indicates the need for additional analysis under the Site-Wide EA, and if based upon that additional analysis and any appropriate mitigation measures, a determination of no substantial impact can be made, it will be documented in a REC and no further NEPA documentation would be required. If a specific action is expected to create impacts greater in magnitude, extent, or duration than those described in the Site-Wide EA, then additional NEPA documentation such as a separate EA document would be prepared for that action.

This Site-Wide EA will be subject to review at a maximum of every 10 years to remain current with relevant rules, regulations, scientific findings, and the NASA/WFF mission. If substantial new information becomes available, such as during the 5-year update of the WFF Environmental Resource Document, this Site-Wide EA will be updated.

1.5 RELATED ENVIRONMENTAL DOCUMENTATION

WFF has had a long history of environmental stewardship. Existing NEPA documents and environmental resources reports were used as the basis for the current operations and existing conditions discussions in this Site-Wide EA. The WFF Master Plan concept was used to identify future actions. In many cases, data were taken from NASA's 1999 Environmental Resources Document (ERD) because it contains the most recent operational and environmental resources information (NASA, 1999a). The following documents analyze single actions at WFF or take a broad look at resources and potential impacts and were reviewed in preparing this Site-Wide EA:

- Environmental Resources Document NASA Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Virginia 23337. 1999;
- Wallops Mission 2005. O'Keefe. 2002;
- Goddard's Wallops Flight Facility Strategic Overview. Campbell. 2003;
- Final Environmental Assessment for AQM-37 Operations at the National Aeronautics and Space Administration, Goddard Space Flight Center Wallops Flight Facility, Wallops Island, Virginia 23337. 2003;
- Environmental Assessment for a Payload Processing Facility, National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility, Wallops Island, Virginia 23337. 2003;
- Final Supplemental Environmental Impact Statement for Sounding Rocket Program, National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility, Wallops Island, Virginia 23337. 2003; and
- Environmental Assessment for Range Operations Expansion at the National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility, Wallops Island, Virginia 23337. 1997.

WFF's mission is to further scientific technology, educational, and economic advancement by supplying facilities and expertise to enable frequent flight opportunities for a diverse customer base. WFF is a national resource for providing low-cost integration and operation of suborbital and small orbital payloads that support space-based research focused on Earth and its environments. Scientists and engineers from NASA, other government agencies, colleges and universities, private industry, and the worldwide scientific community use WFF's assets and services.

The Proposed Action is to continue existing WFF operations, expand operations, construct new facilities, demolish facilities, and improve facilities. WFF is working toward enhancing its capabilities by unifying the organization through a Master Plan concept. The Master Plan concept seeks to provide the following:

- Employees with safe work areas;
- Limit access and increase security for mission-critical activities and critical assets;
- Consolidate people and facilities so they are communicating and working effectively;
- Replace mission essential infrastructure that is in disrepair and guide the replacement by land use;
- Search for public and private financing; and
- Optimize facility investment by aligning NASA planning with existing partners' mission planning and investments (NASA, 2003c).

The Master Plan establishes a core management, engineering, and science area surrounded by operations and then by commercial activities (Figures 5a and 5b). The current Master Plan concept for WFF has several major goals, three of which are to focus on performance, unify the organization, and optimize center resources. WFF intends to do this by phased development of a Core Campus Area. The Master Plan "campus core" concept consolidates inherently governmental functions into a functional core area surrounded by an operations area, with anticipated commercial areas on the outskirts (construction of commercial areas would be covered under separate NEPA documentation). The core area would consist of a science, engineering, project management and administration neighborhood; the operations area would be located for functionality and would include range operations, the ground network, sounding rocket program, and institutional support facilities; and the commercial area would include shared use facilities, research park activities, and non-inherently governmental functions (for example, chemical laboratory, health unit, etc.). This allows for the consolidation of people and facilities based on job function so they are communicating and working together more effectively. This Core Strategy minimizes the chance of any conflict in land uses.

The Proposed Action consists of two categories of activities – Institutional Support and Operational Components. Institutional Support includes construction, demolition of facilities, and routine site activities. Institutional Support also includes permanent physical improvements to buildings, equipment, utilities, and other infrastructure, as well as expansion of activities. Operational Components include rockets, balloons, piloted aircraft, uninhabited aerial vehicles, autonomous underwater vehicles, payloads, tracking and data systems, scientific research programs and facilities, educational programs, the open burn area, rocket boosted projectile testing, and airfield operations.

The actual schedule for implementation of the facility improvements depends upon Federal budgeting decisions and fluctuating priorities; therefore, the Proposed Action cannot be specific with respect to actual construction schedules. In addition, certain site planning and architectural details are tentative and subject to modification. Consequently, those actions most likely to occur in the short-term implementation period are analyzed based on information available at this time, and the analyses recognize that some modifications would be expected. Proposed construction activities are physically constrained by existing infrastructure, current Environmental Restoration Program (ERP) areas, sensitive natural resources, and potential cultural resources (Figure 6a, 6b, and 6c). Operational constraints include current and future land use concepts, airport overlay zones, radio frequency quiet zones, and hazardous operations zones. These factors limit the areas where construction can occur and have helped to bound the Proposed Action and complete the analysis in Section 4.0.

To assess the impacts operations may have on resources at WFF, a range or "envelope" of activities was identified for the actions described in the following sections. The largest envelope for each operation was used to assess impacts. For instance, the largest rocket anticipated to be launched from WFF was used as a model for assessing air quality impacts in Section 4.2.3. Smaller rockets would have fewer impacts; therefore, if a larger rocket has an insignificant impact on a resource, a smaller rocket would also fall within this range of impacts and have an insignificant impact. Table 2-1 lists the Proposed Action and the associated envelopes for this Site-Wide EA.

Table 2-1 Summary of the Proposed Actions

Institutional Support	Actions	Envelope
New Construction	Campus Core: Phase I - Project Support Building; Phase II - Range Administration Building; Phase III - Administration Building; Phase IV - Management Education Center Addition and proposed roads; Phase V - Science Building. M-Area Control Building, Wind Turbine, Central Chiller Plant for E-Area, Advanced Materials and Electronic Laboratory, Wallops Island Fire Station, Rocket Motor Inspection Building, Consolidated Shipment Receiving and Administration Building, Technical Support Building, Commons Facility, permanent liquid and/or cryogenic fuels storage tanks, and Replacement of Buildings N-222 and F-2, additional administration buildings, laboratories, institutional buildings, tracking facilities, communications towers, observation facilities, launchers, launch pads, storage facilities, parking lots, and other infrastructure to support the mission.	For construction not listed, WFF will complete the Site-Wide EA Checklist and determine if substantial impacts would occur to or from geology and soils, topography and drainage, land use, surface or stormwater, wetlands, floodplains, coastal resources, air quality, noise, hazardous materials or waste, radiation sources, vegetation, wildlife and migratory birds or threatened and endangered species, cultural and historic resources, population growth, or to the health and safety of the employees or surrounding human or physical environment.

Table 2-1 Summary of the Proposed Actions		
Institutional Support	**Actions**	**Envelope**
Demolition	F-027, F-030, F-211, H-023, H-114, M-003, M-004, M-005, M-006, N-168, F-008, Y-036, Y-037A, E-108, H-002, H-003, H-004, H-005, H-006, H-007, H-008, H-011, H-0012, H-015, H-016, H-017, H-018, H-019, H-020, H-021, H-024, H-025, H-026, H-027, H-028, A-027, V-026, V-130, W-025, W-096, X-105, Y-038A, Y-064, Z-042, W-100, W-126, W-105, W-110, W-116, W-125, W-128, Y-050, Y-060, Y-067, Z-041, and additional structures and infrastructure as necessary.	Structures would be analyzed for lead-based paints, and asbestos and PCB containing materials. For demolition not listed, WFF would complete the Site-Wide EA Checklist and determine if substantial impacts would occur to or from geology and soils, topography and drainage, land use, surface or stormwater, air quality, noise, hazardous materials or waste, radiation sources, vegetation, wildlife and migratory birds, cultural and historic resources, or to the health and safety of the employees or surrounding human or physical environment.
Maintenance and Improvements	Maintenance and improvements of buildings, grounds, equipment and other facilities; sea wall repair or enhancement; causeway fender replacement; wildlife management; and brush and tree clearing.	For maintenance and improvements not listed, WFF would complete the Site-Wide EA Checklist and determine if substantial impacts would occur to or from geology and soils, surface or stormwater, air quality, noise, vegetation, or cultural and historic resources.
Utility Infrastructure	Utility infrastructure repair replacement, or upgrade; Public-Public Partnership; new electrical distribution system to the Island	For utility infrastructure not listed, WFF would complete the Site-Wide EA Checklist and determine if substantial impacts would occur to storm water or air quality.
Transportation Infrastructure	Repaired, upgraded, removed, or new construction	For transportation infrastructure not listed, WFF would complete the Site-Wide EA Checklist and determine if substantial impacts would occur to stormwater.
Fabrication	Continuation of fabrication activities	For fabrication not discussed, WFF would complete the Site-Wide EA Checklist and determine if substantial impacts would occur to or from air quality, noise, hazardous materials or waste, or to the health and safety of the employees or surrounding human or physical environment.
Payload Processing	Continuation of payload processing activities and the addition of fueling payloads on site. Addition of a scrubber on the PPF.	See payload envelopes.

Table 2-1 Summary of the Proposed Actions		
Institutional Support	**Actions**	**Envelope**
Fueling	Continuation of fuel storage activities. Add permanent fuel storage tanks to temporarily store liquid fuels and/or cryogenic fuels on the Island. Operate a mobile liquid fueling facility. Upgrading fuel storage facilities to aboveground double-lined storage units.	See fuel envelopes. Storage of fuels must be in compliance with the ICP.
Storage	Continuation of storage activities.	For storage not discussed, WFF would complete the Site-Wide EA Checklist and determine if substantial impacts would occur to or from surface or groundwater, air quality, hazardous materials or waste, cultural and historic resources, or to the health and safety of the employees or surrounding human or physical environment.
Safety and Security	Continuation of activities and upgrading security and fire suppression equipment.	For safety and security measures not discussed, WFF would complete the Site-Wide EA Checklist and determine if substantial impacts would occur to surface water, cultural and historic resources, or to the health and safety of the employees or surrounding human or physical environment
Operational Components	**Action**	**Envelope**
Rockets	Continuation of rocket program with an increase of rocket launches per year. Orbital rocket launches would increase to 12 per year. Sounding rocket launches would increase to 60 per year. Drone targets would increase to 30 flights per year.	**Orbital rockets** cannot be larger than the Athena-3's class vehicle propellant weight of approximately 133,120 kilograms (293,479 pounds). Orbitals cannot be launched more than 12 times per year. **Sounding rockets** cannot be larger than the Black Brant XII's propellant weight of approximately 3,350 kilograms (7,385 pounds). Sounding rockets cannot be launched more than 60 times per year. **Drone targets** would not exceed impacts of the AQM-37 and no more than 30 missions would be flown per year.

Table 2-1 Summary of the Proposed Actions		
Operational Components	**Action**	**Envelope**
Fuel Types	Continuation of current liquid and solid fuel usage and addition of hybrid fuels as they become available.	Fuels must be: heating oil #2 or #6, jet fuel JP-5 or JPTS, diesel fuel, gasoline, propane gas, ammonium perchlorate/aluminum, nitrocellulose/nitroglycerin, kerosene, liquid oxygen, liquid hydrogen, liquid nitrogen, hydrogen peroxide, or anhydrous hydrazine or its derivatives. Future hybrid fuels must have fewer potential environmental impacts than the solid fuels analyzed in this Site-Wide EA and pose a lesser safety risk than current liquid fuels and fueling systems.
Motor Types	Continuation of current motor types with the addition of new types when they come available.	Motors must fall within the enveloped emissions of the Castor 120™ with eight Castor IV™ strap-on motors.
Balloons	Continue to launch weather balloons and small science balloons.	Balloons no larger than 1,132,673 cubic meters (40,000,000 cubic feet). Payloads no larger than 3,628 kilograms (8,000 pounds).
Piloted Aircraft	Continuation of current piloted aircraft operations. Commercialize aircraft operations.	Flight operations would not expand more than 25 percent. Non-NASA aircraft may be managed and based at WFF as long as no additional airfield infrastructure is required due to that action. If the basing of non-NASA aircraft would require additional airfield infrastructure, an EA or EIS would be required.
Uninhabited Aerial Vehicles	Increase operations to more than 75 flights a week.	**Uninhabited Aerial Vehicles-** No larger than 1/5 the size of a Boeing 757: **Thrust:** Does not exceed 3,946 kilograms (8,700 pounds). **Fuel:** Not more than 8,695 Liters (2,297 gallons) of Jet-A fuel. **Payload:** Maximum 6,550 kilograms (14,442 pounds) with total weight of 23,133 kilograms (51,000 pounds).

Table 2-1 Summary of the Proposed Actions		
Operational Components	**Action**	**Envelope**
Autonomous Underwater Vehicles	Begin coastal research with AUVs.	Does not exceed size and depth capability of International Submarine Engineers' Theseus vehicle: **Size:** Diameter: 1.27 meters (4 feet); Length: 10.6 meters (35 feet); Weight: 8,618 kilograms (19,000 pounds). **Depth capability:** 1000 meters (3,281 feet).
Payloads	Increased payload launches.	Radio frequency electromagnetic fields must be within ANSI recognized acceptable levels as stated in IEEE C95.1-1991. Lasers must meet ANSI safety standards (ANSI Z136.1-2000 and ANSI Z136.6-2000). Radioactive material is approved by the Nuclear Flight Safety Assurance Manager in accordance with NPR 8715.3. Biological agents must fall under the Centers for Disease Control Biosafety in Microbiological and Biomedical Laboratories rating of Biosafety Level 1. Chemical releases must not be ozone depleting chemicals and cannot have a significant adverse effect on the atmosphere. All orbital payloads must comply with the requirements of NPD 8710.3 NASA Policy for Limiting Orbital Debris Generation and NSS 1740.1. A debris assessment would need to be prepared as required by this policy. Re-entry payloads would carry a maximum weight of 90 kilograms (200 pounds) of fuel. Fuel sources would be identical to those used on the launch vehicle (e.g., solid rocket fuel, liquid oxygen/kerosene, liquid oxygen/liquid hydrogen, or a hybrid fuel). Re-entry payloads must comply with the requirements of NPD 8700.2A, NASA Policy for Safety and Mission Assurance (SMA) for Experimental Aerospace Vehicles (EAV) (Revalidated 4/28/04).

Table 2-1 Summary of the Proposed Actions		
Operational Components	**Action**	**Envelope**
		All payloads must comply with the requirements of NPD 8700.3A, Safety and Mission Assurance (SMA) Policy for NASA Spacecraft, Instruments, and Launch Services.
Tracking and Data System	Continuation of mission.	Radio frequency electromagnetic fields must be within ANSI recognized acceptable levels as stated in IEEE C95.1-1991.
Scientific Research Programs and Facilities	Since WFF is a research facility, the types of laboratories could change with the requirements of testing.	Radio frequency electromagnetic fields must be within ANSI recognized acceptable levels as stated in IEEE C95.1-1991. Lasers meet ANSI safety standards. Radioactive material is approved by the Nuclear Flight Safety Assurance Manager in accordance with NPR 8715.3. Biological Agents must fall under the Centers for Disease Control Biosafety in Microbiological and Biomedical Laboratories rating of Biosafety Level 1. Chemical releases must not be ozone depleting chemicals and cannot have a significant adverse effect on the atmosphere.
Educational Programs	Continuation of current educational programs.	For educational programs not discussed, WFF would complete the Site-Wide EA Checklist and determine if substantial impacts would occur to air quality or to the health and safety of the employees or surrounding human or physical environment.
Open Burn Area	Continue Waste Management Plan to reduce the need to use the open burn area. Continue to burn rocket motors.	The maximum amount of propellant to be disposed of per year is 68 metric tonnes (75 tons).
Rocket Boosted Projectile Testing	Continue Rocket Boosted Projectile Testing.	Proposed project cannot exceed 20 projectile missions per year.
Airfield Operations	Continue airfield operations.	For airfield operations not discussed, WFF would complete the Site-Wide EA Checklist and determine if substantial impacts would occur to or from, surface or stormwater, air quality, noise, hazardous materials or waste, wildlife and migratory birds, or to the health and safety of the employees or surrounding human or physical environment.

Insert Figure 5a - Main Base Land Use Strategy (8.5 x 11 color)

Insert Figure 5b - Wallops Mainland and Wallops Island Land Use Strategy (8.5 x 11 color)

Insert Figure 6a – Main Base Areas of Increased Sensitivity (11 x 17 color)

Insert Figure 6b – Wallops Mainland and Southern Wallops Island Areas of Increased Sensitivity (11 x 17 color)

Insert Figure 6c – Northern Wallops Island Areas of Increased Sensitivity (11 x 17 color)

This section has been organized into two primary categories – Institutional Support and Operational Components. The actions listed under these categories are covered by this Site-Wide EA.

2.1 INSTITUTIONAL SUPPORT

2.1.1 Construction Program

WFF will sustain its vision to be a national resource for enabling low-cost aerospace-based science and technology research. To fulfill the vision and mission themes stated in Section 1.1, new facilities and infrastructure will be necessary in the future and may require construction. The major goals of the construction program are to restore an aging infrastructure, address environmental concerns, and support the enhancement of WFF's research and development capabilities. Physical limitations to construction include existing infrastructure, current hazardous waste sites, sensitive natural resources, and potential cultural resources. Operational limiting factors for construction include current and future land use concepts, airport overlay zones, radio frequency quiet zones, and hazardous operations zones.

WFF will continue to expand and complete its mission through the construction of new facilities. New construction includes planned and anticipated facilities, relocation of structures, and renovation of existing structures to meet current and future needs. These structures could include anything at WFF from the security features to the seawall. Many structures at WFF are obsolete and it is impractical to repair or renovate them. These structures may have to be repaired by replacement to maintain ongoing facility operations or support new operations. In these cases, WFF would repair the existing structure by remediating all potential hazardous materials within the structure (i.e., lead-based paints, asbestos-containing-materials, polychlorinated biphenyl materials) and replace the structure by demolition and reconstruction. The replacement building would incorporate sustainable design elements such as energy-and water-efficient equipment, environmentally friendly and recycled materials, and the use of natural lighting.

The construction program consists of new construction, repair, renovation, relocation, and demolition to fulfill projects currently planned for WFF and potential future projects identified for supporting WFF's mission.

WFF is working toward enhancing its capabilities by unifying the organization through an approved land use plan that drives master planning. In accordance with the Master Plan concept, WFF is planning to centralize the science, engineering, project management, and administrative disciplines by creating a campus core area (Figure 7). The campus core area would provide: integrated engineering laboratory and office space; centralized critical range management operations; project and laboratory space for WFF's growing Earth Science programs; central service areas for quality of work life facilities; and a neighborhood/campus for the Management Education Center (MEC) by grouping dormitories, conferencing facilities, and larger classrooms. Construction is planned to take place in five phases. Phase I of the campus core is construction of the Engineering Building and the Project Support Building. The Engineering Building is not discussed further in this Site-Wide EA because impacts from its construction have been analyzed in a separate NEPA document.

Insert Figure 7 – Conceptual Plan - Campus Core Area (8.5 x 11 color)

Project Support Building

Phase I of the campus core includes construction of the Project Support Building that would be located west of the Range Control Center (Figure 7). The proposed location of the Project Support Building is currently a paved area. The total area of the proposed Project Support Building would be approximately 856 square meters (9,220 square feet) and two stories in height. The design is focused around the needs of large project support teams by incorporating team break-out rooms, a multimedia-equipped large group planning area, and display areas. The multimedia area would be designed to seat approximately 272 people. The total building capacity would be approximately 350 persons.

Campus Area

Concept Phases II through V of the campus core include additional construction to support the campus core area. The construction for these phases has not been designed and the phasing could change based on WFF's changing mission priorities. Phase II would include the construction of a Range Administration Building adjacent to the Phase I Project Support Building. Phase III would include construction of the new Administration Building adjacent to the newly constructed Range Administration Building. Phase IV would include construction of an addition to the existing Administration Building (F-6) for use as an expanded MEC. Phase IV would also include the construction of a new road linking Bond Street to Avery Street. Phase V, the final conceptual phase, would include construction of the Program Support office building and the Science Building. The Program Support office building would be adjacent to the Administration Building, and the Science Building would be adjacent to Fulton Street and Building E-106.

M-Area Control Building

The M-Area Control Building would be constructed to accommodate all non-hazardous operations associated with rocket motor fabrication and storage. The proposed building would be located along the access road to the M-Area north of the runway (Figure 8). The project would include site preparation and the construction of a 204 square meter (2,200 square foot) one-story structure to house project rooms, office space, restrooms, LAN closet, janitor's closet, and storage space. The project would include all civil, architectural, mechanical, and electrical work necessary for a complete facility. Approximately 0.4 hectare (1 acre) of trees would be cleared from the proposed site.

Insert Figure 8 – Location of M-Area Control Building (11 x 17 color)

Wind Turbine

WFF may construct a wind turbine on either the Main Base, Wallops Island, or Wallops Mainland. The proposed wind turbine would be approximately 60 meters (196.8 feet) in height and the blades would be approximately 26 meters (85.3 feet) in length. There are two potential locations to place this turbine. The first potential location is on the northeast corner of Wallops Island, just west of the main road, approximately 1.2 kilometers (0.8 miles) southwest of Cow Gut Flat. The second potential location is on Wallops Mainland at the southwest corner of the property boundary. The wind turbine blades would rotate at 14 to 31 revolutions per minute (rpm) and is proposed to generate 1 megawatt of power to supplement electrical supplies to Wallops Island. The wind turbine would account for approximately 25 percent of the required power on Wallops Island and would reduce fossil fuel consumption by providing a renewable source of energy.

Future Planned Construction

Additional facilities may be constructed at WFF in support of its mission. These facilities could include administration buildings, laboratories, institutional buildings, runways, tracking facilities, communications towers, observation facilities, launchers, launch pads, storage facilities, parking lots, and other infrastructure. Table 2-2 displays specific anticipated construction projects, with the fiscal year (FY) for which they are planned, if known.

Table 2-2 Specific Anticipated Construction Projects

Project Title	Anticipated Construction Year
Project Support Building	FY 2005
M-Area Control Building	FY 2005
Administration Building	Unknown
Addition to the Administration Building for MEC use	Unknown
Commons Facility	Unknown
Science Building	Unknown
Wind Turbine	Unknown
Central Chiller Plant for E-Area	FY 2007
Advanced Materials and Electronics Laboratory	FY 2008
Wallops Island Fire Station	FY 2008
Range Administration Building	FY 2008
Rocket Motor Inspection Building	FY 2009
Consolidated Shipment Receiving and Administration Building	FY 2010
Replacement of Building N-222	FY 2010
Replacement of Building F-2	FY 2010
Technical Support Building	FY 2011
Permanent Liquid and/or Cryogenic Fuels Storage Tanks on Wallops Island	Unknown

2.1.2 Demolition Program

WFF could demolish existing structures to meet current and future needs. Demolition involves tearing down structures, then removing the material for disposal at a Federal or State-permitted facility. Table 2-3 lists structures proposed for demolition through FY 2009; Figures 9a, 9b, and 9c show the locations of the structures. Future demolition activities at WFF could include removal of administration buildings, laboratories, institutional buildings, runways, tracking facilities, observation facilities, launchers, launch pads, storage facilities, parking lots, and other infrastructure to support the WFF mission.

Table 2-3 Property Scheduled For Demolition through FY 2009

Building Number	Property Name	FY
N-168	ADAS TRKG Antenna PED TWR	2005
F-008	Plating Shop	2005
F-030	WEMA Recreation Facility	2005
H-002	U.S. Coast Guard Family Housing	2005
H-003	U.S. Coast Guard Family Housing	2005
H-004	U.S. Coast Guard Family Housing	2005
H-005	U.S. Coast Guard Family Housing	2005
H-006	U.S. Coast Guard Family Housing	2005
H-007	U.S. Coast Guard Family Housing	2005
H-008	U.S. Coast Guard Family Housing	2005
H-011	U.S. Coast Guard Family Housing	2005
H-012	U.S. Coast Guard Family Housing	2005
H-015	U.S. Coast Guard Family Housing	2005
H-016	U.S. Coast Guard Family Housing	2005
H-017	U.S. Coast Guard Family Housing	2005
H-018	U.S. Coast Guard Family Housing	2005
H-019	U.S. Coast Guard Family Housing	2005
H-020	U.S. Coast Guard Family Housing	2005
H-021	U.S. Coast Guard Family Housing	2005
H-024	U.S. Coast Guard Family Housing	2005
H-025	U.S. Coast Guard Family Housing	2005
H-026	U.S. Coast Guard Family Housing	2005
H-027	U.S. Coast Guard Family Housing	2005
H-028	U.S. Coast Guard Family Housing	2005
F-027	Paper Shredder Facility	2006
F-211	Auto Parts Storage Facility	2006
H-023	Water Pump House	2006
H-114	Water Pump House	2006
M-003	Underground Magazine	2006

Table 2-3 Property Scheduled For Demolition through FY 2009		
Building Number	**Property Name**	**FY**
M-004	Underground Magazine	2006
M-005	Underground Magazine	2006
M-006	Underground Magazine	2006
Y-036	Firing Cubical	2006
Y-037A	Launch Complex Fire Cubical 2	2006
A-027	Pistol Range	2006
V-026	Hot Pay ASSEM & CKOUT Building	2006
V-130	Wooden Tower	2006
W-025	Hazardous Waste Storage Building	2006
W-096	ASSY & CKOUT ENVIR Mobile shelter	2006
X-105	Shop & Elect Material Storage Bldg	2006
Y-038A	Launch Complex Fire control shelter	2006
Y-064	POMB Materials Storage Bldg	2006
Z-042	S. Launch Pad Terminal Bldg	2006
W-100	Utility Bldg (Pad 3A)	2007
W-126	Trailer Shelter & Supply Bldg	2007
W-105	Winch Bldg (Pad 3A)	2008
W-110	Guard House (Pad 3A)	2008
E-108	Range Engineering Building	2008
W-116	Service & Storage Bldg	2008
W-125	Launcher Service Bldg (Pad 3A)	2008
W-128	Spacecraft Environmental Control Equip	2008
Y-050	Rocket Flight Hardware Storage Facility	2008
Y-060	Island Radar Control Bldg	2008
Y-067	Support Cubical	2008
Z-041	Multi-function Radar Facility	2009

Insert Figure 9a – Demolition Plan – Main Base (8.5 x 11 color)

Insert Figure 9b – Demolition Plan – North Island (8.5 x 11 color)

Insert Figure 9c – Demolition Plan – South Island (8.5 x 11 color)

2.1.3 Routine Site Activities

Routine site activities at WFF include recurring actions that are conducted to support facility operations and the WFF mission. The activities discussed under this category include Maintenance and Improvements, Utility Infrastructure, Transportation Infrastructure, Fabrication, Payload Processing, Fueling, Storage, and Safety and Security.

2.1.3.1 Maintenance and Improvements

The diverse functions and the magnitude of WFF projects require continuing routine repairs and maintenance of buildings, grounds, equipment, and other facilities. Aircraft, vehicles, laboratory equipment, and instrumentation must be continually maintained. Existing infrastructure such as grounds, roads, and utilities must be maintained on a regular basis to ensure the ongoing operation of the facility. Existing buildings require ongoing maintenance and are managed by the Wallops Facilities Management Branch. Buildings may be rehabilitated or upgraded to meet specific project needs. Brush and trees may need to be removed to construct a new building, keep the airfield's Clear Air Space free of intrusions, manage wildlife, maintain boresight tower line-of-sight, or enhance operation of radar and other radio frequency equipment. Routine repairs are often required after hurricanes or Northeasters. NASA contractors and heavy equipment are used to clear roads, clear stormwater systems, and move beach sand back to its original pre-storm location.

<u>Sea Wall</u>

The sea wall on Wallops Island is approximately 5,029 meters (16,500 feet) in length. It starts at the north end of Building V-24 and ends near Building Z-40. It is the primary shore protection feature for Wallops Island. The existing wall consists of large stone and rip-rap piled to a height of approximately 4.6 meters (15 feet). The sea wall may be repaired or enhanced as needed.

<u>Causeway</u>

The causeway connecting Wallops Mainland to Wallops Island currently has a piling fender system to protect the structure from boat collisions. This fender may be replaced as needed.

<u>Wallops Island Shoreline</u>

WFF operates four docks that allow access to the waters surrounding Wallops Island. These docks include the boat basin adjacent to the Visitors Center, the Oyster Bay dock at the end of Route 692, the Hog Creek dock adjacent to Building Z-25, and the North Island dock adjacent to Building V-80. In the future, the docks may be repaired or the basin dredged as needed by the U.S. Army Corps of Engineers (USACE). The USACE would be responsible for the NEPA documentation associated with the repair or replacement of the docks, as well as any dredging.

The USACE, Norfolk District, is responsible for keeping Chincoteague Inlet navigable. As needed, the USACE dredges the channel to a controlled depth of 1 to 2 meters (3.3 to 6.5 feet) to allow boat traffic from Chincoteague and the Virginia Inside Passage to navigate safely to the Atlantic Ocean. Dredge material from this operation is sometimes placed on Wallops Island and helps to provide a buffer between the ocean and the existing sea wall.

The Norfolk District also conducts dredging of the Virginia Inside Passage (also known as the Waterway on the Coast of Virginia). The channel is dredged to a controlled depth of 1.8 meters

(6 feet). Currently, dredge material is pumped into the Atlantic Ocean or placed on the beaches of Wallops Island to serve as a buffer between the ocean and the existing sea wall. There is the potential for a large beach replenishment project to occur on Wallops Island, in which USACE would place dredge material east of the sea wall to act as the primary buffer between essential facilities and the ocean.

The USACE has the lead role for completing the environmental documentation related to dredging operations and placement of the dredged materials on Wallops Island; therefore, these actions are not covered under this Site-Wide EA.

Wildlife Management

WFF currently conducts wildlife management activities in the Aircraft Operating Area (AOA) at the Main Base. Under an agreement with WFF, the Wildlife Services (WS) Department of the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) assists in managing wildlife risks to aviation. Past tactics have included harassment, trapping, habitat modification, and sharp shooting to control deer and waterfowl. WFF has completed Records of Environmental Consideration (REC) for these activities (NASA, 1999b; NASA, 2000B; NASA, 2003d). The RECs came to the conclusion that there was no significant impact and determined that wildlife management is necessary for aviation safety at WFF.

Tree Clearing

WFF and its partners conduct many programs that need unobstructed airspace. However, in certain areas, there are trees that intrude into this air space. These intrusions pose operational and/or safety concerns. Through a process that includes assessment, planning, and cutting, trees and shrubs may be cleared if:

- WFF's existing programs or activities require unobstructed air space, or
- Re-growth of trees interferes with existing or new programs or activities at WFF.

Limitations to the cutting activities will be determined during the assessment and planning stages. Those limitations may include tree removal budget, erosion and sedimentation laws, wetland regulations, equipment availability, size of the project, and ownership of the trees and/or land.

2.1.3.2 Utility Infrastructure

Utility infrastructure is essential to the operation, safety, and mission goals at WFF. This infrastructure is continuously being upgraded or replaced as the need arises. Infrastructure systems currently in place at WFF include:

- Storm drainage system;
- Potable water supplied by deep wells on site;
- Sanitary sewer systems that include a Federally Owned Treatment Works, pump station, force mains, and septic systems;
- Steam heating lines supplied by diesel-fired boilers;

- Electrical lines supplied by private power companies with facility-owned back-up generators;
- Telephone systems; and,
- Communications that run on a T-3 LAN system over all three land masses.

WFF would repair and/or upgrade the communications, electrical, potable water, stormwater, and sanitary sewer lines as needed.

Potable Water and Wastewater

WFF and Accomack County are considering a Public-Public partnership to transfer operations of supplying potable water and treatment of wastewater to a public entity under a long-term lease agreement. The partnership would allow NASA to meet its water and sewer requirements at WFF while reducing costs, by allowing public ownership of infrastructure and access to WFF's underutilized infrastructure and excess capacity. Currently, the Town of Chincoteague holds an easement for the use of several groundwater wells. The Town is responsible for its own permits, and any Public-Public partnership would be responsible for obtaining and meeting all permit requirements for potable water withdrawal, treatment of wastewater, and upgrading, adding, or closing wells.

Electrical Distribution System

WFF is proposing a new electrical distribution system that would replace the existing primary electrical service conductors to Wallops Island. This is a three-phase project. Phase I would consist of the installation of approximately 1,485 meters (4,875 feet) of ductbank from the Switching Station Building (U-12) to the west side of the Causeway Bridge. Two sets of electrical feeders would be pulled though two of the four conduits in the ductbank, and two conduits would be left empty for future telecommunication cabling. Five new electrical manholes and seven new telecommunication manholes would be installed along the ductbank.

Phase II would consist of the installation of approximately 1,025 meters (3,365 feet) of ductbank from the east side of the Causeway Bridge to the Switching Station Building on the island (X-141). Two sets of electrical feeders would be pulled though two of the four conduits, and the remaining conduits would be left empty for future telecommunication cabling. Four new electrical manholes and seven new telecommunication manholes would be installed along the ductbank.

Phase III would consist of the installation of PVC-coated steel conduit and electrical feeders across the Causeway Bridge. Junction boxes would be provided on either end of the bridge. Two telecommunication manholes would be installed. Approximately 643 meters (2,111 feet) of ductbank would connect the ductbanks installed under Phases I and II.

2.1.3.3 Transportation Infrastructure

The Main Base and Wallops Mainland are connected by approximately 9.65 kilometers (6 miles) of Route 679, a paved, two-lane road maintained by the Commonwealth of Virginia. A NASA-owned road, bridge, and causeway link Wallops Mainland to Wallops Island. Hard surface roads provide access to all buildings on WFF. NASA maintains all roads within the facility. Additionally, the Main Base has extensive sidewalks and parking lots. The transportation

infrastructure may be repaired, upgraded, or removed, or new infrastructure may be constructed. WFF is planning to develop a new right-of-way agreement with the Virginia Department of Transportation (VDOT) for the portion of Route 175 that borders or passes through WFF property. The new right-of-way would supersede existing rights-of-way granted to VDOT.

2.1.3.4 Fabrication

The Payload Fabrication and Integration Laboratory located in Building F-10 on the Main Base includes facilities for mechanical and electrical construction of payloads. The Payload Laboratory also provides quality assurance and quality control inspections for assembled payloads. The laboratory can support multiple payload processes simultaneously, including telemetry ground stations and clean room facilities. A fully equipped machine shop in Building F-10 is capable of fabricating sounding rockets, payloads, and launch vehicle components. There are facilities for the fabrication of electrical components such as circuit boards, cables, and custom interfaces used between experimental and standard sounding rocket components.

Balloon materials testing, including tensile strength, creep, snatch, permeability, stretch, and cold brittle point tests are conducted in Building F-7. Machine shops in Building F-7 fabricate, test, verify, and integrate mechanical hardware such as circuit boards, cables, and custom interfaces with electrical software for balloon components.

The bodies and electrical control and communication systems of UAVs are fabricated in the machine shop in Building C-15. This facility contains a vacuum chamber where UAV and pointing systems are tested at temperatures ranging from -70°Celsius (C) to 177°C (-94°Fahrenheit [F] to 350°F) and at pressures up to 8.28 Torr (0.16 pounds per square inch).

2.1.3.5 Payload Processing

Payload processing occurs in Buildings F-7, M-16, M-20, X-15, W-65, Y-15, and F-10. A new Payload Processing Facility (PPF) is currently under construction and will include facilities for mechanical and electrical construction of payloads as well as fueling (NASA, 2003b). An air scrubber will be added to the PPF to ensure that fumes from fueling do not harm NASA staff or the local air quality. The PPF will also provide quality assurance and quality control inspections for assembled payloads. WFF can support multiple payload processes simultaneously, including fabrication, environmental testing, integration, and clean room facilities. Work areas are available to perform preparatory and post-integration inspections.

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

2.1.3.6 Fueling

Fueling activities at WFF occur throughout the facility. Fuels used at WFF include heating fuel oils #2 and #6, jet fuels JP-5 and JPTS, liquid rocket fuel, diesel fuel, gasoline, and kerosene. Fuel is stored in aboveground storage tanks (ASTs), underground storage tanks (USTs), and within mobile units. WFF has a portable hydrazine fueling system used for fueling spacecraft prior to launch operations, and to support the special fueling needs of the ER-2 aircraft. The ER-2 aircraft are fueled at Hangar N-159.

Fuel storage facilities may be upgraded and WFF may move toward storing fuel in double-lined aboveground storage units. WFF is proposing to construct permanent tanks to temporarily store liquid and cryogenic fuels on Wallops Island. The potential location for this facility is unknown at this time. WFF would only use these storage tanks during the launch period. Fuel storage and use would be compliant with the WFF Integrated Contingency Plan (ICP).

Mobile Liquid Fueling Facility

WFF plans to construct a new mobile Liquid Fueling Facility (LFF) to support liquid-fueled launch vehicles. The LFF would hold more than 56,781 liters (15,000 gallons) of liquid fuels. This capability would be developed in two phases. Phase I is scheduled to be operational by 2005, and would support liquid oxygen (LO_X)/kerosene and hybrid suborbital and small orbital vehicles. Phase I would include an expandable helium (He) gas delivery system and liquid nitrogen (LN_2) chill down system. Phase II is expected to be operational by 2006, and would address the need to support larger orbital launch vehicles and different propellant combinations.

The LFF would be a mobile operation with the ability to operate at various launch locations at WFF and other launch sites as defined by NASA. No permanent structures would be associated with the LFF. The LFF would be capable of movement over paved surfaces at WFF or other designated locations where legal road vehicles may travel. The units of the LFF would be sized in length, width, and height so that they may be moved on U.S. roads with no special permits for hazardous contents or excessive dimensions.

The Phase I LFF would have a Control Trailer that would house the pumps, valves, actuators, sensors, gas intensifiers, piping, and other equipment necessary to handle LO_X, LN_2, and gaseous He for launch vehicle fueling operations. Since high pressure and explosive fuel/oxidizer combinations may be present, the capability to remotely operate (fueling and de-fueling) and monitor the system is required. The remote controller software and hardware would be located up to 3.2 kilometers (2 miles) from the LFF.

The operations of the LFF would support a fueling timeline based on loading of fuel in advance of the count down (final launch sequence) and loading of oxidizer and pressurants during the final launch sequence. The Phase I LFF system would be capable of loading oxidizer and pressurants on the launch vehicle in 4 hours. The Phase I LFF would be remotely operated during all oxidizer and pressurant operations. Loading of kerosene may be conducted with personnel present.

2.1.3.7 Storage

Storage facilities are located throughout WFF. Materials stored can include water, fuels, rockets, motors, payloads, spacecraft or spacecraft components, hazardous materials or wastes, government vehicles, maintenance vehicles, and other miscellaneous supplies.

2.1.3.8 Safety and Security

Security

The Security Office provides both institutional and program security. Guard service is provided 24 hours a day at two fixed posts and throughout the facility. Access to the WFF Main Base is controlled by a guard post at the Main Gate entrance. A second guard post is located at the

common entrance to Wallops Mainland and Wallops Island. Security measures may be upgraded (e.g., addition of barriers and fencing) at WFF.

Fire suppression

The WFF fire prevention and protection program implements Federal standards in the design, construction, and maintenance of all facilities and grounds. The WFF Fire Department maintains two ambulances, two fire trucks, one tanker truck, three crash trucks, and one hazardous material (HAZMAT) unit.

In addition to the fire suppression capabilities of the Fire Department, the majority of WFF buildings have automatic sprinkler systems. In the future, all new buildings and any existing building that lacks a fire suppression system will be provided with an automatic means of fire control. On the Main Base, a foam suppression system is in design for Hangar D-001, with plans to eventually incorporate the same system in the N-159 Hangar. The D-001 and N-159 hangars currently have deluge fire suppression systems that deliver approximately 22,000 liters per minute (6,000 gallons per minute). WFF also plans to upgrade to a new facility-wide addressable fire alarm system.

2.2 OPERATIONAL COMPONENTS

Operations at WFF are program- and project-driven and can change from year to year as missions evolve or change. The Suborbital and Special Orbital Projects Directorate, located at WFF, leads NASA's Suborbital and Special Orbital Programs. Sounding rockets, balloons, aircraft, and orbiting spacecraft are used in NASA programs investigating space science, Earth science, advanced technologies, and aeronautical research. New technologies, including the 100-day balloon capability that is a part of the Ultra Long Duration Flight project (not launched at WFF), are being integrated into the program. WFF provides support for mission and payload management, engineering, payload design and development, launch vehicle systems, Attitude Control Systems (ACS), and payload recovery systems, along with facilities for fabrication, payload integration, and environmental testing.

The WFF Test Range consists of a launch range on Wallops Island, an aeronautical research airport on the Main Base, and associated tracking, data acquisition, and control instrumentation systems throughout the facility. An orbital tracking station operates continuously in support of several scientific satellites. WFF aircraft and UAVs, used as aerial platforms, support the development of remote sensing techniques and instruments to measure ocean and atmospheric parameters and to conduct scientific missions.

The WFF Launch Range includes Wallops Island and extends for 4.8 kilometers (3 miles) over the Atlantic Ocean, using the surface area and airspace above to conduct flight operations. The principal Wallops Island facilities are those required to process, qualify, and launch rockets carrying scientific payloads on orbital or suborbital trajectories. Support facilities for the launch range include launch pads, launchers (mobile and fixed), blockhouses, rocket preparation and payload processing and integration buildings, dynamic balancing equipment, wind measuring devices, communications and control instrumentation, television and optical tracking stations, surveillance and radar tracking units, and other facilities. The launch areas are located on the southern half of Wallops Island. Additional special use facilities are located on the northern

portion of Wallops Island. Occasionally, ground-based scientific equipment that requires isolation from other activities is temporarily located on the northern half of the island.

The primary purpose of the launch range is to provide the infrastructure, data services, logistics, and safety services necessary for flight projects supporting NASA science, technology, and exploration programs; Department of Defense (DoD) and other government agency needs; and academic and commercial industry needs. Facilities on Wallops Island are used as required to support other NASA science and research programs that involve the use of rockets or UAVs to carry instruments to desired altitudes. Additionally, the Launch Range is used cooperatively for rocket and non-rocket programs. Typical additional programs include: VANDAL launches, a high-speed target missile for the Naval Air Warfare Center/Aircraft Division (NAWC/AD); rocket launches for the DoD Missile Defense Agency; full-scale aircraft development programs for the NAWC/AD; and rocket boosted projectile testing for the U.S. Navy and U.S. Army.

The primary existing operations at WFF are discussed below and include Rockets, Balloons, Piloted Aircraft, Uninhabited Aerial Vehicles, Autonomous Underwater Vehicles, Payloads, Tracking and Data Systems, Scientific Research Programs and Facilities, Educational Programs, the Open Burn Area, Rocket Boosted Projectile Testing, and Airfield Operations.

2.2.1 Rocket Operations

Orbital Rockets

Numerous existing and future Expendable Launch Vehicles (ELV) and Reusable Launch Vehicles (RLV) could be used at WFF to support payload delivery to orbit. The Athena-3 class vehicle is the largest vehicle expected to be launched from WFF in terms of solid propellant weight for the first stage (approximately 133,120 kilograms [293,479 pounds]). Therefore, the Athena-3 class vehicle has been selected as the demonstration vehicle to evaluate the environmental impacts of orbital launches at WFF. WFF's Launch Range Expansion EA analyzed 12 annual launches of the Lockheed Martin Athena-3 class vehicle as an upper bound for environmental effects (NASA, 1997b). The Launch Range Expansion EA analyzed the 12 launches from Launch Complex 0. While the Athena-3 vehicle program is currently inactive, the cumulative amount of impact from 12 annual Athena-3 launches remains a valid benchmark. Smaller vehicles would be used where appropriate. Future ELVs and RLVs would encompass spacecraft that use accepted materials, methods, and techniques and would present no new or substantial environmental impacts or hazards. Table 2-4 lists the potential rockets to be launched at WFF.

Table 2-4 List of Rockets and Associated Motors and Propellants

Name	Motor type	Potential Propellant
Orbital Rockets		
Athena 1	Castor 120 solid motor first stage Orbus 21D solid motor second stage Hydrazine-fueled Orbit Adjust Module	Hydroxyl-terminated polybutadiene (HTPB) ammonium perchlorate (AP)/ aluminum (Al) powder hydrazine
Athena 2	2-Castor 120 solid motor first stage Orbus 21D solid motor second stage Hydrazine-fueled Orbit Adjust Module	HTPB AP/Al powder hydrazine

Table 2-4 List of Rockets and Associated Motors and Propellants		
Name	**Motor type**	**Potential Propellant**
Athena 3 Class	8- Castor 120 solid motor Hydrazine-fueled Orbit Adjust Module	HTPB AP/Al powder hydrazine
Pegasus	Three Orion solid rocket motors	HTPB AP/Al powder
Taurus	Castor 120 first stage and a slightly larger Orion 50S-G second stage	HTPB AP/Al powder
Minotaur	M55A-1 SR-19 Orion-38 Orion-50XL	AP/Al powder HTPB
Minuteman Class	M55A-1 first stage SR19-AJ-1 second stage Third and fourth stages either: Orion-50XL Orion-38 M57A-1 SR73-AJ-1 Star-48	AP/Al powder HTPB Carboxyl-terminated polybutadiene (CTPB) Nitrocellulose (NC)/ nitroglycerin (NG) family Cyclotetramethylene tetranitramine Triacetin
Peacekeeper Class	SR-118 first stage SR-119 second stage SR-120 third stage Fourth stage either: Orion-38 Star-48	AP/Al HTPB Cyclotetramethylene tetranitramine Polyethylene glycol
Space America Enterprise		Liquid oxygen Kerosene Helium
Microcosm Sprite		Liquid oxygen Kerosene Helium
Lockheed Martin (Hybrid) SPIDER		Liquid oxygen Helium
StartBooster 5		Liquid oxygen Kerosene Helium
StarBooster 30		Liquid oxygen Kerosene Helium

Table 2-4 List of Rockets and Associated Motors and Propellants		
Name	**Motor type**	**Potential Propellant**
Sounding Rockets		
Super Arcas	Arcas	Solid: AP, polyurethane, and nitroguanandine.
Orion	Orion	Solid: AP, polyurethane, and nitroguanandine.
Black Brant	Black Brant	AP/Al/plastic binder type
Nike-Orion	Nike Orion	NC/NG family
Nike-Tomahawk	Nike Tomahawk	NC/NG family
Taurus-Tomahawk	Taurus Tomahawk	NC/NG family
Taurus-Orion	Taurus Orion	NC/NG family
Terrier-Lynx	Terrier Lynx	NC/NG family
Terrier-Malemute	Terrier Malemute	NC/NG family
Terrier-Orion	Terrier Orion	NC/NG family
Terrier-Oriole	Terrier Oriole	NC/NG family
Nike-Black Brant	Nike Black Brant	NC/NG family
Taurus-Nike-Tomahawk	Taurus Nike Tomahawk	NC/NG family
Black Brant IX	Terrier Black Brant VC	NC/NG family
Black Brant X	Terrier Black Brant VC NHKA	NC/NG family
Black Brant XI	Talos Taurus Black Brant VC	NC/NG family
Black Brant XII	Talos Taurus Black Brant V NHKA	NC/NG family

Sounding Rockets

The NASA Sounding Rockets Program, managed by the Sounding Rockets Program Office, provides overall management of sounding rocket and flight projects for campaigns conducted at WFF and for mobile campaigns that occur around the world. The sounding rockets carry research payloads with scientific instruments to altitudes up to 1,600 kilometers (994 miles). Scientific data are collected and returned to Earth by telemetry links. Parachutes are frequently used to recover the payloads. Scientific mission requirements determine the particular type of rocket used to deliver a specific payload. Criteria evaluated include payload weight, size, and trajectory. The rockets are matched to meet the scientific requirements of each project. New scientific requirements may lead to new sounding rockets that go beyond 1,600 kilometers (994 miles). These new rockets, however, will be smaller and have less environmental impacts than the orbital vehicles defined in Table 2-4.

Currently, there are 15 types of sounding rocket launch vehicle systems in the WFF inventory. Each launch vehicle system provides unique weight and altitude performance capabilities for various experiments. The NASA Sounding Rockets Program has the flexibility and capability to respond quickly to scientific requirements for launch operations from practically any place on Earth using either permanent or mobile range facilities. The NASA Sounding Rockets Program primarily operates for NASA, but serves other government agencies, universities, industry, and foreign countries as well.

As technological and scientific advancements increase, the NASA Sounding Rockets Program will require the flexibility to meet research demands. It is anticipated that future programs will require increases in payload weight, number of launches, and rocket motor capacities.

Several launch vehicles could be used to support the sounding rocket program. The largest sounding rocket launched to date in terms of propellant weight is the Black Brant XII (approximately 3,350 kilograms [7,385 pounds]). Therefore, the Black Brant XII has been selected as the enveloped vehicle to evaluate the environmental impacts from sounding rocket launches. Currently, sounding rocket missions average 30 per year. There is the potential for the sounding rocket program to grow to more than 50 launches per year over the next 10 years. Therefore, 60 launches per year is the envelope for the number of sounding rocket launches.

Drones and Missiles

Drone targets are used at WFF in the VACAPES OPAREA as part of missile training exercises conducted by the U.S. Navy and supported by NASA. Targets are used to test the performance of shipboard combat systems, as well as to provide simulated real-world targets for ship defense training exercises.

Drone targets are either launched from the WFF Range or air-launched from military aircraft in the VACAPES OPAREA controlled airspace. Targets travel on a preprogrammed flight path. Shipboard interceptor missiles engage the target over the VACAPES OPAREA and all debris from the intercept falls within the VACAPES OPAREA boundary.

Targets may use liquid fuels, such as JP-5 jet fuel or hydrazine derivatives, or solid rocket propellant as fuel. The BQM-34 is currently the most commonly used drone target at WFF. Approximately five to ten of these targets are launched per year. The assembled BQM-34 is approximately 7 meters (23 feet) long and 2 meters (7 feet) in diameter, with a wingspan of 4 meters (13 feet). The target weighs 1,100 kilograms (2,500 pounds) when flight-ready and

contains 400 liters (105 gallons) of JP-5 jet fuel. The target is capable of reaching altitudes between 3 and 15,240 meters (10 and 50,000 feet) and speeds of 1,120 kilometers per hour (Mach 0.94) over 115 minute endurance. WFF is proposing to launch the much smaller JP-5 fueled target, BQM-74, at a similar annual rate. A new target, the Coyote, is a solid rocket propellant fueled vehicle, very similar to the Terrier sounding rocket motor. The AQM-37 arrives at WFF pre-fueled, with a self-contained hypergolic propellant system consisting of MAF-4 and IRFNA as an oxidizer. The assembled AQM-37 is approximately 4.3 meters (14 feet) long and 0.3 meters (13 inches) in diameter, with a wingspan of 1 meter (3.3 feet). The target weighs 281 kilograms (620 pounds) when flight-ready. The target is capable of being launched from an aircraft at altitudes between 300 and 18,000 meters (1,000 and 60,000 feet) and at speeds between 835 and 2,150 kilometers per hour (Mach 0.7 to 1.8). Approximately 20 AQM-37 target flights may be flown per year, with a maximum of 30 flights per year.

In 2003, NASA completed the *Final Environmental Assessment for AQM-37 Operations at the National Aeronautics and Space Administration Goddard Space Flight Center Wallops Flight Facility* (NASA, 2003a). NASA concluded that there were no significant environmental effects from AQM-37 operations at WFF that could not be mitigated by operational procedures. Because NASA has already completed NEPA documentation for AQM-37 operations, and impacts from jet fueled and rocket motor drones would be identical to those discussed for aircraft and rocket motors, respectively, there is no further discussion of drone target operations in this Site-Wide EA. If future drone target operations extend past the 30 flights per year maximum, or if new drone targets are used that have more significant impacts than what is presented in the AQM-37 EA, then NASA will conduct additional environmental review in accordance with NEPA.

The environmental impacts of ship-launched interceptor missiles have been analyzed in separate documentation prepared by the U.S. Navy – *Final Environmental Impact Statement Naval Air Warfare Center Weapons Division Point Mugu Sea Range* (U.S. Navy, 2002) – and will not be discussed further in this Site-Wide EA unless impacts exceed those in the EIS.

Fuel Types

The orbital launch vehicles to be addressed by this Site-Wide EA utilize liquid and/or solid propulsion systems. A solid propulsion system will be the enveloping system for this Site-Wide EA since it represents a greater potential environmental impact from emissions than a liquid system. However, impacts from an accidental spill of liquid fuels such as kerosene, liquid oxygen, liquid hydrogen, and liquid nitrogen would result in damage to soils, groundwater, surface water, and vegetation (see Section 4.4.4, Safety and Security). Anhydrous hydrazine (N_2H_4) is a toxic substance that is commonly used in payload attitude adjustment systems, which are used to control the orientation of a spacecraft.

The solid propellant system is based on either an ammonium perchlorate/aluminum (AP/Al) combination, or a nitrocellulose/nitroglycerin (NC/NG) combination. The emissions from the AP/Al propellant combination include hydrogen chloride (HCl) and aluminum oxide (Al_2O_3), and are generally considered to be more environmentally damaging than emissions from the NC/NG propellant combinations (NASA, 2000a).

Hybrid fuels would continue to be utilized at WFF. Hybrid fuels can include fuels that have not been engineered or are not currently utilized at WFF. These hybrids are not excluded from

inclusion in this Site-Wide EA analysis. In order to operate with the hybrid fuels, NASA would be required to conduct further review, complete the NEPA Checklist, and complete an REC. These reviews must prove that the hybrid fuels have fewer potential environmental impacts than the solid fuels analyzed in this Site-Wide EA and pose a lesser safety risk than current liquid fuels and fueling systems.

Motor Types

The Castor 120™ is the core motor for several ELVs, such as the Athena-3, Taurus, and Conestoga. Although the Athena-3 program is currently inactive, the impacts from this vehicle present a valid benchmark. Therefore, the Athena-3 model has been chosen as the enveloping vehicle that will emit the highest ground level emissions of those vehicles anticipated to be launched from WFF. The Castor 120™ is a solid propellant rocket motor containing approximately 49,600 kilograms (109,349 pounds) of AP/Al powder in hydroxyl terminated polybutadiene (HTPB). This motor produces approximately 166,015 kilograms (366,000 pounds) of thrust and burns approximately 620 kilograms (1,367 pounds) of propellant per second.

Major exhaust products from the Castor 120™ include Al_2O_3 particles, carbon monoxide (CO), HCl, nitrogen gas (N_2), water, and carbon dioxide (CO_2). The anticipated highest ground level emissions would emanate from the launch of a Castor 120™ with eight Castor IV™ strap-on motors. A single Castor IV™ contains approximately 10,440 kilograms (23,016 pounds) of the same propellant, and emits the same major exhaust components, as both the Castor 120™ and the Orbus 21D. During lift-off, the eight strap-on motors would fire simultaneously with the main stage, resulting in the highest ground level emissions.

This Site-Wide EA analyzes the impacts of approximately 12 launches per year using the Castor 120™ with eight Castor IV™ strap-on motors. New motors may be developed or other types of motors may be chosen for specific missions that do not have the same emissions as the Castor 120™ with eight Castor IV™ strap-on motors. These motors must fall below the enveloped emissions of the Castor 120™ with eight Castor IV™ strap-on motors to be covered under this Site-Wide EA.

2.2.2 Balloons

The WFF Balloon Program Office conducts several types of balloon operations. WFF staff manage, engineer, design, and conduct limited tests for large scientific balloons, which are launched from Palestine, Texas; Fort Sumner, New Mexico; and around the world. For safety considerations, the majority of these balloons cannot be launched from WFF. These large balloons carry scientific payloads of up to 2,721 kilograms (6,000 pounds) to an altitude of 40 kilometers (25 miles). They are capable of traveling at lower altitudes than sounding rockets and satellites, and can carry laboratory equipment that measures the lower atmospheric layers. The duration of these balloon flights can last for hours or even days, and the balloons can be tethered or free-flying. The balloons are made of a thin polyethylene material that is inflated with helium gas to lift the payload.

National Weather Service (NWS) meteorological balloons and small scientific balloons are launched from WFF. The meteorological balloons, which are 600-gram (1.3-pound) latex balloons with 350-gram (0.8-pound) radiosonde payloads, are launched twice a day. The

radiosonde contains instruments capable of making direct *in-situ* measurements of air temperature, humidity, and pressure at certain altitudes, typically to altitudes of approximately 30 kilometers (19 miles). These observed data are transmitted immediately to the ground station by a radio transmitter located within the instrument package. The balloons are inflated with helium gas to a 1.8-meter (5.8-feet) diameter and free-fly from Building N-179 to a bursting elevation of 30.5 kilometers (19 miles). At this height, the balloon is approximately 6.1 meters (20 feet) in diameter, and when it bursts, it shreds completely. Parachutes deploy the payload and prevailing westerly winds carry it over the Atlantic. Payloads are not recovered from the ocean by NWS. However, they are packed in floating styrofoam containers with waterproof pre-paid labels for return to the NWS.

The most common scientific balloon launched from WFF is a 1,200-gram (2.7-pound) latex ozonesonde balloon with a 900-gram (2.0-pound) payload (radiosonde plus an electrochemical concentration cell). The ozonesonde is a lightweight, balloon-borne instrument integrated with a conventional meteorological radiosonde. As the balloon carrying the instrument package ascends through the atmosphere, the ozonesonde telemeters information on ozone and standard meteorological quantities, such as pressure, temperature, and humidity, to a ground receiving station. The heart of the ozonesonde is an electrochemical concentration cell (ECC) that senses ozone as is reacts with a dilute solution of potassium iodide to produce a weak electrical current proportional to the ozone concentration of the sampled air. These balloons are inflated with helium gas to a diameter of 1.9 meters (6.3 feet) and launched from building N-159. At least one balloon is launched per week, with a maximum of three launches per week. This type of balloon will burst and shred completely at a height of 33 kilometers (20.5 miles), at which point it will be about 8.5 meters (28 feet) in diameter. The payload, which is in a styrofoam container, falls into the ocean and eventually sinks to the ocean floor.

One of the largest scientific balloons currently launched from WFF are 3,000-gram (6.6-pound) ozonesonde balloons with 4.5-kilogram (10-pound) payloads used for science operations. Approximately four to five of these balloons are launched per year. These balloons are inflated with helium gas to a diameter of 2.1 meters (7 feet) and will burst and shred at a height of 38 kilometers (23.7 miles). The diameter of this type of balloon at bursting elevation is 13 meters (42.5 feet). The payload, which is in a styrofoam container, falls into the ocean and eventually sinks to the ocean floor.

The largest balloon anticipated to be launched from WFF is made of polyethylene and is 1,132,673 cubic meters (40,000,000 cubic feet) in size. This balloon can carry a 3,628 kilogram (8,000 pound) payload for scientific missions. Wind conditions would be carefully monitored during science balloon missions in order to keep the balloon over unpopulated areas. To terminate the mission, a radio signal command is sent to a small charge on the balloon which punctures the balloon and separates the balloon from the payload. Upon separation, a parachute deploys from the payload. The balloon collapses and falls to the earth in the approximate location of the payload. Both the balloon and payload would land in the Atlantic Ocean. The balloon and payload are immediately recovered by the U.S. Coast Guard. This balloon has the largest payload anticipated to be launched from WFF, and therefore, has been chosen as the envelope for assessing balloon operations. However, most of the balloons launched from WFF are much smaller and carry small payloads used to conduct weather and scientific experiments.

2.2.3 Piloted Aircraft

The WFF aircraft fleet is operated, maintained, and managed by highly qualified flight crews and personnel with the goal of providing efficient and safe airborne operations. Aircraft are modified and upgraded, as needed, for mission requirements. The maintenance and operation of the aircraft are the responsibility of the Aircraft Office. WFF piloted aircraft operations can include payload delivery, launching platforms, in-flight scientific experiments, and employee transportation. NASA-owned aircraft based at WFF include the 4-engine turboprop, heavy-lift, P-3 aircraft, which supports science missions; and a 2-engine turboprop, 9-passenger Beechcraft-200 aircraft to support Agency mission management. A 4-engine, jet powered DC-8 science platform is managed by WFF but based at the University of North Dakota. WFF has proposed to assume management and basing of the high altitude ER-2 craft, currently sponsored by the NASA Langley Research Center. Customer activities include many of the same activities, but also include DoD training, such as touch-and-go exercises by military pilots.

Several types of piloted aircraft could be used to support operations at WFF. The following data were gathered from the air traffic control tower. Aircraft from the following agencies and organizations landed and departed from the NASA airfield from January 2004 to August 2004:

- NASA aircraft include the King Air B-200, P3 Orion, Lance Air, Gulfstream, I30, and T38. NASA accounted for 124 flights during this time period.
- Civilian, DoD and FAA aircraft include the Cessna, helicopter, Lear Jet, Gulfstream, AC-130, Merlin Sweringer FW4, and Dash-6. These miscellaneous customers accounted for 106 flights during this time period.
- The U.S. Navy aircraft include the C-9 Nightingale, C-130, test pilot craft, H3 to H60 helicopters, Kingair, T-38, P-3, F-18, E-2, C-2, MWs-474, and T34. The Navy accounted for 3,429 flights during this time period.
- Air National Guard aircraft included the F-18, C-130, and F-16. The Air National Guard accounted for 124 flights during this time period.
- The U.S. Coast Guard aircraft included the H-65 Dolphin, S-65 Dolphin, C-130, Falcon, and Lear Jet. The U.S. Coast Guard accounted for 11 flights during this time period.
- The U.S. Air Force aircraft included the F-16, C-5, Air force One, a helicopter, Kingair, Lear Jet, C-9, 747, and C-130. The U.S. Air Force accounted for 105 flights during this time period. .
- The U.S. Army aircraft included the Kingair C-12, and H-60, H-1, H-47, H-53 class helicopters. The U.S. Army accounted for 50 flights during this time period.

The total number of flights at WFF between January and August 2004 was 4,281. From the data above, it has been determined that the Navy has the most flights at WFF. To envelope aircraft operations and assess impacts it was determined that operations would not expand more than 25 percent of current levels.

Commercialization of Aircraft Support Services

NASA is proposing to commercialize aircraft operations at WFF by contracting with a non-governmental entity. The selected contractor would work under NASA regulations and would operate the aircraft support services by maintaining the fuel farm, operating the control tower,

providing mission support (local and deployed areas), and supplying operational readiness for NASA, other U.S. government and non-U.S. government customer aircraft, and UAVs. Non-NASA aircraft may be managed and based at WFF as long as no additional airfield infrastructure is required due to that action. If the basing of non-NASA aircraft would require additional airfield infrastructure, an EA or EIS would be required.

2.2.4 Uninhabited Aerial Vehicles (UAV)

UAVs are frequently designed, fabricated, and tested at WFF. UAVs are most frequently used as aerial platforms, to support the development of remote sensing techniques and instruments for measuring ocean and atmospheric parameters, and to conduct scientific missions. The road to the open burn area on Wallops Island has been improved for use as a small runway for UAVs. UAVs also utilize the runways at the research airfield on the Main Base. Currently, WFF flies a maximum of approximately 75 UAV missions a week. Table 2-5 lists the typical UAVs flown at WFF.

Table 2-5 Typical UAVs Operating at WFF

UAV	Endurance (Hours)	Payload Weight (kilograms/pounds)
Blimp (tethered)	-	21.3 / 47
Aerosonde	40	0.997 / 2.2
Altus2	24	150 / 330
Exdrone	2.5	11 / 25
Global Hawk	30	889 / 1,960
Gnat 750	48	64 / 140
Pioneer	5.5	34 / 75
Shadow 200	4	23 / 50

To provide for expansion of WFF's UAV operations, a model UAV that is one-fifth the size of a Boeing 757 would be the largest UAV tested at WFF in terms of engine size and fuel capacity. Therefore, it is considered the envelope for UAV operations at WFF. A full-sized Boeing 757 uses a Rolls-Royce RB211-535E4B engine that has 19,731 kilograms (43,500 pounds) of thrust. It is anticipated that a one-fifth scale UAV would have a thrust of 3,946 kilograms (8,700 pounds). This UAV may use jet fuel and have a capacity of 8,695 liters (2,297 gallons). The anticipated maximum payload would be 6,550 kilograms (14,442 pounds) with a total weight of 23,133 kilograms (51,000 pounds). To determine whether significant environmental consequences would result from the use of UAVs at WFF, environmental impacts are based on the evaluation of a UAV one-fifth the size of a Boeing 757.

2.2.5 Autonomous Underwater Vehicles (AUV)

AUVs are small uninhabited submarines used to explore and study deepwater and coastal environments. NASA would use AUVs to continue scientific research in underwater environments. AUVs are currently powered by batteries and fuel cells. New methods such as solar power and improvements of the current source of energy are being investigated. The length of AUV missions would range from a few hours to approximately six days. Because the AUV

must emerge above the water to send information gathered back to the operator, the range of missions is limited, increasing the chance of mission failure. Communication can also be conducted through the use of acoustical telemetry, although this method can only send limited amounts of data. AUVs use single-beam echo sounders and multi-beam sonar units to avoid obstacles. AUVs can detect a large variety of chemical and biological compounds, and measure and monitor salinity, conductivity, temperature, depth, currents, and small-scale turbulence.

The smallest proposed AUV is the Miniature AUV designed by the Virginia Polytechnic Institute and State University (Virginia Tech). The Miniature UAV has a diameter of 8.8 centimeters (3.5 inches) and a length of 70.1 centimeters (27.6 inches). It typically travels at 3.7 kilometers per hour (2 knots) for 1.5 hours, but can reach up to 5.5 kilometers per hour (3 knots). The largest AUV is the Theseus from the International Submarine Engineers and will be the enveloping vehicle. It has a diameter of 1.27 meters (4 feet) and a length of 10.6 meters (35 feet). It weighs 8,618 kilograms (19,000 pounds) and can reach a depth of 1,000 meters (3,281 feet). Its typical speed is 7.4 kilometers per hour (4 knots). To determine whether significant environmental consequences would result from the use of AUVs at WFF, environmental impacts are based on an evaluation of the Theseus.

2.2.6 Payloads

For the purpose of this Site-Wide EA, payloads consist of spacecraft or scientific equipment designed, tested, and/or launched at WFF using rockets, balloons, aircraft, UAVs, and AUVs. Payloads may be suborbital or orbital, or may re-enter the earth's atmosphere. WFF can build, test, and fly payloads that exceed 4,535 kilograms (10,000 pounds). Payloads may contain: mechanical structures, batteries or solar power cells, re-entry fuel sources, transmitters, receivers, antennas, other communication system components, small radioactive sources, recovery systems, in-space maneuvering systems, and science and technology instruments (lasers, sensors, atmospheric sampling devices, optical devices, and biological experiments). Since payloads can contain many different variants that could result in environmental impacts, there are multiple envelopes. The envelopes for payloads are discussed below.

Payloads use radio frequencies to transmit data back to receivers on the ground. Payloads may carry a variety of low-power radio transmitters (for telemetry, tracking, and data downlink) and high-power radar transmitters (for remote studies of planetary surfaces). The power and operating characteristics of these transmitters would be within defined limits to assure that their operation meets the American National Standards Institute (ANSI) recognized acceptable levels as stated in Institute of Electrical and Electronic Engineers (IEEE) 95.1-1991 standards for human health and safety. Payload communication devices must adhere to IEEE standards to be included in this Site-Wide EA.

Payloads may utilize lasers to conduct innovative research. Current research includes the Oceanographic LIDAR Project (OLP) and the Geoscience Laser Altimeter System (GLAS). The OLP uses the Airborne Oceanographic LIDAR (AOL3) fluorosensor mounted on an aircraft to remotely measure chlorophyll and other biological and chemical substances in the world's oceans. The AOL3 fluorosensor uses a pulse of laser light, which hits the single-celled plants in the ocean. The chlorophyll inside the plants absorbs the laser light, giving off a red light that is recorded by instruments onboard the aircraft. The AOL3 uses two laser wavelengths, one ultraviolet (355 nanometers) and one green (532 nanometers). This laser is considered a Class 2 laser. The lasers enveloped for this EA must meet ANSI and Occupational Safety and Health

Administration (OSHA) safety standards (see Section 4.4.4, Safety and Security). Specifically, laser use must adhere to ANSI Z136.1-2000 (Safe Use of Lasers) and ANSI ZI36.6-2000 (Safe Use of Lasers Outdoors).

Payloads may carry small quantities of encapsulated radioactive materials for instrument calibration or similar purposes. The amount and type of radioactive material that can be carried is strictly limited by the approval authority level delegated to the NASA Nuclear Flight Safety Assurance Manager (NFSAM) in accordance with NPR 8715.3. As part of the approval process, the spacecraft program manager must prepare a Radioactive Materials Report (RMR) that describes all of the radioactive materials to be used on the payload. The NFSAM would certify that preparation and launching of routine payloads carrying small quantities of radioactive materials would not present a substantial risk to public health or safety. The envelope for radioactive materials that would be used in payloads is the requirement to meet the approval of the NFSAM.

Payloads may also carry biological agents, insects, and fungi into orbit for scientific experiments. The biological agents must fall under the National Institutes of Health (NIH) and the Centers for Disease Control (CDC) Biosafety in Microbiological and Biomedical Laboratories established safety rating of "Biosafety Level 1." Biosafety Level 1 includes defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy adult humans. *Baccillus subtilis*, *Naegleria gruberi*, infectious canine hepatitis virus, and exempt organisms under the NIH Recombinant DNA Guidelines are representative of microorganisms meeting the Biosafety Level 1 standard. Therefore, the envelope for biological agents in payloads is a Biosafety Level 1 status.

Payloads may also utilize chemicals or release chemicals into the atmosphere. NASA commonly conducts sounding rocket campaigns using trimethyl aluminum (TMA) chemical release modules. Puffs of TMA would be released from altitudes of 80 to 150 kilometers (50 to 95 miles). An instrumental payload would collect data on the TMA release, such as plasma density, temperature, collision frequency, electric field profiles, neutral density, and electron, ion, and particle environmental mechanisms. Other chemicals may be released as long as they pose no substantial hazard.

All orbital payloads must comply with the requirements of NPD 8710.3 NASA Policy for Limiting Orbital Debris Generation and NSS 1740.1. This policy would require a debris assessment to be prepared.

Re-entry payloads may be either an orbital payload that, upon receiving a signal from command control, de-orbits, reenters the earth's atmosphere, deploys a parachute, lands, and is recovered. This payload may also resemble a space shuttle type vehicle that orbits the earth, completes its mission, then de-orbits, returns to earth, and lands on an aircraft runway. In both cases, re-entry payloads will require fuel to break orbit, and, in the case of the shuttle-type craft, they need fuel to land. Re-entry payloads would carry a maximum weight of 90 kilograms (200 pounds) of fuel. Fuel sources would be identical to those used on the launch vehicle (e.g., solid rocket fuel, liquid oxygen/kerosene, liquid oxygen/liquid hydrogen, or a hybrid fuel). Re-entry payloads must comply with the requirements of NPD 8700.2A, NASA Policy for Safety and Mission Assurance (SMA) for Experimental Aerospace Vehicles (EAV) (Revalidated 4/28/04).

All payloads must comply with the requirements of NPD 8700.3A, SMA Policy for NASA Spacecraft, Instruments, and Launch Services.

2.2.7 Tracking and Data Systems

WFF maintains multiple tracking and data systems. These systems include: Wallops Orbital Tracking System, Data Systems, Radar, Telemetry, Optics, Meteorological Support, Command System, Range Control, and Communications Systems. Potential environmental impacts for new construction of data and tracking systems are covered under Section 2.1.1, Construction Program. New data and tracking systems implemented at WFF must be within acceptable levels for human exposure to radio frequency electromagnetic fields (3 kHz to 300 GHz) and must be in compliance with IEEE C95.1-1991.

2.2.7.1 Wallops Orbital Tracking System

In 1986, the Wallops Orbital Tracking System (WOTS), located in Building N-162 on the Main Base, was established at WFF. This ground-based satellite tracking station acquires telemetry from satellites to support several important programs, including the Transition Regional and Coronal Explorer (TRACE), the Quick Scatterometer (QuikSCAT), Sea-Viewing Wide Field-of-View Sensor (SEAWIFS), Gravity Recovery and Climate Experiment (GRACE), and Space Shuttle tracking. In 1994, a Transportable Orbital Tracking Station (TOTS) began providing support to the Fast Auroral Snapshot Explore. Telemetry data are delivered in real-time or near real-time. For high data rate S-band projects, digital cassette tapes are available at a greatly reduced cost when compared to the dedicated circuit costs. Post-pass playback of high-rate recorded data can be scheduled. The WOTS currently provides approximately 14,000 hours of mission support per year.

WOTS also provides backup to some of the Command and Data Acquisition functions for NOAA. An orbital tracking station operates continuously in support of several scientific satellites. Tracking and data operations include the design, development, and operation of a wide variety of tracking, communications, telemetry, optical, meteorological, and specialized instrumentation.

2.2.7.2 Data Systems

Data are acquired during operations from radar, telemetry, optical, meteorological, timing, and communications systems. These data are processed by computers at WFF to provide operations support and information for scientific experiments. A variety of data systems acquire, record, and display information in real-time for command, control, and monitoring of flight performance.

2.2.7.3 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 Test Range and Earth Science programs. The frequency bands in which these systems operate include UHF, L-, S-, C-, X-, Ku-, and Ka-band. Three surveillance radars and up to seven (three fixed and four mobile) tracking radars provide data for range safety and customer requirements for missions on the Wallops Test Range. These systems are located on the Main Base, Wallops Mainland, and Wallops Island. The targets that are tracked include aircraft, balloons, drones, ELVs, RLVs, satellites, and sounding rockets. Position data are

recorded at the radar sites and transmitted to the Range Control Center on the Main Base in real-time in support of mission operations. Both NASA and contract personnel conduct the operations, maintenance, and sustainable engineering on the WFF radar systems.

2.2.7.4 Telemetry

Telemetry systems provide downlink data services from instruments and payloads flying on-board aircraft, balloons, drones, expendable launch vehicles, satellites, and sounding rockets. Scientific, engineering, and housekeeping data can be received, demodulated, and decoded by the telemetry ground stations using analog and digital data transmission techniques. The capabilities exist to record the data on-site, transmit it to the user in real-time, or transmit it to the user when the mission or pass is complete. Telemetry downlink services are available in the following frequency bands: VHF, UHF, L-, S-, and X-band. Development work has begun on a new system at Ka-band. Uplink data services are also available in the S-band. The WFF fixed telemetry systems are all located in and around Building N-162 on the Main Base. The available systems include antennas with the following diameters: 2.4, 5, 7.3, 8, 9, and 11 meters (7.9, 16.4, 24, 26.2, 29.5, and 36 feet, respectively). The telemetry facilities support both range operations and low Earth orbiting satellites. The satellite tracking and data functions are continuous operations (24-hours-per-day, 365-days-per-year).

2.2.7.5 Optics

WFF's Optical, Photographic, and Video Facilities and its Radar Instrumentation provide a range of services to visually record events for analysis and historical record. Remote controlled television cameras monitor range operations and provide safety-related information. Tracking cameras that include both film and long-range video recording systems provide visual information from remote locations for project and range support. The Photographic Laboratory in Building E-2 on the Main Base provides developing and reproduction capabilities for photographic film. Cameras using video film or digital photography may record rocket vehicle/payload build-up, launch pad operations, lift-off, visible portions of aircraft or rocket flights, airport runway activities, and other project activities. High-speed motion picture photography of ignition, lift off, umbilical releases, and rail exit are also available. The Photographic Laboratory is transitioning to an all digital photography process that is expected to be completed in calendar year 2005. This transition to digital photography would eliminate film and print processing.

2.2.7.6 Meteorological Support

A fully qualified staff of meteorologists provides detailed local forecasts to support launch and other range activities. Wind data systems are used to support launch operations. Fixed, balloon-borne, and optical sensors are available for coordinating experimental data with existing conditions. Current weather data from WFF weather sensors on the Main Base and Wallops Island are continuously displayed on the local WFF closed-circuit television system. An ionospheric sounding station can provide detailed data on ionosphere characteristics. A Dobson ozone spectrophotometer can provide total ozone measurements. Balloon-launched radiosondes can provide profiles of atmospheric temperature and humidity. Several lightning detection systems display lightning conditions locally and throughout the United States. An electric field

measuring system is used with the lightning detection systems to quantify the probability of both local, naturally occurring lightning and lightning triggered by range operations.

2.2.7.7 Command System

A command system allows flight termination and control of an airborne vehicle's on-board experimental devices (sounding rockets, balloons, or aircraft). In the case of rockets and balloons, the Range Safety Officer can terminate some flights in the unlikely event that a malfunction presents a range safety hazard.

2.2.7.8 Range and Air Traffic Control

The WFF Range Control Center in Building E-106A on the Main Base controls rocket and drone target launch, tracking and data acquisition operations. It is the focal point for communications, operational management, and range safety. The Air Traffic Control Operations in Building A-1 on the Main Base controls aircraft using the WFF Research Airport. Instantaneous communication with all participants in a mission allows coordination of complex operations.

2.2.7.9 Communications Systems

WFF operates ground-to-ground, air-to-ground, ship-to-shore, and inter-station communications systems. These systems are composed of radios, cables, microwave links, closed-circuit television systems, command and control communications, frequency shift tone keying systems, operational teletype systems, high-speed data circuits, and the WFF NASA Communications System (NASCOM) Network terminal. WFF also makes use of satellite communications and fiber optics.

From a cable plant on the Main Base, buried copper and fiber optic cables extend to and throughout the Main Base, Wallops Mainland, and Wallops Island. These systems provide the means for managing operations at WFF and communication and coordination with related operations in other geographic areas; for example, providing communications and tracking support for Space Shuttle operations at the Kennedy Space Center (KSC) in Florida.

2.2.8 Scientific Research Programs and Facilities

WFF's Science Research programs are essential to the ongoing missions to understand the Earth and advance space exploration. Without the research and development at WFF, operations would not continue to grow. Specific programs and facilities discussed below include Atmospheric Sciences Research, Unique Laboratory Facilities, and Research and Development Programs.

2.2.8.1 Atmospheric Sciences Research

Atmospheric Sciences Research at WFF supports scientific investigations of the atmosphere. The unique capabilities for data acquisition, processing, display, and recording have produced significant results in research conducted by governmental and non-governmental agencies. The instrumentation systems and technical support personnel have made important contributions to the understanding of atmospheric turbulence, cloud and precipitation development and dynamics, and lightning discharge characteristics and distribution patterns, including the effects of

precipitation on the transmission of electromagnetic radiation. Permanent data acquisition systems include two powerful radar systems and a data acquisition and recording system.

2.2.8.2 Unique Laboratory Facilities

WFF has numerous unique laboratory facilities, which are described in Table 2-6 below. The following laboratory facilities are currently operating at WFF. Laboratory facilities support research programs that can change over time. Future facilities would be reviewed by the NEPA checklist and a REC would be completed; if no significant impacts are found they would be implemented. Envelopes would be the same as payloads for radio frequencies, lasers, radioactive materials, biological agents, and chemical releases (see Section 2.2.6 and the Site-Wide NEPA Checklist in Appendix A).

Table 2-6 Laboratory Names and Functions

Laboratory Name	Laboratory Function
Balloon Laboratory	Used to perform materials testing of polymeric films and balloon component fabrication and testing to support the NASA Balloon Program
Rain-Sea Interaction Research Facility	Used to study the interaction between rain and the ocean to quantify the effects of rain on the data collected by satellite sensors looking at the ocean surface. Its drop tower simulates rainfall and can vary the drop size. Research projects have included rain effects on microwave scattering from the sea surface, mixing of fresh and saltwater, and gas exchange rates. The latest development is an inexpensive, portable rain imaging system that measures the size and shape of raindrops and snowflakes.
Phytoplankton Photophysiology	Used for laboratory experiments and supporting field experiments aimed at understanding the range in variability, and ultimately the behavior, of phytoplankton photophysiological processes within the range of environmental conditions encountered in the ocean. Cultures of specific phytoplankton are maintained to support a variety of culturing experiments. Field experiments are focused on coastal and polar physiology and bio-optical processes of marine phytoplankton. WFF proposes to use a stock solution consisting of 18.6 millicurries of Carbon-14 in this laboratory.
Air-Sea Interaction Research Facility	Contains an 18.28-meter (60-foot) wave tank used to conduct research on air-sea interactions. Research projects include studying wind-generated waves, interactions between water currents and winds, shoaling waves, and gas exchange between the water and the air. An underwater wave generator can create water waves and variable wind speeds can generate surface wind waves. The temperature of both the water and the wind can be varied over a wide range. The laboratory has a large variety of instruments including a low-power laser system and a digital video imaging system.
Upper Air Instrumentation	Used to prepare electrochemical ozonesondes for launch, and to develop and test other sensors used to measure atmospheric properties. A reference radiosonde and a chilled mirror instrument for precise humidity measurements are two of the more unique instruments used to profile the atmosphere.
Calibration	This laboratory is equipped to repair and calibrate test instruments in support of NASA and its tenants such as the U.S. Navy. The Calibration Laboratory maintains a standards laboratory for testing instruments against required standards. The equipment in the standards laboratory is in accordance with standards set forth by the National Institute of Standards and Technology (NIST).

Table 2-6 Laboratory Names and Functions

Laboratory Name	Laboratory Function
Chemical	A variety of testing functions are performed in this laboratory. It is the primary source for chemistry tests for the Federally Owned Treatment Works, including biological oxygen demand, total Kjeldahl nitrogen, and chemical oxygen demand. Laboratory personnel also perform chlorine and fecal coliform tests, record temperatures, and complete other waste treatment tests, as required. Chemical Laboratory personnel monitor the water supply through well readings, pump flow readings, metals in water measurements, and perform other drinking water quality tests. The Chemical Laboratory performs analysis as requested by the U.S. Government. Examples include wear metal in aircraft engine oils, particulate counts, moisture and viscosity tests, and polychlorinated biphenyl (PCB) screen analysis. The Chemical Laboratory also performs preparation and calibration of balloon package ozone probes.
Photographic	Photographic film is developed and reproduced in this laboratory. Cameras using video film or digital photography may record rockets vehicle/payload build-up, launch pad operations, lift-off, visible portions of aircraft or rocket flight, airport runway activities, and other project activities.
Environmental Testing	Payloads, sub-assemblies, and payload components are tested in this laboratory. Environmental testing of payloads verifies flight readiness through exposure to the intended flight environment.
Microwave Instrumentation	This laboratory supports airborne microwave research instruments. Instruments developed and maintained in this laboratory include the Scanning Radar Altimeter and the Radar Ocean Waves Spectrometer.
Airborne LIDAR Laboratory and Optical Darkroom	This laboratory is used to develop and test active airborne laser instruments, including the Airborne Oceanographic Lidar (AOL3) fluorosensor, which is mounted on an aircraft to remotely measure chlorophyll and other biological and chemical substances in the world's oceans. The AOL3 fluorosensor uses a pulse of laser light, which hits the single celled plants in the ocean. The chlorophyll inside the plants absorbs the laser light giving off a red light that is recorded by instruments onboard the aircraft. The AOL3 uses two laser wavelengths, one ultraviolet (355 nanometers) and one green (532 nanometers). The Airborne Terrain Mapper (ATM) is a laser altimeter used in the Arctic Ice Program to monitor the changes in the Greenland ice sheet, map sea ice, and map ice streams in Antarctica.
UAV Development	This laboratory is used to design, build, and fly small UAVs to meet the requirements of scientific researchers. UAVs are designed to meet the needs of the scientific payload rather than forcing the payload to meet the requirements of the vehicle.
Precipitation Radar	This laboratory supports ground-based radar systems. The TOGA radar is a C-band portable system that has been installed on ships, but is normally used at land locations. It has a 2.4-meter (8-foot) diameter antenna and is self-contained in shipping sea containers. The NASA Polarimetric (NPOL) is a polarimetric diverse S-band radar with a 5.5-meter (18-foot) diameter antenna. It is transportable and self-contained in shipping sea containers.
Instrumentation Fabrication	New instrumentation systems are prototyped and constructed in this laboratory. The laboratory has metal working machines and has been used to fabricate most of the airborne instruments described above.

2.2.8.3 Research and Development Programs

Research and Development Programs at WFF include Satellite Altimetry, Upper Air Instrumentation Research, Airborne Altimetry, Cryospheric Research, Coastal Zone Research, and Precipitation Research. The following research and development programs are currently operating at WFF. Research and Development Programs change over time. Future programs would be reviewed by the NEPA checklist and a REC would be completed; if no significant impacts are found they would be implemented. Envelopes would be the same as payloads for radio frequencies, lasers, radioactive materials, biological agents, and chemical releases (see Section 2.2.6 and the Site-Wide NEPA Checklist in Appendix A).

Satellite Altimetry

Data from the TOPEX satellite and the Geoscience Laser Altimeter System (GLAS) instrument on ICESat is processed and quality controlled. Support is provided for the altimeters on the JASON project and the Geosat Follow On (GFO). The GLAS system is the first laser-ranging instrument for continuous global observations of Earth. The GLAS is designed to measure ice-sheet topography and associated temporal changes, clouds and atmospheric properties, and detail height and thickness of cloud layers. The GLAS transmits short pulses (4 nanoseconds) of infrared light (1,064 nanometers) and green light (532 nanometers).

Upper Air Instrumentation Research

Measurements of the characteristics of the atmosphere are made as part of a long-term investigation of changes in the climate and weather patterns. Instruments are flown on sounding rockets, balloons, and UAVs.

Airborne Altimetry

Mapping and monitoring of surface topography, coral reefs, and surface and submerged vegetation is conducted to support research into seasonal and interannual variability and to quantify the consequences of natural and human-caused events. Most of the coastline of the lower 48 states, as well as Puerto Rico, has been mapped. Several areas have been remapped to measure the effects of winter storms and hurricanes.

Cryospheric Research

The amount of fresh water stored as ice in the Artic and Antarctic serves as an indicator of changes in the climate. Research on the extent of the Greenland ice sheet is conducted as a proxy of the changes taking place in the polar regions. The ATM LIDAR system is used to make annual surveys of any changes.

Coastal Zone Research

Most oceanic biological interactions take place within coastal waters. A large percentage of the U.S. population lives in or near coastal regions. Research into coastal phenomena has been ongoing for more than 25 years with the AOL3 LIDAR system. Plans are underway to establish a coastal ocean observing system at WFF that would include instrumented buoys, autonomous surface ocean instrumentation platforms, and a coastal radar (CODAR) system.

Precipitation Research

Global precipitation is an important component in the energy balance of the Earth. Research at WFF focuses on improving techniques for measuring precipitation to provide better ground validation for satellite sensors. Part of the instrumentation used includes weather radars, rain gauges, disdrometers, and a profiler. The Wallops region is currently being used as a regional validation site for satellite derived rainfall estimates.

2.2.9 Educational Programs

A component of WFF's mission is to provide science and technology education and outreach programs. These programs, discussed below, include the NASA Management Education Center and Educational Outreach.

2.2.9.1 NASA Management Education Center

The Management Education Center (MEC) is used to conduct the NASA Management Education Program, the Goddard Leadership Education Series, and the Langley Research Center's Management and Supervisory Training Program. It is currently located on the Main Base.

2.2.9.2 Educational Outreach

WFF participates in a number of flight education programs designed to excite youth about NASA's space-related activities. The NASA Student Involvement Program is a national program that consists of six investigations and design challenges for students in grades K-12. It is designed to link students with NASA's exciting missions of exploration and discovery. Another program, the Space Experiment Module Satchel Carrier System, places student experiments in a satchel that is taken to the International Space Station. The Student Experiment Module – Balloon program allows students to create their own experiments and then fly them onboard a high altitude NASA balloon. The FreeSPACE project offers students an opportunity to fly piggy-back experiments on NASA sounding rocket missions. The Small-Scale Educational Rocket Initiative is another educational program under development by the Sounding Rocket Programs Office at NASA WFF.

2.2.10 Open Burn Area

WFF has designated a small portion of the south end of Wallops Island as an Open Burn (OB) area. Rocket motors are classified as explosive hazardous waste and are treated at the OB area to remove their reactivity. At the OB area, the motors are placed either on a concrete pad or in a subunit and bolted down. Once properly secured, the motors are ignited to burn off the stored propellant. Once the burn is complete, the motor casing is allowed to cool before inspection. Any visible ash is removed and reburned or stored for less than 90 days at Building U-81 before being sent off site for disposal. Currently, the motor casing is disposed of as scrap metal. Starting in 2005, WFF will steam clean the motor casings. The water from the cleaning will be captured, tested for toxins, and disposed of properly. WFF typically uses the OB area to dispose of motors up to four times a year. Currently the OB operation is operating under an interim permit issued by the Virginia Department of Environmental Quality (DEQ). WFF has submitted an application to operate as a treatment, storage, and disposal facility under the Resource Conservation and Recovery Act (RCRA). The permit is currently under review by the Virginia DEQ. All OB activities would fall under the RCRA Part B permit.

Through a Waste Minimization Plan, rocket motor waste will be minimized at the OB area by determining other uses for each rocket motor. Rocket motors that do not meet contractor performance standards may be used on missions in which minor flight performance is not an issue. Rocket motors may also be used by NASA on university, student, or other missions. Rocket motors may be tested to determine the extent of deviation from performance standards and other uses may also be found. In addition, many times rocket motors manufactured by commercial manufacturers can be returned.

Table 2-7 summarizes the most recent OB activities at WFF. No burns have been conducted since 2000, due to the effectiveness of the above-mentioned Waste Minimization Plan. The OB operations envelope would be the maximum amount of propellant to be disposed of per year, which is 68 metric tonnes (66.9 tons).

Table 2-7 Summary of OB Operations

Year	Rocket Motor Types	Weight kilograms (lbs)
2000	7 Spin motors, 1 Nike, 1 Tomahawk, 1 Orion, 1 Vernier	1,350 (2,978)
2001	-	0
2002	-	0
2003	-	0

2.2.11 Rocket Boosted Projectile Testing

The U.S. Army and the U.S. Navy periodically conduct rocket boosted projectile tests from Wallops Island. These tests consist of firing 155-millimeter (6-inch) projectiles over the Atlantic Ocean. Projectiles resemble small solid propellant carbon-graphite based rocket motors carrying electronic communications payloads. Determining the initial velocity of the test projectile is critical. Typical test scenarios involve warming up the gun barrel by firing 2 solid steel slugs followed by velocity calculations based on firing blunt front end slugs calibrated to be the same weight as the test article. Lastly, the test article is fired. All objects follow a ballistic trajectory. The range of the articles varies; the warm up slugs travel less than 1.6 kilometers (1 mile), the velocity test slug impacts 10 to 13 kilometers (6 to 8 miles) downrange, while the current maximum range of the rocket boosted projectiles is 103 kilometers (64 miles). Test articles and projectiles are rarely recovered. Approximately 20 missions would be conducted per year; therefore, the rocket boosted projectile testing envelope is 20 missions per year at WFF.

2.2.12 Airfield Operations

The airfield continuously supports ongoing operations taking place at WFF. Typical support components include the airfield, hangars, fueling systems, security, tracking systems, and control tower. The airfield is used by NASA to conduct real-time tests in support of aeronautical research activities.

An example of aeronautical research activities at WFF is the testing of the Synthetic Vision Integrated Test and Evaluation (GVSITE) program. This project is a part of NASA's goal to develop breakthrough concepts and technologies for aircraft, airspace systems, and air safety and

security. Utilizing artificial vision, advanced sensors, digital terrain databases, and digital processing, the GVSITE program will demonstrate technologies that will enhance safety by providing a very clear three-dimensional picture of the terrain, obstacles, runway, and traffic regardless of weather conditions.

WFF's airport infrastructure provides communications, telemetry, radar tracking, and flight path guidance, as well as refueling and maintenance facilities for aircraft of all types. The airfield is also used as a divert field for aircraft (commercial, private, and military) experiencing difficulties in flight. The airfield supports the launch range by providing an enabling platform. UAVs, as well as aircraft carrying orbitals and drone targets, take off from the airfield.

2.3 NO ACTION ALTERNATIVE

Inclusion of a No Action Alternative in the environmental analysis and documentation for an Environmental Assessment is required under NEPA and is defined as maintaining the status quo. Under this Site-Wide EA, status quo is the continuation of existing WFF operations. Operations and routine assistance activities at WFF would continue at current levels and would not expand or change. Infrastructure would not be constructed, upgraded, or improved, eliminating the potential for growth. Not only would the No Action Alternative eliminate the potential for growth, but it may also cause a decrease in activities at WFF due to the inability of the aging infrastructure to support ongoing missions.

3.1 INTRODUCTION

Section 3 presents information regarding existing resources at WFF that may be affected by NASA operations and proposed future actions. This section contains discussions on resources under the three main categories of Physical Environment, Biological Environment, and Social and Economic Environment.

3.2 PHYSICAL ENVIRONMENT

3.2.1 Land Resources

This section is based on information taken from the 1994 soil survey for Accomack County, Virginia, and the 1999 ERD. Discussed under Section 3.2.1, Land Resources, are Topography and Drainage, Geology and Soils, Land Use, and the Atlantic Ocean Substrate within the WFF operating area.

3.2.1.1 Topography and Drainage

The topography at WFF is typical of the Mid-Atlantic coastal region, and is mostly flat without unusual features. Wallops Island is 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.

The Main Base, Wallops Mainland, and Wallops Island lie within the Tidewater region of the Embayed section of the Atlantic Coastal Plain Physiographic Province. The three major landforms found at the WFF site are mainland, tidal marsh, and barrier island.

The mainland includes low and high terraces separated by a discontinuous escarpment at 7.62 meters (25 feet) above mean sea level (amsl). Low terraces are found west of Route 13 and on the extreme eastern edge of Wallops Mainland. The low terrace consists of broad to narrow flats bordered by tidal marshes on the east and a discontinuous escarpment on the west. The high terrace ranges in elevation from 7.62 to 15.24 meters (25 to 50 feet) amsl. The high terrace topography is more complex than the low terrace, and is generally characterized by broad, nearly level terraces that are broken by narrow elliptical ridges (Carolina Bay features), gentle escarpments, tidal creek, and drainageways. Extensive tidal marshes are located between the mainland and barrier islands. The marshes flood regularly with the tides, are drained by an extensive system of meandering creeks, and have immature soils. Barrier islands are approximately parallel to the mainland and are generally less than 3 meters (10 feet) amsl. Topography varies from nearly level to steep, and soils are immature and vary widely from very poorly to excessively drained.

The majority of the WFF Main Base is located on a high terrace landform (7.62 to 12.19 meters [25 to 40 feet] amsl) with the northern and eastern portions located on low terraces (0 to 7.62 meters [0 to 25 feet] amsl) and tidal marsh. The Wallops Mainland is primarily located on low terrace and tidal marsh, and Wallops Island is a barrier island with extensive tidal marshes between the island and the Wallops Mainland. Presently, the highest elevation on Wallops Island is approximately 4.57 meters (15 feet) amsl. However, topography on barrier islands changes due to the dynamics of ocean currents, wind erosion, and severe weather conditions.

The Main Base has both natural drainage patterns and stormwater swales and drains to intercept and divert flow. The natural drainage pattern on the northern portion of the Main Base drains to Mosquito Creek and eventually flows to the Atlantic Ocean. The eastern and southeastern portions of the Main Base have a natural drainage pattern that flows to Simoneaston Bay, then into Cockle Creek, Shelly Bay, and Chincoteague Bay, before draining to the Atlantic Ocean. The natural drainage pattern on the western and southwestern portion of the Main Base is toward Wattsville Branch, and then to Mosquito Creek, and on to the Atlantic Ocean. Stormwater drains on the Main Base intercept natural drainage ditches and divert the flow to numerous discharge locations. Stormwater drains are located throughout the developed portion of the Main Base; the majority of stormwater discharges into the surrounding waterways, and eventually to the Atlantic Ocean.

On Wallops Mainland, the eastern sloping grade forms a natural drainage pattern that flows toward Hog Creek, and then to Oyster Bay, Assawoman Creek, and finally the Atlantic Ocean. Surface water on Wallops Island flows east through numerous tidal tributaries and subsequently flows to the Atlantic Ocean. Additionally, Wallops Island has storm drains that divert the water flow to several individual discharge locations.

3.2.1.2 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, 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 units is to the east, toward the ocean. The two uppermost stratigraphic units at WFF 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. 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 18.28 to 42.67 meters (60 to 140 feet) in Accomack County (NASA, 1999a).

The soil classifications for WFF (Table 3-1) are based on the 1998 Accomack County Soil Conservation Service preliminary soil classification map (Figure 10). The Coastal Plain soils of the Eastern Shore are generally very level soils and many soil types are considered to be prime farmland by the U.S. Department of Agriculture (USDA). The dominant agricultural soils are high in sand content, which results in a highly leached condition, an acidic pH, and a low natural fertility (Accomack County SCS, 1988). Adequate artificial drainage improves productivity for poorly drained soils. Prime and unique farmlands in Accomack County are classified as the following soils:

- Bojac fine sandy loam soils;
- Bojac loamy sand soils;
- Munden fine sandy soil;
- Munden loamy sand;

- Dragston fine sandy loam, if adequately drained; and
- Nimmo fine sandy loam, well-drained.

Table 3-1 Predominant Soil Types at Wallops Flight Facility

Location	Soil Type	Typical Slopes	Description
Main Base – inland Areas	Bojac fine sandy loam	0-2 percent	Nearly level, very deep, well-drained soils. Suitable for agriculture.
Main Base – perimeter areas	Molena loamy sand	6-35 percent	Very deep and somewhat excessively drained. The severe erosion potential and low availability of water make it unsuitable for cultivation.
Wallops Mainland – western portion	Bojac loamy sand	2-6 percent	Gentle sloping, very deep, well-drained; can be used for cultivation; sloping and erodibility limit its productivity.
Wallops Mainland – middle portion	Magotha fine sand loam	0-2 percent	Nearly level, very deep, poorly drained hydric soils. This soil provides a suitable wildlife habitat.
Wallops Mainland – eastern and Wallops Island western portions	Chincoteague silt loam	0-1 percent	Nearly level, very deep, very poorly drained hydric soils. This soil provides a suitable wildlife habitat.
Wallops Island – eastern portion	Chincoteague silt loam	0-1 percent	Nearly level, very deep, very poorly drained hydric soils. This soil provides a suitable wildlife habitat.
Wallops Island – east of Chincoteague silt loam	Udorthents and Udipsamments	0-35 percent	Nearly level to steep, very deep, and range from well-drained to somewhat poorly drained.
Wallops Island – southern end	Fisherman Assateague fine sands complex	0-35 percent	Nearly level to steep, very deep, moderately well-drained, to excessively drained. This soil is used mainly for wildlife habitat and recreation.
Wallops Island – depressions and areas associated with dunes and salt marshes	Fisherman Comacca fine sands complex	0-6 percent	Very poorly to moderately well-drained.
Wallops Island – central and western portions in depressions and on flats associated with dunes and marshes	Comacca fine sand	0-2 percent	Nearly level, very deep, very poorly drained. The soil is used mainly for wildlife habitat and recreation.
Wallops Island – eastern portion	Assateague fine sand	2-35 percent	Gently to steeply sloping, very deep, excessively drained. This soil is rarely flooded and is used primarily for wildlife and recreation.
Wallops Island – eastern portion	Beaches		Moderately sloping and used mainly for wildlife habitat.

Source: NASA, 1999a

Insert Figure 10 – Soil Types (11x17 color)

3.2.1.3 Land Use

WFF is located in the northeastern portion of Accomack County, Virginia, on the Delmarva Peninsula. WFF has its own land use classification based on operational areas on the Main Base, Wallops Mainland, and Wallops Island (Figure 11).

The Main Base comprises 720 hectares (1,800 acres). Main Base facilities include offices, laboratories, maintenance and service facilities, a NASA-owned airport, air traffic control facilities, hangars, runways, and aircraft maintenance and ground support buildings. In addition, there are water and sewage treatment plants, rocket motor storage magazines, U.S. Navy administration and housing as well as USCG housing, and other miscellaneous structures.

Wallops Mainland consists of 40.5 hectares (100 acres) with long-range radar, communications, and optical tracking installations. Wallops Island comprises 1,680 hectares (4,600 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.

The Navy Housing Center includes residences for both bachelors and families. The Bachelor Officers Quarters contain 6 efficiency units and 10 one-bedroom units. The Bachelor Enlisted Quarters, with its attached dining facility, provides dormitory living for up to 120 personnel. There are four two-bedroom and 24 three-bedroom homes. In addition, dormitories in Buildings F-004 and F-005 are available to researchers and other visiting personnel.

The Main Base, Wallops Mainland, and most of Wallops Island are zoned for industrial use by Accomack County, Virginia. The marsh area between Wallops Mainland and Wallops Island is not included in the industrial zoned area and is classified as marshland in the County's plan. The area surrounding WFF consists of rural farmland and small villages and is regulated by local County government and several town councils.

Wallops Mainland consists mostly of marshland and is bordered by agricultural land to the north, south, and west. Wallops Main Base is bordered by agricultural land to the south, west, and north, and by marshland to the northeast, east, and southeast. Most of the agricultural land surrounding WFF, as well as part of the Main Base, is designated as prime or unique farmland based upon the soil classification. Corn, wheat, soybeans, cabbage, potatoes, cucumbers, and tomatoes are examples of the commodities produced on the surrounding farms.

Rural residential land borders the Main Base to the southwest and small villages and businesses are scattered throughout this area. The businesses include fuel stations, retail stores, markets, and restaurants. Horntown is located 4 kilometers (2.5 miles) north of the Main Base and has a land area of approximately 578 hectares (1,446 acres); Wattsville is located 1.6 kilometers (1 mile) to the west and has a land area of approximately 330 hectares (826 acres); and Atlantic is located 4.4 kilometers (2.75 miles) to the southwest and has a land area of approximately 183 hectares (459 acres). Each of these villages has a population of less than 500 people.

The Town of Chincoteague, located approximately 8 kilometers (5 miles) east of the Main Base on Chincoteague Island, Virginia, is the largest of the surrounding communities with approximately 4,317 residents, and attracts a large tourist population during the summer months because of the beaches and the annual Assateague Island pony swim and round-up.

Insert Figure 11 – Wallops Flight Facility Land Uses (11x17 color)

Because of this, hotels and motels as well as other summer season tourist businesses can be found on Chincoteague Island. Under an easement agreement with NASA, the Town of Chincoteague operates a series of drinking water production wells to the east of Runway 04-22 of the Wallops Airfield. WFF also has an agreement with the Town of Chincoteague to allow them to draw treated water from NASA during high use periods.

The Wallops Visitors Center, located on Route 175, gives tourists an understanding of WFF functions. WFF has given permission to the Marine Science Consortium (MSC) to moor boats at the dock located near the Visitors Center. The MSC, established in 1965, is a non-profit educational corporation of 15 universities. The MSC facilities are located near the Main Gate of the Main Base, and include housing for students, staff, and faculty; a cafeteria; classrooms/laboratories; recreation areas; administration offices; vehicles; research vessels; and oceanographic equipment.

The MSC uses the Chincoteague National Wildlife Refuge, Assateague Island National Seashore, and WFF for access to salt and freshwater marshes, estuaries, and barrier island beaches and dunes. The Chincoteague National Wildlife Refuge is under the jurisdiction of the U.S. Department of Interior, Fish and Wildlife Service (USFWS) and is located 9.6 kilometers (6 miles) to the northeast of WFF. Assateague Island National Seashore is under the jurisdiction of the National Park Service (NPS) and is located north of Chincoteague National Wildlife Refuge, both of which attract a multitude of seasonal tourist. The Wallops Island National Wildlife Refuge is located adjacent to the Wallops Visitors Center and is under the jurisdiction of the USFWS. This refuge is not open for use by the general public.

3.2.1.4 Atlantic Ocean Substrate

The Atlantic Ocean substrate located within the VACAPES OPAREA lies in the Mid-Atlantic Bight with Baltimore Canyon bounding the north and Washington Canyon bounding the south. The depth of water in the continental shelf at the VACAPES OPAREA averages 75 meters (246 feet). Sediment texture varies from gravel patches and a fine sand mixture inshore, to medium sand offshore extending to the shelf edge. Fine sandy silt characterizes the edge of the shelf from 200 to 400 meters (656 to 1,312 feet). The sediments in the VACAPES OPAREA are typical of the offshore to shelf-edge area, consisting of fine quartz sand with a patchy veneer of shells (NASA, 1999a).

3.2.2 Water Resources

WFF is located in the Eastern Lower Delmarva and the Chincoteague watersheds. The entire Main Base, portions of Wallops Mainland north of Route 803, and the western portion of Wallops Island north of Route 803 are part of the Chincoteague watershed. The portion of Wallops Mainland south of Route 803 and the portions of Wallops Island south of Route 803 and all along the eastern edge of the island are part of the Eastern Lower Delmarva watershed.

3.2.2.1 Surface Waters

Numerous inlets, marshes, bays, creeks, and tidal estuaries are found in and around all three installation areas of WFF. A section of the Virginia Inside Passage is located west of Wallops Island and east of the Main Base and Wallops Mainland. 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.

The Virginia DEQ has designated the surface waters in the vicinity of WFF as Class II – Estuarine Waters (NASA, 1999a). The Atlantic Ocean is designated as Class I – Open Ocean. Surface waters in Virginia must meet the water quality criteria specified in 9 Virginia Administrative Code (VAC) 25-260-50. This set of criteria establishes limits for minimum dissolved oxygen concentrations, pH, and maximum temperature for the different surface water classifications in Virginia. In addition, Virginia surface waters must meet the surface water criteria specified in 9 VAC 26-260-140. This set of criteria provides numerical limits for various potentially toxic parameters. For the Class I and II waters in the vicinity of WFF, the saltwater numerical criterion is applied. Both sets of standards are used by the Commonwealth of Virginia to protect and maintain surface water quality.

3.2.2.2 Stormwater

The Main Base has both natural drainage patterns and stormwater drains to intercept and divert stormwater flow. On the northern portion of the Main Base, stormwater flows drain to Little Mosquito Creek and eventually flow to the Atlantic Ocean. On the eastern and southeastern portions of the Main Base, the natural drainage pattern flows to Jenneys Gut and Simoneaston Bay, then into Cockle Creek, Shelly Bay, and Chincoteague Bay before draining to the Atlantic Ocean. On the western and southwestern portions of the Main Base, the natural drainage pattern is toward Wattsville Branch, then to Little Mosquito Creek, and on to the Atlantic Ocean. Stormwater drains on the Main Base intercept natural drainage ditches and divert the flow to numerous discharge locations. The Main Base's extensive storm drain network discharges into Little Mosquito Creek to the north and west, and into Simoneaston Bay to the south and east.

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.

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

National Pollutant Discharge Elimination System (NPDES) regulations require permits for stormwater discharges associated with industrial activities. The Virginia DEQ is authorized to carry out NPDES permitting under the Virginia Pollutant Discharge Elimination System (VPDES). WFF currently holds VPDES permit number VA0024457 for 12 outfalls. Descriptions of the outfalls are provided in Table 3-2.

Table 3-2 Outfalls Associated with VPDES Permit Number VA0024457

Outfall Number	Description
003	Drains airfield runways, taxiways, aprons, and a hangar; satellite accumulation areas and a less-than-90-day accumulation area (Building E-2); aboveground fuel storage tanks; office buildings; roadways, parking areas, and grassy areas. This outfall discharges to Little Mosquito Creek. Potential sources of pollution include possible fuel spills from airfield activities or releases from fuel delivery vehicles or possible hazardous waste spills from either a satellite accumulation area

Table 3-2 Outfalls Associated with VPDES Permit Number VA0024457	
Outfall Number	**Description**
	or the less-than-90-day accumulation area. A slight chance of stormwater contamination from hazardous wastes exists; however, all satellite accumulation areas are required to have secondary containment and are located inside covered structures. In addition, the less-than-90-day accumulation area is located inside a brick building. During a 24-hour, 2-year storm event, approximately 8.03 million gallons per day (MGD) would discharge from this outfall.
004	Drains airfield runways and taxiways, satellite accumulation areas, an enclosed salt storage facility, an automobile fueling facility and a maintenance garage, aboveground fuel storage tanks, roadways, parking areas, office and storage buildings, and grassy areas. This outfall discharges to Little Mosquito Creek. Potential sources of pollution include possible fuel spills from automobile fueling and maintenance, releases from fuel delivery vehicles, or airfield activities. The slight possibility of hazardous waste spills from satellite accumulation areas also exists; however, all satellite accumulation areas are required to have secondary containment and are located inside covered structures. During a 24-hour, 2-year storm event, approximately 1.72 MGD would discharge from this outfall.
005, 006, 007, 008	Drain airfield runways, taxiways, and grassy areas. These outfalls discharge to Little Mosquito Creek. Potential sources of pollution include possible fuel spills from airfield activities. During a 24-hour, 2-year storm event, discharges would be approximately 1.00 MGD from outfall 005, 0.16 MGD from outfall 006, 0.51 MGD from outfall 007, and 1.36 MGD from outfall 008.
009	Drains airfield runways, taxiways, and grassy areas. This outfall discharges to Jenneys Gut. Potential sources of pollution include possible fuel spills from airfield activities. During a 24-hour, 2-year storm event, approximately 0.85 MGD would discharge from this outfall.
010	Drains airfield runways, taxiways, and aprons, satellite accumulation areas, a less-than-90-day accumulation area (Building B-29), a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) restoration site with low-level pesticide soil impacts and aboveground fuel storage tanks; office buildings, roadways, parking areas, and grassy areas. This outfall discharges to Jenneys Gut. Potential sources of pollution include possible fuel spills from airfield activities or releases from fuel delivery vehicles or possible hazardous waste spills from either a satellite accumulation area or the less-than-90-day accumulation area. The slight possibility of stormwater contamination from hazardous wastes exists; however, all satellite accumulation areas are required to have secondary containment and are located inside covered structures. In addition, the less-than-90-day accumulation area is located in a concrete building protected by drains and troughs that would contain a spill within the area. The potential for contaminated runoff from the CERCLA site exists, but due to site topography, it is highly unlikely. During a 24-hour, 2-year storm event, approximately 4.43 MGD would discharge from this outfall.
012, 013	Drain airfield runways and taxiways and grassy areas. These outfalls discharge to Little Mosquito Creek. Potential sources of pollution include possible fuel spills from airfield activities. During a 24-hour, 2-year storm event, approximately 0.17 MGD would discharge from outfall 012 and 0.14 MGD from outfall 013.
014	Drains airfield runways, taxiways, and a hangar; satellite accumulation areas and an aboveground fuel storage tank; roadways and parking areas; office and storage buildings; and grassy areas. This outfall discharges to Simoneaston Bay. Potential sources of pollution include possible fuel spills from runway activities or releases from fuel delivery vehicles or possible hazardous waste spills from satellite accumulation areas. However, all satellite accumulation areas are now required to have secondary containment and are located inside covered structures. During a 24-hour, 2-year storm event, approximately 3.32 MGD would discharge from this outfall.
302 (intermediate outfall)	Intermediate Outfall 302 is an oil/water separator located at the aviation fuel tank farm. Water exiting outfall 302 travels a short distance through a ditch, enters the stormwater system, and discharges through outfall 003 to Little Mosquito Creek. Potential pollution sources include fuel spills or leaks from the aviation fuel tank farm. However, the oil/water separator will capture any petroleum products released. During a 24-hour, 2-year storm event, approximately 0.01 MGD

Table 3-2 Outfalls Associated with VPDES Permit Number VA0024457	
Outfall Number	**Description**
	would discharge from this outfall.

VPDES regulations also require permitted facilities to develop a Stormwater Pollution Prevention Plan (SWPPP). WFF's most recent SWPPP was developed in 2001; the document is being revised, however. The SWPPP describes current stormwater management systems and associated outfalls, potential pollutant sources, and best management practices (BMPs) implemented to reduce runoff. In addition, the SWPPP details stormwater sampling activities, procedures for completing annual comprehensive site compliance evaluations, and the employee training program (NASA, 2001b).

Scheduled samplings of stormwater drainage areas are performed in accordance with VPDES water quality monitoring requirements. Analysis is conducted in accordance with U.S. Environmental Protection Agency (EPA) analytical laboratory test methods, and quality control/quality assurance reviews are conducted to ensure the validity of results. Sample results are submitted to DEQ in a monthly Discharge Monitoring Report (DMR). No discharge violations were reported during the most recent permit term.

3.2.2.3 Marine Waters

Temperature and Salinity

There are distinct differences in stratification of the mid-Atlantic Ocean between summer and winter. In the winter, the water column is vertically well mixed, with water temperatures averaging 14° Celsius (C) (57° F) at the surface and 11° C (52° F) at depths greater than 200 meters (656 feet). In summer (August), the water column is vertically stratified with 25° C (77° F) water near the surface and 10° C (50° F) water at depths greater than 200 meters (656 feet) (NASA, 2003a).

Among the large rivers and estuaries that discharge fresh water into the mid-Atlantic Ocean are the Hudson River, Delaware Bay, and Chesapeake Bay. The salinity over the continental shelf ranges from 28 to 36 parts per thousand (ppt), with lower salinities found near the coast and highest salinities found near the continental shelf break. Salinities are highest in continental shelf waters during winter and lowest in the spring. Variability in this area is due to the intrusion of saltier (greater than 35 ppt) water from the continental slope waters and freshwater input from coastal sources (NASA, 2003a).

Continental slope waters in the VACAPES OPAREA maintain a fairly uniform salinity range (32 to 36 ppt) throughout the year, with pockets of high salinity water (38 ppt) found near the Gulf Stream in the fall (NASA, 2003a).

Circulation

The surface water masses found in the VACAPES OPAREA are the Gulf Stream, Chesapeake Bay, and Delaware Bay plume waters, and mid-Atlantic shelf water. The Gulf Stream exerts a considerable influence on the oceanographic conditions in the VACAPES OPAREA. In general, the Gulf Stream flows roughly parallel to the coastline from the Florida Straits to Cape Hatteras, where it is deflected from the North American continent and flows northeastward past the Grand

Banks. After the Gulf Stream separates from the east coast in North Carolina, the current passes approximately 175 kilometers (95 nautical miles) from the coast, through the southeastern portion of the VACAPES OPAREA. In this area, the Gulf Stream is approximately 50 kilometers (31 miles) wide and 1,000 meters (3,281 feet) deep. Surface velocity ranges from 3.7 to 9.3 kilometers per hour (2 to 5 nautical miles per hour) and temperatures from 25 to 28° C (77 to 82° F) (NASA, 2003a).

Relatively fresh or brackish water from the Chesapeake and Delaware Bays flows out of these estuaries in the form of plume water. This less dense (due to lower salinity) water flow turns south in response to the Coriolis force (Earth's rotation), resulting in southward flowing, coastally trapped currents. An increase in river flow and ebbing tides force more water out of the respective bays; predominant southwesterly winds cause a seaward expansion of the plume over the continental shelf, creating a well-stratified, two-layer system. The warm surface waters are constantly replaced by deeper, more saline, nutrient-rich water (NASA, 2003a).

3.2.2.4 Groundwater

Hydrogeology

The Virginia DEQ has identified four major aquifers on the Eastern Shore of Virginia: the Columbia aquifer and the three aquifers comprising the Yorktown-Eastover aquifer system.

The water table aquifer, known as the Columbia aquifer, primarily consists of Pleistocene sediments of the Columbia Group (Richardson, 1992). It is unconfined and typically overlain by wind-deposited beach sands, silts, and gravel. The aquifer occurs between depths of 1.5 to 18.3 meters (5 to 60 feet) below the ground surface. The water table ranges from depths of 0 to 9.1 meters (0 to 30 feet) below the ground surface. Groundwater flow is generally east and north toward nearby creeks and the marsh area that separates Chincoteague Island from the mainland.

The Yorktown-Eastover aquifer system is a multiaquifer unit consisting of late Miocene and Pliocene deposits and is composed of the sandy facies of the Yorktown and Eastover Formations (Meng and Harsh, 1988). The top of the shallowest confined Yorktown-Eastover aquifer at WFF is found at depths of approximately 30.5 meters (100 feet) below the ground surface. It is separated from the overlying Columbia aquifer by a 6.1- to 9.1-meter (20- to 30-foot) confining layer (aquitard) of clay and silt. The Yorktown-Eastover aquifers are classified as the upper, the middle, and the lower Yorktown-Eastover aquifers. Correspondingly, each Yorktown-Eastover aquifer is overlain by the upper, middle, and lower Yorktown-Eastover aquitards. In the Wallops area, the Lower Yorktown-Eastover aquifer contains the freshwater/saltwater interface, which occurs at a depth of approximately 91.4 meters (300 feet) below mean sea level.

In general, the water table (Columbia) aquifer on the Delmarva Peninsula is recharged by surface waters or infiltration of precipitation. The confined aquifers are recharged by the same process, but from more distal areas located beyond the immediate vicinity of WFF.

Groundwater Appropriation

WFF contains 17 water supply wells that are screened in the Columbia and Yorktown-Eastover Multiaquifer System, which is protected by the EPA as a sole source aquifer (EPA, 2003). A sole source aquifer is a drinking water supply located in an area with few or no alternative sources to the groundwater resource, and where if contamination occurred, using an alternative

source would be extremely expensive. The designation protects an area's groundwater resource by requiring the EPA to review any proposed projects within the designated area that are receiving Federal financial assistance. All proposed projects receiving Federal funds are subject to review to ensure they do not endanger the water source.

NASA operates five supply wells on the Main Base and three on Wallops Mainland, one well is operated by NOAA, and eight wells are operated under easement by the Town of Chincoteague. Most of the supply wells are several hundred feet deep and are constructed to withdraw water from one of the Yorktown Aquifers. Three of the wells that are operated by the Town of Chincoteague (located near the eastern boundary of the Main Base) are 18.3 meters (60 feet) or less in depth and withdraw water from the Columbia Aquifer (NASA, 2004b).

Groundwater is the sole source of potable water for WFF and the general vicinity. No major streams or other fresh surface water supplies are available as alternative sources of water for human consumption. In addition to the groundwater management program that has been established by the Virginia DEQ for the entire Eastern Shore, a Groundwater Committee was established in 1990 to ensure that an optimal balance exists between groundwater withdrawals and recharge rates. This balance helps to minimize the problems of water quality due to saltwater intrusion, aquifer de-watering, and well interference in the general area (NASA, 1999a).

In accordance with Federal and State requirements, WFF's Chemical Laboratory performs routine analytical sampling of WFF's water systems and submits the results to State authorities for review. Recent sampling of the drinking water system has found that lead and copper concentrations are above regulatory limits (NASA, 2003e). These contaminants are from corrosion of the supply pipes rather than contaminants present in the groundwater. Two sites out of 20 sampled in 2003 were above the copper action level of 1.3 parts per million (ppm). The highest level of copper detected during sampling was 2.38 ppm. Four sites out of 20 sampled in 2003 were above the lead action level of 15 parts per billion (ppb). The highest level of lead detected during sampling was 63 ppb.

In December 2003, NASA notified users of the drinking water system that monitoring had detected lead levels above the action level and provided them with guidance on reducing their exposure to lead. NASA has since instituted a comprehensive treatment program to reduce lead and copper concentrations and will continue monitoring the drinking water system. If the treatment program does not successfully reduce the lead concentrations, then NASA is required to replace each service line that it controls that contributes to lead concentrations of more than 15 ppb (NASA, 2003g).

Groundwater Quality

Past contamination at three sites on the Main Base has impacted groundwater quality at WFF. Chemical releases at the Former Fire Training Area, Waste Oil Dump, and Old Aviation Fuel Tank Farm resulted in contaminant plumes that have affected local groundwater quality in the Columbia Aquifer. Water quality in the underlying Yorktown Aquifer has not been affected due to the presence of the intervening aquitard, which prevents impacted groundwater from flowing down from the Columbia Aquifer. The principal chemicals in the plumes include components of fuels and oils (in all three plumes) and solvents (chiefly in the Former Fire Training Area plume) (NASA, 2004b).

None of the 14 water supply wells located on the Main Base have been affected by the contaminant plumes. Most of the supply wells are located in the Yorktown Aquifer, which is protected from the plumes by an aquitard. The wells that are located in the Columbia Aquifer have not been impacted because the plumes are not large enough to reach them. NASA regularly samples the supply wells and the area groundwater to ensure that the plumes are not expanding and that there is no impact on the drinking water supply.

The results of comprehensive investigations indicate that each of the plumes is either at steady-state or possibly receding, but none is continuing to expand. NASA has imposed institutional controls (restriction zones), intrinsic remediation, and long-term monitoring to mitigate the adverse impact of contaminants on groundwater. NASA is working with Federal and State environmental agencies to ensure that plumes do not expand and to restore groundwater to natural conditions (NASA, 2004b).

3.2.2.5 Wetlands

Executive Order (EO) 11990 (Wetland Protection) directs Federal agencies to minimize the destruction, loss, and degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetland communities.

Extensive marsh wetland systems border all three areas at WFF. The Main Base has tidal and nontidal wetlands along its perimeter in association with Mosquito Creek, Jenneys Gut, Simoneaston Bay, and Simoneaston Creek. Wallops Island has nontidal wetlands in its interior and marsh wetlands on the western edge. Marsh wetlands also fringe Wallops Mainland along Arbuckle Creek, Hogs Creek, and Bogues Bay (NASA, 2003a). Figure 12 provides further details on the types and locations of wetland communities present at WFF.

In accordance with the Clean Water Act (CWA) (33 U.S.C. §1251 *et seq*.), projects at WFF involving dredging or filling of tidal or nontidal wetlands require Section 404 permits from the U.S. Army Corps of Engineers (USACE). In addition, development activities in Virginia wetlands require State permits from DEQ, through the Virginia Water Protection Permit program and Section 401 of the CWA, and from the Virginia Marine Resources Commission (VMRC) and local wetland boards, through the Virginia Tidal Wetlands Act of 1972.

3.2.2.6 Floodplains

EO 11988 (Floodplain Management) requires Federal agencies to take action to minimize occupancy and modification of the floodplain. Specifically, EO 11988 prohibits Federal agencies from funding construction in the 100-year floodplain unless there are no practicable alternatives.

As shown on the Flood Insurance Rate Maps (FIRMs) produced by the Federal Emergency Management Agency (FEMA), the 100-year floodplain designates the area inundated during a storm having a 1 percent chance of occurring in any given year. The 500-year floodplain designates the area inundated during a storm having a 0.2 percent chance of occurring in any given year.

FIRM Community Panels 5100010070B and 5100010100C indicate that Wallops Island is located entirely within the 100-year floodplain. In addition, the same FIRM Community Panels show that the 100-year and 500-year floodplains surround the perimeter of the Main Base, along

Mosquito Creek, Jenneys Gut, and Simoneaston Creek; and the 100-year and 500-year floodplains border the eastern edge of Wallops Mainland along Arbuckle Creek and Hog Creek (NASA, 2003a) (Figure 13). Definitions of mapped FEMA flood hazard zones are provided in Table 3-3.

Table 3-3 Flood Hazard Zone Definitions

Zone	Definition
A	Designates 100-year floodplains that are determined by approximate methods in a FEMA Flood Insurance Study (FIS). Because detailed analyses are not performed for such areas, no Base Flood Elevations (BFEs) or depths are shown within this zone.
AE	Designates 100-year floodplains that are determined by detailed methods in a FEMA FIS. In most instances, BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.
ANI	Designates an area that is not mapped on a FIRM.
UNDES	Designates a body of open water, such as a pond, lake, or ocean that is located within a community's jurisdictional limits and has no defined flood hazard.
VE	Designates 100-year coastal floodplains that have additional hazards associated with storm waves. BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.
X	Designates areas outside of the 100-year floodplain, areas of sheet flow flooding where average depths are less than 1 foot, areas of 100-year stream flooding where the contributing drainage area is less than 1 square mile, or areas protected by levees from 100-year flooding. No BFEs or depths are shown within this zone.
X500	Designates areas inundated by 500-year flooding, areas inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile, or areas protected by levees from 100-year flooding.

Source: FEMA, 2003

Insert Figure 12 – Wetlands (11x17 color)

Insert Figure 13 – Floodplain Zones (11x17 color)

3.2.2.7 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, unique recreation resources, important natural habitats to unique species, and valuable economic opportunities to the country. Wallops Island contains coastal primary sand dunes that serve as protective barriers from the effects of flooding and erosion caused by coastal storms (NASA, 1999a).

The Coastal Barrier Resources Act (CBRA [P.L. 97-348]), enacted in 1982, designated various undeveloped coastal barrier islands as units in the Coastal Barrier Resources System. Designated units are ineligible for direct and indirect Federal financial assistance programs that could support development on coastal barrier islands; exceptions are made for certain emergency and research activities. Wallops Island is not included in the Coastal Barrier Resources System; therefore, CBRA does not apply and will not be discussed further in this document.

The Virginia DEQ is the lead agency for the Virginia Coastal Resources Management Program, which is authorized by the National Oceanic and Atmospheric Administration (NOAA) to administer the Coastal Zone Management Act (CZMA) of 1972. Any Federal agency development in Virginia's Coastal Management Area (CMA) must be consistent with the enforceable policies of the Virginia Coastal Resources Management 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 Virginia Coastal Resources Management Program (Virginia DEQ, 2003).

Enforceable policies of the Virginia Coastal Resources Management Program that must be considered when making a Coastal Zone Consistency Determination include:

- **Fisheries Management**. Administered by the Virginia Marine Resources Commission (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 the VMRC, this program establishes conditions for granting permits to use State-owned bottomlands;
- **Wetlands Management.** Administered by the VMRC and the DEQ, the wetlands management program preserves and protects tidal wetlands;
- **Dunes Management.** Administered by the VMRC, the purpose of this program is to prevent the destruction and/or alteration of primary dunes;
- **Non-point Source Pollution Control.** Administered by the Virginia Department of Conservation and Recreation (DCR), the Virginia Erosion and Sediment Control Law is intended to minimize non-point source pollution entering Virginia's waterways;
- **Point Source Pollution Control.** Administered by the State Water Control Board, the NPDES permit program regulates point source discharges to Virginia's waterways;
- **Shoreline Sanitation.** Administered by the Department of Health, this program regulates the installation of septic tanks to protect public health and the environment;

- **Air Pollution Control.** Administered by the State Air Pollution Control Board, this program implements the Federal Clean Air Act (CAA) through a legally enforceable State Implementation Plan (SIP); and
- **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.

3.2.3 Air Quality

This section presents information about existing air quality conditions around Wallops Flight Facility. Included are the identification and description of various sources of air emissions associated with WFF and their pollutants, along with an emission inventory of existing conditions. Air quality is dependent upon weather patterns and emission sources.

3.2.3.1 Ambient Air Quality

The Clean Air Act (CAA), as amended, requires the 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 standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set to limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The EPA has set NAAQS for six principal pollutants, which are called "criteria" pollutants. They include: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), lead (Pb), particulate matter less than or equal to 10 microns (PM_{10}), and sulfur dioxide (SO_2). The Ambient Air Quality Standards published by the Commonwealth of Virginia must be equal to, or more stringent than the NAAQS. The Commonwealth promulgates air quality standards through the State Air Pollution Control Board overseen by the Virginia DEQ.

Section 176(c) of the CAA requires Federal agencies to ensure that actions undertaken in nonattainment or maintenance areas are consistent with the CAA and with federally enforceable air quality management plans. WFF is located in an attainment area for the Ambient Air Quality Standards, therefore, is not required to complete the CAA conformity process. The Standards are contained in 9 VAC 5-30 for the Control and Abatement of Air Pollution. Primary standards for protection of human health, and secondary standards for protection of public welfare, are included in Section 9 VAC 5-30 for criteria pollutants. The Standards are summarized in Table 3-4.

Table 3-4 Commonwealth of Virginia Ambient Air Quality Standards

Parameter (Criteria Pollutant)	Primary		Secondary	
	(μg/m3)	(ppm)	(μg/m3)	(ppm)
Sulfur Dioxide (SO_2)				
Annual arithmetic mean	80	0.03	-	-
Maximum 24-hour concentration*	365	0.14	-	-
Maximum 3-hour concentration*	-	-	1300	0.50
Carbon Monoxide (CO_2)				
Average 8-hour concentration*	10,000	9	10,000	9
Average 1-hour concentration*	40,000	35	40,000	35

Table 3-4 Commonwealth of Virginia Ambient Air Quality Standards				
Parameter (Criteria Pollutant)	**Primary**		**Secondary**	
	(μg/m3)	**(ppm)**	**(μg/m3)**	**(ppm)**
Ozone (O_3)				
Maximum 1-hour concentration	235	0.12	235	0.12
Particulate Matter (PM_{10})				
24-hour average concentration	150	-	150	-
Annual arithmetic mean	50	-	50	-
Nitrogen Dioxide (NO_2)				
Annual arithmetic mean	100	0.053	100	0.053
Lead (Pb)				
Maximum arithmetic mean (averaged over calendar year)	1.5	-	1.5	-

* = Not to be exceeded more than once per year
ppm = parts per million
(μ/m3) = micrograms per cubic meter
Source: Commonwealth of Virginia, 1999

The Virginia DEQ does not currently perform ambient air quality monitoring in the vicinity of WFF. The Virginia DEQ considers the Eastern Shore of Virginia to be an attainment area for ozone, indicating compliance with primary and secondary standards. Accomack County is not designated as an Air Quality Maintenance Area. An Air Quality Maintenance Area is defined as "any area which, due to current air quality or projected growth rate or both, may have the potential for exceeding any ambient air quality standard (for criteria pollutants) within a subsequent 10-year period" (Commonwealth of Virginia, 1999). WFF has an air permit from the Virginia DEQ that allows it to maintain emissions for criteria pollutants and hazardous air pollutants below major source thresholds.

3.2.3.2 Regional Weather Patterns

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 air current, know as the Labrador Current, which originates in the polar latitudes and moves southward along the Delmarva coastline. The current creates a wedge between the warm Gulf Stream offshore and the Atlantic coast. The climate of the region is dominated in winter by polar continental air masses and in summer by tropical maritime air masses. Clashes between these two air masses create frontal systems, resulting in thunderstorms, high winds, and precipitation.

Temperature and precipitation in this climate zone vary seasonally. Four distinct seasons each demonstrate characteristic temperatures. 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.

3.2.3.3 Local Climatological Data

Climatological records are maintained by the WFF Meteorological Office. A summary of local climatological data is presented in Table 3-5.

Table 3-5 Local Climatological Data

Temperatures °C (°F)		
	Normal Daily Maximum	19.2 (66.5)
	Normal Daily Minimum	9.4 (49.0)
	Annual Daily Average	14.3 (57.7)
	Extreme High	38.3 (101)
	Extreme Low	17.8 (0.0)
Wind		
	Prevailing Direction: South	
	Months of greatest mean wind speed: February and March	
	Months of lowest mean wind speed: July and August	
Precipitation in centimeters (inches)		
	Normal yearly	99.1 (39.0)

Sources: NASA, 1999a; NOAA, 2004a

3.2.3.4 Severe Weather

Severe weather such as hurricanes, northeasters, and thunderstorms can result in high winds, heavy rainfalls, and reduced visibility. All of these factors can result in significant impacts to operations at WFF, particularly those related to the airport and sounding rockets program. Hurricanes are the most severe type of storm in this area, with high winds and heavy rainfall. A hurricane is an intense cyclonic storm originating in tropical or subtropical latitudes in the Atlantic Ocean just north of the equator. Hurricanes are known to affect this area from May through November, but most occur from August through October. Hurricanes, or remnants of hurricanes, which have affected the WFF area within the last 50 years include Hurricane Hazel (October 1954), Hurricane Connie (August 1955), Hurricane Donna (September 1960), Hurricane Agnes (June 1972), Hurricane Gloria (September 1985), Hurricane Bertha (July 1996), Hurricane Floyd (September 1999), and Hurricane Isabel (September 2003) (NOAA, 2004b).

Northeasters are also cyclonic-type storms, but normally develop near the Atlantic coast, intensify, and produce high winds, waves, tides, and rainfall along the coast. This type of storm occurs most frequently in the winter, but can occur at any time and develop very rapidly, sometimes in a matter of hours. Major northeasters can do as much damage or more than some hurricanes. Major northeasters affected the WFF area in November 1950, March 1962, October and November 1991, January 1992, and July 2001 (NASA, 1999a). Thunderstorms are a common occurrence during the summer months, often providing the only source of precipitation during the season. During June, July, and August, thunderstorms occur on an average of four to seven days per month. Most of the thunderstorms occur during late afternoon and evening and are accompanied by wind gusts up to 74.1 to 92.6 kilometers per hour (40 to 50 knots) (NASA, 1999a).

Tornadoes have been known to affect the area occasionally, with four records in the past 50 years (Watson, 2001). Wallops Island also has infrequent snow storms.

3.2.3.5 Atmosphere

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

The lowest level of the atmosphere, the troposphere, extends from the Earth's surface to approximately 10 kilometers (6.2 miles). The Earth's weather evolves within this very turbulent region. This layer contains an estimated 75 percent of the total mass of the atmosphere. Solar radiation penetrates the atmosphere, causing heating at the surface that decreases with height within the lower atmosphere. This variation in temperature makes the troposphere the most dynamic of the four atmospheric layers. The troposphere is composed of 76.9 percent nitrogen and 20.7 percent oxygen by weight. The relative concentrations of these gases are highly uniform throughout the lower atmosphere. Water vapor is the next largest component (1.4 percent average by volume throughout the lower atmosphere), although its concentration is quite variable near the Earth's surface. Trace gases comprise the remainder of the lower atmosphere. These gases, in order of decreasing abundance, are argon, carbon dioxide, neon, helium, methane, krypton, nitrous oxide, hydrogen, xenon, and ozone (NASA, 2000a).

The stratosphere extends from 10 to 50 kilometers (6 to 31 miles) and is identified by both physical stability and maximum ozone concentration. It is characterized by an increase in temperature with altitude. This is due to the ozone layer, which absorbs ultraviolet solar radiation and reradiates it back at longer wavelengths. The base of the stratosphere is marked by an increase in ozone concentration over levels found in the troposphere. The highest ozone concentrations are found near the middle of the stratosphere, in the center of the ozone layer, at approximately 25 kilometers (15.5 miles).

An ozone molecule contains three atoms of oxygen and is produced by the chemical combination of an oxygen molecule with an atom of oxygen. Atomic oxygen is produced by the breakdown of molecules of oxygen, nitrogen dioxide, or ozone. The ozone distribution in the stratosphere is maintained as the result of a dynamic balance between creation and destruction mechanisms. The distribution fluctuates seasonally by approximately 25 percent and annually by approximately 5 percent. Although it comprises only several parts per million (ppm) in the stratosphere, ozone absorbs virtually all ultraviolet solar radiation of wavelengths less than 295 Angstroms, and much of the radiation in the range of 290 to 320 Angstroms (the ultraviolet - B [UV-B] region). Ozone also contributes to the heat balance of the Earth by absorbing radiation in the infrared near the 9,600-Angstrom wavelength (NASA, 2000a).

The mesosphere extends from 50 to 80 kilometers (31 to 50 miles) and is a transition layer between the stratosphere and the ionosphere. The base of the mesosphere marks the upper boundary of the ozone layer. This area is warmed by the absorption of solar ultraviolet energy by ozone. Ozone production/destruction also occurs in the lower part of the mesosphere, although these mechanisms are most critical in the stratosphere. The temperature of the mesosphere decreases with altitude, reaching a minimum at the top of the mesosphere. This layer is an area of varied wind speeds and directions due to the occurrence of turbulence and atmospheric waves (NASA, 2000a).

The ionosphere, or thermosphere, which extends from 80 to beyond 1,000 kilometers (50 to 622 miles), is characterized by high ion and electron density. Although this region is highly rarefied compared to the atmosphere at the Earth's surface, it still causes some drag on satellites orbiting

within it. The ionosphere's several layers of differing properties are particularly important to low-frequency radio communications. It is also the region where radiation in the visible spectrum, such as the aurora, originate. The ionosphere is influenced by solar radiation, variations in the Earth's magnetic field, and motion of the upper atmosphere. Because of these interactions, the systematic properties of the ionosphere vary greatly with time (diurnally, seasonally, and over the approximately 11-year solar cycle) and geographical latitude (NASA, 2000a).

3.2.3.6 Emission Sources

Emission sources at WFF include:

- Sounding Rocket Program (SRP)
- Orbital and other rocket programs
- Airport activities
- Distillate/residual oil fired boilers in Central Boiler House D-8
- Various distillate oil fired boilers and heaters
- Various heaters, generators, and pumps
- Painting/coating operations
- Soil Vapor Extraction System
- Vehicle Fueling Facility
- Work/maintenance shops
- Laboratory hoods
- Welding equipment
- Deacidification equipment
- Photo-mounting operations
- Various non-New Source Performance Standards storage tanks
- Parts washers
- Offset press
- Construction-related activities
- Vehicular traffic.

Permit levels and pollutant emissions from point sources for WFF for 2001 are listed in Table 3-6.

Table 3-6 2001 Point Source Criteria Pollutant Emissions						
Metric tonnes/year (tons/year)						
	CO	**NO_2**	**PM**	**PM_{10}**	**SO_2**	**Volatile Organic Compound (VOC)**
FY 2001	1.5 (1.66)	12.7 (14.00)	.89 (.98)	1.27 (1.40)	16.60 (18.30)	1.12 (1.23)
Permit Limits	14.1 (15.6)	85.7 (94.5)	12.6 (13.9)	11.3 (12.5)	88.2 (97.2)	86.3 (95.2)

Source: Virginia DEQ, 2004b

A discussion of the more consequential emission sources follows:

Rocket Launches

WFF launches sub-orbital and orbital rockets. During a typical flight of a three-stage rocket, several materials are ejected into the atmosphere. Propellant is burned (exhaust gases and products of combustion) from the first-, second-, and third-stage rocket mixing with the air and driven by the wind. Chemicals are released from the scientific payload, usually gaseous or liquid, in the higher reaches of the trajectory, mixing with the air and driven by the wind. Altitude control fluids or gases are released. Residual propellant is released in case of a launch failure. The rockets also outgas materials due to low pressure and aerodynamic heating (NASA, 2000a).

Rocket launches generate emissions through the combustion of fuel and self-contained oxidizers. Combustion products emitted are predominantly aluminum oxide, carbon monoxide, hydrogen chloride, water, nitrogen, carbon dioxide, and hydrogen. The meteorological rockets also emit sulfur dioxide and a small amount of lead.

Of the predominant combustion products, carbon monoxide (CO), lead (Pb), and sulfur dioxide (SO_2) are the only ones regulated by the EPA and the Commonwealth of Virginia under the State-adopted NAAQS. Aluminum oxide (Al_2O_3), chlorine (Cl), and hydrogen chloride (HCl) are rocket launch combustion products that have been identified as Priority Chemicals by the Commonwealth of Virginia. Exposure guidelines used by the Commonwealth of Virginia are derived from the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs). The values are presented in Table 3-7 as Time-Weighted Averages (TWA), ceilings, and short-term exposure limits (STEL). The TWA is the average concentration for a normal 8-hour workday to which nearly all workers may be repeatedly exposed, without adverse effects. The ceiling is the concentration that should not be exceeded during any part of the working exposure. The STEL is the concentration to which workers can be exposed continuously for a short period of time without suffering from irritation, chronic or irreversible tissue damage, or narcosis severe enough to increase the possibility of accidental injury, impair self-rescue, or reduce work efficiency. The Commonwealth of Virginia uses these values to determine exempt emission rates for toxic pollutants emitted by a stationary source or an operation that is not part of a stationary source (Commonwealth of Virginia, 1999).

Table 3-7 Air Quality Guidelines for Exposure to Rocket Exhaust				
Combustion Product	**CAS No.**	**TWA mg/m³**	**CL mg/m³**	**STEL mg/m³**
Aluminum oxide (as Aluminum)	1344-28-1	10	-	-
Chlorine	7782-50-5	1.5	-	2.9
Hydrogen Chloride	7647-01-0	-	2.98	-
Lead, inorganic dusts and fumes (as Pb)	7439-92-1	0.05	-	-

Abbreviations: CAS No. = Chemical Abstract System Number
TWA = Time-Weighted Average
CL = Ceiling Limits
STEL = Short-Term Exposure Limits
mg/m^3 = Milligrams per cubic meter

Source: ACGIH, 2004

The emitted combustion products are distributed along the rocket trajectory under normal launch conditions. Burn times per stage vary per rocket and range up to 33 seconds. The quantities emitted per unit length of the trajectory are greatest at ground level and decrease continuously as the rocket launches. Some launch vehicles are equipped with destruct systems that rupture the propellant tanks and release all remaining propellants in the event of an in-flight vehicle failure (NASA, 1999a).

Piloted Aircraft

Aircraft are exempt from the Commonwealth of Virginia regulations that govern emissions standards for mobile sources (9 VAC 5-40-5680). Aircraft operating from Wallops Flight Facility generally have reciprocating, turbo-prop, or jet engines. Most of the aircraft use JP-5 fuel, although ER-2 aircraft use JPTS and hydrazine fuel, and small amounts of 100-octane low-lead gasoline are used (NASA, 1999a). A portion of those emissions may be volatile organic compounds (VOCs), which are associated with the generation of ground level ozone. However, the volume of aircraft operations at the WFF is relatively small and the area is considered to be an attainment area for ozone levels (NASA, 1999a).

Open Burn

Under EPA interim permitting status, WFF operates an Open Burn (OB) Area, located on the southern end of Wallops Island. Wallops Flight Facility has submitted an application to operate as a treatment, storage, and disposal facility under the RCRA. The permit is currently under review by the Virginia DEQ.

Rocket motors that do not meet launch or test specifications and cannot be reused are thermally treated in the OB area. After thermal treatment, the rocket motors are no longer reactive. On average, the OB area is used 4 days per year. The primary combustion products resulting from the thermal destruction process are the same as those resulting from the launch of rockets containing these motors, therefore, they would have the same air pollutants. The combustion products include carbon monoxide, carbon dioxide, water, nitrogen, hydrogen, hydrogen chloride, aluminum oxide, and lead. Summaries of the chemical composition and the maximum frequency of rocket motor destruction are presented in Table 3-8. The maximum amount of

propellant which can be treated at the OB area is 18.1 metric tons/year (20 tons/year) (Bott, pers. comm.).

Table 3-8 Summary of OB Area Operations

	ROCKET MOTORS DESTROYED		
	Nike	**Orion**	**Spin**
Propellant (kg (lbs) each)	340 (751)	278 (613)	0.9 (2)
Burn Time (seconds each)	3.5	20	< 1
Est. Number to be Treated (annually)	1	2	12
CHEMICAL COMPONENTS PRESENT			
Nitrocellulose	X		X
Nitroglycerine	X		X
Nitroguanidine		X	
Ammonium perchlorate		X	
Aluminum		X	

Note: Nike, Orion, and Spin Motors are common examples of motors destroyed at the OB area.
Source: NASA, 1999a

Central Boiler Plant

The Central Boiler Plant is located in Building D-008 on the Main Base and houses three distillate/residual oil-fired boilers that alternate use throughout the year. The stacks on the three boilers are permitted by the Commonwealth of Virginia. Individual boilers are used to provide heat to buildings not serviced by the Central Boiler Plant.

Two back-up diesel generators are operated at the Central Boiler Plant on an as-needed basis. One of the generators is used to supply power to mission-essential buildings in the event of a power failure or a low-voltage warning from Conectiv, the local power company. Sites on Wallops Mainland and Wallops Island are all heated by individual boilers with individual fuel supplies. Most buildings on the Main Base are served by the Central Boiler plant (NASA, 1999a). Emissions generated by the Central Boiler Plant and the individual boilers from combustion of hydrocarbons may include particulates, sulfur dioxide, carbon monoxide, nitrogen oxides, and VOCs. The Central Boiler Plant, emergency generators, and small boilers are regulated under the DEQ permit.

Work/Maintenance Shops

A penetrant inspection station is located in Building D-001. A vehicle fueling facility (gasoline and diesel fueling) is located at Building F-025. A welding shop is in Building F-020. Various other work/maintenance shops are located in Buildings F-010 and F-016.

Painting/Coating Operations

Paint spray/coatings booths are located in Buildings F-016, F-010B, and N-159 on the Main Base and in Building X-030 on Wallops Island. The spray booths have filtering efficiencies of 94 percent (NASA, 1999a). Paint booths are regulated under the DEQ permit and cannot exceed 9.1 metric tonnes (10 tons) of VOC emissions per year.

In accordance with 9 VAC 5-40-210 of the Virginia Regulations for the Control and Abatement of Air Pollution, WFF submitted data in 1990 to the Virginia DEQ regarding operations of the

NASA paint booth facilities, including paint usage information. The Virginia DEQ found, through modeling, that WFF emits 33 non-criteria toxic air pollutants. Of those pollutants, 21 are exempt from regulations. The remaining 12 non-criteria pollutants are subject to regulation. Based on the data provided to the Virginia DEQ, WFF is in compliance with regulations for non-criteria pollutant emission rates. Any increase in emissions (e.g., increased paint usage) must be reported to the Virginia DEQ to ensure continued compliance. A summary of Virginia DEQ's findings is presented in Tables 3-9 and 3-10.

Table 3-9 Summary of Emissions from Paint Spray Booths for Exempt Non-Criteria Air Pollutants

Pollutant Name	CAS Number	Uncontrolled Emission Rate kg/hr (lb/hr)	Exempting Rate kg/hr (lb/hr)
n-Butyl acetate	123-86-4	2.4 (5.2)	57.5 (126.77)
n-Butyl alcohol	71-63-3	2.9 (6.4)	5.8 (12.90)
Ethyl benzene	100-41-4	0.4 (0.8)	28.8 (63.51)
Ethyl benzene	107-21-1	0.5 (1.1)	5.8 (12.9)
Ethylene glycol Monopropyl ether	2807-30-9	2.1 (4.7)	28.8 (63.51)
Isobutyl acetate	110-19-0	0.2 (0.4)	57.5 (126.7)
Isobutyl alcohol	78-83-1	0.1 (0.2)	5.8 (12.90)
Isopropyl alcohol	67-63-0	4.7 (10.3)	57.5 (126.77)
Magnesium naphthenate	1336-93-2	0.05 (0.1)	0.34 (0.76)
Methyl ethyl ketone	78-93-3	0.2 (0.5)	57.5 (126.77)
Methyl isobutyl ketone	108.10-1	1.72 (3.8)	5.85 (12.90)
Mica	12003-38-2	0.05 (0.1)	0.34 (0.76)
Nitroethane	79-24-3	0.54 (1.2)	28.8 (63.51)
2-Nitropropane	79-46-9	1.04 (2.3)	2.98 (6.58)
Polypropylene glycol Monomethyl ether	107-98-2	0.77 (1.7)	28.8 (63.51)
Polypropylene glycol Monomethyl ether acetate	108-65-6	1.54 (3.4)	57.5 (126.77)
Stoddard solvent	8052-41-3	0.14 (0.3)	57.5 (126.77)
Toluene	108-88-3	2.4 (5.3)	28.8 (63.51)
Trimethyl benzene	25551-13-7	0.14 (0.3)	5.85 (12.90)
VM&P Naphtha	8032-32-4	5.49 (12.1)	57.5 (126.77)
Xylene	1330-20-7	4.98 (10.8)	28.8 (63.51)

CAS Number = Chemical Abstract System identification number.
Uncontrolled Emission Rate = Emission rate of facility modeled.
Exempting Rate = Maximum allowable emission rate.
VM&P = Varnish Maker's and Painter's
Source: NASA, 1999a

Table 3-10 Summary of Emissions from Paint Spray Booths for Regulated Non-Criteria Air Pollutants				
Pollutant Name	**CAS Number**	**Emission Rate kg/day (lb/day)**	**Predicted Ambient Concentration ($\mu g/m^3$)**	**Significant Ambient Concentration ($\mu g/m^3$)**
Aluminum oxide	1344-28-1	34.9 (77.0)	14.9	166.7
Aluminum silicate	1335-30-4	8.3 (18.4)	3.6	166.7
Barium metaborate Monohydrate	13701-59-2	4.0 (8.8)	1.7	8.3
Calcium carbonate	1317-65-3	14.0 (30.8)	6.0	166.7
Cobalt naphthenate	61789-51-3	0.45 (1.0)	0.2	1.7
Iron oxide	1309-37-1	4.35 (9.6)	1.9	83.3
Magnesium silicate	14807-96-6	5.99 (13.2)	2.6	166.7
Phosphoric acid	7664-38-2	8.3 (18.3)	3.6	16.7
Silica, amorphous Fused	60676-86-0	1.8 (4.0)	0.8	1.7
Silica, diatomaceous Earth	68855-54-9	12.6 (27.9)	5.4	166.7
Titanium dioxide	13463-67-7	17.4 (38.4)	7.5	166.7
Zinc borate	1332-07-5	3.9 (8.7)	1.7	166.7

Predicted Ambient Concentration – Concentration of toxic pollutant in ambient air based on modeling and emission rate data.
Significant Ambient Concentration – Concentration of a toxic pollutant in the ambient air which if exceeded may have the potential to injure human health.
$\mu g/m^3$ – micrograms per cubic meter
Source: NASA, 1999a

3.2.4 Noise

In EPA's Noise Control Act (NCA) of 1972 and as amended by the Quiet Communities Act of 1978, Congress declares that it is the policy of the United States to promote an environment for all Americans free from noise that jeopardizes their health or welfare.

Significant noise sources associated with NASA's activities at WFF include vehicular traffic, aircraft traffic, and rocket launches. In general, vehicular traffic on Wallops Island is minimal, and rocket launches are infrequent. Wind, wildlife, and surface water wave action are the predominant sources of naturally occurring noise on Wallops Island. The predominant noise sources at Wallops Mainland are vehicular traffic, wind, and wildlife. Predominant noise sources on the Main Base include aircraft operations and vehicular traffic. Air traffic from the Main Base does fly over Wallops Mainland and Island.

3.2.4.1 Noise Standards and Criteria

Noise is defined as any loud or undesirable sound. The standard measurement unit of noise is the decibel (dB), generally weighted to the A-scale (dBA), corresponding to the range of human hearing. The maximum permissible noise exposures for persons working in high noise environments are presented in Table 3-11.

Table 3-11 Maximum Permissible Noise Exposures	
Duration (Hours)	**Sound Level (dBA)**
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

dBA – decibel, A-scale
Note: The values in this table apply to industrial areas and workers. The maximum permissible exposure levels were established by OSHA to protect the hearing of workers exposed on a daily basis to these noise levels as well as the duration over a lifetime of employment.
Source: OSHA, 2004

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 Wallops Flight Facility. It conforms to the requirements in 23 CFR, Part 772, and is a descriptor recommended by the Federal Highway Administration (FHWA) for describing noise levels during peak traffic periods.

3.2.4.2 Subsonic Noise

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

3.2.4.3 Aircraft Operations

Aircraft operations are a potential source of noise to the surrounding area. A variety of military and non-military aircraft use the airfield and its airspace. Some examples of the types of aircraft that use the facility and their associated noise levels are included in Table 3-12. The aircraft using the airfield are prohibited from creating sonic booms (NASA, 1999a).

Table 3-12 Aircraft Noise Levels				
TYPE AIRCRAFT	TAKEOFF		LANDING	
	dBA	(EPNdB)	dBA	(EPNdB)
727, 737, DC9, BAC111	94-100	92-96	85-90	97-104
707, 720, DC8	100-105	--	94-100	--
F-18	155	--	--	--
DC10, L1011	90	95-106	84	99-108
DC3, Propeller	85-90	--	75-82	--
Single-Engine Propeller	76-90	77-78	67-77	87-88
Multipropeller	79-93	--	70-80	--
Executive jet	93-97	83-94	81-87	92-101
OH58 (Ranger Helicopter)	84	--	72	--
UH1 (Huey Helicopter)	77	--	77	--
C141 (Cargo Plane)	134	--	117	--
C-5 Galaxy Class	106.2	--	98.4	--

EPNdB: Effective Perceived Noise Level
Source: NASA, 1999a

Aircraft operations at the WFF airfield are intermittent. In many cases flight patterns are over marshland or farmland with primary periods of use during daylight hours. Personnel exposed to aircraft noise during airfield operations are required to wear hearing protection (NASA, 1999a).

Environmental Health personnel (Industrial Hygienists) conduct baseline surveys of each new operation (Noise Related Services). An example of a survey is a report by the U.S. Army Environmental Hygiene Agency (USAEHA) on the environmental noise contours analysis for future operations of the L-1011 aircraft at WFF (USAEHA, 1993). The 65 and 75 day-night average sound level (L_{dn}) noise contours were identified for air operations including the L-1011 aircraft (see Table 3-12). The area within the noise contours with and without the L-1011 aircraft differed by less than 0.1 percent, indicating that the L-1011 aircraft does not significantly add to the existing noise effects of the airport operations (NASA, 1999a).

Noise contours are not a precise representation of noise zones; rather, they represent an approximation of noise zones. Actual noise impacts are influenced by variables such as geographic features, meteorology, and the receiver's perception of the sources (NASA, 1999a).

3.2.4.4 Rocket Launches

NASA is proposing to launch approximately 82 rockets a year from the launch areas on Wallops Island. These include 50 from the sounding rocket program, 12 from the orbital rocket missions, and 20 from Navy missiles and drones. The marshland and water surrounding Wallops Island act as a noise buffer zone due to the sound absorption capacity of the vegetation. The Wallops Island launch areas are located approximately 4 kilometers (2.5 miles) from Wallops Mainland (NASA, 1999a).

The noise levels generated and the noise frequency spectrum depend primarily upon the thrust level of the rocket motors. The Castor-120™ rocket motor is the loudest rocket engine expected to be used at WFF.

3.2.4.5 Supersonic Noise

Supersonic noise (sonic boom) is defined as the noise caused by a designated medium having a speed greater than that of sound (Mach 1). Aircraft are prohibited from causing supersonic noise, but WFF has a permit for target launches that cause supersonic booms over the ocean.

Supersonic, low flying rocket launches are limited to Wallops Island eastward over the Atlantic Ocean. Several factors influence sonic booms: weight, size, and shape of target; altitude; flight path; and weather or atmospheric conditions. A larger and heavier target must displace more air and create more lift to sustain flight, compared with a smaller, lighter target. Therefore, larger targets create sonic booms that are stronger and louder than those of smaller, lighter targets. Consequently, the larger and heavier the target, the stronger the sonic shock waves would be (NASA, 2003a).

Of all the factors influencing sonic booms, increasing the altitude of the target is the most effective method of reducing the sonic boom intensity. The width of the boom "carpet," or area exposed to sonic boom beneath a target is about 1.6 kilometers (1 mile) for each 300 meters (1,000 feet) of altitude. The sonic boom, however, would not be uniform. Maximum intensity is directly beneath the target and decreases as the lateral distance from the flight path increases, until the shock waves refract away from the surface and the sonic boom attenuates. The lateral spreading of the sonic boom depends only upon the altitude, speed, and the atmosphere, and is independent of the vehicle's shape, size, and weight. The ratio of target length to maximum cross sectional area also influences the intensity of the sonic boom. The longer and more slender the target, the weaker the shock wave, while the wider and more blunt the vehicle, the stronger the shock wave (NASA, 2003a).

In recent tests, the maximum boom measured during flight conditions was 102.5 kilograms per square meter (21 pounds per square foot). The energy range of the sonic boom is concentrated in the 0.1 – 100 hertz frequency range. These frequencies are considerably below those of subsonic aircraft, gunfire, and most industrial noise. The duration of a sonic boom is brief, usually less than a second for most fighter-sized aircraft (NASA, 2003a).

3.2.4.6 Noise Monitoring Programs

WFF has performed two noise monitoring programs. The first was to determine baseline noise levels using traffic noise in March of 1992. The second was a test firing of a 155-millimeter (6-inch) Howitzer cannon in September of 1996.

Traffic Noise Monitoring Program

In 1992, Metcalf & Eddy developed a program of noise monitoring and modeling to determine baseline noise levels for Wallops Flight Facility. Sources of noise associated with the Main Base included vehicular traffic and aircraft operations. However, only traffic noise was examined in detail by this program. At the Main Base, the roadways of significance included State Route 175, State Route 798, and Mill Dam Road. All of these carry traffic to and from the Main Gate. The aircraft runways at the Main Base are Runway 10-28, which is the main runway; Runway

04-22, which is used for friction testing and touch-and-go tests; and Runway 17-35, which is an infrequently used crosswind runway.

The FHWA has established criteria for characterizing motor vehicle noise on roads constructed with Federal funds. The FHWA criteria were used in analyzing baseline conditions because they represent an established analysis for traffic noise levels. These criteria are shown on Table 3-13. An exterior L_{eq} of 67 dBA is the standard typically used to evaluate outdoor noise levels along roadways. Therefore, this 67-dBA value was used to evaluate the noise levels in the vicinity of Wallops Main Base.

Table 3-13 Threshold for Noise Interference and Noise Abatement Criteria (dBA)

Activity Category	Noise Abatement Criteria		Description of Activity Category
	L_{10}	$L_{eq}(1)$	
A (Exterior)	60	57	Tracts of land for which serenity and quiet are of extraordinary significance and which serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Such areas could include amphitheaters, particular parts or portions of parks, open spaces, or historic districts that are dedicated or recognized by appropriate local officials for activities requiring special qualities or serenity and quiet.
B (Exterior)	70	67	Picnic areas, recreation areas, playgrounds, active sports areas, and parks that are not included in Category A, residences, motels, hotels, public meeting rooms, schools, churches, libraries, and hospitals.
C (Exterior)	75	72	Developed lands, properties or activities not included in Categories A or B above.
D	---	---	Undeveloped lands.
E (Interior)	55	52	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Note: L_{10} = The sound level exceeded 10 percent of the time.
$L_{eq}(1)$ = The time-averaged sound level for 1 hour.
Source: USDOT, 1995

Sensitive Receptor Locations

Sensitive receptors include homes, schools, and parks where conversation, sleeping, or other activities would be disrupted by a noisy outdoor environment. Outdoor noise levels at the property boundary of a sensitive receptor are typically the focus of analysis. Noise levels may also be measured at the property boundary of a site that directly or indirectly generates noise (e.g., the Main Base).

Thirteen sites were selected for the noise-monitoring program; eight sites are in the vicinity of the Main Base, four are on Wallops Island, and one is in Assawoman along the route to Wallops Island.

Noise levels within the boundaries of the subject site are not usually included in a study of site-generated impacts. For this study, however, some locations within NASA boundaries were monitored, including the former Coast Guard housing near Runway 10-28 on the Main Base and

some sites on Wallops Island. Baseline noise levels at these sites will be useful in determining the effects of aircraft flights and rocket launches for future studies.

Most of the sensitive receptors in the vicinity of the Main Base are located along the roadways that carry vehicular traffic to and from the Main Gate. Sensitive receptors south of the facility include:

- Homes along Mill Dam Road between the Main Gate and State Route 175;
- Homes along State Route 798 between the Main Gate and State Route 175; and
- Homes along State Route 175 between Mill Dam Road and State Route 798.

East of the Main Base boundary, sensitive receptors include Wallops Island National Wildlife Refuge, Wallops Visitors Center, and the Boat Basin. Sensitive receptors lie to the north and west of the Main Base, as well. Locations west of the Main Base include homes along State Route 679 directly in the flight path for Runway 10-28. Locations north of Main Base include farm residences across Little Mosquito Creek and directly in the flight path for Runway 17-35, as well as the Trails End Campground across Little Mosquito Creek, directly in the flight path for Runway 04-22. Sensitive receptors associated with Wallops Island include homes along State Route 803, which carries traffic to and from Wallops Island.

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

At sites along roadways, traffic counts were taken during the monitoring period for the purpose of calibrating the traffic noise analysis model. Vehicles were counted according to direction and type (i.e., autos and light trucks, medium trucks, and heavy trucks) for subsequent input to the STAMINA 2.0 traffic noise model.

Methods of Analysis

The FHWA's STAMINA 2.0 computerized noise program was used to model noise levels resulting from vehicular traffic. Inputs to the STAMINA program include vehicular mix, vehicular speeds, roadway grades, ground elevations, and the physical characteristics of the roadway-receptor relationships. Additionally, the STAMINA program incorporated calculated adjustments for ground cover, barriers, and shielding effects.

Table 3-14 shows the monitored and modeled noise levels based on field traffic counts. Since a change in noise level of at least 3 dBA is necessary before most people will notice any difference, an acceptable range of accuracy of ± 3 dBA between monitored and modeled noise levels is typical. All modeled noise levels fell within 3 dBA of the monitored noise levels. Slight under or over predictions may be due to specific field conditions not represented by the model. These may include aircraft flybys, vehicles (especially trucks) with improperly maintained mufflers, or vehicles that exceed the speed limit.

Noise levels during peak traffic periods are represented by the modeling levels, while off-peak periods are represented by field observations. The noise levels range from an L_{eq} of 49.2 dBA at the Trails End Campground and Marina (Site 8) during off-peak traffic periods to an L_{eq} of 64.7

dBA at a roadway intersection on Wallops Island (Site 12) during peak PM traffic. All but one of these baseline levels is below the 67-dBA criterion used by FHWA.

Table 3-14 Wallops Flight Facility Noise Levels (dBA)

Site		AM Representation	Field Conditions Monitored Modeled PM L_{eq}	L_{eq}
Main Base Area				
1	Mill Dam Rd./Rte 798	Homes, wooded area	57.0	58.4
2	Mill Dam Rd./Rte 175	Single family homes	57.7	60.6
3	Rte 175/Rte 697/ 798	Single family homes	65.0	65.6
4	Gate 4	Wildlife refuge	63.1	63.8
4A	Gate 4, Touch & Go x 2	Wildlife refuge	80.5	N/A
5	Fleming Road	Single family homes	55.7	N/A
6	Coast Guard Housing	Homes	52.4	N/A
7	Dublin Farms	Farm, residence	57.7	N/A
8	Trails End Campground	RV campground, marina	49.2	N/A
Route 803				
9	Assawoman P.O.	Homes	62.0	59.4
9A	Assawoman P.O.	Homes	64.4	61.9
Wallops Island				
10	WI 1	Observation tower	52.5	N/A
11	WI 2	Launch Pad 0	63.5	N/A
12	WI 3	Special Projects & Camera Site	63.1	61.4
13	WI 4	Building U-30 (SPANDAR, radar tracking)	61.1	N/A

Source: NASA, 1999a
Note: Homes and buildings within the NASA boundaries are not considered to be sensitive receptors, but have been included in the analysis for comparative purposes in the event that additional analyses are carried out at a future date.

Summary Main Base

Homes along intersections and roadways adjacent to the Main Base generally experience noise levels of 56 to 61 dBA during peak traffic periods, and 54 to 58 dBA during off-peak traffic periods. However, higher noise levels were found at the busy intersection of State Routes 175, 679, and 798. At this site, noise levels ranged from 64 to 67 dBA during both peak and off-peak periods.

Noise at homes in relatively quiet areas (away from the roadways) ranged from 49 dBA to 58 dBA, depending on the range of background noises. This range was determined for housing on the Main Base itself, and areas north of the Main Base such as Dublin Farms and Trails End Campground and Marina.

Areas near the ends of the airport runways sometimes experience noise due to aircraft operations that exceed the 67-dBA criterion when occurring for an extended time period. The worst-case situation is represented by extended touch-and-go activities with one touch-and-go every 10 minutes. Under these conditions, the 1-hour L_{eq} is 80.5 dBA several hundred feet from the end of a runway. This level would be experienced at the Trails End Campground and Dublin Farms north of the Main Base, the Wallops Island National Wildlife Refuge adjacent to the eastern boundary of the Main Base, homes along State Route 175 south of the Main Base, and some homes along Flemings Road west of the Main Base (NASA, 1999a).

Summary Wallops Island/Mainland

Activities at Wallops Island and Wallops Mainland generate traffic along Route 803. Homes along this roadway experience baseline noise levels of 62 to 63 dBA during peak traffic periods, and 59 dBA during off-peak traffic periods.

Wallops Island contains a wide range of noise levels. At the northern portion of Wallops Island, natural sounds of wind, trees, and birds are the predominant source of the 53-dBA noise level. At the southern end of the island, as well as along the eastern shorewall, the sounds of water and waves affect 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 AM and PM traffic (NASA, 1999a).

Howitzer Cannon Firing

On September 12, 1996, the U.S. Army, Aberdeen Test Center, fired a 155-millimeter (6-inch) Howitzer cannon over the Atlantic Ocean (NASA, 1996a). During this testing a noise monitoring program was also performed. The activity was recorded at four locations that lie within WFF or are in proximity to WFF. Background noise checks were performed prior to the activity in a manner similar to which the actual event was recorded. The background noise was collected as the highest noise at one given time from all sources (i.e., traffic, outdoor equipment use, etc.). The activity's noise was monitored as an impulse peak with a reset performed after each event (round fired) occurred.

The outcome of the activity and the sound monitoring of the events concluded that the highest recorded sound/noise occurred at the Modest Town location, with the highest peak impulse at 99 dB. The Chincoteague location recorded background noise levels above the highest impulse sound monitored at the Modest Town location. The Atlantic, Chincoteague, and Main Base Gate locations are lateral and behind the activity in relation to the 155-millimeter (6-inch) Howitzer Cannon's positioning and attribute to no detected noise response by the impulse sound monitors (NASA, 1996a).

The public response from the NASA News Release had an 87 percent response rate with no significant negative reply from those who participated. No significant noise levels were recorded that indicated or posed a risk to the health and well being of the public, wildlife inhabitants of Wallops Island, non-civilian residents of WFF (Navy Housing residents), or civil service and contractor employees of WFF (NASA, 1996a).

3.2.5 Hazardous Materials and Hazardous Waste

3.2.5.1 Hazardous Materials

In May 2001, Virginia DEQ issued its formal approval of WFF's Integrated Contingency Plan (ICP). The ICP, developed by the Environmental Office in accordance with 29 CFR 1910, Subpart H (Hazardous Materials), includes the following procedures:

- WFF labels each container of hazardous material in English with the following minimal description: name of the chemical and all appropriate hazard warnings;
- WFF has on file in each work area Material Safety Data Sheets (MSDS) for each hazardous material used onsite. Each MSDS is in English and contains all required information. WFF utilizes an online electronic chemical inventory (MSDS-Pro) 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; and
- WFF prepares and implements spill contingency and response procedures.

3.2.5.2 Hazardous Waste Management

The regulations that govern hazardous waste management are 40 CFR 260-270 (Federal) and 9 VAC 20-60 (Commonwealth of Virginia). The Environmental Office manages hazardous waste generation, including inspection, onsite transportation, storage, and shipment of all hazardous waste. This office is responsible for tracking manifests and certificates of disposal for hazardous wastes that leave the facility. The Environmental Office also provides annual Hazardous Waste training to all contractor and civil service employees who handle hazardous wastes.

Approximately 11.2 kilometers (7 miles) of public roadway separate the Main Base from Wallops Island and Wallops Mainland. Therefore, to prevent unauthorized transportation of hazardous waste, the EPA has assigned a separate hazardous waste generator number to the Main Base (VA8800010763) and Wallops Mainland and Wallops Island combined (VA7800020888). Both sites are classified as Large Quantity Hazardous Waste Generators because each generates more than 1,000 kilograms (2,205 pounds) of hazardous waste per month. In 2003, 11,378 kilograms (25,086 pounds) of hazardous waste were generated on the Main Base, and 2,015 kilograms (4,443 pounds) were generated on Wallops Island and Wallops Mainland combined.

WFF hazardous waste generators are responsible for the following:

- Properly containerizing waste;
- Properly labeling waste containers with information pertaining to the contents and with the words "Hazardous Waste";
- Ensuring that less than 208 liters (55 gallons) of hazardous waste or less than 1 liter (1.05 quart) of acute hazardous waste are accumulated at or near the point of generation; and
- Properly completing and transferring a disposal inventory sheet to the Environmental Office.

Building B-029 is the less-than-90-day hazardous waste accumulation area for the Main Base. Additionally, Building N-223 is the Main Base facility for the storage of used oil, and Building E-002 is a less-than-90-day accumulation area for photographic process waste. Wastes generated on Wallops Mainland and on Wallops Island are stored on the Mainland at Building U-081, a less-than-90-day accumulation area. Hazardous waste may be stored at an accumulation area for up to 90 days from the date of initial accumulation. WFF uses a licensed hazardous waste transporter to transport hazardous waste to a licensed Treatment, Storage, and Disposal Facility (TSDF).

Propellants, including ammonium perchlorate/aluminum (AP/Al), nitrocellulose/nitroglycerin (NC/NG), and hydrazine (N_2H_4) are used in rocket operations. These propellants are considered to be hazardous materials. Rocket motors and batteries that do not meet factory specifications and cannot be used are considered to be hazardous waste. As discussed in Section 2.2.10, unusable rocket motors are treated at the OB to remove their reactivity. Rocket motors are treated at the OB until the casings are certified to be free of contamination.

Payload processing operations utilize hazardous materials and generate hazardous waste. Hazardous materials are used in the machine shop, guidance, navigation, and control laboratory, and paint booth. These materials include cutting fluids, solvents, flammables, and paint thinner. Hazardous wastes generated during these operations include cutting fluid waste, solvent waste, lead paste, and waste thinner.

Data acquisition activities at the Atmospheric Sciences Research Facility use hazardous materials, such as various solvents, and generate hazardous solvent waste. The Chemical Laboratory in Building F-160 is used to perform testing on waste treatment strategies, wear metal in engine oils, and polychlorinated biphenyl screen analyses. The Photographic Laboratory in Building E-002 provides developing and reproduction capabilities for photographic film. These activities generate hazardous wastes including waste silver and corrosives. With an increase in activity, it is anticipated that hazardous waste material would also increase.

Table 3-15 lists the satellite accumulation areas on the Main Base, Wallops Mainland, and Wallops Island. Those waste streams considered hazardous are denoted in the “HW” column. The remaining wastes are considered regulated, non-hazardous waste streams.

Table 3-15 Satellite Accumulation Areas

Bldg.	Type of Area					Waste Codes	Waste Description
	HW	Oil/Oily Rags	Universal	Project	Parts Washer		
A-041				•		Non	Hydraulic oil from antenna changes
B-031 GM		•				Non	Used oil from mowers
D-008		•			•	Non	Oily rags, Non-hazardous petroleum wastes
D-037	•					D001	JP5/JPTS fuel changes
D-050		•				Non	Used oil

Table 3-15 Satellite Accumulation Areas

Bldg.	Type of Area					Waste Codes	Waste Description
	HW	Oil/Oily Rags	Universal	Project	Parts Washer		
E-002	•					D011	Silver in photo processing chemicals
F-010	•	•				F003, D008, Non	Acetone rags, non-hazardous cutting fluid, oil, and blaster grit containing lead
F-010A		•				Non	Used oil from machine shop
F-010B	•					D001, F003, F005, D035	Thinner from cleaning paint gun
F-010 3rd floor W301	•					D008	Solder past and wipes
F-010 3rd floor W302			•			UW	NiCad batteries
F-010 ACS	•					D001, F003, Non	Acetone rags, HC141b
F-014		•				Non	Glycol water mixture
F-016El	•		•			D009, UW	Crushed fluorescent tubes, UW lead acid batteries
F-016AC		•	•			Non, UW	Refrigerant oil, UW batteries, thermostats
F-016G	•	•			•	D018, D039, Non	Used oil, fuel filters, D039 PW
F-016PS	•					D001, D035, F003, F005	Paint related materials, thinner, paint, paint rags
F-020		•				Non	Oily rags, oil filters
F-160 Chem	•					D001, various	JP5, various
M-015	•	•				F003, D003	Reactive trimmings from rocket motors, acetone rags, oily rags
D-002					•	Non	Aqueous PW
D-001 Hangar	•	•	•	•		D001, D035, F003, F005, Non, D007, D002, UW	MEK rags, Alodine, Methylene Chloride, JP5, oil, oily rags, spray cans, UW batteries, paint thinner

Table 3-15 Satellite Accumulation Areas

Bldg.	Type of Area					Waste Codes	Waste Description
	HW	Oil/Oily Rags	Universal	Project	Parts Washer		
D-001 N-120	•					F001, F003, F005	Solvent rags
N-159 PB	•					D001, D035, F003, F005	Paint waste, Paint thinner
N-159 hangar	•	•	•			D001, Non	JP5, oil, oily rags, batteries
N-159 BL	•		•			D002, D006	UW batteries, electrolyte
N-159 BGC Laboratory	•					F003	Acetone, Methanol, Oxazine 1-perchlorate
N-162 Rm 114			•			UW	UW NiCad batteries
N-168		•		•	•	Non	Used oil, D039, D040 PW, used oil from antenna changes
NOAA	•	•	•			D001, D035, F003, F005	Paint thinner, UW fluorescent tubes, used oil, oily rags
Cropper		•				Non	Used oil, used antifreeze, oily rags
U-025	•	•				D001, F001, Non	Used oil, Exolve
U-030				•		Non	Used oil from antenna changes
U-070		•		•		Non	Oily rags, used oil from antenna changes
V-010	•	•				Various, D001, D035, F003, F005, Non	Various expired chemicals, oily rags, paint rags
V-024		•				Non	Oily rags and oily condensate
W-015		•				Non	Used oil
W-040	•					Non, D001	Used oil, JP10 mixed with hydraulic fluid
W-065				•			Drones and special projects

Table 3-15 Satellite Accumulation Areas							
	Type of Area						
Bldg.	HW	Oil/Oily Rags	Universal	Project	Parts Washer	Waste Codes	Waste Description
X-030	•					D001, F003, F005, D035	Paint thinner
X-035		•				Non	Used oil and oily rags
Y-055				•		Non	Antenna oil changes

3.2.5.3 Environmental Restoration Program

Several sites on WFF have been identified as either Formerly Used Defense Sites (FUDS) or remediation sites. These sites are currently being managed by the WFF Environmental Restoration Program (ERP), through partnerships with either the DEQ Petroleum Storage Tank Management Division, the USACE, or an Administrative Agreement on Consent, per RCRA 7003, between NASA, EPA, and DEQ.

Table 3-16 lists properties proposed for demolition that have hazardous materials/wastes concerns. Data on the abandoned Coast Guard family housing was obtained from the *Asbestos and Lead Based Paint Survey Report for Coast Guard Family Housing at Wallops Flight Facility*. This report concluded that no lead contamination is present in the soils surround the abandoned Coast Guard housing (Trans Systems, 2004).

Table 3-16 Properties with Hazardous Materials or Waste Concerns		
RP ID	Property Name	Hazardous Materials/Waste Concerns
F-211	Auto Parts Storage Facility	Solvents and other hazardous materials will need proper handling and disposal during demolition.
M-003	Underground Magazine	CERCLA/ Toxic Substance Control Act (TSCA) Site – special handling required; TSCA residual waste. Investigation to close December 2004.
M-004	Underground Magazine	CERCLA/TSCA Site – special handling required; TSCA residual waste. Investigation to close December 2004.
M-005	Underground Magazine	Residual lead
M-006	Underground Magazine	Residual lead
F-008	Plating Shop	Hazardous materials will need proper handling and disposal during demolition.
H-002	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-003	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-004	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during

Table 3-16 Properties with Hazardous Materials or Waste Concerns		
RP ID	**Property Name**	**Hazardous Materials/Waste Concerns**
		demolition.
H-005	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-006	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-007	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-008	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-009	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-010	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-011	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-012	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-015	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-016	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-017	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-018	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-019	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-020	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-021	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.

Table 3-16 Properties with Hazardous Materials or Waste Concerns		
RP ID	**Property Name**	**Hazardous Materials/Waste Concerns**
H-024	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-025	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-026	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-027	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
H-028	Family Housing	Coast Guard Housing – potential for asbestos and lead based paint; hazardous materials will need proper handling and disposal during demolition.
A-027	Pistol Range	CERCLA Liability
W-025	Hazardous Waste Storage Building	Hazardous waste will need to be transported and disposed of prior to demolition.
X-105	Shop and Electrical Material Storage Building	CERCLA Sites 5/12; Hazardous materials/waste will need to be removed and properly stored and/or disposed of during demolition.
Z-042	South Launch Pad Terminal Building	CERCLA/TSCA Site – special handling required; TSCA residual waste. Investigation to close December 2004.
Z-041	Multi-function Radar Facility	Identified as potential Environmental Site; evaluate when Navy vacates the building in 2006

3.2.6 Radiation

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

Radiation-emitting materials and equipment can be classified as either ionizing or non-ionizing radiation. Ionizing radiation is any type of radiation capable of directly or indirectly producing ions as it passes through a medium. In general, ionizing radiation has considerably greater kinetic energy than non-ionizing radiation. Non-ionizing radiation is not strong enough to produce free ions as it passes through media (NASA, 1999a).

3.2.6.1 Ionizing Radiation

Sources of ionizing radiation at WFF include radioactive materials for science instruments and experiments and for instrument calibration. They are used in the laboratory and in the field and aboard payloads. WFF does not maintain permanent storage of radioactive sources, except for two check sources for calibration of radiation monitoring equipment.

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

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

3.2.6.2 Non-ionizing Radiation

Equipment in use at WFF that produces non-ionizing radiation includes lasers, radars, microwaves, and ultraviolet and high-intensity lamps.

Laser radiation sources include pulsed or continuous wave systems capable of producing laser light from ultraviolet to the far infrared. Lasers produce an intense, coherent, directional beam of light by stimulating electronic or molecular transitions to lower energy levels. The lasers at WFF are used for research and testing, as well as communication and atmospheric research. Laser devices are used in a variety of experiments at WFF in both laboratories and payloads.

Outdoor laser tests are also conducted. The biological effects of lasers are well known, including damage to the eye or skin. The hazards of lasers are also well known, and proper handling techniques have been developed and implemented.

All of NASA's laser operators must be trained in the proper use of the class of lasers they use. NASA classifies all lasers into one of four categories based on use and light intensity in compliance with ANSI standard 7136.6:

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

Other sources of non-ionizing radiation include high intensity light sources such as compact arc lamps, tungsten-halogen lamps, and electronic flash lamps. Some high-intensity light sources may produce ultraviolet, visible, and/or infrared radiation.

Sources of radio-frequency radiation that produce power densities greater than 100 milliwatts per square centimeter are also potentially hazardous. Sources of radio frequency at WFF that fall into this category include radar units, microwave ovens, diathermy units, induction heating devices, and radio-frequency generators. Radio frequency is measured by the Safety Office.

The Payload Fabrication and Integration Laboratory can support multiple payload processes simultaneously, including telemetry ground stations (a non-ionizing radiation source) and clean room facilities.

Activities conducted at the Launch Range utilize radar in tracking units. The Research Airport Infrastructure contains non-ionizing radiation sources, including telemetry and radar tracking.

The Atmospheric Sciences Research Facility utilizes two powerful radar systems. The Rain Laboratory uses microwaves in its research of the interactions between rain and the ocean. Tracking and data systems at the NASA Wallops Orbital Tracking Station consist of the operation of a wide variety of telemetry and optical instrumentation (sources of non-ionizing radiation).

WFF range instrumentation systems include sources of non-ionizing radiation, such as radar and telemetry. Communication systems are composed of radios and microwave links, both sources of non-ionizing radiation.

3.3 BIOLOGICAL ENVIRONMENT

3.3.1 Vegetation

Habitats within the WFF area include dune systems, maritime forests, salt marshes, swamps, thickets, upland grasslands, and upland forests. Specifically, dune systems, maritime forest, and salt marsh are found on Wallops Island, and salt marsh, swamps, thickets, upland grasslands, and upland forest are found on Wallops Mainland and the Main Base. Descriptions of these systems are provided below.

3.3.1.1 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 border salt marshes.

The dune system from east to west includes the sub-tidal zone, inter-tidal zone, and upper beach zone. The inter-dune swale zone includes the area located between the westernmost portion of the dune zone and the maritime zone. The dune and swale zone is an extremely harsh environment. Biotic resources in this zone must be very adaptable to contend with high temperatures, high winds, salt, sandblasting, drought, and low nutrient levels in the sandy soil medium (NASA, 1999a). Dominant species within the dune system include seabeach orach (*Atriplex arenaria*), common saltwort (*Salsola kali*), sea rocket (*Cakile edentula*), American beachgrass (*Ammonphila breviligulata*), and seaside goldenrod (*Solidago sempervirens*).

The sub-tidal zone on the eastern side of Wallops Island extends from the lower limit of low tide to the seaward-most limit of wave action. Because of the dynamics of wave action, few plants

exist in the sub-tidal zone. Phytoplankton are prevalent, as well as macroalgae, algae attached to substructure, and eelgrass (*Zostera marina*) in areas of diminished wave action.

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

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

On the southern part of Wallops Island, the dune and swale zone extends to the tidal marsh on the western side of Wallops Island without any maritime forest. In the middle and northern areas, the dune and swale zone extends to the maritime zone that starts where the secondary dune line once existed. The northern part of Wallops Island within the dune and swale zone is in an almost-natural state, and is dominated by northern bayberry (*Morella pensylvanica*), wax myrtle (*Morella cerifera*), groundsel-tree (*Baccharis halimifolia*), and American beachgrass.

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

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

Between Wallops Island and Wallops Mainland extends 1,140 acres (461.3 hectares) of tidal marsh. A tidal marsh is an area of low-lying wetlands that is influenced by the tides. The marsh is interlaced with small streams known locally as “guts.” The marsh itself can be divided into the low marsh and the high marsh – each a distinctive community. The low marsh, which is inundated at high tide, is dominated by saltmarsh cordgrass (*Spartina alterniflora*). The high marsh, which is flooded by approximately 50 percent of the high tides, is dominated by salt meadow cordgrass (*S. patens*). The marshes are of tremendous importance to marine life and to the terrestrial and avian species that depend on the marshes for their existence.

3.3.1.2 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 and complete cover of 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 the Wallops Mainland and Wallops 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 (*Liquidamber styraciflua*), red maple (*Acer rubrum*), and sassafras (*Sassafras albidum*). Black willow (*Salix nigra*) and red maple are dominant species in the swamps. Salt marshes occupy 59 percent of Wallops Mainland and the Main Base. Wallops Mainland and the Main Base of WFF include marsh located between Wallops Island and Wallops Mainland, and the northern marsh that borders Mosquito Creek. The tidal marsh found on Wallops Mainland and the Main Base is similar to the tidal marsh on Wallops Island. Anthropogenically influenced areas are very apparent on the Main Base; the lawns, buildings, and pavement all affect the biological environment. The Main Base also includes fields, forested open land, lawns, areas returning to a natural state, undeveloped areas, and pine forests.

3.3.2 Terrestrial Wildlife and Migratory Birds

The Main Base, Wallops Mainland, and Wallops Island have 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.

3.3.2.1 Invertebrates

Wallops Island, particularly the tidal marsh area, has an extensive variety of invertebrates. Salt marsh cordgrass marshes have herbivorous insects such as the salt marsh grasshopper (*Orchelium fidicinium*) and the tiny plant hopper (*Megamelus* spp). Plant hopper eggs are in turn preyed upon by a variety of arthropods. 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 found in dead smooth cordgrass (*Spartina alterniflora*). Salt marsh mosquitoes (*Ochlerotatus sollicitans*) and greenhead flies (*Tabanus nigrovittatus*) are prevalent insects at WFF.

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

Coastal invertebrates in the Wallops Island area include ghost crabs (*Ocypode quadrata*), calico crabs (*Ovalipes ocellatus*), fiddler crabs (*Uca* spp.), sand shrimp (*Cragon septemspinosa*), moon jelly (*Aurelia aurita*), and coffee bean snails (*Melampus bidentatus*). Crab distributions are limited by high salinities. Squid (*Lolliguncula brevis*) are prevalent during the winter.

3.3.2.2 Amphibians and Reptiles

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

3.3.2.3 Mammals

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

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

3.3.2.4 Avifauna

During spring and fall migrations, approximately 15 species of shorebirds feed on microscopic plants and animals in the inter-tidal zone. Abundant among these are the sanderling (*Calidris alba*), semi-palmated plover (*Charadrius semipalmatus*), red knot (*Calidris canutus*), short-billed dowitcher (*Limnodromus griseus*), and dunlin (*Calidris alpina*). The willet (*Catoptrophorus semipalmutus*) is very common during the breeding season. Royal tern (*Sterna maxima*), common tern (*S. antillarum*), and least tern (*S. hirundo*) can be observed during the summer months. In addition, the piping plover (*Charadrius melodus*), a federally listed threatened species, and Wilson's plover (*Charadrius wilsonia)*, a State-listed threatened species, sometimes nest on the northern and southern ends of Wallops Island. More information on these threatened and endangered species can be found in Section 3.3.3 (Threatened and Endangered Species).

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

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.

Herring gulls and laughing gulls occasionally can be a problem on the runways, especially during inclement weather (e.g., birds gathering in pooled water).

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 WFF. However, there is an active bald eagle nest just north of the WFF Main Base.

3.3.2.5 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) was enacted to ensure the protection of shared migratory bird resources. The MBTA prohibits the take and possession of any migratory bird, their eggs, or nests, except as authorized by a valid permit or license. A migratory bird is any species that lives, reproduces, or migrates within or across international borders at some point during its annual life cycle. The Atlantic Flyway route is of great importance to migratory waterfowl and other birds. The coastal route of the Atlantic Flyway, which in general follows the shoreline, is a regular avenue of travel for migrating land and water birds that winter on the waters and marshes south of Delaware Bay. Ducks, geese, shorebirds, songbirds, and raptors pass through the Atlantic Flyway, using WFF as a stopover and also as an overwintering area.

3.3.3 Threatened and Endangered Species

The Endangered Species Act (ESA) (16 USC 1531 et seq.) provides a legal mechanism to protect species that are in danger of extinction. As stated in the ESA, an endangered species is “any species which is in danger of extinction throughout all or a significant portion of its range” and a threatened species is “any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.” The WFF is obligated to protect any federally listed species present on facility grounds. The Virginia Endangered Species Act (VAC, Sections 29.1-563 – 29.1-570) is administered through the Virginia Department of Game and Inland Fisheries and prohibits the taking, transportation, processing, sale, or offer for sale of any State or federally listed threatened or endangered species. As a Federal agency, NASA voluntarily complies with Virginia’s Endangered Species Act. Table 3-17 lists Federal and State threatened and endangered species that may exist on or in the vicinity of WFF.

Table 3-17 Threatened and Endangered Species in the WFF Area		
Scientific Name	**Common Name**	**Status**
Dermochelys coriaces	Leatherback Sea Turtle	Federally Endangered
Eretmochelys imbricate	Hawksbill Sea Turtle	Federally Endangered
Lepidechelys kempi	Kemp's Ridley Sea Turtle	Federally Endangered
Charadrius melodus	Piping Plover	Federally Endangered
Haliaeetus leucocephalus	Bald Eagle	Federally Threatened
Caretta caretta	Loggerhead Sea Turtle	Federally Threatened
Chelonia mydas	Atlantic Green Sea Turtle	Federally Threatened
Charadrius wilsonia	Wilson's Plover	State Endangered
Falco peregrinus	Peregrine Falcon	State Endangered
Bartramia longicauda	Upland Sandpiper	State Threatened
Sterna nilotica	Gull-billed Tern	State Threatened

The Leatherback, Hawksbill, Kemp's Ridley, Loggerhead, and Atlantic Green sea turtles are known to migrate along east coast beaches. Nests have not been discovered on Wallops Island; however, sea turtle crawl tracks, a sign of nesting activity, have been found infrequently.

During the migratory season, upland sandpiper may occur in large grassy areas such as those adjacent to the runways on the Main Base. Piping plover nesting habitat has been delineated on Wallops Island dunes. Wilson's plover tend to nest with piping plovers. Gulled-billed terns can be found nesting on the beaches or mud flats on Wallops Island. A resident pair of peregrine falcons nests on a hacking tower on the northwest side of Wallops Island; migrating peregrine falcons occur along the Wallops Island beach during fall migration. An active bald eagle nest exists across the northern border of the WFF Main Base. Figure 14 shows the known locations of endangered 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. The piping plover is known to breed on Wallops Island, and therefore, portions of the island are protected as critical habitat (Figure 14). The northern and southern beaches have been closed to vehicle and human traffic during the plover's nesting season (March 15th through September 1st) since 1986. Biologists from the Chincoteague National Wildlife Refuge and the Virginia Department of Game and Inland Fisheries monitor piping plover nesting activities and provide advice to WFF on protection and management of the species (NASA, 2003a). Biologists from the USDA WS aid with predator control.

Letters have been sent to USFWS and the National Marine Fisheries Service (NMFS) requesting comment on this Site-Wide EA regarding resources under their jurisdiction; responses received to date are included in Appendix B. Past correspondence with Federal and state agencies on endangered species at WFF exist and are documented in this Site-Wide EA (Appendix C and D). The existing consultation between NASA and USFWS is discussed below.

On April 22, 1997, NASA initiated formal Section 7 consultation with the USFWS for potential impacts to the piping plover from the expansion of range operations at WFF. On July 14, 1997, USFWS issued their biological opinion on the effects of the range expansion on the piping

plover (Appendix C). In summary, the USFWS stated that depending on the time of year, time of day, and proximity to the launch site, piping plovers will temporarily abandon the area during migration and/or the breeding season during a rocket launch. However, USFWS does not anticipate the proposed action will incidentally take any piping plovers due to the short duration of the disturbance, the long distance between the disturbance and the area used by plovers, the limited number of launches during the nesting season, and the lack of other disturbances (e.g. recreation) to the plovers at this site. As part of this consultation, NASA agreed to monitor piping plovers. The monitoring plan can be found in Appendix C and is summarized in Section 4.3.3.

In a letter dated February 27, 1998, from NASA to USFWS, NASA summarizes a telephone conference between USFWS, VDGIF, and NASA. The telephone conference discussed the 1997 USFWS biological opinion on impacts to the piping plover and the agreement that NASA could conduct year round open burning of rocket motors at the OB site located north of the southern piping plover habitat. The OB site and UAV runway are the closest NASA operations to piping plover habitat.

In a memorandum dated March 14, 2003, NASA documents consultation with the U.S. Fish and Wildlife Service (USFWS) concerning the UAV runway on Wallops Island and the potential for UAV activities to disturb piping plovers (Appendix C). USFWS has imposed a no-fly zone 304 meters (1,000 feet) horizontally and vertically from any active piping plover nesting site. Any negative impact to piping plovers resulting from disregard of the 304-meter (1,000-foot) buffer can result in enforcement action under the ESA.

Insert Figure 14 – Known Locations of Endangered Species (11x17color)

3.3.4 Marine Mammals and Fish

3.3.4.1 Marine Mammals

The Marine Mammal Protection Act of 1972 (MMPA) prohibits the taking of marine mammals on U.S. seas. The statutory definition of "take" is "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill." Section 101(a)(5) of the MMPA directs the Secretary of the Department of Commerce to allow, upon request, the incidental (but not intentional) take of marine mammals. There are 40 marine mammal species with possible or confirmed occurrence in the VACAPES OPAREA (NASA, 2003a). Included are cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals). See Table 3-18 for a list of the most common marine mammals found in the VACAPES OPAREA.

Table 3-18 Marine Mammals in the VACAPES OPAREA

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

Source: NASA, 2003a

NASA has coordination with NMFS concerning impacts from lasers on marine mammals and fish. In a letter dated February 27, 2004, NMFS stated that the use of an airborne laser to measure the productivity of phytoplankton is not likely to adversely affect federally endangered and threatened species under NMFS jurisdiction (Appendix D).

3.3.4.2 Fish

Common fish in the waters near WFF include the Atlantic croaker (*Micropogonias undulatus*), sand shark (*Carcharias taurus*), smooth dogfish (*Mustelus canis*), smooth butterfly ray (*Gymnura micrura*), bluefish (*Pomatomidae saltatrix*), spot (*Leiostomus xanthurus*), and flounder (*Paralichthys dentatus*) (NASA, 1999a). Salinity and water depths play a major role in determining if a coastal fish species is present in the bays and inlets. An example of this is the sandbar shark (*Carcharhinus plumbeus*), which is one of the most common sharks in the coastal and estuarine waters near WFF. If the channels located between Wallops Mainland and Wallops Island are at least 3.66 meters (12 feet) deep and the salinity is at least 30 parts per thousand, then the sandbar shark can thrive in the channels (NASA, 1999a).

The tidal marsh areas of WFF act as nursery grounds for a variety of fish species due to the protection the marsh grasses provide and the abundance of food (NASA, 1999a). Eelgrass, for example, provides protection to the spot (*Leiostomus xanthurus*), the northern pipefish (*Syngnathus fuscus*), the dusky pipefish (*Syngnathus floridae*), and bay anchovy (*Anchoa mitchilli*) (NASA, 1999a).

There are no fish species within the VACAPES OPAREA that are listed as threatened or endangered under the ESA.

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 (Magnuson-Stevens Act), 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 322 kilometers (3 to 200 miles) offshore. The Mid-Atlantic Fisheries Management Council (MAFMC) is responsible for managing fisheries in Federal waters off the Atlantic Coast, including the VACAPES OPAREA fisheries, in accordance with the Magnuson-Stevens Act. To promote the long-term health and stability of managed fisheries, the MAFMC utilizes Fishery Management Plans (FMPs) for the following species or species complexes: mackerel, squid and butterfish; bluefish; dogfish; surf clam and ocean quahog; summer flounder, scup, and 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. Table 3-19 provides a list of species with designated EFH for areas of the Atlantic Ocean potentially affected by WFF proposed actions. The VACAPES OPAREA also features intermittent floating *Sargassum* habitat, which is considered EFH. Live/hard EFH communities are not known to occur naturally in the VACAPES OPAREA, except those that exist on man-made structures such as shipwrecks and artificial reefs.

Table 3-19 Species with Designated Essential Fish Habitat in the Proposed Project Area				
Species Common (Scientific) Name	**Eggs**	**Larvae**	**Juveniles**	**Adults**
red hake (*Urophycis chuss*)	X	X	X	
witch flounder (*Glyptocephalus cynoglossus*)	X	X		
winter flounder (*Pleuronectes americanus*)	X	X	X	X
yellowtail flounder (*Pleuronectes ferruginea*)		X		
windowpane flounder (*Scopthalmus aquosus*)	X	X	X	X
Atlantic sea herring (*Clupea harengus*)				X
monkfish (*Lophius americanus*)	X	X		
bluefish (*Pomatomus saltatrix*)		X	X	X
Atlantic butterfish (*Peprilus triacanthus*)			X	X
summer flounder (*Paralicthys dentatus*)	X	X	X	X
scup (*Stenotomus chrysops*)			X	X
black sea bass (*Centropristus striata*)		X	X	X
surf clam (*Spisula solidissima*)			X	
spiny dogfish (*Squalus acanthias)*			X	X
king mackerel (*Scomberomorus maculates*)	X	X	X	X
Spanish mackerel (*Scomberomorus maculates*)	X	X	X	X
cobia (*Rachycentron canadum*)	X	X	X	X
red drum (*Sciaenops occelatus*)	X	X	X	X
sand tiger shark (*Odontaspis taurus*)		X		X
Atlantic angel shark (*Squatina dumerili*)		X	X	X
Atlantic sharpnose shark (*Rhizopriondon terraenovae*)				X
dusky shark (*Charcharinus obscurus*)		X	X	
sandbar shark (*Charcharinus plumbeus*)		X	X	X
scalloped hammerhead shark (*Sphyrna lewini*)			X	
tiger shark (*Galeocerdo cuvieri*)		X		

3.4 SOCIAL AND ECONOMIC ENVIRONMENT

The following sections provide background information on the social and economic characteristics of WFF and the surrounding area. The majority of the data presented was collected from the U.S. Department of Commerce Bureau of Census 2000 data, with supplemental information gathered from WFF and local sources.

3.4.1 Population

The study area chosen for the WFF Site-Wide EA includes Accomack and Northampton Counties in Virginia, and Somerset, Worcester, and Wicomico Counties in Maryland. WFF is located in Accomack County, Virginia, which is the northernmost of the two Virginia counties on the southern end of the Delmarva Peninsula.

WFF is located in a rural area, and year-round densities of neighboring areas are low. Table 3-20 shows the population and density of Accomack and neighboring counties.

Table 3-20 County Population and Density

County	Population	Land Area Square Kilometer (square miles)	Density People/Square Kilometer (square mile)
Accomack, VA	38,305	732 (455)	52.3 (84.1)
Northampton, VA	13,093	333 (207)	39.3 (63.1)
Somerset, MD	24,747	526 (327)	47 (75.6)
Wicomico, MD	84,644	606 (377)	139.6 (224.4)
Worcester, MD	46,543	761 (473)	61.1 (98.4)

Source: U.S. Census Bureau, 2004

Chincoteague Island, Virginia, is approximately 8 kilometers (5 miles) east of the Main Base. It is the largest densely populated area near WFF, with a resident population of 4,317 people. Area populations fluctuate seasonally. During the summer months, the population increases due to tourism and vacationers who visit the nature reserve and beaches of Assateague Island. Daily populations often reach up to 15,000 in the summer months. Special events, such as the carnival and pony roundup/auction, sponsored by the Chincoteague Volunteer Fire Department in July, draw crowds of up to 40,000. Table 3-21 lists the Census 2000 population of nearby towns in Accomack and Northampton Counties.

Table 3-21 Town Population and Housing Units

Location	Population	No. of Housing Units
Accomac Town	547	235
Belle Haven Town	421	213
Bloxom Town	395	175
Chincoteague Town	4,317	3,970
Hallwood Town	290	121
Keller Town	173	90
Melfa Town	450	205
Onancock Town	1,525	733
Onley Town	496	271
Painter Town	246	117
Parksley Town	837	405
Saxis Town	337	193
Tangier Town	604	270
Wachapreague Town	236	225
Cape Charles Town	1,134	740
Cheriton Town	499	239
Eastville Town	203	75
Exmore Town	1,136	524
Nassawadox Town	572	207

Source: U.S. Census Bureau, 2004

Table 3-22 lists the geographical distribution by county of NASA and U.S. Navy employees in 1999. It is apparent that the majority of employees reside locally in Accomack County, Virginia.

Table 3-22 Geographic Distribution by County of Residence

County	NASA Employees	Navy Employees
Accomack	617	297
Northampton	18	3
Somerset	46	16
Wicomico	100	38
Worcester	177	57
Other	9	2
Total	967	413

Source: NASA, 1999a

3.4.2 Recreation

WFF is located on Virginia's Eastern Shore, which is a popular tourist destination, and the surrounding counties offer numerous recreational opportunities, including the NASA WFF Visitors Center. For most of the year the Visitors Center is open free of charge to the public from Thursday through Monday, from 1000 hours to 1600 hours. The Wallops Visitors Center is open seven days a week from July 4 through Labor Day. All Visitors Center buildings and facilities are wheelchair accessible, and interpreters are available for the hearing impaired for all tours and events.

The Wallops Visitors Center houses a variety of educational exhibits and displays including a moon rock, scale models of space probes, satellites, and aircraft, displays of current and future NASA projects, and full-scale aircraft and rockets. Other special activities sponsored by the Wallops Visitors Center include weekly and monthly educational programs such as games, films on space, and model rocket demonstrations. An expansion of the Visitors Center is planned for completion by the end of 2004

Many other activities and facilities are offered to WFF employees and their families through the Wallops Employee Morale Association (WEMA). There are numerous clubs (for example, Music Clubs, Dart League, Aerobics Club, Women of Wallops, Black History Club, Voices of Wallops, and the Prayer Club) and recreational facilities located at the Building D-10 gymnasium, in addition to ball fields, volleyball court, tennis courts, indoor and outdoor basketball courts, the pavilion, exercise trail, Building F-3 "Rocket Club," as well as many WEMA sponsored dinners and large-screen pay-per-view events throughout the year. The Women of Wallops biannually sponsors speakers and lunches. WEMA also sponsors seasonal events such as Oktoberfest, an Easter egg hunt, and children's and employee's holiday parties. WFF sponsors a Wallops Heritage week, various concerts, Earth Day events, a Health Fair, Directors Colloquia, and weekend use of the Wallops Island beach. The Navy rents canoes, kayaks, boats, and camping gear to all WFF and Navy employees.

Many tourists and vacationers visit the Eastern Shore throughout the late spring, summer, and early fall. Regional attractions include the Assateague Island National Seashore, which has 24

kilometers (15 miles) of undeveloped shoreline in Virginia and Maryland, and the Chincoteague National Wildlife Refuge, which is home to many species of animals including the Chincoteague wild ponies. Winter hunting season draws people to hunt local game including dove, quail, deer, fox, and many types of geese and ducks. The coast of Virginia is a popular area for recreational and sport fishing as well. Over 224,000 fishing trips were taken in 2001 by individual recreational anglers fishing off the coast of Virginia. The Marine Recreational Fishery Statistics Survey (MRFSS) conducted by the National Marine Fisheries Service (NMFS) provides estimates of fishing effort, catch, and participation by recreational anglers in the marine waters of the U.S. According to the MRFSS estimates, almost 1.9 million people participated in recreational, marine fishing in waters off the coast of Virginia (MRFSS, 2004).

Two herds of wild ponies make their home on Assateague Island, separated by a fence at the Maryland-Virginia line. The Virginia herd is owned by the Chincoteague Volunteer Fire Company and allowed by permit to graze on the Chincoteague National Wildlife Refuge. In July of each year, the Virginia herd is rounded up for the internationally recognized Pony Penning and Auction. The auction provides revenue to the fire department and trims the herd's numbers. To retain the permit to graze on the refuge, the herd must not exceed 150 ponies. The Maryland herd is managed by using contraceptive vaccines for females. Both of these management techniques reduce the impact the horses pose to their natural environment and help provide a sustainable resource for the future.

Accomack and Northampton Counties in Virginia also offer an assortment of recreational opportunities. Two county park facilities support many recreation programs, including softball, volleyball, and basketball leagues, as well as youth football, soccer, and little league baseball programs. Tennis courts, ball fields, public beaches, a roller rink, and indoor movie theaters also provide sources of recreation and entertainment throughout the area.

Many of the towns in the area are home to historic sites and landmarks. The annual Garden Tour, held as a one-day event at the end of April, showcases many of these attractions at various locations throughout the Eastern Shore.

3.4.3 Employment and Income

This section provides general background information on employment and income data for the WFF region. This includes Census 2000 data on the employment, unemployment, income, and poverty characteristics of the region, as well as statistics for WFF itself.

Table 3-23 shows the labor force and unemployment rates of Accomack and neighboring counties. Accomack and Northampton Counties are both approximately average in the region in terms of unemployment rates. It is also notable that employment fluctuates seasonally in this region, with lower unemployment during the months of June through October. Unemployment typically falls to between 4 and 6 percent during these months (NASA, 2003a).

Table 3-23 Labor Force and Unemployment			
County	**Total Labor Force**	**Armed Forces**	**Percent Unemployed**
Accomack, VA	18,116	133	7.6
Northampton, VA	5,581	15	7.0
Somerset, MD	10,398	17	9.7
Wicomico, MD	44,815	132	5.5
Worcester, MD	23,122	44	6.8

Source: U.S. Census Bureau, 2004

Table 3-24 lists the distribution by broad occupational categories for Accomack and Northampton Counties, as reported by the 2000 Census.

Table 3-24 County Employee Distribution		
Category	**Accomack Employees (percent)**	**Northampton Employees (percent)**
Management, professional, and related occupations	24	27
Service occupations	17	20
Sales and office occupations	22	20
Farming, fishing, and forestry occupations	6	7
Construction, extraction, and maintenance occupations	11	10
Production, transportation, and material moving occupations	20	16

Source: U.S. Census Bureau, 2004

NASA employed 233 permanent, full-time civil service personnel at WFF in 1999. Navy and NOAA personnel also work at the facility. At the WFF site, there were approximately 944 employed personnel, including civil service and contractor employees in 1999. Table 3-25 illustrates the number of full-time WFF employees from 1982 through 1999. WFF employees make up approximately 5 percent of the total work force in Accomack and Northampton Counties (NASA, 1999a). WFF is the third largest employer in Accomack County. Other large employers on the Eastern Shore are Perdue Farms (1,900 employees) and Tyson Foods (950 employees) (ESVEDC, 2004).

Table 3-25 Full-Time WFF NASA Employees		
FY	**NASA Civil Service**	**NASA Contractors**
1982	354	353
1983	385	385
1984	362	405
1985	359	441
1986	351	536
1987	368	560
1988	375	709
1989	380	725
1990	*	766
1991	361	817
1992	391	791
1993	363	*
1994	355	*
1995	348	588
1996	303	*
1997	280	577
1998	250	617
1999	233	711

Source: NASA, 1999a
* Data not available

Table 3-26 lists the employee distribution by employment category for WFF. In fiscal year 1998, military, civilian, and contractor personnel were employed by the AEGIS Combat System Center (346 personnel), Naval Surface Warfare Center (21 personnel), and Naval Air Warfare Center (5 personnel).

Table 3-26 WFF Employee Distribution		
EMPLOYEES (percent)		
Category	**Civil Service**	**Contractor**
Scientific/Engineering	39	20
Professional/Administrative	19	20
Technical	30	34
Secretarial/Clerical	12	4
Crafts/Trades	0	22
TOTAL	100	100

Source: NASA, 1999a

Table 3-27 lists the staffing changes at WFF between 1981 and 1999 (NASA, 1999a).

Table 3-27 Staffing Changes at WFF (including government and support contractors)

Facility	1981	1999
NASA	732	963
NAVY	31	387
NOAA	105	99

Source: NASA, 1999a

Table 3-28 lists the total WFF labor force including NASA civil service (233 employees), NASA support contractors (711 employees), Navy (372 employees), and NOAA (99 employees) (NASA, 1999a).

Table 3-28 Total WFF Labor Force

Employer	Employees
NASA Civil Service	252
NASA Support Contractors	711
NAVY	387
NOAA	99
TOTAL	1,449

Source: NASA, 1999a

3.4.3.1 Income

Table 3-29 shows the income and poverty rates of Accomack and neighboring counties. Accomack and Northampton Counties are both on the lower end of income measures in the region. Naturally, both counties are also on the higher end of poverty levels in the region based on Census 2000 data reports using 1999 dollars.

Table 3-29 Income and Poverty

County	Median Household Income (1999$)	Per Capita Income (1999$)	Percent of Families Below Poverty Level (Based On 1999$)
Accomack, VA	30,250	16,309	13.0
Northampton, VA	28,276	16,591	15.8
Virginia	46,667	23,975	7.0
Somerset, MD	29,903	15,965	15.0
Wicomico, MD	39,035	19,171	8.7
Worcester, MD	40,650	22,505	7.2
Maryland	52,868	25,614	6.1

Source: U.S. Census Bureau, 2004

Table 3-29 highlights some key income and poverty data for the area surrounding WFF. All five counties have a lower per capita income than their respective states as a whole; however, none of these counties includes major urban centers. This most likely drives down the cost of living in these counties, as compared to the states as a whole. Unfortunately, cost of living data are published for comparison of the major urban centers, and not for comparison of rural to urban areas. Therefore, the poverty rates may be a more telling sign of the financial well-being of the residents in the surrounding area. The poverty data indicate that all of the counties have a higher percentage of the population living in poverty than their respective states. Northampton has the highest percent of population living in poverty, at more than double the Virginia State average.

Table 3-30 groups the NASA civil service employees at WFF by income. NASA employment categories at WFF consist largely of managerial, professional, and technical disciplines with higher than regional average salaries. The mean salary of NASA civil service employees at WFF for FY 1998 was $55,172 (NASA, 1999a). WFF mean annual income exceeds the median family income of $30,250 for Accomack County and $28,276 Northampton County in 1999. Due to the wide gap between salaries of WFF employees and most area residents, the facility contributes significantly to the local economy.

Table 3-30 Civil Service Employee Income

Salary In 1999 $	Percent Employees
Under 20,000	0
20,000-25,000	0.5
25,000-30,000	8.0
30,000-35,000	5.5
35,000-40,000	5.5
40,000-45,000	4.5
over 45,000	76.0

Source: NASA, 1999a

3.4.4 Health and Safety

3.4.4.1 Health Facilities

Three local emergency health services are located in the vicinity of WFF. WFF has its own health unit with a full-time nursing staff and a full-time physician to provide first aid and immediate assistance to patients in emergency situations. The Health Unit operates from 0800 hours to 1630 hours. After-hours emergency medical care is provided by Emergency Medical Services staff of the WFF Fire Department. The Chincoteague Medical Center on Chincoteague Island and the Atlantic Medical Center in Oak Hall, Virginia, also provide emergency assistance, and both are located within 8 kilometers (5 miles) of WFF. Four hospitals are also located in the region, all within 64 kilometers (40 miles) of WFF. These hospitals include:

- Atlantic General Hospital in Berlin, Maryland;
- McCready Memorial Hospital in Crisfield, Maryland;
- Peninsula Regional Medical Center in Salisbury, Maryland; and

- Shore Memorial Hospital in Nassawadox, Virginia.

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

3.4.4.2 Fire and Police Protection

Fire company personnel are housed in two buildings on the facility, one on Wallops Island and one on the Main Base. There is 24-hour protection, and personnel are trained as first responders for hazardous materials, waste, and oil spills. The WFF Fire Department has a Mutual Aid Agreement with the Accomack-Northampton Fireman's Association for any outside assistance needed at the facility (NASA, 1999a). There are 21 existing Fire and Rescue stations in Accomack County. The local fire companies nearest WFF are in Atlantic, Chincoteague, and New Church.

WFF maintains a security force that is responsible for the internal security of the base. The force provides 24-hour-per-day protection services for 2,428 hectares (6,000 acres) of real estate, 513 buildings and structures, and approximately 1,600 employees and 11,000 visitors per year (NASA, 1999a). Two entrance gates to the WFF are used to control and monitor daily employee and visitor traffic. Other services provided by the security force include security patrols, employee and visitor identification, mail delivery, after-hours security checks, and police services.

Police protection for the surrounding areas is supplied by town, county, and State personnel. The Commonwealth of Virginia's police force employs 23 officers in the area, while the Accomack County Sheriff's Office has approximately 34 officers. Several towns also have their own police forces, including: Bloxom, Cape Charles, Chincoteague, Exmore, Ocean City, Onancock, Onley, Parksley, Pocomoke, Salisbury, Saxis, and Tangier (Eastern Shore Chamber of Commerce, 2004).

3.4.5 Cultural Resources

Cultural resources include archaeological and historical objects, sites, and districts; historic buildings and structures; cultural landscapes; and sites and resources of concern to local Native Americans and other ethnic groups. The National Historic Preservation Act (NHPA) of 1966, as amended, outlines Federal policy to protect historic sites and values in cooperation with other nations, Tribal Governments, States, and local governments. Subsequent amendments designated the State Historic Preservation Officer (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 providing commentary on Federal activities, programs, and policies that impact historic resources.

Section 106 and Section 110 of the NHPA and implementing regulations (36 CFR 800) outline the procedures to be followed in the documentation, evaluation, and mitigation of impacts for cultural resources. The Section 106 process applies to any Federal undertaking that has the

potential to affect cultural resources. The Section 106 process includes identifying significant historic properties and districts that may be affected by an action and mitigating adverse effects to properties listed, or eligible for listing in the NRHP (30 CFR 60.4). Section 110 of the NHPA outlines the obligations Federal agencies have in regard to historic resources under their ownership.

In November 2003, WFF prepared a *Cultural Resources Assessment of Wallops Flight Facility, Accomack County, Virginia* that examined each of the three areas of the facility: Wallops Main Base, Wallops Mainland, and Wallops Island (NASA, 2003f). The study, included as Appendix E, was completed to assist WFF in meeting its obligations under Section 106 and Section 110 of the NHPA. To conduct the study, URS cultural resource specialists undertook background research, a windshield survey of archaeological sites and historic structures, and a selective reconnaissance level survey of above-ground structures. The survey of archaeological sites consisted of assessing land forms for their archaeological potential. The age criterion for consideration of an historic structure is 50 years; and, for planning purposes, the study used the 1955-2005 date range as the youngest applicable 50-year period. Additionally, it established a predictive model for understanding the archaeological potential at WFF.

The *Cultural Resources Assessment* determined that cultural resources at WFF consist of six archaeological sites — three numbered prehistoric sites on the Main Base, one unnumbered prehistoric site on Wallops Mainland, and two historic sites on Wallops Island (Figures 15-20) — and a total of 166 structures that are at least 55 years old. Of these structures, 99 were built between 1936 and 1949, and the remainder were built between 1950 and 1955.

The standing structures review confirmed that no buildings at WFF are currently listed in the VDHR's inventory of historic properties. Likewise, none of the WFF buildings, structures or facilities is listed on the National Register of Historic Places, or is recognized as a National Historic Landmark.

The *Cultural Resources Assessment* was submitted to WFF and the Virginia Department of Historic Resources (VDHR), the Commonwealth of Virginia SHPO. Comments from the VDHR were received in a letter dated December 4, 2003 (Appendix E). The letter concurred with the recommendations of the Assessment, which included developing a specific historic context for WFF related to the Cold War and Space Race and undertaking a comprehensive architectural survey that would include a more thorough investigation of buildings identified as potentially eligible for the NRHP. The 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 construction or site use.

Following these recommendations, NASA developed an historic context and initiated a reconnaissance-level survey of the WFF structures constructed prior to 1956. The historic context and survey, entitled *Historic Resources Survey and Eligibility Report for Wallops Flight Facility* (NASA, 2004a) is included as Appendix F. Research was conducted at WFF, historic repositories in Richmond, Virginia, and Washington, D.C., including the VDHR, the Library of Congress, the National Archives, and NASA, among others. The historic context follows the historic time periods and themes developed by the VDHR. The context focuses on the use and development of the WFF property as a U.S. Government installation, including its function as an aeronautics and space research facility. Government association began in 1883, with the establishment of a Life Saving Station on the north end of Wallops Island. The Life Saving

Service became the U.S. Coast Guard in 1915. In 1942, the U.S. Navy established the Naval Auxiliary Air Station on what is now the Main Base. New runways and supported buildings were added the following year and the station was renamed the Chincoteague Naval Auxiliary Air Station. The National Advisory Committee for Aeronautics' (NACA) Langley Field Research Center established a base on Wallops Island in 1945, and in June of that year launched its first rocket from the facility. NACA served as the basis for NASA, which was officially formed by the National Aeronautics and Space Act of 1958. As such, structures constructed by NASA on WFF fall outside of the 50-year period. However, structures less than 50 years old are eligible for the NRHP if it is deemed that they are of exceptional importance or if they are essential elements of districts eligible for the NRHP.

The historic context developed for the report served as the basis of evaluation for the buildings determined to be (or soon to be) 50 years or older at WFF. Field work determined that 124 buildings that pre-date 1956 still exist on the base.[1] These 124 properties were included in a comprehensive reconnaissance-level architectural survey of the facility (Figures 21 and 22). In compliance with Section 106 of the NHPA, these properties were assessed according to the National Register Criteria for Evaluation as contained in *National Register Bulletin 15*, for both their individual significance and their potential to contribute to one or more historic districts. Of the 124 buildings surveyed, it was determined that one resource — the Wallops Beach Lifeboat Station (VDHR #001-0027-0100; WFF# V-065) and its associated Coast Guard Observation Tower (001-0027-0101; WFF# V-070) — is eligible for listing in the National Register and Virginia Landmarks Register. The remaining 122 surveyed resources are not National Register-eligible because they lack the historical significance and/or integrity necessary to convey significance. No districts are National Register-eligible. Many of the inventoried buildings and structures have been modified through additions and other alterations to original building fabric. In other instances, the settings and landscapes in which the surveyed resources are located lack integrity.

As part of the Section 106 process, following the research and field work tasks, the illustrated *Historic Resources Survey and Eligibility Report for Wallops Flight Facility* was submitted to the WFF and the VDHR for review and comment. The VDHR concurred with the survey findings, recommending that the Wallops Beach Lifeboat Station is potentially eligible for the National Register, with the Observation Tower as a contributing structure (Appendix B).

[1] Incomplete maintenance records resulted in incorrect reporting of the number of standing structures in the 2003 *Cultural Resources Assessment*.

Insert Figure 15 - Main Base Prehistoric Archaeology Site Sensitivity (11x17 color)

Insert Figure 16 - Main Base Historic Archaeological Site Sensitivity (11x17 color)

Insert Figure 17 – Wallops Mainland and Southern Wallops Island Prehistoric Archaeological Site Sensitivity (11x17 color)

Insert Figure 18 – Wallops Mainland and Southern Wallops Island Historic Archaeological Site Sensitivity (11x17 color)

Insert Figure 19 – Northern Wallops Island Prehistoric Archaeological Site Sensitivity (11x17 color)

Insert Figure 20 – Northern Wallops Island Historic Archaeological Site Sensitivity (11x17 color)

Figure 21 – Main Base Historic Resources Survey Sites

Figure 22 – Wallops Island Historic Resources Survey Sites

3.4.6 Environmental Justice

The basic 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."

WFF has prepared an Environmental Justice Implementation Plan (EJIP) to comply with EO 12898. Within this EJIP, the EJ Coordination Committee (EJCC) at WFF has defined low-income as the average income of all households with 1 to 8 persons per occupancy (NASA, 1996b). The Census 2000 average household income for Accomack County is $30,250. The EJCC has also defined minority communities as exceeding a 50 percent minority population. A review of Accomack County Census data provided the baseline for the facility's EJIP.

A review of updated Census data is provided in Table 3-31.

Table 3-31 Environmental Justice Concerns – by Census Tract, Accomack County, VA

	Percent Minority – 2000	Percent Low Income – 2000	Percent Poverty – 2000
Tract 9901	1.97 percent	51.53 percent	12.80 percent
Tract 9902	41.75 percent	49.96 percent	16.38 percent
Tract 9903	24.66 percent	55.94 percent	19.28 percent
Tract 9904	59.14 percent	51.61 percent	27.14 percent

Source: U.S. Census 2004

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

EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks," encourages Federal agencies to consider the potential effects of Federal policies, programs, and activities on children. Consistent with NEPA, this and other EOs concerned with impacts to the human environment have been analyzed in this document. The closest day cares, schools, camps, nursing homes, and hospitals are addressed within the EJIP.

Low-income and minority communities do occur in the vicinity of WFF. No nursing homes, hospitals, or schools are located in close proximity to WFF. One public campground, Trail's End, is located approximately 1.48 kilometers (0.92 mile) northeast of the Magazine Storage Area (M-Area). One day care center, Three Bears, is located approximately 2.51 kilometers (1.56 miles) south-southwest of the M-Area. Neither of these facilities would be in the planned flight path of the aircraft and both are well beyond the explosive/hazard zone of the M-Area.

3.4.7 Transportation

The Eastern Shore of Virginia is connected to the rest of the state by the double span of the 28.3-kilometer (17.6-mile) long 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. 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.

The 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 all buildings on WFF. NASA maintains all roads within the facility. Additionally, the Main Base has extensive sidewalks.

NASA and most organizations at WFF own and maintain a variety of vehicles ranging from sedans and vans to trucks. Several organizations provide bicycles for employees to use on the Main Base. There is no organized transportation on base.

There are established facilities and procedures for the movement of hazardous materials, such as rocket motors at WFF.

Many WFF employees carpool to and from the facility. The majority of civil service and contractor employees commute to and from Accomack County, Virginia. Some employees commute from Wicomico County, Maryland, a daily round-trip distance of approximately 80-95 kilometers (50-60 miles).

Commercial air service to the area is provided through the Norfolk International Airport, about 145 kilometers (90 miles) to the south, and the Salisbury Regional Airport, about 64 kilometers (40 miles) to the north. Air service is also available through the Accomack County Airport in Melfa, which normally provides flights during daylight hours. Surface transportation from the airports to WFF is by private rentals, government vehicles, and commercial bus or taxi. In addition, ground transportation to the Salisbury Airport is occasionally provided by a WFF Shuttle Bus for NASA employees.

Chartered and private aircraft that have the appropriate clearance may land at WFF Airport for business purposes. Air-freight services are available from the Salisbury Regional Airport and are provided by U.S. Air and Butler Air Freight.

Rail freight service is provided to the peninsula by the Eastern Shore Railroad. No rail passenger service is available to WFF. Eleven motor freight carriers that serve the eastern United States are authorized to provide service to the Accomack-Northampton District.

Ocean cargo shipments are off-loaded at the Port of Baltimore, Maryland, or Cape Charles, Virginia, and transferred to commercial trucks or rail for transport to Wallops Flight Facility. There are numerous small harbors located throughout Accomack and Northampton Counties, which are used primarily for commercial or recreational fishing and boating.

4.1 INTRODUCTION

As discussed in Chapter 2, operations at WFF are mission-driven and can change from year to year as missions evolve, terminate, or new missions are anticipated. To assess the impacts operations may have on resources at WFF, a range or "envelope" of activities was identified for the actions described in the following sections. The worst-case scenario within each operation's envelope was used for assessing impacts. For instance, the largest rocket anticipated to be launched from WFF was used as a model for assessing air quality impacts in Section 4.2.3. Smaller rockets would have fewer impacts; therefore, if a larger rocket has an insignificant impact on a resource, a smaller rocket would also fall within this range of impacts and have an insignificant impact.

If one or more of the Proposed Actions would have no impact on a resource, that action is not discussed under that resource area. For example, because no construction and demolition activities would occur offshore, those activities would have no impact on marine mammals or fish, and those actions are not discussed in Section 4.3.4. Table 4-1, Impact Summary Matrix, illustrates which WFF actions impact specific resources. Impacts that are discussed below are grouped into two categories, General Consequences of the Proposed Actions and Consequences Attributable to Specific Proposed Actions. The discussion under General Consequences of the Proposed Actions details generic impacts that potentially could occur from any of the construction, demolition, or operational components and the typical mitigation measures or permits needed. The discussion under Consequences Attributable to Specific Proposed Actions details potential impacts from each Proposed Action that has been determined to have an impact.

Table 4-1: Impact Summary Matrix

Resource Areas	New Construction	Demolition	Maintenance and Improvements	Utility Infrastructure	Transportation Infrastructure	Fabrication	Payload Processing	Fueling	Storage	Safety and Security	Rockets	Balloons	Piloted Aircraft	Unmanned Aerial Vehicles	Autonomous Underwater Vehicles	Payloads	Tracking and Data Systems	Scientific Research Programs and Facilities	Educational Programs	Open Burn Area	Rocket Boosted Projectile Testing	Airfield Operations	
4.2 Physical Environment																							
4.2.1 Land Resources																							
4.2.1.1 Topography and Drainage	√	√																					
4.2.1.2 Geology and Soils	√	√	√					√															
4.2.1.3 Land Use	√	√																					
4.2.1.4 Atlantic Ocean Substrate										√													
4.2.2 Water Resources																							
4.2.2.1 Surface Water	√	√	√					√	√	√		√	√	√							√	√	
4.2.2.2 Stormwater	√		√		√						√		√	√								√	
4.2.2.3 Marine Waters										√	√	√	√	√	√								
4.2.2.4 Groundwater		√		√				√	√												√		
4.2.2.5 Wetlands	√									√											√		
4.2.2.6 Floodplains	√																						
4.2.2.7 Coastal Zone Management	√																						
4.2.3 Air Quality	√	√	√	√		√	√	√	√	√	√	√	√	√	√		√	√	√	√	√		
4.2.4 Noise	√	√	√			√	√			√		√	√	√					√	√	√		
4.2.5 Hazardous Materials and Hazardous Waste	√	√				√	√	√	√	√	√	√				√				√	√		
4.2.6 Radiation	√	√													√	√							
4.3 Biological Environment																							
4.3.1 Vegetation	√	√	√							√										√			
4.3.2 Terrestrial Wildlife and Migratory Birds	√	√								√		√	√	√						√			
4.3.3 Threatened and Endangered Species	√									√		√									√		
4.3.4 Marine Mammals and Fish										√	√				√				√				
4.4 Social and Economic Environment																							
4.4.1 Population	√									√		√											
4.4.2 Recreation	√									√													
4.4.3 Employment and Income	√	√																					
4.4.4 Health and Safety	√	√				√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		
4.4.5 Cultural Resources	√	√	√					√	√	√													
4.4.6 Environmental Justice																							
4.4.7 Transportation	√	√																					

4.2 PHYSICAL ENVIRONMENT

4.2.1 Land Resources

4.2.1.1 Topography and Drainage

General Consequences of the Proposed Actions

The Proposed Actions, primarily construction or demolition activities, would potentially disturb the existing topography and possibly the drainage patterns in the area of the proposed action. A project requires a VPDES Construction Stormwater Permit if it would disturb 1 or more acres of land and would result in stormwater discharges to a surface water from a point source (pipe, ditch, channel, etc.). The operations portion of the Proposed Actions is not likely to affect topography, soils, or drainage patterns.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

Construction activities, including new construction, repair/renovation, and building replacement, would cause land disturbances, such as grading and excavation, which have the potential to alter project site topography and drainage patterns. NASA would minimize negative impacts to topography and drainage patterns by implementing WFF's Storm Water Pollution Prevention Plan and a site-specific Sediment and Erosion Control Plan prior to any intrusive activity.

Demolition

Impacts to topography and drainage from demolition activities would be similar to those described for construction activities. Following demolition, and especially for instances of structures with basements or with extensive below-grade structural foundations, the disturbed area should be restored to a level grade, erosion control measures installed, and vegetative cover established.

Operational Components

In general, existing and proposed operations are not expected to impact topography and drainage at WFF. Most activities take place at or adjacent to impervious surfaces (i.e., concrete, tarmac, asphalt).

No Action Alternative

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

4.2.1.2 Geology and Soils

General Consequences of the Proposed Actions

It is unlikely that the Proposed Action would affect the geology at WFF, because any impacts would only occur on the surface, with no deep excavations anticipated. The Proposed Action, primarily construction or demolition activities, would disturb the existing soils in the area of a specific action. Operational Components could affect soils if an activity resulted in the release of contaminants.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

Construction activities, including new construction, repair/renovation, and building replacement, would cause localized land disturbances, such as land clearing, Earth moving, and excavation. These activities have the potential to negatively impact soils at a project site through disturbance and removal of soils and vegetation, which could result in soil erosion. NASA would minimize negative impacts to soils by implementing WFF's Storm Water Pollution Prevention Plan and a site specific Sediment and Erosion Control Plan prior to any intrusive activity.

Demolition

Impacts to soils from demolition activities would be similar to those for construction activities.

Operational Components

In general, existing and proposed operations are not expected to significantly impact soils at WFF. All activities take place at or adjacent to impervious surfaces (i.e., concrete, tarmac, asphalt). Also, existing WFF policies are in place to ensure the safe storage, transfer, and mixing of hazardous materials. Any accidental release of liquid fuels would be addressed in accordance with existing management and response plans, and are not expected to significantly impact soil resources. However, there is some potential for the release of contaminants into the soil resulting from routine maintenance and fueling activities or an accident that releases liquid fuels to a non-impervious surface. The impacts associated with such a release are detailed in Section 4.2.5.

No Action Alternative

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

4.2.1.3 Land Use

General Consequences of the Proposed Actions

Any action that includes constructing, modifying, or relocating facilities has the potential to result in a direct change in land use or cause a conflict with existing zoning ordinances or land

use/general plans. Before implementing any action, NASA would review existing land use and master plans to ensure that the action is compatible.

NASA's land use plan has allocated particular areas for specific uses and has accounted for NASA considerations and partner requirements, as well as future needs. Existing land uses at WFF include: administrative areas, fabrication areas (vehicle and payload), housing and recreation areas, institutional areas, separate operational areas (NOAA, Navy Range), operations aircraft area, operations range, operations/explosive storage, Mid-Atlantic Regional Spaceport, and the Visitors Center Complex Area. As long as existing and new activities continue to occur in their designated land use areas, there should not be adverse impacts to land use.

The current Master Plan concept for WFF has several major goals, three of which are to focus on performance, unify the organization, and optimize center resources. WFF intends to do this by phased development of a Core Campus Area. The Master Plan "campus core" concept consolidates inherently governmental functions into a functional core area surrounded by an operations area, with anticipated commercial areas on the outskirts (construction of commercial areas would be covered under separate NEPA documentation). The core area would consist of a science, engineering, project management, and administration neighborhood; the operations area would be located for functionality and would include range operations, the ground network, sounding rocket program, and institutional support facilities; and the commercial area would include shared use facilities, research park activities, and non-inherently governmental functions (for example, chemical laboratory, health unit, etc.). This would allow for the consolidation of people and facilities based on job function so they are communicating and working together more effectively. This Core Strategy minimizes the chance of any conflict in land uses.

It is also important to note, that through master planning and by preparation of this Site-Wide EA, NASA can evaluate both the positive and negative impacts of proposed projects. This process allows NASA to incorporate mitigation measures to minimize potential negative impacts from land development and changes or conflicts in land uses.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

New construction planned for WFF is broken into five future phases according to the Master Plan. Phase I has been designed and includes a new Project Support Building. The proposed location for this facility is west of the Launch Range Control Tower on what is currently a paved area. The building would be approximately 856 square meters (9,220 square feet) and two stories in height. This building would be constructed in an area designated for this type of use and minimal impacts to land use are expected.

Phases II-V have not been designed yet, but it is expected that all new construction would be located in the Core Campus Area and/or areas designated for the appropriate type of land use. No significant impacts to land use are anticipated.

WFF is proposing to construct the M-Area Control Building north of the runway and outside of the security gate for M-Area. This structure is a support building for M-Area workers who

previously had to cross the runway to use offices and store items associated with their daily job. The construction of the M-Area control building would not impact land use.

WFF may construct a wind turbine at WFF. The proposed location on Wallops Island is in the northeast corner of the island just west of the main road and 1.2 kilometers (0.8 miles) southwest of Cow Gut Flat. The proposed location on Wallops Mainland is at the southwest corner of the property boundary. Construction of the wind turbine at either of these locations is not expected to have a significant impact on land use.

Demolition

Demolition itself is not expected to have significant impacts on land use, but the replacement or relocation of structures or facilities could have impacts. WFF has accounted for this through the facility master planning process and the core campus concept. Because this plan accounts for locations of facilities based on their function and needs, impacts to land use are not anticipated.

No Action Alternative

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

4.2.1.4 Atlantic Ocean Substrate

General Consequences of the Proposed Actions

Operations involving drone targets and rocket motors could potentially impact the Atlantic Ocean substrate when drone targets and rocket motors enter the marine environment.

Consequences Attributable to Specific Proposed Actions

Operational Components

Rockets

As discussed in the EA for AQM-37 Operations at WFF (NASA, 2003a), drone targets are used to test the performance of shipboard weapons systems, as well as provide simulated real-world targets for ship defense training exercises. Drone targets land on the ocean floor either as debris if they are destroyed by the weapons system or in their original condition if missed by the weapon system. Drone targets may contain batteries, which have the potential to affect marine sediments when they come to rest on the ocean floor. However, battery constituent concentrations have been found to represent a less than significant impact on marine sediment quality for each target event. In terms of long-term accumulation of contaminants in marine sediments, the impact from battery constituent concentrations is considered less than significant because it is highly unlikely that the same area of marine sediment would be affected more than once in a given year (NASA, 2003a).

Corrosion of drone target hardware and rocket motors present another potential source of pollution to marine sediments. However, toxic concentrations of metal ions are not produced because the corrosion rates are slow in comparison to the mixing and dilution rates associated with marine environments. Also, metal ions do not adhere to the sandy substrate of the Atlantic Ocean; therefore, no negative impact to the substrate is anticipated (NASA, 2003a).

In the event of a launch failure, debris from reentered hardware could impact the ocean much closer to shore than would occur with a successful launch, and could result in more substantive impacts. However, the probability of such an event is extremely small (estimated at 1 percent probability); therefore, such an event should not pose a significant environmental impact (NASA, 1997a).

Payloads

Payloads have the potential to affect marine sediments when they come to rest on the ocean floor and begin to release metal ions. As mentioned above, however, toxic concentrations of metal ions are not produced because the corrosion rates are slow in comparison to the mixing and dilution rates associated with marine environments and metal ions do not adhere to the sandy substrate of the Atlantic Ocean; therefore, no negative impact to the substrate is anticipated (NASA, 2003a). Payloads may contain batteries, which have the potential to affect marine sediments when they come to rest on the ocean floor. However, battery constituent concentrations have been found to represent a less than significant impact on marine sediment quality for each target event. In terms of long-term accumulation of contaminants in marine sediments, the impact from battery constituent concentrations is considered less than significant because it is highly unlikely that the same area of marine sediment would be affected more than once in a given year (NASA, 2003a).

Rocket Boosted Projectile Testing

The rocket boosted projectile testing has the potential to affect marine sediments when the projectiles come to rest on the ocean floor and begin to release metal ions. However, similar to drone targets, toxic concentrations of metal ions are not produced because the corrosion rates are slow in comparison to the mixing and dilution rates associated with marine environments. Also, metal ions do not adhere to the sandy substrate of the Atlantic Ocean; therefore, no negative impact to the substrate is anticipated from 20 missions per year (NASA, 2003a).

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to the Atlantic Ocean's substrate.

4.2.2 Water Resources

4.2.2.1 Surface Water

General Consequences of the Proposed Actions

The accidental release of hazardous materials, including fuels, from operational activities or from an accident could impact water resources at WFF by contaminating surface waters. WFF has developed and implemented an Integrated Contingency Plan (ICP) to minimize hazards to human health and the environment that could occur as the result of an accidental release of hazardous materials. The ICP identifies the locations of hazardous material storage areas and outlines spill prevention, control, response, and remediation procedures, and training protocols for personnel who work with hazardous materials (NASA, 2001c). Strict compliance with the ICP should

minimize the risk of accidental releases of hazardous materials that could impact surface waters and minimize impacts to surface waters should an accidental release occur.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

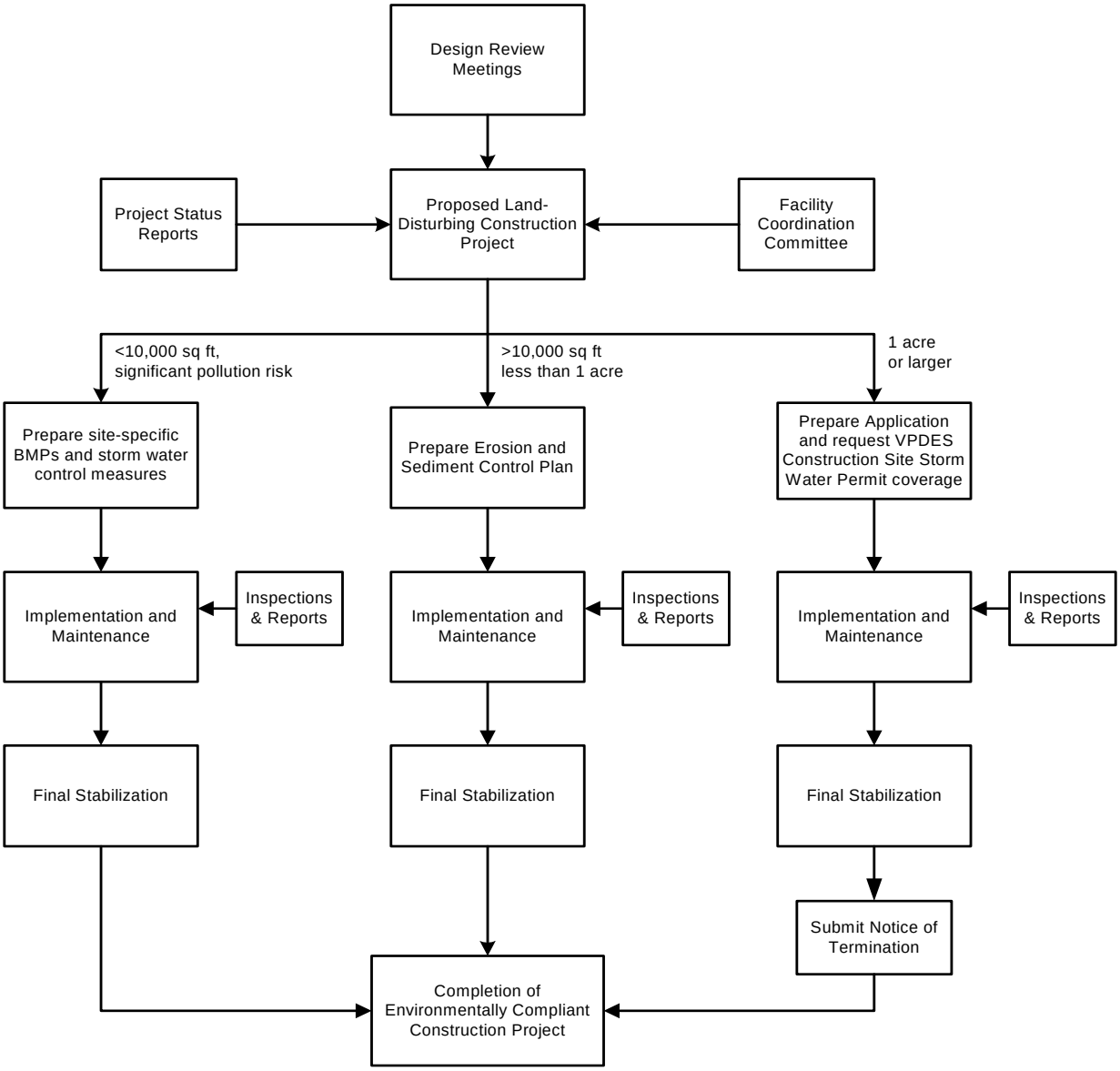
Temporary impacts to surface water resources could occur due to the operation of heavy equipment, disturbance of soil, and placement of rock or soil in surface waters during proposed construction activities at WFF. Impacts associated with the construction of the Project Support Building would be minor since the proposed construction would occur in a previously developed area of the facility and would not occur in close proximity to any surface waters. Construction of the other buildings proposed for Phases II through V of the campus core concept would also result in only minor construction impacts. The proposed locations of these buildings are in previously developed areas of the facility and are not in close proximity to any surface waters.

The M-Area Control Building would be constructed in a forested area near Little Mosquito Creek. Although land clearing would be performed the construction and operation of the M-Area Control Building would have minimal impacts on surface waters since NASA would implement BMPs.

NASA has a formal process in place to ensure that new construction at WFF has a minimal impact on surface water resources and that all applicable permits and regulatory controls are in place. This process is depicted in the flow chart below.

NASA would implement appropriate BMPs for stormwater management and erosion and sediment control, such as installing silt fences, revegetating bare soils, and implementing erosion and sediment control plans, to minimize impacts associated with construction activities. Any construction activity impacting more than 0.40 hectare (1 acre) would require a *VPDES General Permit for Stormwater Discharges from Construction Sites* from the Virginia DEQ. Most land disturbing activities in Virginia must also comply with the Virginia Erosion and Sediment Control Program, which is implemented by the Virginia Department of Conservation and Recreation (DCR). WFF would coordinate with DCR on individual construction projects to determine whether compliance with the Virginia Erosion and Sediment Control Program would be required.

Flow chart of NASA's Process for Minimizing Environmental Impacts from Proposed Land-Disturbing Construction Projects



Demolition

Ground disturbing activities associated with proposed demolition projects could increase runoff and sediment transportation to nearby surface waters. Proposed demolition projects that have the greatest potential impacts are those in proximity to surface waters in the vicinity of WFF, including the underground magazine facilities (M-003, M-004, M-005, and M-006) located on the Main Base near Mosquito Creek and the pistol range (A-027) located near the marsh on the northern portion of the Main Base and Mosquito Creek. To minimize impacts associated with demolition activities, NASA would implement appropriate BMPs, such as

installing silt fences or hay bales, revegetating bare soils, and implementing an erosion and sediment control plan.

Hazardous materials present in debris or disturbed soil could also impact water quality if the materials enter nearby surface waters. Residual lead is present in the soil at two underground magazine locations (M-005 and M-006). To minimize the risk of contamination, WFF would handle and dispose of all hazardous materials used, generated, or uncovered during demolition activities in accordance with Federal and State regulations.

Routine Site Activities

Aircraft and vehicle maintenance operations could negatively impact water resources at WFF if contaminants in wash water or oil and fluids discharged onto impervious surfaces were to runoff into nearby surface waters. To minimize impacts associated with aircraft maintenance, NASA has constructed an airplane wash rack that includes an oil/water separator near Building D-001 on the Main Base. Once the water has been separated from the oil it is discharged to the Main Base Federally Owned Treatment Works. Stormwater systems are annually inspected and scheduled for facility rehabilitation. To minimize impacts associated with vehicle maintenance, such activities are performed inside Building F-016 to prevent the accidental discharge of oil or other fluids to outside impervious surfaces where the contaminants could be transported to nearby surface waters. To minimize impacts from washing government fleet vehicles, NASA has constructed a vehicle wash facility that recycles wash water through sand filters for 100 percent decontamination and reuse.

Repair or replacement of the piling fender system used to protect the causeway that connects Wallops Mainland to Wallops Island could result in increased sedimentation to Cat Creek (Virginia Inside Passage). The disturbance would be minor and temporary, and NASA would implement appropriate BMPs to further minimize the impact. Since this activity would involve work in a waterway, NASA would apply for and obtain appropriate Federal and State permits. NASA would consult with the USACE to ensure compliance with Section 404 of the CWA and Section 10 of the Rivers and Harbor Act. NASA would also coordinate with Virginia DEQ and the Virginia Marine Resources Commission (VMRC) to comply with the Virginia Water Protection Permit program and Section 401 of the CWA.

Grounds maintenance activities may include removal of brush or trees. If removal of vegetation occurs near a water body, this action may result in increased erosion and sedimentation. To minimize impacts, NASA would minimize the removal of vegetation near water bodies and would implement appropriate BMPs.

Fueling

Fueling activities at WFF occur throughout the facility. Spills or leaks from any type of fueling facility (i.e., ASTs, USTs, temporary storage, mobile storage, and the proposed LFF) could contaminate surface waters. Strict compliance with the ICP should minimize the risk of accidental releases of fuels that could impact surface waters and minimize impacts to surface waters should an accidental release occur. If a hydrazine (or hydrazine derivative) spill should occur, the WFF Fire Department would take the lead in containing and cleaning up the spill. The Fire Department would follow the guidelines set out in the WFF Hydrazine Response Plan (NASA, 2004c).

Storage

Storage facilities located throughout WFF house various types of fuels and other hazardous materials. Spills or leaks of fuels or hazardous materials could contaminate surface waters. Strict compliance with the ICP should minimize the risk of accidental releases of hazardous materials that could impact surface waters and minimize impacts to surface waters should an accidental release occur.

Safety and Security - Fire Suppression

Fire prevention and protection is an important component of WFF safety and security operations. The WFF Fire Department has access to a fully equipped hazardous materials spill response trailer, which is able to respond to hazardous materials incidents. A quick response by the Fire Department and proper use of the spill response trailer would minimize the probability that any accidentally released hazardous materials would be discharged to nearby surface waters.

Some fire fighting activities, however, could result in a temporary disturbance to nearby surface waters. Water or other materials used to fight fires may runoff to nearby water bodies, collecting contaminants and sediments in its path. Any impacts associated with fire suppression activities are expected to be minor and temporary.

Operations

Rockets

All rocket launches at WFF are from the beach and directed toward the ocean. Consequently, the impacts on surface waters at WFF are minimal and are limited to the launch pad area. Chemical compounds emitted as part of solid propellant launch rocket exhausts include hydrogen chloride gas, water vapor, and aluminum oxide particles. It is likely that stormwater runoff would collect aluminum oxide particulates that settle on the pad following a launch. Aluminum oxide is not listed by the EPA as a hazardous substance that requires special treatment or disposal.

Numerous NASA studies have evaluated the hydrogen chloride-aluminum oxide scavenging process. Aluminum oxide particulates are known to gather water vapor and hydrogen chloride gas to form acidic droplets in the immediate vicinity of the pad. Should a storm event occur soon after a launch event, the potential for strongly acidic stormwater runoff from the pad area exists. However, since launches are not undertaken under potentially adverse weather conditions, the chance of a storm event very soon after a launch are small. Any surface water in the vicinity of the launch pad may incur a short-term increase in acidity as a result of localized emission cloud formation. The salinity of estuarine and ocean waters would buffer acidity changes in such water bodies. From an environmental perspective, Launch Complex 0 is the most sensitive launch area on Wallops Island. Launch Complex 0, which includes both Pad 0-A and 0-B, lies between the Atlantic Ocean and Hog Creek on the southern end of the island and would be used for launching orbital rockets. Launch Pad 0-B is equipped with a flame duct to direct the flame toward the Atlantic Ocean, which should help minimize impacts to the marshland and Hog Creek, west of the pad. Due to the proximity of these bodies of water, the pH of nearby surface waters may slightly decrease for 1 to 2 hours after a rocket launch; however, changes in water quality should be negligible due

to the rapid buffering capacity of estuarine waters. A nominal launch would have no substantial impacts to the local water quality (NASA, 2000a).

Rocket motors burned at the OB area are the same as those that are launched. The only difference is that during a burn, the motor is strapped in one place and all deposition occurs immediately surrounding the OB area versus along a launch trajectory. Therefore, a burn would likely result in a greater impact than a launch. To analyze impacts from OB activities, the WFF Environmental Office has performed surface water quality checks of the wetlands surrounding the OB area both prior to and after an open burn event. Over three sampling events, pH in the wetlands decreased an average of 0.1 with a standard deviation of 0.4. No decrease in pH was noted in the Atlantic Ocean. Therefore, no impacts are anticipated from acid deposition during a launch.

Piloted Aircraft

In the event of an accident, debris from a stricken aircraft could land in the surface waters in the vicinity of WFF. Water quality impacts associated with the release of fuels and corrosion of reentered hardware would be expected. However, the probability of an accident happening is small; therefore, such an event should not pose a significant environmental impact.

Mobile tankers are used to fuel aircraft. The largest tanker has a capacity of 26,500 liters (7,000 gallons) and a fueling rate of or 346 liters per minute (100 gallons per minute). At regular, grid intervals, stormwater inlets are inlaid in the apron of the runway. The inlets are interconnected by the stormwater system piping and drain to outfalls around the runway (see Figure 3a). Many of these outfalls lead to bodies of surface water. Therefore, if a tanker were to rupture on the apron, a potential release of 26,500 liters (7,000 gallons) of fuel oil could enter the surface waters of the Commonwealth (see Figure 3a). In order to confirm this theory, the WFF Environmental Office conducted a simulated spill exercise on the runway apron east of Building D-1. The simulated release traveled from the tarmac east of the D-1 Hangar through the stormwater system and to Outfall 003 in approximately 40 minutes. The release then flowed through the unnamed tributary to Little Mosquito Creek. After six hours from release initiation, the release was still over 305 meters (1,000 feet) southwest of Little Mosquito Creek. Therefore, it was concluded that a worst case spill would reach Outfall 003 in 40 minutes from initial release. This outfall empties into a manmade “pool” prior to flowing into the tributary and a spill could be blocked from going further downstream and contained at Outfall 003. If this containment opportunity is missed, the resultant spill would not reach the outer most boundaries of the facility property, or Little Mosquito Creek, for a period greater than 6 hours. In conclusion, if a spill incident occurred on the airport tarmac under similar weather conditions, containment, collection, and recovery operations could be implemented within a reasonable response time. The likelihood of a spill impacting state waters would diminish or be eliminated.

Uninhabited Aerial Vehicles

Impacts of UAVs on surface waters are expected to be similar to but smaller than those discussed above for piloted aircraft, due to the smaller scale of the UAVs.

No Action Alternative

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

4.2.2.2 Stormwater

General Consequences of the Proposed Actions

Future development at WFF could increase stormwater runoff to surface waters. To minimize impacts associated with stormwater runoff, NASA would implement the BMPs detailed in the SWPPP. NASA would also continue to comply with the conditions of VPDES permit number VA0024457 for stormwater discharges.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

Future construction activities would increase the amount of impervious surface at WFF, which would increase stormwater runoff to local waterbodies. To minimize impacts associated with stormwater runoff, NASA would implement the BMPs detailed in the SWPPP. Any construction activities impacting more than 1 acre would require a *VPDES General Permit for Stormwater Discharges from Construction Sites* from the Virginia DEQ. NASA would be responsible for applying for and obtaining this permit prior to construction.

Routine Site Activities

Aircraft and vehicle maintenance operations could negatively impact water resources at WFF if contaminants in wash water or oil and fluids discharged onto impervious surfaces were to runoff into nearby surface waters. To minimize impacts associated with aircraft maintenance, NASA has constructed an airplane wash rack that includes an oil/water separator near Building D-001 on the Main Base. Once the water has been separated from the oil, it is discharged to the Main Base Federally Owned Treatment Works. Stormwater systems are inspected annually and scheduled for facility rehabilitation. To minimize impacts associated with vehicle maintenance, such activities are performed inside Building F-016 to prevent the accidental discharge of oil or other fluids to outside impervious surfaces where the contaminants could be transported to nearby surface waters.

Transportation Infrastructure

Construction of new transportation infrastructure (e.g., roads, parking lots, and sidewalks) at WFF could increase stormwater runoff to nearby surface waters. To minimize impacts during construction of new infrastructure, NASA would implement appropriate BMPs, such as installing silt fences or hay bales, revegetating bare soils, and implementing an erosion and sediment control plan. NASA would also comply with all applicable Federal and State regulations.

Operations

Rockets

Stormwater runoff from WFF launch pads may contain aluminum oxide particles that have accumulated from the launch of solid rocket motors. Aluminum oxide is not classified as a hazardous substance by the Environmental Protection Agency (EPA), but aluminum oxide particles have been known to accumulate water vapor and hydrogen chloride gas to form acidic droplets. In the event a storm occurs immediately following a launch, the potential for runoff with a low pH may exist. However, due to the potential of lightning strikes, the launching of vehicles would not occur under adverse weather conditions, thus reducing the probability of a storm event and runoff immediately following a launch.

Piloted Aircraft

Stormwater runoff from airport runways at WFF could potentially be contaminated with pollutants, such as benzene, toluene, ethylbenzene, xylene, and surfactants, which could collect on the runway surface during piloted flight operations. To minimize the risk of contaminated runoff entering nearby surface waters, WFF personnel would follow the runway maintenance guidance provided in the ICP. Maintenance activities include: 1) daily inspections by the Fire Department; 2) sweeping and vacuuming of runway surfaces as needed; and 3) maintenance of grass buffer zones between runways and stormwater catch basins to intercept any loose debris and sediment not removed by airport maintenance personnel.

Uninhabited Aerial Vehicles

Impacts of UAVs on stormwater are expected to be similar but less than those discussed above for piloted aircraft, due to the smaller scale of the UAVs.

No Action Alternative

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

4.2.2.3 Marine Waters

General Consequences of the Proposed Actions

The accidental release of hazardous materials, including fuels, from operational activities or an accident could impact water resources at WFF by contaminating marine waters. Strict compliance with the ICP should minimize the risk of accidental releases of hazardous materials that could impact marine waters and minimize impacts to marine waters should an accidental release occur.

Consequences Attributable to Specific Proposed Actions

Operations

Rockets

Corrosion of jettisoned or reentered hardware is a potential source of pollution to the marine environment; however, toxic concentrations of metal ions would not likely be produced

because corrosion rates are slow in comparison to the mixing and dilution rates associated with marine environments. Insubstantial quantities of unspent propellants may also fall into the ocean. Unspent solid propellant dissolves slowly, and impacts to marine life are expected only in the immediate vicinity of the remaining propellant, if at all. Unspent liquid propellants such as liquid oxygen and liquid hydrogen pose no toxic threat to the marine environment; however, liquid fuels, such as kerosene, which are relatively insoluble in water, pose a slight risk to the marine environment until evaporation occurs. Hydrazine fuels are soluble and would disperse rapidly. The insubstantial quantity of propellant would form a thin film that would be broken up by wave action, sunlight, and oxygen. All traces of propellant would quickly dissipate within 1 to 2 days. Due to the insubstantial quantity of liquid fuel remaining in reentered hardware, no significant environmental impact is expected. The presence of miscellaneous materials such as battery electrolytes and hydraulic fluids would be in such small quantities that only temporary effects would be expected (NASA, 1997a).

In the event of a launch failure, debris from reentered hardware could impact the ocean much closer to shore than would occur with a successful launch, and could result in more substantive impacts. However, the probability of such an event is extremely small (estimated at 1 percent probability); therefore, such an event should not pose a significant environmental impact (NASA, 1997a).

The probability for accidental release of rocket propellant in the early stage of flight is small (estimated at 1 percent probability). Rockets launched from WFF are equipped with radio receivers and ordnance for in-flight destruction if the flight is determined to be erratic. The system is designed to terminate rocket motor thrust upon activation; however, it is possible that a portion of the fuel may fall into the ocean. Due to the low toxicity of ammonium perchlorate leaching from the propellant, impacts to marine life would occur only in the immediate vicinity of the propellant, if at all. Toxic concentrations of ammonium perchlorate would be quickly dissipated by the ocean currents.

A 1986 Department of Transportation (USDOT) Programmatic EA discusses the accidental release of an entire load of kerosene from an Atlas rocket in the ocean. An Atlas is a liquid-fueled main stage rocket that is substantially larger than any rocket expected to be launched from WFF. Evaporation of the thin film of liquid propellant released from an Atlas rocket is rapid. While evaluating the accidental release from an Atlas, the USDOT determined that "due to the relatively small area involved and fleeting nature of the phenomena, no significant environmental effect is expected" (USDOT, 1986). The 1986 Programmatic EA also addressed near-shore (shallow water) accidental releases from Titan and Delta rockets. Although this type of event might be regarded as having a substantial environmental impact, such an extreme event is not considered likely (1 percent probability). "Since the probability of such an event is extremely small, there should not be a significant impact" (USDOT, 1986). Both the Titan and Delta rockets are also larger than any rocket anticipated to be launched from WFF.

Balloons

Some NWS and small and large scientific balloons and their associated payloads could land in the Atlantic Ocean. The balloons are shredded in the atmosphere once they reach bursting

elevation and land in the water in small pieces that would be disbursed by the tides. It is unlikely that the balloon fragments would impact water quality.

The NWS payloads parachute down from the atmosphere in addressed, postage paid, Styrofoam containers. A large percentage of the containers are retrieved by boaters and returned to NWS. No significant impacts would be expected because only a small number of payloads are not retrieved and actually remain in the water.

Payloads from small scientific balloons launched from NASA are also encapsulated in Styrofoam containers. These payloads may land in the ocean and would not be retrieved. One to three small scientific balloons (0.9 kilogram [2.0 pound] payload) are launched per week, and approximately four to five larger scientific balloons (4.5 kilogram [10.0 pound] payload) are launched per year. After the styrofoam degrades, the payloads would be exposed to the water. These payloads may contain metals, electrical components, and batteries. This is a potential source of pollution to the marine environment, although it is unlikely to cause significant impacts. Toxic concentrations of metal ions would not likely be produced because corrosion rates are slow in comparison to the mixing and dilution rates associated with marine environments.

The larger balloons that carry the 3,628 kilogram (8,000 pound) payloads are retrieved immediately by the U.S. Coast Guard. It is anticipated that these balloons would impact the marine environment because they are recovered.

Piloted Aircraft

In the event of an accident, debris from the stricken aircraft could land in the Atlantic Ocean. Water quality impacts associated with the release of fuels and corrosion of reentered hardware would be expected. However, the probability of an accident happening is small; therefore, such an event should not pose a significant environmental impact.

Payloads

Various types of payloads could enter the marine environment. Sounding rocket payloads are generally recovered and therefore would not result in significant water quality impacts.

A payload entering the marine environment as a result of a launch accident could result in water quality impacts. The payload could contain metals, electrical components, propellant, radioactive materials, biological agents, or chemicals. Depending on the exact components of the payload, this type of accident could result in degraded water quality and impacts to aquatic life. The probability of an accident that could cause significant water quality impacts is small.

Uninhabited Aerial Vehicles

Impacts of UAVs on marine waters are expected to be similar to but less than those discussed above for piloted aircraft, due to the smaller scale of the UAVs.

Autonomous Underwater Vehicles

Loss of an AUV or an accident involving an AUV could temporarily impact water quality in the Atlantic Ocean. Corroded hardware would be a potential source of pollution; however, toxic concentrations of metal ions would not likely be produced because corrosion rates are slow in comparison to the mixing and dilution rates associated with marine environments.

Batteries or other hazardous materials potentially onboard the AUV could cause temporary localized impacts to water quality and marine life; however, these impacts are not expected to be significant because AUVs do not generally contain large amounts of hazardous materials.

AUVs may be used to conduct research on coastal and deepwater ocean environments. The use of AUVs to expand knowledge and understanding of the ocean would be considered a beneficial impact.

Rocket Boosted Projectile Testing

Projectiles from rocket boosted projectile testing land in the Atlantic Ocean. The projectiles can be made of a variety of metals that could cause localized, temporary water quality effects; however, toxic concentrations of metal ions would not likely be produced because corrosion rates are slow in comparison to the mixing and dilution rates associated with marine environments.

No Action Alternative

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

4.2.2.4 Groundwater

General Consequences of the Proposed Actions

The accidental release of hazardous materials, including fuels, from operational activities or an accident could impact water resources at WFF by contaminating groundwater. Strict compliance with the ICP should minimize the risk of accidental releases of hazardous materials that could impact groundwater and minimize impacts to groundwater should an accidental release occur.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Demolition

Hazardous materials present in debris or disturbed soil could impact water quality if the materials were to enter the groundwater supply. Residual lead may be present in the soil at properties scheduled for demolition, including two underground magazine locations (M-005 and M-006). To minimize the risk of contamination, WFF would handle and dispose of all hazardous materials used, generated, or uncovered during demolition activities in accordance with Federal and State regulations. In addition, any septic tanks or sumps associated with demolished properties would be properly closed to prevent leaching of contaminants to groundwater. WFF would close such facilities in accordance with Federal and State regulations.

Utility Infrastructure

Upgrading or replacing groundwater production wells at WFF could impact groundwater levels in the Yorktown or Columbia Aquifers. NASA would consult with the Virginia DEQ prior to modifying or replacing any current wells to prevent potential groundwater supply

impacts. NASA would apply for and obtain any required Federal or State permits prior to modifying, replacing, or adding any groundwater production wells.

If NASA transfers operations of the potable water system to a public entity under the proposed Public-Public partnership, that entity would be responsible for obtaining and meeting all permit requirements for potable water withdrawal and upgrading, adding, and closing wells. This partnership may result in increased groundwater usage, but consultations with DEQ would ensure that the groundwater supply is not significantly impacted.

Fueling

Fueling activities at WFF occur throughout the facility. Spills or leaks from any type of fueling facility (i.e., ASTs, USTs, temporary storage, and the proposed LFF) could contaminate groundwater. Strict compliance with the ICP should minimize the risk of accidental releases of fuels that could impact groundwater and minimize impacts to groundwater should an accidental release occur. If a hydrazine (or hydrazine derivative) spill should occur, the WFF Fire Department would take the lead in containing and cleaning up the spill. The Fire Department would follow the guidelines set out in the WFF Hydrazine Response Plan (NASA, 2004c).

Storage

Storage facilities located throughout WFF house various types of fuels and other hazardous materials. Spills or leaks of fuels or hazardous materials could contaminate groundwater. Strict compliance with the ICP should minimize the risk of accidental releases of hazardous materials that could impact groundwater and minimize impacts to groundwater should an accidental release occur.

No Action Alternative

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

4.2.2.5 Wetlands

General Consequences of the Proposed Actions

If a Proposed Action would affect or take place within a wetland or waters of the U.S., NASA would ensure that the action complies with EO 11990 (Wetland Protection) and 14 CFR 1216.2 (NASA regulations on Floodplain and Wetland Management). Such an action would be implemented only if there were no practicable alternatives. In accordance with EO 11990 and 14 CFR 1216.2, NASA would minimize wetland impacts and protect and restore the natural and beneficial functions of wetlands. In addition, NASA would notify the public and coordinate with applicable agencies when evaluating an action that may affect a wetland or waters of the U.S.

Actions that affect wetlands and other waters of the U.S. would require consultation with the USACE to ensure compliance with Section 404 of the CWA and Section 10 of the Rivers and Harbor Act. NASA would be responsible for applying for and obtaining any necessary Section 404 and/or Section 10 permits. NASA would also be responsible for coordinating with the Commonwealth of Virginia on projects that may affect wetlands. Development activities in Virginia wetlands require State permits from Virginia DEQ, through the Virginia Water

Protection Permit program and Section 401 of the CWA, and from the Virginia Marine Resources Commission and local wetland board, through the Virginia Tidal Wetlands Act of 1972.

Consequences Attributable to Specific Proposed Actions

Operations

Rockets

Ground cloud formation from rocket launches may result in short-term impacts to vegetation in the areas surrounding the launch pads. Loss of vegetation may cause soil erosion and subsequent leaching of sediments, particulate matter, and nutrients that may eventually discharge into wetland areas. Increased sediment, particulate, and nutrient loads have the potential to negatively impact benthic species in the wetland system (NASA, 1999a). Sediments and particulates can smother benthic organisms. Excess nutrients can cause algal blooms that deplete the water of dissolved oxygen and reduce the amount of light that reaches the bottom, resulting in degraded habitat for benthic species. Historic losses of vegetation around launch pads have not been substantial. The loss of vegetation surrounding launch pads from increased future launches is not anticipated to be substantive and no significant impacts are anticipated from ground cloud formation.

No Action Alternative

Under the No Action Alternative, activities at WFF would remain at current levels and there would be no additional impacts to wetlands.

4.2.2.6 Floodplains

General Consequences of the Proposed Actions

If a Proposed Action would affect or take place within a 100-year floodplain (or 500-year floodplain for proposed critical facilities), NASA would ensure that the action complies with EO 11988 (Floodplain Management) and 14 CFR 1216.2. Such an action would be implemented only if there were no practicable alternatives. In accordance with EO 11988 and 14 CFR 1216.2, NASA would minimize floodplain impacts and protect and restore the natural and beneficial functions of floodplains wherever possible. In addition, NASA would notify the public and coordinate with applicable agencies when evaluating an action that may affect a floodplain.

No Action Alternative

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

4.2.2.7 Coastal Zone Management

General Consequences of the Proposed Actions

Actions that have reasonably foreseeable effects on coastal resources must be consistent with the CZMA, as implemented by the Virginia Coastal Resources Management Program (VCRMP). NASA must ensure that all future actions are consistent with the enforceable policies of the

Virginia Coastal Resources Management Program (discussed in Section 3.2.2.7), and would be responsible for submitting Coastal Zone Consistency Determinations for Proposed Action that have reasonably foreseeable coastal effects. It is not anticipated that the Proposed Action would have a negative effect on the coastal zone or be inconsistent with current VCRMP laws.

No Action Alternative

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

4.2.3 Air Quality

General Consequences of the Proposed Actions

Several ongoing operations use equipment that have the potential to generate emissions that could negatively impact the local air quality. This equipment may increase the discharge of regulated air pollutants. Operations that could potentially result in emissions of regulated pollutants include airport operations, rocket launches, wastewater treatment operations, welding, and electroplating. Emissions of criteria pollutants from paint shops, fuel storage areas, the print shop, laboratory hoods, or boilers could negatively impact local air quality. An accidental release of toxic gases stored at WFF also has the potential to negatively impact air quality.

GSFC Industrial Hygiene Technicians review complaints on air quality and perform air quality surveys. Ventilation systems are also reviewed to assure compliance with the American Conference of Governmental Industrial Hygienists (ACGIH), and American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) standards. The GSFC's Industrial Hygienists also evaluate air quality for permitting purposes. Regulatory emission limits have been established by the Virginia DEQ for NASA as discussed in Sections 3.2.3. Any changes in either permit application specifications or to existing facilities that alter the impact of the facility on air quality may require a new or updated permit through the Virginia DEQ. WFF plans to increase many activities under the proposed plan which would increase emissions.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

Construction activities have the potential to cause temporary, short-term air quality impacts due to land clearing and grading, ground excavation, the construction of various structures, and the operation of fossil-fuel burning equipment. Restoring and repairing aging structures is likely to increase energy efficiency and reduce fossil fuels emissions in the long term. The implementation of the wind turbine at WFF would positively impact air quality by reducing the use of fossil fuels to generate electricity. Construction vehicles and equipment used for projects shall be maintained in good working order to minimize pollutant emissions. NASA would water down construction areas when necessary to reduce dust emissions. Overall, construction activities would not have a significant impact on air quality.

Demolition

Demolition projects have the potential to cause temporary, short-term air quality impacts due to fugitive dust emissions created during the demolition of existing structures, land clearing and grading, and ground excavation. NASA would water down these areas when necessary to reduce dust emissions. All dust producing hazardous waste encountered during demolition (i.e., lead-based paints, asbestos containing material, or polychlorinated biphenyl materials) would be removed following Federal and State regulations. Overall, demolition activities would not have a significant impact on air quality.

Routine Site Activities

Increased air emissions could result from the use of mechanical vehicles and fuel-powered chainsaws and lawn mowers. Equipment should be maintained in good working order to limit emissions. The application of herbicides could increase emissions of VOCs, federally listed hazardous air pollutants, or State toxic air contaminants. Use of EPA-approved herbicides according to manufacturer specifications would result in negligible emissions. Routine site activities are not anticipated to have a negative impact on air quality.

Utility Infrastructure

Emissions from utility infrastructure such as the Central Boiler Plant, smaller boiler plants, emergency generators, and other small sources result in minor impacts to air quality. NASA complies with all requirements of both of its Virginia DEQ air permits.

Payload Processing

The cleaning of payloads, electronic hardware and shipping container surfaces involves the use of solvents to remove organic contaminants. The standard solvent used is isopropyl alcohol (IPA), and approximately 208 liters (55 gallons) of IPA are used per mission. IPA is used because of its low toxicity and flashpoint of 11.6 degrees Celsius (53 degrees Fahrenheit). Ethyl alcohol may also be used for optical surfaces, but in very small quantities. It has a low toxicity level and a flashpoint of 17 degrees Celsius (62 degrees Fahrenheit). Small amounts of other chemicals are often used incidentally in preparing spacecraft for assembly, test, loading, and launch. These are used in such minor amounts and are of such low toxicity that they present no substantial potential for adverse environmental impacts.

Loading of hypergolic propellants is performed either in the principal PPF or an auxiliary facility. The fuel can be either hydrazine for mono or bipropellant systems, or MMH for bipropellant systems. The oxidizer used for these systems include NTO, MAF-4 and IRFNA. Each loading operation would be independent, sequential and conducted using a closed loop system. During the operation, all propellant liquid and vapors would be contained. If small leaks occur during propellant loading, immediate steps would be taken to stop loading, correct the leakage, and clean up leaked propellant with approved methods before continuing. Personnel would wear protective clothing during hazardous propellant operations. Leakage would be absorbed in an inert absorbent material for later disposal as hazardous waste, or aspirated into a neutralizer solution. Propellant vapors left in the loading system would be routed to air emission scrubbers. Liquid propellant left in the loading system would be either drained back to supply tanks or into waste drums for disposal as hazardous waste.

Estimates of scrubber emission rates during fueling operations, based on the Titusville Astrotech PPF experience, are 0.045 kg/hr (0.099 lb/hr) for N_2H_4, 0.13 kg/hr (0.28 lb/hr) for NTO, and 0.064 kg/hr (0.14 lb/hr) for MMH. These rates are for typical periods of less than 30 minutes per spacecraft (NASA, 2002a). Although both NTO and hydrazine are classified as hazardous air pollutants (HAPs), the National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulations under Title III of the CAA have not yet established control standards. The packed bed scrubber systems usually used are considered Best Available Control Technology (BACT) and should be considered acceptable when NESHAP regulations are promulgated (NASA, 2002a). Additional generators in the PPF would require modification of permits issued by the DEQ.

Inadvertent releases of toxic air contaminants are possible as a result of accidents during payload processing, transportation, and launch. The largest releases would result from the spillage of the entire quantity of liquid propellants. Lesser releases would result from fires or explosions that would consume significant fractions of the propellants. Safety procedures would be implemented at WFF to ensure that these events are unlikely to occur. In addition, spill response planning procedures are in place to minimize spill size and duration, as well as possible exposures to harmful air contaminants. The magnitude of air releases from payload accidents would be relatively small compared to possible releases from accidents involving launch vehicles. Impacts would be temporary and disperse, and therefore have no substantial impact on ambient air quality.

Storage

Accidental release of toxic gases stored at WFF would have a negative impact on local air quality. Impacts would be temporary and disperse, and therefore have no substantial impact on ambient air quality.

Operations

The Earth's atmosphere has been described in Section 3.2.3. The lower, turbulent part of the atmosphere (troposphere) is impacted by the combustion products of propellants from the first-stage rockets. The upper reaches of the atmosphere (above 10 kilometers [6.2 miles]) are impacted by the exhaust from upper stage rockets, and by physical and chemical interactions between the vehicle/payload combination and the atmosphere. The environmental impacts on the atmosphere in this instance are global in nature and are not specific to any one site. For the following discussion of potential impacts, the following definitions and typical altitude ranges apply:

Lower Atmosphere:

- Troposphere - 0 to 10 kilometers (0 to 6.2 miles)

Upper Atmosphere:

- Stratosphere - 10 to 50 kilometers (6.2 to 31 miles)
- Mesosphere - 50 to 80 kilometers (31 to 50 miles)
- Ionosphere - above 80 kilometers (50 miles), to 1,000 kilometers (622 miles)

The susceptibility of each atmospheric shell to change is based on naturally present matter and the relative influence and proximity of the Earth and Sun. Emissions into the atmosphere include

halogens (chlorine), particulates (aluminum oxide), carbon monoxide, carbon dioxide, oxides of nitrogen, and trace metals.

The atmospheric impacts due to emission of these substances could include:

- Photochemical oxidation (smog);
- Cloud nucleation due to particulates;
- Acid rain due to sulfur dioxide (SO_2) and nitrogen oxides (NOx) (primary causes);
- Ozone depletion;
- Increase in ultraviolet radiation reaching the Earth;
- Greenhouse effect (global warming); and
- Formation of holes in ion/electron layers.

Rockets

As defined above, the upper atmosphere begins at 10 kilometers (6.2 miles) and extends to the upper reaches of the ionosphere. At lower levels, there are emissions from the exhausts of upper stage rockets and ACS fluid jets. The emissions and impacts of payload chemical releases, rocket exhausts, and ACS fluids are addressed below. As stated in the Proposed Action, the Athena-3(8) class of orbital rockets has been chosen as the demonstration vehicle for this Site-Wide EA, since it is the largest rocket with the highest ground level emissions expected to be launched at WFF.

The Athena-3 system would consist of a Castor 120™ main stage motor, with up to eight Castor IV™ solid rocket motors strapped onto the first stage. During lift-off of the Athena-3, the strap-on motors would fire simultaneously with the main stage. The Castor 120 ™ is a motor that uses solid fuels such as solid ammonium perchlorate/aluminum (AP/Al) powder in hydroxyl terminated polybutadiene (HTPB) matrix. The Castor IV™ motor contains the same fuel as the Castor 120™ motor. The major exhaust products from the Castor 120™ motor and the Castor IV™ motor are Al_2O_3 particles, CO, HCl, N_2, H_2O, and CO_2. The solid rocket propellant incorporated in the Castor 120 ™ motor and Castor IV ™ motor produces exhaust products containing approximately 27 percent (by weight) Al_2O_3, 28 percent CO, and 22 percent HCl.

The Castor 120™ motor contains approximately 49,600 kilograms (109,349 pounds) of solid propellant, and burns at a rate of 620 kilograms (1,367 pounds) per second, for approximately 80 seconds. The Castor IV™ motor contains approximately 10,440 kilograms (23,016 pounds) of propellant and uses 174 kilograms (383.6 pounds) per second and burns for approximately 60 seconds. The Athena-3 system, configured with eight Castor IV ™ strap-on motors [Athena-3 (8)], would contain approximately 133,120 kilograms (293,479 pounds) of propellant. With all eight strap-on motors firing simultaneously with the main stage, this system would use approximately 2,012 kilograms (4,436 pounds) of propellant per second for the first 60 seconds and 620 kilograms (1,367 pounds) of propellant for the remaining 20 seconds. The Athena-3(8) class vehicle would leave the launch pad within one second of first stage ignition, and achieve an altitude of approximately 1 kilometer (0.62 mile) after 20 seconds.

Constituents of concern emitted from the rocket motor exhaust in the first 1 kilometer (0.62 mile) are: 11,610 kilograms (25,596 pounds) of Al_2O_3; 12,040 kilograms (26,544 pounds) of CO; and 9,460 kilograms (20,856 pounds) of HCl. These air pollutants are dispersed over a

large area within a short period of time. The concentration of emissions varies over the trajectory of the vehicle due to the continuous acceleration of the rocket. Due to the ignition of the rocket in the troposphere, the lower atmosphere would receive the highest concentration of emissions.

Potential concentrations of the emissions of concern from an Athena-3 (8) type rocket launched at WFF can be characterized for three meteorological conditions (a sea breeze, and spring and fall prevailing winds) based upon modeling for the Scout, Delta, Atlas, and Titan rockets; this modeling was performed using the NASA/MSFC multilayer atmospheric diffusion model (NASA, 1997a). The results of this modeling, based on actual WFF conditions, is directly supported by current dispersion modeling and ground truth testing for actual launches conducted at the Kennedy Space Center.

Anticipated impacts to air quality from launching a rocket of the Athena-3 caliber at WFF are discussed in more detail below. In addition, more detailed discussions of potential impacts to air quality from launching vehicles with different propellant systems can be found below.

With three- and four-stage launch vehicles, such as the Taurus-Nike-Tomahawk and Black Brant XII, apogees up to the 1,500-kilometer (932-mile) level have been reached. The highest altitudes for sounding rocket emissions are in the range of hundreds of kilometers where chemical releases from payloads may take place. The Black Bryant XII, the largest sounding rocket launched from WFF to date by exhaust emission weight, contains only a fraction of the propellant the Athena-3(8) class vehicle contains. Sounding rockets fall within the limits set by the Athena -3(8) envelope as described below for emissions for this Ste-Wide EA.

Motor Types and Fuels

Much of the following information was obtained from existing documentation on the effects of rocket launches on air quality. These sources include:

- Final Programmatic Environmental Impact Statement for Licensing Launches, 2001. Office of the Associate Administrator for Commercial Space Transportation, Federal Aviation Administration Department of Transportation. Prepared by ICF Consulting, Inc.;
- Environmental Assessment (EA) for Range Operations Expansion at the NASA GSFC Wallops Flight Facility. 1997;
- EA of the Kodiak Launch Complex. 1996. Prepared by Brown & Root Environmental; and
- Programmatic EA of Commercial Expendable Launch Vehicle Programs, 1986. Prepared by the Office of Commercial Space Transportation.

Potential air quality impacts in the atmosphere from the burning of solid and liquid fuels have been examined in the troposphere and stratosphere (USDOT/FAA, 2001). No change is anticipated in the mesosphere or ionosphere and therefore these are not discussed further (USDOT/FAA, 2001). It is important to note that conclusive data and analysis regarding the specific impacts of emissions from multi-propellant propulsion systems (e.g., liquid and solid combinations, hybrid fuels) currently do not exist. Because the environmental impacts related to combined emissions of multi-propellant systems have not been adequately

characterized at this time, this analysis relies on existing, available data on emissions from single propellant systems. Ongoing U.S. Air Force, NASA, and industry research in this area may alter the future understanding of the cumulative atmospheric impacts of multi-propellant propulsion systems and the relative atmospheric impacts of these different types of systems (USDOT/FAA, 2001). It is anticipated that future fuel combinations and hybrid fuels would follow the current trend of using fuels that have less of an effect on air quality.

Air emissions from rockets are determined by propellant type. The environmentally harmful chemicals emitted to the atmosphere vary by the type of propellant used. For example, most propellant systems produce CO_2, which is a greenhouse gas. Greenhouse gas emissions in the troposphere and stratosphere are of concern as they contribute to global warming by trapping re-radiated energy in the atmosphere. Hybrid and liquid propellant systems produce more CO_2 than solid propellant systems; however, they emit less NO_X than systems using hypergolic propellants. NO_X is an ozone depleting substance and a contributor to smog. Only solid propellant systems produce tropospheric and stratospheric emissions of HCl and Al_2O_3. HCl is a toxic gas that can destroy stratospheric ozone and is defined by the EPA as a HAP. Al_2O_3 is a particulate that can serve as a site for atmospheric reactions depleting ozone. Emissions of HCl and Al_2O_3 from solid rocket motors are more significant, immediate environmental threats than the greater amount of CO_2 emissions produced by hybrid and liquid propellant systems. Emissions from hydrogen peroxide propulsion systems are expected to be similar to those from liquid oxygen and kerosene systems. Table 4-2 below summarizes the major exhaust products from propellants that are currently used in spaceflight or that are under development.

Table 4-2 Major Exhaust Products from Propellant Systems

Solid	Liquid Hydrocarbon	Hypergolic	Cryogenic	Hybrid Propellant
HCl, Al_2O_3, CO, N_2, CO_2, NO_X, Cl^-, H_20	CO_2, CO, H_2, H_20, OH^-, NO_X	CO_2, CO, NO_X, N_2, H_20, H_2	H_20, H_2	CO, CO_2, H_2, H_20, NO_X, OH^-

The solid rocket motor (solid propellant system) emissions cause a greater impact to the environment; therefore, this EA examines impacts from the Athena-3 (8) class solid rocket as an envelope. There may be trace quantities of other chemicals found in rocket exhaust such as mono-atomic hydrogen, mono-atomic oxygen, and hydroxyl radicals, but these are chemically unstable, and therefore are short-lived. The chemical composition of the exhaust is relatively constant throughout the period that the rocket is firing. This results from a homogeneous fuel mixture being maintained throughout the solid rocket motor.

Troposphere Impacts

Potential impacts to the troposphere may result from the ground cloud formed from the ignition of rocket motors and the resulting launch of the rocket. Other potential impacts to the troposphere could result from accidents on the launch pad or during flight (discussed later in this section). A ground cloud forms within the first 10 to 12 seconds of a rocket launch. It is composed of a complex mixture of gases, dissolved and particulate exhaust products, water

used for fire suppression, and materials from the physical surfaces on and around the launch pad. As the rocket accelerates off the launch pad, the emission levels are greater near the ground, forming the "ground cloud". For some medium and larger launch vehicles this cloud may rise to 1 kilometer (0.62 mile) or more before stabilizing. This height remains relatively constant as it is transported and dispersed downwind by the prevailing winds. The most environmentally significant chemicals resulting from ground cloud formation include HCl, Al_2O_3, NO_X, and CO_2. Not all of these chemicals are produced by all the various propellant systems. HCl and Al_2O_3 will be discussed at length below. NO_X is an ozone depleting substance that is produced by all propellant systems with the exception of cryogenics (LO_X/LH_2). Environmental effects from CO_2 occur in the stratosphere and are therefore discussed in the stratosphere subsection. The other chemical emissions are either insignificant or would not be harmful to the troposphere. CO is assumed to convert to CO_2; OH converts to water vapor and is emitted in very small quantities; and some N_2 is converted to NO_X. NO_X is a component of acid rain and photochemical smog.

Hydrogen Chloride

HCl is an HAP and is toxic, corrosive, and an irritant. EPA regulates 188 HAPs, including HCl, but launch vehicles are not included as one of the regulated source categories. However, because HCl is toxic, its impacts are considered in this Site-Wide EA. In the troposphere, HCl emissions from launch vehicles are estimated to be approximately 6,300 to 26,250 kilograms (7 to 19 tons) per launch for vehicles that use solid propellant systems (USDOT/FAA, 2001).

To analyze the impacts of the ground cloud, the quantity of HCl is compared to the HCl threshold limit value (TLV). The TLV is the exposure limit value set by the Occupational Safety and Health Administration (OSHA) protecting workers over an 8-hour day and a 40-hour week. It is the upper limit of a toxicant concentration that a healthy human being can be exposed to on a daily basis without experiencing adverse health effects. The TLV for HCl is 5 parts per million (ppm) or the one-time short-term public emergency guidance level developed by the National Research Council of 1 ppm as a maximum concentration (USDOT/FAA, 2001). Modeling using the Rocket Exhaust Effluent Diffusion Model (REEDM) conducted for other analyses has shown HCl concentrations of 0.9 ppm for the Space Shuttle, 0.0005-0.5 ppm for the Titan III, 0.22 ppm (one-hour average) for the Titan IV-Type 1 with solid propellant systems, and less than 2 ppm (30 minute average) for the Athena class.

The launch vehicle envelope for this Site-Wide is the Athena-3(8) model. HCl emissions from the Athena-3 (8) model are estimated to be approximately 11.1 metric tons (11 tons) per vehicle launch. Table 4-3 lists the estimated peak concentrations of HCl from an Athena-3(8) class vehicle at a distance of 1 kilometer (0.62 mile) from the nearest sensitive receptor (the designated piping plover nesting area) and at 1.4 kilometers (0.87 mile), the area where peak concentrations are anticipated during spring and fall (piping plover nesting season).

Table 4-3 Estimated Peak Concentrations of HC1 from an Athena-3(8)			
	Meteorological Conditions		
Distance	Sea Breeze	Fall	Spring
1,000 meters (3,280 feet)	1.12 ppm	0.22 ppm	0.21 ppm
1,400 meters (4,593 feet)	0.25 ppm	0.33 ppm	0.25 ppm

A comparison of the estimated peak concentrations of HCl to the TLV at distances of 1 kilometer (0.62 miles) and 1.4 kilometers (0.87 miles) shows that the estimated peak concentrations are below the human health exposure levels. Human health standards are below levels shown to affect laboratory animals (10 ppm for rats) (EPA, 2004a). Based on these comparisons, the launch of an Athena-3 (8) class vehicle would not have a substantial effect on air quality for humans or wildlife outside of the safety zone.

Aluminum Oxide

Al_2O_3 is not toxic, but is particulate matter that could potentially cause irritation and damage to human respiratory tracts if it bypasses the natural human filtering systems. The EPA regulates particulate matter equal to or less than 10 microns and additional more stringent standards for particulate matter equal or less than 2.5 microns in size. Most of the particles of Al_2O_3 are assumed to be greater than 10 microns in size; therefore, they do not fall under the EPA's current regulations. In the troposphere, emissions of Al_2O_3 from the Athena-3(8) class vehicle are estimated to be approximately 13.2 metric tonnes (13 tons) per launch (USDOT/FAA, 2001).

The specific effects of particulate matter on air quality are dependent on meteorological data (wind speed and direction, mixing heights of air, and temperature) and site-specific receptors. To determine the impacts of Al_2O_3, modeled concentrations may be compared to the TLV of 10 milligrams per cubic meter (mg/m^3) (0.0003527 ounces per cubic foot) for Al_2O_3. Table 4-4 lists the estimated peak concentrations of Al_2O_3 from an Athena-3(8) class vehicle at distances of 1 kilometer (0.62 mile) and 1.4 kilometers (0.87 mile).

Table 4-4 Estimated Peak Concentrations of Al_2O_3 from an Athena-3(8)			
	Meteorological Conditions		
Distance	Sea Breeze	Fall	Spring
1 kilometer (0.62 mile)	1.7 mg/m^3	0.64 mg/m^3	0.55 mg/m^3
1.4 kilometers (0.87 mile)	0.58 mg/m^3	0.9 mg/m^3	0.66 mg/m^3

Based on comparing Al_2O_3 concentrations of an Athena-3(8) class vehicle to the TLV, there would be no significant impact to air quality from the launch of an Athena-3(8) or similar vehicle systems.

Acid Rain

The HCl vapor may combine with moisture in the air and form hydrochloric acid. The HCl vapor may exist in hazardous quantities in the immediate vicinity of the launch pad and downwind. High wind conditions and strong sunshine could dissipate the HCL concentrations. The CO and NO_2 emissions could impact the air quality in the area for that

day. The NOx emissions could also contribute to acid rain. The CO_2 emissions from accidents would result in negligible impacts to global warming compared to other sources of CO_2 emissions. The Al_2O_3 emissions would primarily occur in particle form from the burned solid propellant.

Stratosphere Impacts

In the stratosphere, launch vehicle emissions could potentially affect global warming (the greenhouse gas effect) and depletion of the stratospheric ozone layer.

Global Warming

The Earth absorbs energy from the sun and radiates this energy back into the atmosphere. The greenhouse gas effect, or global warming, results when the re-radiated energy is trapped by gases in the atmosphere and warms the Earth's surface and atmosphere. Greenhouse gases include water vapor, carbon dioxide, methane, ozone, chlorofluorocarbons (CFCs), hydrofluorocarbons, and perfluorinated carbons. Although ozone exists in both the troposphere and stratosphere, most ozone is found in the stratosphere where it provides a protective layer shielding the Earth from ultraviolet (UV) radiation and subsequent harmful effects. Some ozone is transported to the troposphere. In the troposphere, ozone is a chemical oxidant and a major component of smog. Other photochemically important gases such as CO, NO_x, and nonmethane hydrocarbons (NMHC) are not greenhouse gases, but contribute indirectly to the greenhouse gas effect. These indirect contributors influence the rate at which ozone and other gases are created and destroyed in the atmosphere.

The potential launch vehicle emissions that may affect global warming include water vapor and CO_2. For most greenhouse gases, a global warming potential has been developed to allow for comparison of the ability of each greenhouse gas to trap heat in the atmosphere. However, no global warming potential has been developed for water. The total launch vehicle emissions of CO_2 range from 15 to 261 metric tonnes (15 to 257 tons) per launch, depending on the launch vehicle's payload capacity and propellant type (USDOT/FAA, 2001). The estimated total CO_2 emissions from launches into the troposphere for the period 2000-2010 is approximately 25,401 metric tonnes (25,000 tons) (USDOT/FAA, 2001). In comparison, the total CO_2 emissions from all sources in the U.S. was 5,778 million metric tonnes (5,687 million tons) in 1994 (USDOT/FAA, 2001). Even if all of the launches occurred in one year, based on 1994 CO_2 emission levels, these launches would only be a very small fraction (less than 0.00005 percent) of the total CO_2 emissions in the U.S.(USDOT/FAA, 2001). Consequently, the CO_2 emission effects from launch vehicles on global warming would be insignificant. The total water vapor generated is approximately 9 to 95 metric tonnes (9 to 94 tons) per launch, or about 12,192 metric tonnes (12,000 tons) for the period 2000-2010 into the troposphere. In comparison, the total carbon-equivalent direct and indirect emissions effects (excluding the photochemically important emissions) in the U.S. were 1,864 million metric tonnes (1,835 million tons) in 1994. Water vapor from launch vehicles would also have an insignificant effect on global warming. A total estimate of all launches from all vehicles from WFF is approximately 118 metric tonnes (130 tons) in a year. Launches from WFF are about 0.1 percent of the national average. While specific data is not available for the Athena-3(8) class vehicle this analysis would be applicable for the use of this launch vehicle or a similar vehicle at WFF.

Ozone Depletion

Stratospheric ozone layer depletion is a major environmental concern. The stratospheric ozone layer protects the Earth from adverse levels of UV radiation. Excess UV exposure can lead to increased incidences of skin cancer, sunburn, and immune deficiencies. The protective ozone layer is mostly contained within the stratosphere. The highest concentrations of ozone are found in the middle of the stratospheric layer and ozone is continually created and destroyed by naturally occurring photochemical processes. Ozone is made up of three oxygen atoms and is generated by the action of sunlight to combine an O_2 molecule with an atom of oxygen. Conversely it can be destroyed through a series of photochemical reactions that can catalyze the reactions:

- $+ O_3 = 2O_2$ and $2O_3 = 3O_2$ of compounds that break up O_3 into various other compounds.

Chlorine is the chemical of primary concern with respect to ozone depletion. Human activity has significantly contributed to the chlorine load levels in the stratosphere. Chlorine accounts for approximately 13 percent of ozone destruction. Launches are one of the man-made sources of chlorine in the stratosphere. Emissions from launch vehicle motors are of concern because substances that can lead to ozone depletion (HCl, Al_2O_3, NOx, and Cl) can be injected directly into the stratosphere during approximately 60 seconds of a launch vehicle ascent. For example, studies have shown the percent reduction of ozone per ton of HCl is 2.8 $x10^{-5}$, 7.5 x 10^{-6} for Al_2O_3, and 1.6 $x10^{-6}$ for NO.

The estimated emission load of HCl in the stratosphere for all U.S. launches from 2000-2010 is approximately 3,328 metric tonnes (2,292 tons) and additional free Cl load is 31 metric tonnes (34 tons) (USDOT/FAA, 2001). This averages to approximately 214 metric tonnes (211 tons) of HCl and Cl load to the stratosphere from U.S. launches per year. Before Cl can deplete ozone, the HCl must be photolyzed (i.e., light must interact with the HCl molecule and release Cl) and the resulting Cl can then deplete ozone. Some of the HCl in the troposphere can mix with water and be precipitated out of the atmosphere before it has a chance to release Cl, thus reducing some destruction of ozone by Cl.

Beside gases, solid propellant systems release particulates and Al_2O_3. Attempts to determine the distribution and effect on ozone depletion of particulates and Al_2O_3 have been limited. Therefore current models are based upon homogenous gas phase chemistry, which acts as a site for the ozone depleting reaction. The significance of this stage is unclear. Heterogeneous chemistry (which accounts for particulates, plume temperature, and afterburning of fuel-rich exhaust) is not included in this Site-Wide EA, because there are very limited data and modeling available to date. However, future analysis of launches using heterogeneous chemistry could alter the understanding of potential impacts of launches on stratospheric ozone depletion. In terms of local ozone depletion in the general exhaust of the launch vehicle limited field data and several computer models have estimated local ozone depletion from 7 to 40 percent for several minutes to hours after the launch. Winds rapidly disperse the exhaust and return the ozone to approximately normal levels. The recent field study on Rocket Impact on Stratospheric Ozone (RISO) has confirmed that ozone depletion related to launch emissions is a temporary and limited phenomenon (USDOT/FAA, 2001). Initial results from this study have indicated that LOx/kerosene engines may be more potent in ozone depletion than previously expected. Additional data collection is ongoing to further

evaluate LOx/kerosene exhaust impacts. Ground-based light detection and ranging equipment results from this study have indicated that (1) the relative rates of plume expansion and diffusion are quite different than previously assumed; (2) stratospheric plumes stratify into stable layers of only several hundred meters thick; and (3) large solid rocket motors aerosol emissions consist of alumina and an additional aerosol that disappear within 90 minutes of launch and do not appear in plumes above approximately 35 kilometers (21.7 miles). In general, preliminary findings from this study indicate that the potential for ozone depletion associated with launch vehicle exhaust to cause an increase in solar UV intensity near launch sites is extremely limited (USDOT/FAA, 2001).

There has been extensive research on the potentially harmful effects of large solid rocket motor exhaust on global ozone depletion by the Air Force and NASA. These studies are generally based on a high launch rate, which allows for evaluation of large HCl and Cl loads to the stratosphere. One such study by the World Meteorological Organization examined the effects of 10 launches of each of the following vehicles per year: Space Shuttle, Titan IV, and Ariane 5, which release 69, 32, and 58 metric tonnes (68, 32, and 57 tons) of Cl per launch, respectively, directly into the stratosphere. A total of 1,595 metric tonnes (1,570 tons) of Cl deposited in the stratosphere each year from these launches corresponds to only 0.064 percent of the 1994 total stratospheric burden of chlorine from industrial sources (USDOT/FAA, 2001). Analyses in the RISO study have confirmed that ozone loss occurs in the plume wakes of large solid rocket motors (e.g., Titan IV and Space Shuttle), but the amount and duration of the loss appears to be temporary and limited.

In comparison, solid rocket motors on launch vehicles used at WFF are smaller than those on the Space Shuttle and the upgraded solid rocket motors on the Titan IV. The specific HCl input to the stratosphere from launch exhaust can be estimated if the HCl amount and its time-dependent releases along the ascent are known. It has been estimated by the FAA that emission loads of HCl in the stratosphere for all U.S. licensed launches from 2000 to 2010 are approximately 2,328 metric tonnes (2,292 tons), and the additional free Cl load is 31 metric tonnes (31 tons). This averages to approximately 214 metric tonnes (211 tons) of HCl and Cl load to the stratosphere from U.S. licensed launches per year. The RISO study results indicate that ozone depletion related to alumina emissions from solid rocket motors is proportional to the fraction of alumina in the smallest size mode. Previous estimates have suggested that about 10 percent of solid rocket motors alumina is in the smallest size mode, while RISO measurements indicate that only about 0.1 percent of solid rocket motor alumina is in the smallest mode. This suggests that the role of solid rocket motor-emitted alumina may be less important in global atmospheric reactions than was previously estimated. In the environmental assessment of the Atlas IIAS, a comparison was made between the effect of an Atlas IIAS and a Titan IV on ozone depletion. The ozone depletion from three Titan IV launches per year would be approximately 0.01 percent — a conservative estimate because it assumed all of the emissions would migrate to the stratosphere. An Atlas IIAS launch would emit approximately 8 metric tonnes (7.9 tons) of HCl, compared to 147 metric tonnes (145.5 tons) emitted by a Titan IV launch. Therefore, by simple ratio, the estimate of peak ozone depletion due to six Atlas IIAS launches per year would be 0.001 percent of total ozone depletion.

Another study entitled “Atmospheric Environmental Implications of Propulsion Systems” concluded that even vastly increased launch activities (50 Space Shuttle or Energia launches

per year) would not significantly impact stratospheric ozone depletion (USDOT/FAA, 2001). A comparison in this study was made between the chlorine loads in the stratosphere from launches and the chlorine loads from other natural and man-made sources. The primary sources of ozone depleting chemicals are CFCs and other manmade ozone-depleting chemicals, and natural sources from the oceans, burning vegetation, and volcanic eruptions. It is also noted in this article that launch vehicles release mostly HCl into the stratosphere. Thus, although the increased rocket launches would increase the Cl load to the stratosphere, the global effects would be far below and indistinguishable from the effects caused by other natural and man-made causes. Even with the production ban on CFCs, HCFCs, and methyl bromide, launch vehicle exhaust from licensed launches (similar to any given man-made source of HCl considered in isolation) would remain an insubstantial part of the overall chlorine load to the stratosphere over the next 50 years due to the long-life of CFCs. Nonetheless, the serious nature of the problem of ozone depletion implies that all sources must be considered. Hybrid propulsion systems have the potential to greatly reduce the HCl emitted from launch vehicle exhaust into the stratosphere. The hybrid propulsion systems, currently undergoing testing, burn solid fuel (aluminum) and a cryogenic oxidizer (LO_x). Thus, these propellants do not release HCl when burned.

Launch vehicle emissions that may affect global warming the greatest include water vapor and CO_2. However, there is currently no way to study the effects of water vapor from launch vehicle emissions on the greenhouse effect. The total amount of CO_2 that is released from launches is thought to be so much less than the contributions of CO_2 by other industries as to make launches an insignificant source of CO_2. Protecting the stratospheric ozone layer is a major global concern. Emissions from rocket launches do contribute to the creation of "holes" in the stratospheric ozone layer as the launch vehicle passes through, although these "holes" tend to "fill back in" rapidly following a launch (USDOT/FAA, 2001). The amount of depletion depends on the type of propellants used.

Accidents in the Troposphere and Stratosphere

The impacts from accidents on the launch pad or as a result of a flight anomaly requiring the use of a flight safety system may impact the air quality in the atmosphere at the time of the accident. The impacts of accidents are typically described by propellant type. However, some rockets, especially medium and high capacity vehicles, may use a combination of propellant systems. Accidents on the launch pad would result in significant concentrations of air emissions. The impacts would differ from normal flights because all or a larger portion of the propellant would burn at the launch pad or within 10 seconds after ignition.

Solid Rocket Motors

During an accident, the emissions of most concern for a rocket using solid propellant systems are HCl, CO, CO_2, Al_2O_3, and NO_X. The rate at which the solid propellant would burn depends on the size of the solid fuel fragments and the air pressure. Open burning of all the propellant may release approximately 3,200 kilograms (3.5 tons) of HCl emissions; 3,520 kilograms (3.9 tons) of CO_2 emissions; 2,720 kilograms (3 tons) of CO emissions; 6,434 kilograms (7 tons) of Al_2O_3 emissions; and 550 kilograms (0.6 tons) of NO_x emissions, based on the Castor 120™ motor and approximately 49,033 kilograms (108,100 lb) of propellant. Solid propellant is broken into relatively small pieces and only a small percentage of it burns completely. Therefore the amounts released from a

failed vehicle launch may be less than these estimates; however, emissions would be higher from vehicles with larger solid rocket motors.

HCl released in an accident may combine with moisture in the air and form hydrochloric acid. This vapor may exist in hazardous quantities in the immediate vicinity of the launch pad and downwind. High wind conditions (greater than 4 miles per hour) and strong sunshine could dissipate the HCl concentrations. The HCl may also be diluted by moisture in the air resulting in acid rain. The CO and NO_X emissions could impact the air quality in the area for that day. The NO_X emissions could also contribute to acid rain. The CO_2 emissions could affect global warming, but compared to other sources of CO_2 emissions, accidents would result in negligible impacts. The Al_2O_3 emissions would primarily occur in particle form from the burned solid propellant.

Liquid Oxygen (LOx)

For rockets using LOx propellants, hybrid propellants, or hydrogen peroxide, the CO_2 emissions would be the most significant. As noted below, the CO_2 emissions could affect global warming, but even with the open burning of all the propellant, these emissions from rocket accidents would be negligible compared to the rest of the CO_2 emissions sources in the U.S. and worldwide.

Cryogenics.

Rockets using cryogenic propellants, LOx and LH_2, would mainly emit water vapor. Accidents during which a flight safety system is activated may result in the burning of the remaining propellant in the atmospheric layer where the termination occurs. If the accident occurs in the troposphere, all of the propellant may burn. The emissions would be similar to those described for an accident on the launch pad; however, the impacts may not be as localized. For accidents with flight safety system activation in the stratosphere, the remaining propellant may burn. The emissions from such an accident would be expected to be insignificant with respect to global warming and most likely less than the emissions expected from a normal, full duration launch (USDOT/FAA, 2001).

Hypergols

If a launch vehicle had a rapid, sudden explosion of hypergolic propellant (such as nitrogen tetroxide (N_2O_4)-aerozine-50 [a mixture of 50 percent, by weight, hydrazine and 50 percent unsymmetrical dimethylhydrazine) (A-50)]), the release of N_2O_4 would create NO_2 emissions.

EPA regulates NOx emissions alone and as a tropospheric ozone precursor, although not specifically from rockets. EPA does not provide a maximum NOx concentration level for a short-term averaging period; however, a short-term (1-hour) standard is provided for ozone (0.12 ppm). The relationship between NOx and O_3 is complex. Sometimes, NOx emissions contribute to the formation of ozone; other times, NOx emissions prevent ozone formation.

Accidents in the Mesosphere

No impacts are predicted during normal launches. If an accident occurs in the mesosphere, the emissions would be greater than a launch pad accident, but no additional impacts are anticipated on the mesosphere.

Accidents in the Ionosphere

Accidents in the ionosphere are rare and data are not readily available; however, impacts to the ionosphere have been studied for launches and test firing of payload ACS. The data gathered from the studies can be applied to accidents in the Ionosphere.

Some exhaust products from launch vehicles generated during launch from Earth to space have been found to have a temporary effect on electron concentrations in the F layer of the ionosphere. Specifically, these exhaust products are CO_2, water, and atomic hydrogen. These compounds can react with ambient electrons and ions in the F layer of the ionosphere to effectively form a "hole" in this region by reducing the concentration of electrons and ions within the path of the vehicle. This effect in the F layer is believed to be caused by a rapid charge-exchange reaction between the rocket exhaust products and the ambient atomic oxygen ions in the F layer. Ambient atomic oxygen ions (O^+) are the dominant ion in the F layer. At lower altitudes of the ionosphere (i.e., below 140 kilometers [87 miles]), this reaction is not effective because the dominant positive ions are NO^+ and O_2^+, not O^+. For example, the reaction between water and O+ is as follows:

H2O + O+ = H2O+ + O followed by the rapid recombination

H2O+ + e- = OH- + H

Similar reactions also occur with carbon dioxide and hydrogen. These reactions result in a net decrease in electron concentration in the F layer, potentially affecting radio communication, such as short-wave broadcasts, which interact with the ionosphere. An experimental test firing of the propulsion unit used by the Space Shuttle for maneuvering within the ionosphere was conducted in 1985. This test firing provides some data on the rapidity with which a "hole" in the F layer may disappear. The propellants used in this test firing were monomethylhydrazine (MMH) and nitrogen tetroxide (N_2O_4), similar to the propellants used for routine launches of other launch vehicles. However, the quantities of propellants consumed for this test are smaller than the quantities of propellants consumed during launches of medium to large-scale capacity rockets. The test involved consuming 290 kilograms (640 pounds) total mass of MMH and N_2O_4. Exhaust products from this experimental test firing consisted of approximately 117.7 kilograms (259.5 pounds)(40.6 percent) nitrogen, 92.5 kilograms (203.9 pounds)(31.9 percent) carbon dioxide, 75.7 kilograms (166.8) (26.1 percent) water, and 4.1 kilograms (9.0 pounds) (1.4 percent) hydrogen. The percentages represent percent by mass, and complete combustion was assumed. Thus, about 172 kilograms (379 pounds) of potential electron-depleting substances (CO_2, H_2O, and H) were emitted. The associated "ion/electron hole" disappeared into the lower F layer within five minutes. This quantity of by-products represents only 0.2 percent of by-products produced in the upper atmosphere during a typical launch from Earth to space. Using the same methodology used to estimate emission loadings to the stratosphere and troposphere, rough estimates of electron-depleting loadings to the ionosphere were also calculated (USDOT/FAA, 2001). These loadings were estimated for the vehicle capacity types (i.e., small, medium, intermediate, and high) and three categories of propellant type (solid, liquid and hybrid, and hypergolic). A small vehicle burning only solid propellant would emit approximately 100 kilograms (220 pounds) of electron-depleting substances (CO_2, H_2O, and negligible H), similar to the Space Shuttle test results above. However, a medium vehicle burning both solid and hypergolic propellants in the ionosphere would emit

approximately 2,400 kilograms (5,291 pounds) of electron-depleting substances (CO_2, H_2O, and H), 14 times greater than the test results above.

Data are unavailable to estimate the differences in the size of the "ion/electron hole" that might be created with larger vehicles and the amount of time it would take for these holes to dissipate. As stated earlier, an important variable concerning whether or not there would be ionospheric effects is location of the final parking orbit. For example, the 12 Saturn V ELVs launched during the Apollo program did not cause an ionospheric hole measurable from the Earth's surface because all of their final parking orbits (and therefore their second stage burns) were below 190 kilometers (118 miles) (where the ionospheric chemistry is different from the F-layer).

However, the Saturn V launch of Skylab did create a sizable ionospheric hole, because orbital insertion of this launch occurred at 442 kilometers (274 miles). In the worst case, these holes appear to dissipate in a matter of minutes. Therefore, it does not appear that the effects of this phenomenon could accumulate to any degree, unless there were launches through the same region of the atmosphere every few minutes.

Rocket Impact Summary

Since rocket launches would be increased to approximately 82 launches per year, emissions would increase and may have a negative impact on air quality. Factors at WFF such as infrequent launches, dispersion, and inappreciable emission quantities released lessen the negative effects of the emissions on air quality.

Balloons

Daily weather balloons launched from WFF are used to forecast the weather for project monitoring and for use by the National Weather Service. Gathering of weather data provides a positive benefit to WFF projects and to an understanding of the atmosphere and weather patterns. Detailed local weather information helps to ensure the safety of WFF launch activities. Balloons are inflated with helium, which is not listed as an air pollutant under Title III of the Clean Air Act, and balloons releasing helium would not have any impact on air quality.

Piloted Aircraft

Aircraft are exempt from the Commonwealth of Virginia regulations that govern emissions standards for mobile sources (9 VAC 5-40-5680). Aircraft operating from WFF generally have reciprocating, turbo-prop, or jet engines. Most of the aircraft use JP-5 fuel, although small amounts of 100-octane low-lead gasoline are also used. A portion of these emissions may be VOCs, which are associated with the generation of ground level ozone. While most aircraft remain in the lower atmosphere, the ER-2 flies in the upper atmosphere. The main engine fuel for the ER-2 aircraft is JPTS. However, liquid fuels do not ignite in the thin oxygen of the upper atmosphere; therefore, in case the aircraft stalls, the ER-2 is equipped with a backup, high altitude restart system fueled by 22.1 liters (5.8 gallons) of hydrazine. Hydrazine emission impacts from the ER-2 would be identical to those of the launch vehicles discussed above.

Anhydrous hydrazine is a caustic, fuming, hygroscopic liquid at ordinary temperature and pressure. It decomposes on heating or when exposed to ultraviolet radiation to form ammonia, hydrogen, and nitrogen. This reaction may be explosive, especially when catalyzed by certain metals and metal oxides. Spontaneous ignition can occur in contact with porous materials (National Library of Medicine, 2004). Accidental release of hydrazine during transport or handling could cause detrimental air emissions for personnel. The Short-Term Public Emergency Guidance Levels (SPEGLs) for hydrazine is 0.12 ppm 1-hour average. ACGIH sets a TLV of 0.01 ppm TWA.

Table 4-5 shows weighted average emissions per type of flight event for several example aircraft. However, emissions produced by aircraft are less than that produced by rockets and the volume of aircraft operations at the WFF is relatively small. The area is also considered to be an attainment area for ozone level. Therefore, aircraft operations would have a temporary impact on air quality.

Table 4-5 Weighted Average Emissions per Type of Flight Event

kilograms/event (pounds/event)

	VOC	NOx	CO	SOx	PM_{10}
P-3 Flight Activity					
Departure	8.26 (18.22)	5.70 (12.56)	12.34 (27.21)	0.39 (0.86)	8.73 (19.25)
Arrival	2.50 (5.51)	4.17 (9.19)	3.65 (8.04)	0.20 (0.44)	6.21 (13.69)
Touch-and-go	0.04 (0.08)	2.04 (4.49)	0.18 (0.40)	0.08 (0.18)	2.38 (5.25)
C-130 Flight Activity	**VOC**	**NOx**	**CO**	**SOx**	**PM_{10}**
Departure	8.17 (18.01)	5.07 (11.18)	15.34 (33.82)	0.36 (0.80)	9.29 (20.49)
Arrival	2.49 (5.50)	4.26 (9.40)	3.93 (8.66)	0.20 (0.45)	6.39 (14.10)
Touch-and-go	0.04 (0.08)	2.00 (4.41)	0.16 (0.35)	0.08 (0.17)	3.28 (5.24)
F-15 Flight Activity	**VOC**	**NOx**	**CO**	**SOx**	**PM_{10}**
Departure	0.79 (1.74)	17.55 (38.69)	33.09 (72.96)	0.40 (0.88)	3.45 (7.61)
Arrival	0.35 (0.78)	2.85 (6.28)	2.53 (5.59)	0.13 (0.28)	2.65 (5.85)
Touch-and-go	0.07 (0.16)	2.84 (6.27)	0.41 (0.91)	0.06 (0.13)	1.03 (2.27)

Source: U.S. Navy, 2004

Uninhabited Aerial Vehicles

The UAVs launched from WFF are considered to be about one-fifth the size of a Boeing 757. Since it was determined that aircraft do not have a significant, permanent impact on air quality, then it is expected that emissions from UAVs would not have a significant, permanent impact on air quality.

Payloads

Payloads from orbital rockets release chemicals from scientific missions and ACS fluid/gases in the upper atmosphere. TMA is a common gas released from payloads to study disturbances in the ionosphere created by the interaction between the Sun and Earth's magnetic fields. Typically, puffs of TMA would be released into the ionosphere from the payload at 80 to 150 kilometers (50 to 95 miles) altitude. TMA spontaneously combusts on contact with air and reacts violently on contact with water. The products of the combustion in either case are water vapor (H_2O), carbon dioxide (CO_2), and aluminum oxide (Al_2O_3) which appear as a white cloud of gas. The shape of the cloud is determined by the disturbances in the ionosphere. The instruments in the payload would collect data on the TMA release, such as: plasma density, temperature, collision frequency, electric field profiles, neutral density, and electron, ion, and particle environmental mechanisms. Impacts from the TMA release would be identical to those discussed for the launch vehicles. Other chemicals may be released as long as they pose no substantial hazard.

The Aerojet Mark VI is a common ACS used in payloads. This system emits small emissions while stabilizing a payload's trajectory. During the 10-year period FY 86 through FY 95, chemical releases from payloads around the U.S. ranged from 5.0 to 272 kilograms (11 to 600 pounds) and averaged 43.4 kilograms (95.7 pounds) per flight. This is a small portion of the overall emissions from a rocket. Releases from payloads are in the form of "trails" over an altitude range, either on an "upleg" (e.g., 50 to 150 kilometers [31 to 93 miles]) or a "downleg" (e.g., 200 to 80 kilometers [124 to 50 miles]) of the flight (NASA, 2000).

Many payloads use a liquid hydrazine propulsion system. The Athena 3 class vehicle can carry payloads that contain up to 354 kilograms (780 pounds) of liquid hydrazine propellant, with gaseous nitrogen as the pressurant. Hydrazine emissions would cause a small impact in the upper atmosphere, but the effect should be temporary as discussed in the Rocket section and Piloted Aircraft section above.

Payloads may also carry biological agents into orbit for scientific experiments. The biological agents must be classified under the National Institutes of Health (NIH) and the Centers for Disease Control Biosafety in Microbiological and Biomedical Laboratories established safety rating of "Biosafety Level 1."

Due to the small number of low orbit payloads launched per year, there should be no significant impact from payloads. Orbital payloads are launched infrequently from WFF and should pose no significant impact.

Scientific Research Programs and Facilities

The release of toxic gases through laboratory fume hoods may result in minor impacts to local air quality. Laboratory fume hoods are permitted under WFF's air permit and meet regulatory requirements.

No Action Alternative

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

4.2.4 Noise

General Consequences of the Proposed Actions

Mechanical noise sources from daily operations at WFF include rocket launches, aircraft operations, vehicular traffic, stationary and portable generators, pumps, fire engines, heating and air conditioning units, grounds maintenance equipment, and equipment used in industrial shops. For many of these sources, exposure to noise is either short-term (e.g., fire engines), or can be minimized through use of personal hearing protection. The Range Safety Office is responsible for occupational safety and determining the need for personal hearing protection.

Cannon-like noises generated by a propane tank are used for bird control in the vicinity of the runways. The use of firearms by USDA-licensed sharpshooters for deer and bird control is sometimes necessary. Human exposures to noise from firearms, which can be addressed by personal hearing protection, are infrequent and of short duration.

The GSFC Industrial Hygienist conducts baseline surveys of each new operation, conducts annual walk-through surveys, monitors and evaluates noise hazards, and recommends appropriate means of controlling noise exposures.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

Throughout WFF, project-specific construction activities generate temporary increased noise levels from heavy equipment operations. Construction may also introduce permanent noise sources, including traffic. However, these impacts are anticipated to be minor. Construction projects are expected to continue through the next 10 years, depending on funding, so noise levels would rise and fall depending on the number of projects undertaken at any given time. Special precautions may be required when construction occurs near housing or occupied facilities. Noise suppression systems may be utilized on heavy equipment. NASA would comply with local noise ordinance and State and Federal standards and guidelines for potential impacts caused by construction.

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 would be required to wear hearing protection equipment. Therefore, impacts to the occupational health of construction workers as a result of construction noise would not be expected.

Demolition

A number of structures are identified for demolition scheduled through FY 2009. Noise levels would be increased temporarily during demolition activities due to heavy equipment operation. The increased noise levels due to demolition activities are localized and temporary. Noise suppression may be used on heavy equipment. Workers would follow the same OSHA guidelines as outlined above and should not be impacted by noise.

Operational Components

Rockets

As long as the rocket motors on the launch vehicles are burning, noise would be generated, especially at the lower altitudes when the air density is appreciable. The attenuation due to increasing distance and the thinning of the atmosphere would reduce sound transmission. Above a 10-kilometer (6.21-mile) altitude where vacuum conditions are approached, no sound would be propagated. When the rockets become spent, only aerodynamic noise would prevail as the spent rockets (and there may be two, three, or four stages in a launch vehicle) follow a ballistic path to the water. Oblique shock systems are formed as the denser air slows down the incoming projectile objects to lower but still supersonic speeds near the 1,000 meters per second (0.62 mile/second) level. The characteristic "screaming" or "roaring" frequently reported when such high-velocity projectiles approach the Earth in close to vertical trajectories has not been analyzed. It is clear, though, that the sound levels must be smaller than when the rockets are burning (NASA, 1997a).

The launch areas on the island are located approximately 4.02 kilometers (2.5 miles) from the mainland. The marshland and water surrounding the island act as a buffer zone for noise generated during rocket launches due to the sound absorption capacity of the vegetation. The noise levels generated during launches depend principally upon the thrust of the rocket motors. The expected launch noise from a Castor-120™ motor on the Athena-3 class vehicle is 125 dB at the launch pad and drops to approximately 80 dB at 12.06 kilometers (7.5 miles) (USDOT/FAA, 1996). The towns of Atlantic and Chincoteague, as well as private farms, are located within this 12.06-kilometer (7.5-mile) radius. The town of Assawoman would experience noise levels around 100 dB. While some observers may, under appropriate atmospheric conditions, find the noise from a launch to be an annoyance, the noise is maintained for about 20 seconds, is of low frequency, attenuates rapidly, and occurs infrequently. The public is notified in advance of launch dates and noise levels experienced by the public would be well within the OSHA standard of 115 dBA over 15 minutes (29 CFR 1910.95(b)(2)) for permissible noise exposures.

Rockets and Navy missiles are generally launched over water from Wallops Island and the noise generated is usually low frequency and of short duration. Rocket launches can be heard throughout the surrounding community; however, not at levels that generate complaints or damage property. All non-essential personnel are evacuated from the safety zone during a launch. All essential personnel are restricted to a blast-proof building called a blockhouse. Personnel outside the hazard area may be restricted to their buildings depending on the size of the hazard area.

The impact of spent rockets or unrecoverable payloads as supersonic projectiles would produce momentary sounds as the water surface is broken. When payload recovery is desired, usually a parachute is deployed at an altitude of about 6 kilometers (3.7 miles) to slow down the payload for aerial or water recovery. For aerial recovery, specially equipped aircraft or helicopters are used to locate and retrieve the payload prior to splashdown. The payload is then transported directly by the recovery plane/helicopter to a landing area support facility. For water recovery, USCG cutters are used. The noise generated by these vehicles while searching for, recovering, and transporting the payload to the support facility is comparable to that from normal daily transportation activities. The splash site, however, may

be in a remote area that is seldom visited by automobiles or aircraft. Nonetheless, the noise generated during recovery operations should not exceed 110 dB and is of short duration. Therefore, no substantial adverse noise impacts are expected.

Birds are most sensitive to noises at far higher frequencies than those associated with launch vehicles. Birds may be startled by impulsive noises created by rocket launches, but because launches are infrequent as described in the proposed action, this impact is not significant. Despite the noise from rocket launches, the piping plover population has survived and continues to nest in the Wallops Island area. Mammals seem to be less disturbed by noise than birds, but startle effects can still occur.

In addition to the noise of the rocket engine, sonic booms are possible. A sonic boom is a sound that resembles an explosion and is produced by a shock wave that forms at the nose of a vehicle that is traveling faster than the speed of sound. The potential for, and the intensity of, a sonic boom being heard on the surface of the Earth depend upon the vehicle length, the nose cone shape, the trajectory of the launch, the vehicle velocity, and weather conditions. As the launch vehicle rises from the pad and achieves supersonic speed, the shock wave is projected over the horizon without impacting the Earth's surface. After launching almost vertically, the vehicle begins to tilt, or pitch over, a maneuver designed to align the vehicle's path more closely to that of an orbit around the Earth. Pitch-over also points the shock wave downward towards the Earth's surface where the sonic boom can be heard.

Sonic booms are only permitted to occur over the ocean so no negative noise impacts to humans should occur. Ocean-going vessels would be expected to experience sound resembling mild thunder (USDOT/FAA, 1996). Sonic booms from launches could also impact underwater environments. These types of booms represent a threat of physical and physiological impairments to marine animals in the vicinity of the water surface, particularly if these animals are in the relatively restricted impact zone of the boom. However, the likelihood of such an occurrence is very small and is discussed in detail in Section 4.3.4 Marine Mammals.

Piloted Aircraft

WFF is used for landing and take-off and "touch-and-go" exercises by military pilots who need practice time and to test instrumentation and equipment. The F-18 is the loudest aircraft currently exercised at WFF with a noise level of 155 dB at takeoff. The noise level decreases to 90 dB at a distance of 1.2 kilometers (4,000 feet). This plane, along with the F-15, is the vehicle most often flown for these exercises at WFF. Under touch-and-go conditions, with one touch-and-go every 10 minutes, the 1-hour L_{eq} is 80.5 dBA several hundred feet from the end of the runway. This noise level would be experienced at the Trail's End campground and Dublin Farms, north of the Main Base; the Wallops Island National Wildlife Refuge, adjacent to the eastern boundary of the Main Base; homes along Route 175, south of the Main Base; and some homes along Flemens Road, west of the Main Base. The number of flights performed on WFF does not exceed the allowable limits set by OSHA as described in Section 3.2.4.1.

The Lockheed C-5 Galaxy is the largest plane that could take off and land at WFF. The Lockheed C-5 Galaxy has a takeoff noise level of 106.2 dB. Since, the F-18 and C-5 planes represent the loudest and largest aircraft flown from WFF, noise would be enveloped under

them. Flights are intermittent and noise levels would be temporary and should not exceed allowable limits.

Uninhabited Aerial Vehicles

UAVs launched from WFF would cause intermittent, temporary noise with no significant impacts.

No Action Alternative

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

4.2.5 Hazardous Materials and Hazardous Waste

General Consequences of the Proposed Actions

The greatest potential impact to the environment due to the release of hazardous materials would result from an accident at a storage location (e.g., leak, fire, or explosion) or, to a lesser degree, from an accidental release during normal operating activities (e.g., spills or human exposure). The short- and long-term effects of an accident on the environment would vary greatly depending upon the type of accident and the substance(s) involved.

NASA has implemented various controls to prevent or minimize the effects of an accident involving hazardous materials, including the following:

- NASA has prepared an ICP;
- NASA has prepared emergency plans and procedures designed to minimize the effect an accident has on the environment;
- GSFC maintains an online database (MSPro®) of hazardous materials and the associated buildings where they are stored or used; and
- Training is provided annually for all users of hazardous materials.

Sources of hazardous wastes have the potential to adversely impact the environment. Hazardous waste is stored in accumulation areas for less than 90 days. NASA uses licensed contractors to transport and dispose of hazardous waste at permitted offsite facilities. The greatest potential impact to the environment would result if an accident were to occur at an accumulation or staging facility (e.g., fire, spill, or explosion). The effect an accident would have on the environment (e.g., release of toxic gases, soil contamination, or surface water/groundwater contamination) would vary greatly depending upon the type of accident and hazardous waste(s) involved.

WFF has implemented various controls to prevent or minimize the potential for and effect of an accident involving hazardous waste, including the following:

- All wastes are stored in closed containers, and accumulation areas have the capability of containing a leak or spill;
- The containers are inspected for leaks on a scheduled basis;

- All civil service and contractor personnel who handle hazardous waste as part of their job are trained in hazardous waste management procedures;
- A communication/alarm system is in place that is capable of providing immediate emergency instructions to facility personnel in the event of an accident and summoning emergency assistance;
- Fire extinguishers and fire control equipment are available onsite; and
- An ICP with annual training has been developed to deal with release of hazardous waste.

Several sites on WFF have been identified as either FUDS or remediation sites. These sites are currently managed by the WFF ERP, through partnerships with either the DEQ Petroleum Storage Tank Management Division, the USACE, or an Administrative Agreement on Consent, per RCRA 7003, between NASA, EPA, and DEQ.

Hazardous wastes are collected and removed from WFF by a base contractor.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

Future construction of new facilities planned at WFF may increase the use of hazardous materials at WFF and hazardous waste generation. Should this be the case, however, these new facilities and operations would also follow the same procedures already established for the handling, storage, and disposal of hazardous materials and wastes to ensure no adverse effects to human health or the environment. It is not anticipated that construction would significantly increase hazardous materials or hazardous wastes at WFF.

Demolition

In general, the demolition of structures at WFF could result in the generation of hazardous waste, including lead-contaminated building materials and lead-contaminated soil. Asbestos-containing building materials and lead-contaminated building materials and soil would need to be properly disposed of according to applicable Federal, State, and local laws. Additionally, hazardous materials in use at the facilities and hazardous waste being stored at the facilities would need to be properly relocated and/or disposed of prior to demolition activities. Table 3-16 in Section 3.2.5.3 lists properties that have hazardous materials/wastes concerns.

During demolition of facilities, proper precautions would be necessary. The hazardous materials would need to be managed with standard procedures. Guiding principles would include proper containment, separation of incompatible and reactive chemicals, worker warning and protection systems, and handling procedures to ensure safe operations. The demolition of structures and handling of any associated hazardous wastes is not anticipated to impact human health or the environment.

Operational Components

Rockets

All hazardous materials associated with rocket operations are managed with standard procedures. Guiding principles include proper containment, separation of incompatible and reactive chemicals, worker warning and protection systems, and handling procedures to ensure safe operations. All personnel working in the M-area (rocket motor assembly, integration, and storage) receive HAZCOM training. Hazardous wastes are also managed according to standard procedures. Operational requirements and personnel training requirements are followed by all personnel involved with motor assembly, integration, and storage. It is not anticipated that an increase in rocket operations would significantly impact human health or the environment.

Balloons

Balloons launched from WFF use helium, a hazardous material, to lift the payload. The helium is managed with standard safety procedures. Guiding principles include proper containment, worker warning and protection systems, and handling procedures to ensure safe operations. It is not anticipated that balloon operations would increase hazardous materials or wastes; therefore, there would be no impact on human health or the environment.

Piloted Aircraft

Mobile tankers are used to fuel aircraft with JP-5 or JPTS. The largest tanker has a capacity of 26,500 liters (7,000 gallons) and a fueling rate of 346 liters per minute (100 gallons per minute). At regular, grid intervals, stormwater inlets are inlaid in the apron of the runway. The inlets are interconnected by the stormwater system piping and drain to outfalls around the runway (see Figure 2). Many of these outfalls lead to bodies of surface water. Therefore, if a tanker were to rupture on the apron, a potential release of 26,500 liters (7,000 gallons) of fuel oil could enter the surface waters of the Commonwealth (see Figure 2). In order to confirm this theory, the WFF Environmental Office conducted a simulated spill exercise on the runway apron east of Building D-1. The simulated release traveled from the tarmac east of the D-1 Hangar through the stormwater system and to Outfall 003 in approximately 40 minutes. The release then flowed through the unnamed tributary to Little Mosquito Creek. After six hours from release initiation, the release was still over 305 meters (1,000 feet) southwest of Little Mosquito Creek. Therefore, it was concluded that a worst case spill would reach Outfall 003 in 40 minutes from initial release. This outfall empties into a manmade “pool” prior to flowing into the tributary and a spill could be blocked from going further downstream and contained at Outfall 003. If this containment opportunity is missed, the resultant spill would not reach the outer most boundaries of the facility property, or Little Mosquito Creek, for a period greater than 6 hours. In conclusion, if a spill incident occurred on the airport tarmac under similar weather conditions, containment, collection, and recovery operations could be implemented within a reasonable response time. The likelihood of a spill impacting state waters would be diminished or eliminated.

Hazardous materials in use as part of flight operations include solvents, hydraulic fluid, oil, antifreeze, and paint. These hazardous materials are managed according to standard safety procedures. Guiding principles include proper containment, separation of incompatible and reactive chemicals, worker warning and protection systems, and handling procedures to

ensure safe operations. All personnel who transport, fuel, and maintain aircraft in the area receive HAZCOM training. Hazardous wastes are also managed with standard safety procedures. Operation requirements and personnel training requirements are followed by all personnel. With an increase of aircraft operating out of WFF, there would be a slight increase in the amount of hazardous waste created. This potential increase is not anticipated to significantly impact the environment.

Payloads

Fuels

Liquid hypergolic propellants make up the largest proportion of hazardous materials used in processing NASA routine payload spacecraft. The hazardous materials used to process routine payload spacecraft could potentially generate hazardous waste. NASA would be responsible for identifying, containing, labeling, and accumulating the hazardous wastes in accordance with all applicable Federal, State, and local regulations. All hazardous wastes generated from payload processing would be transported, treated, stored and disposed of by the base contractor. It is not anticipated that an increase in payload processing would negatively impact the environment.

Liquid wastes would be generated almost exclusively from fuel and oxidizer transfer operations. Separate propellant transfer equipment is used for each separate fuel (typically hydrazine and MMH) and the one oxidizer (NTO). After loading hydrazine into the payload, transfer equipment and lines would be flushed first with potable water and then with an isopropyl alcohol (IPA) and demineralized water mixture. After fuels have been loaded, equipment and lines used to transfer the fuels would also undergo potable water flushes followed by an isopropyl alcohol (IPA) and demineralized water flush. Similarly, potable water would be used to flush oxidizer transfer equipment and lines after NTO has been transferred to the payload. The rinses resulting from the first three flushes of potable water for hydrazine, MMH, and NTO lines and equipment would be considered hazardous waste. Further flushes with IPA and demineralized water may or may not be considered hazardous waste depending on the waste characterization. Approximately 23 liters (5 gallons) of sodium hydroxide solution used for soaking small oxidizer transfer equipment parts (e.g., seals and fittings) would be added to the oxidizer rinse water. All five rinse-water waste streams would be collected in separate, DOT-approved containers. The containers would be placed in the waste propellant area (satellite accumulation points) outside the facility until retrieved by the base contractor.

The fuel and oxidizer rinse-water wastes may or may not be hazardous depending on how the waste was generated and/or the characteristics of the wastes. Waste from each drum would be sampled and characterized based on laboratory analysis and the generation process. Based on the results of the waste characterization, drums would be labeled as hazardous or non-hazardous and disposed of according to applicable regulations by the base contractor (NASA, 2002a).

Solid hazardous wastes from payload processing would be generated almost exclusively from fuel and oxidizer transfer operations. Pads, wipes, and other solids would be used to clean minor fuel drips. Solids coming into contact with a fuel or oxidizer would be double-bagged and placed in a DOT-approved container. A separate container would be used for each fuel or oxidizer. Containers would be labeled as hazardous waste and

accumulated in the waste fuel and oxidizer areas until collected by the base contractor (NASA, 2002a).

Because solids contaminated with MMH and NTO are acutely toxic hazardous waste, these containers would be moved to a 90-day waste accumulation facility within 72 hours if amounts exceed 1.1 liter (1 quart). Processing of routine payloads would increase hazardous waste production at the launch sites by very small percentages.

Small quantities of hazardous materials and wastes are used and generated during payload processing; therefore, it is not anticipated that payload fueling activities would negatively impact human health or the environment.

Chemical Releases

TMA, a common gas expelled from payloads, is extremely flammable when exposed to air and water. It is a pyrophoric material that can react explosively with the moisture in tissues, causing severe burns. Though it breaks down quickly in the atmosphere, all precautions would be taken during storage, transportation and handling. Only personnel employed by Clemson University and trained in the handling, transportation, loading, and disposal of TMA would perform these tasks. When handling TMA, these personnel would adhere to the following: *TMA Disposal Procedures* (6 February 2004), *TMA Loading Procedures* (10 January 2003), *TMA Payloads: Piston Removal and O-Ring Replacement Procedure* (10 January 2003), and *TMA Unloading Procedures* (10 January 2003). All other chemicals scheduled for release in the atmosphere must be approved prior to use. It is not anticipated that the use of chemicals would impact human health or the environment.

Data Tracking Systems

Data acquisition activities at the test range utilize hazardous materials such as solvents. Additionally, solvent waste is generated as a hazardous waste as a result of these operations. These hazardous materials are managed in accordance with standard safety procedures. Guiding principles include proper containment, separation of incompatible and reactive chemicals, worker warning and protection systems, and handling procedures to ensure safe operations. Personnel working or maintaining the systems receive HAZCOM training. Hazardous wastes are also managed according to standard safety procedures. Operational requirements and personnel training requirements are followed by all personnel. The implementation of the above protective measures limits the potential of a negative impact on humans or the environment.

Scientific Research Programs

Scientific research programs utilize hazardous materials such as solvents, acids, bases, and oxidizers. Additionally, hazardous waste is generated as a result of these operations. These hazardous materials are managed in accordance with standard safety procedures. Guiding principles include proper containment, separation of incompatible and reactive chemicals, worker warning and protection systems, and handling procedures to ensure safe operations. Personnel working or maintaining the systems receive HAZCOM training. Hazardous wastes are also managed according to standard safety procedures. Operational requirements and personnel training requirements are followed by all personnel. The implementation of

the above protective measures limits the potential of a negative impact on humans or the environment.

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to infrastructure or transportation. Over an extended period of time, with no expansion of operations, WFF may experience a reduction in hazardous waste generation.

4.2.6 Radiation

General Consequences of the Proposed Actions

Non-ionizing Radiation

Non-ionizing radiation sources may have a negative potential impact to biological organisms, including humans. Radio frequency devices include radar, radios, microwaves, and telemetry devices. The greatest potential bioeffect of non-ionizing radiation sources is the potential for lasers to damage the skin and eyes of humans.

The GSFC Radiation Safety Committee oversees the use of non-ionizing radiation sources to ensure personnel protection. Prior to the arrival of non-ionizing radiation sources at WFF, information on the sources is obtained and reviewed by the Radiation Safety Committee. Hazard evaluations are conducted and controls are established based on the hazards to ensure a safe working environment.

The proposed action involves the use of lasers for science instrumentation. Admissible safety analysis techniques are well established based on ANSI Z136.1-2000 and ANSI Z136.6-2000. According to ANSI Z136.6-2000, the maximum permissible exposure (MPE) values are below known injury levels. Therefore, for the purpose of this EA, a laser is considered to be eye-safe when potential exposure levels are below the MPE value. The ANSI safety analysis applies to any laser (not only nadir-pointing laser systems) that might be operationally or accidentally pointed toward people, aircraft, or the Earth. Laser systems meeting the checklist must be analyzed and found to be within ANSI standards for safe operations if they can be operated in an Earth-pointing mode. Earth-pointing laser systems are safely and routinely used from a variety of airborne and orbital platforms for scientific measurements.

Since the energy threshold for skin damage exceeds that for eye injury, any system found to be eye-safe would not present a substantial hazard to skin, structures, or plants. Gases and particles in the atmosphere can absorb the energy from laser systems and cause changes in atmospheric chemistry by initiating various chemical reactions. However, for a typical laser system utilized by Earth orbiting spacecraft, the mean beam power and, therefore, the maximum available atmospheric energy deposition rate is not substantial when compared to the mean solar energy deposition rate so that substantial atmospheric impacts are not expected. For LIDAR and topographical mapping applications, the local impact from use of the laser is “infrequent” since the system only samples a particular location occasionally (e.g., once a week or month) and the sampling time corresponds to a few nanoseconds (i.e., only one pulse). No cultural impact is expected from the “infrequent” and eye-safe laser use associated with NASA’s space and Earth exploration missions.

Per NPG 8715.3 Section 6.16.1.2, there are Federal (21 CFR Part 1040) and NASA requirements for the safe use of lasers. ANSI documents outline permissible exposure limits needed to avoid eye and skin injury from lasers (ANSI Z136.1-2000 and ANSI Z136.2-2000) and to safely use visible lasers outdoors (ANSI Z136.6-2000). In addition to eye and skin hazards, ANSI Z136.6-2000 also requires visible lasers, used outdoors, to not cause interference with spacecraft and aircraft operations. For visible lasers, the Federal Aviation Administration must provide a letter of non-objection for outdoors scientific use of lasers. This added requirement for visible lasers is needed to protect potentially exposed persons from hazardous reactions to bright light. These hazards include transient visual effects of laser beams such as flash blindness, afterimage, glare, and startle. ANSI Z136.6-2000 also documents the need for a standard operating procedure (SOP) for use of all Class 3b and Class 4 lasers. Per NPG 8715.3 and ANSI Z136.6-2000, when a planned laser operation has the potential for the beam to strike an orbiting craft, the Program Manager or designated laser safety officer must contact the laser safety clearing house to obtain a "Site Window" clearance. The clearance is obtained from the Orbital Safety Officer, U.S. Space Command/J3SOO at Cheyenne Mountain Air Force Base.

Per NPG 8715.3 Section 6.16.3, airborne Class III-B and IV laser operations shall include system interlocks to prevent inadvertent exposure to laser beam output and shall only proceed in accordance with the prescribed mission or test plan. The mission and test plans must include a hazard evaluation as well as written safety precautions. The hazard analysis shall consider catastrophic events and the need for very reliable, high-speed laser shutdown should such events occur (ANSI Z136.1-2000). Qualified personnel perform the laser hazard evaluations, which shall consider and document the atmospheric effects of laser beam propagation, the transmission of laser radiation through intervening materials, the use of optical viewing aids, and other resultant hazards (e.g., electrical, cryogenic, and toxic vapors).

Ionizing Radiation

Sources of ionizing radiation at WFF include instruments, experiments and calibration sources. All sources of ionizing radiation are used and/or stored at WFF under a radiation protection program that is overseen by NASA's Radiation Safety Committee. Because protection guidelines must be followed for all radiation-emitting sources and equipment, the potential for human exposure to ionizing radiation is minimal. However, if human exposure were to occur, the potential impacts could include cancer, cataracts, sterility, and genetic defects.

Radiation safety is maintained by monitoring and inspecting radioactive items and the areas in which these items are located. Devices are used for monitoring radioactive sources, personnel, and areas where radioactive sources are used and stored. Inspections of areas where radioactive sources are used or stored occur periodically. In the event an area or item is found to be above the WFF limits, proper decontamination methods are performed. The Radiation Safety Committee surveys ionizing radiation devices, and, if necessary, properly disposes of the devices.

Routine payloads sometimes use small amounts of radioactive materials as scientific instrument components. For the purposes of this EA, the amount of radioactive material that could be carried and, thus launched, is strictly limited by the approval authority level delegated to the NASA Nuclear Flight Safety Assurance Manager (NFSAM) by NPG 8715.3. As part of the approval process, the payload program manager must prepare a Radioactive Materials Report (RMR) that describes all of the radioactive materials to be used on the spacecraft. The RMR

would be submitted to the NFSAM for safety review and included with the Checklist (Appendix A).

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

Consequences Attributable to Specific Proposed Actions

Institutional Support

Demolition

Demolition of facilities that utilize radiation-containing equipment, such as lasers, radar, radios, microwaves, and telemetry devices, calibration sources, ionizing smoke detectors, and X-ray producing devices, would require proper handling and disposal of the sources. It is not anticipated that the demolition of structures containing equipment that use radiation would impact human health or the environment given the safety precautions that would be followed.

Operational Components

Payloads

Radioactive Materials

Payloads may carry small quantities of encapsulated radioactive materials for instrument calibration or similar purposes. The amount and type of radioactive material that can be carried is strictly limited by the approval authority level delegated to the NASA Nuclear Flight Safety Assurance Manager (NFSAM) by NPR 8715.3. As part of the approval process, the spacecraft program manager must prepare a Radioactive Materials Report (RMR) that describes all of the radioactive materials to be used on the spacecraft. The NFSAM would certify that preparation and launching of payloads that carry small quantities of radioactive materials would not present a substantial risk to public health or safety.

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

Radio Frequency Electromagnetic Fields

Most of the proposed spacecraft would be equipped with radar, telemetry, and tracking system transmitters. For radar, a power limit of 10 kW encompasses the proposed programs. A radar instrument of this size on a nadir-viewing satellite can provide useful information with no risk to people on the Earth or in aircraft above the Earth. A 2-kilowatt radar (94 GHz with a 1.95-meter [6.4-foot] antenna) drops to safe levels in less than 2.5 kilometers (1.6 miles) from the satellite. Considering that Low Earth Orbit

(LEO) altitudes range from 200 to 800 kilometers (124 to 497 miles), such a system presents no radiation hazard to populated regions of Earth or its atmosphere.

The accepted levels for human exposure to radio frequency electromagnetic fields (3 kHz to 300 GHz) are described in the "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz" (IEEE C95.1-1991). IEEE C95.1-1991 is recognized as a standard of the American National Standard Institute (ANSI). IEEE Standard C95.3-1991, entitled "IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave," is also recognized as an ANSI standard and provides formulas needed to determine the fields associated with RF and microwave sources.

Lasers

Lasers may be used for science instrumentation on payloads. Admissible safety analysis techniques are well established based on ANSI Z136.1-2000 and ANSI Z136.6-2000. According to ANSI Z136.6-2000, the maximum permissible exposure (MPE) values are below known injury levels. Therefore, for the purpose of this EA, a laser is considered to be eye-safe when potential exposure levels are below the MPE value. The ANSI safety analysis applies to any laser (not only nadir-pointing laser systems) that might be operationally or accidentally pointed toward people, aircraft, or the Earth. Laser systems meeting the checklist must be analyzed and found to be within ANSI standards for safe operations if they can be operated in an Earth-pointing mode. Earth-pointing laser systems are safely and routinely used from a variety of airborne and orbital platforms for scientific measurements.

Since the energy threshold for skin damage exceeds that for eye injury, any system found to be eye-safe would not present a substantial hazard to skin, structures, or plants. Gases and particles in the atmosphere can absorb the energy from laser systems and cause changes in atmospheric chemistry by initiating various chemical reactions. However, for a typical laser system utilized by Earth orbiting spacecraft, the mean beam power and, therefore, the maximum available atmospheric energy deposition rate is not substantial when compared to the mean solar energy deposition rate so that substantial atmospheric impacts are not expected. For LIDAR and topographical mapping applications, the local impact from use of the laser is "infrequent" since the system only samples a particular location occasionally (e.g., once a week or month) and the sampling time corresponds to a few nanoseconds (i.e., only one pulse). No cultural impact is expected from the "infrequent" and eye-safe laser use associated with NASA's space and Earth exploration missions.

Per NPG 8715.3 Section 6.16.1.2, there are Federal (21 CFR Part 1040) and NASA requirements for the safe use of lasers. ANSI documents outline permissible exposure limits needed to avoid eye and skin injury from lasers (ANSI Z136.1-2000 and ANSI Z136.2-2000) and to safely use visible lasers outdoors (ANSI Z136.6-2000). In addition to eye and skin hazards, ANSI Z136.6-2000 also requires visible lasers, used outdoors, to not cause interference with spacecraft and aircraft operations. For visible lasers, the Federal Aviation Administration must provide a letter of non-objection for outdoors scientific use of lasers. This added requirement for visible lasers is needed to protect potentially exposed persons from hazardous reactions to bright light. These hazards

include transient visual effects of laser beams such as flash blindness, afterimage, glare, and startle. ANSI Z136.6-2000 also documents the need for a standard operating procedure (SOP) for use of all Class 3b and Class 4 lasers. Per NPG 8715.3 and ANSI Z136.6-2000, when a planned laser operation has the potential for the beam to strike an orbiting craft, the Program Manager or designated laser safety officer must contact the laser safety clearing house to obtain a "Site Window" clearance. The clearance is obtained from the Orbital Safety Officer, U.S. Space Command/J3SOO at Cheyenne Mountain Air Force Base.

Per NPG 8715.3 Section 6.16.3, airborne Class III-B and IV laser operations shall include system interlocks to prevent inadvertent exposure to laser beam output and shall only proceed in accordance with the prescribed mission or test plan. The mission and test plans must include a hazard evaluation as well as written safety precautions. The hazard analysis shall consider catastrophic events and the need for very reliable, high-speed laser shutdown should such events occur (ANSI Z136.1-2000). Qualified personnel shall perform the laser hazard evaluations, which shall consider and document the atmospheric effects of laser beam propagation, the transmission of laser radiation through intervening materials, the use of optical viewing aids, and other resultant hazards (e.g., electrical, cryogenic, and toxic vapors).

Scientific Research Programs

Radioactive Materials

The Phytoplankton Photophysiology Laboratory is used for laboratory experiments and supporting field experiments aimed at understanding the range in variability, and ultimately the behavior, of phytoplankton photophysiological processes within the range of environmental conditions encountered in the ocean. Cultures of specific phytoplankton are maintained to support a variety of culturing experiments. Field experiments are focused on coastal and polar physiology and bio-optical processes of marine phytoplankton. WFF proposes to use a stock solution of 18.6 millicuries of Carbon-14 in this laboratory. The Carbon-14 will be used to determine the rate of photosynthesis by a particular culture of phytoplankton compared to its growth rate to extrapolate the carbon dioxide flux (i.e., health of ocean) where the original culture was collected. Research utilizing radioactive material must comply with the requirements of GPG 1860.1,Goddard Procedures and Guidelines for Ionizing Radiation Protection.

No Action Alternative

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

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Vegetation

General Consequences of the Proposed Actions

Current and proposed actions at WFF may impact vegetation by removing it during construction, demolition, and routine site activities. In many cases impacts to vegetation communities would

be permanent. Demolition and routine site activities would have less of an impact since in most cases vegetation would be replanted. Reseeding with native grasses around the impact areas is encouraged to reduce erosion. Impacts to vegetation communities are not considered significant as most landscaping, clearing, construction, and demolition activities would occur in previously disturbed areas of the facility.

Consequences Attributable to Specific Proposed Actions

Institutional Components

Project Support Building

Phase I of the campus core includes construction of the Project Support Building, which would be located west of the Range Control Center. The proposed location of the Project Support Building is currently a paved area so there are no expected impacts to vegetation.

M-Area Control Building

The M-Area Control Building would be constructed to accommodate all non-hazardous operations associated with rocket motor fabrication and storage. Site preparation would impact approximately one acre of trees as the trees would be cleared prior to construction. It is not anticipated that the loss of one acre of trees would be a significant impact to vegetation at WFF.

Operational Components

Rockets

Primary impacts to vegetation in the vicinity of WFF rocket launch pads would result from exhaust products such as gases, high temperature, and fire. The most sensitive environmental areas on Wallops Island are located near the launch pads comprising Launch Complex 0. Launch Complex 0 is located on the south end of Wallops Island near the OB area. Since the largest rockets being launched from WFF leave from Complex 0, the following analysis pertains to that area. Impact to vegetation at smaller launch complexes would be similar, but less extensive. Damage to vegetation resulting from launch activities can be anticipated within a 1,000-meter (3,280-foot) radius of the launch pad. The principal impacts would radiate out approximately 200 to 300 meters (656 to 984 feet) from the combustion path. Searing of vegetation can occur within this radius (NASA, 1997a). Launch Complex 0 contains flame trenches that direct the principal exhaust and flames toward the beach and over the open ocean. The flame trench directs the principal impacts away from the undisturbed marshes and piping plover habitat located west and south of Launch Complex 0, respectively.

Exhaust emissions of hydrogen chloride produce short-term acidic conditions, and can result in vegetation mortality adjacent to the launch pad. Studies of Space Shuttle launches on vegetation revealed that thick cuticled plant species and grasses that are adapted to harsh salt environments are more tolerant to launch conditions (NASA, 1997a). This study suggests that vegetation communities adjacent to the launch pad can evolve into grass and herb communities that are more tolerant. At WFF, wax myrtle (*Myrica cerifera*) is common in the vicinity of Launch Complex 0 and is fairly resistant to near-field effects. This tolerance

should prevent a major transformation of the vegetation community (NASA, 1997a). The impacts to vegetation from rockets are considered temporary due to the infrequencies of launches and the observed recovery of the vegetation between launches.

No Action Alternative

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

4.3.2 Terrestrial Wildlife and Migratory Birds

General Consequences of the Proposed Actions

The Proposed Actions could potentially affect terrestrial wildlife by removing or altering terrestrial habitats, or rendering them unsuitable for wildlife. If a Proposed Action would affect or take place within undisturbed wildlife habitats on WFF, such as forested areas, marshes, or beaches, proper measures would be taken to limit disturbance as much as practicable. Proposed Actions would need to take into account impacts to migratory birds on an individual basis. Potential impacts and mitigation measures would be documented in a Site-Wide EA NEPA Checklist and in a REC (Appendix A).

Studies have concluded that tall standing structures, specifically illuminated communication towers with guy wires, have the highest mortality rate for migratory birds. In accordance with the MBTA, NASA must consult with USFWS when an activity authorized, funded, or carried out by NASA may affect a migratory bird species. Through consultation, the appropriate mitigation measures would be determined and implemented. It is anticipated that NASA would voluntarily comply with USFWS' "Guidance on the Siting, Construction, Operation and Decommissioning of Communications Towers". The consultation and mitigation measures would be documented in a Site-Wide EA NEPA checklist and in a REC (Appendix A).

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

Future construction activities at WFF could displace wildlife and/or migratory birds at proposed project sites. However, since the majority of the proposed construction sites considered in this Site-Wide EA are located in developed areas of the facility, which provide minimal wildlife habitat, it is unlikely that proposed construction activities would significantly impact wildlife or migratory birds.

M-Area Control Building

The construction of the M-Area Control Building would result in the removal of approximately one acre of trees. Wildlife would be permanently displaced from this area. There is other habitat available surrounding the project site and WFF. The loss of one acre of trees would not be a significant impact.

Wind Turbine

The proposed construction of the wind turbine on Wallops Island has the potential to negatively impact migratory birds. A summary of existing studies produced by the National Wind Coordinating Committee (NWCC) states that it has been estimated that between 10,000 and 40,000 birds are killed annually in the United States by wind generation facilities. This number can be compared to the estimated annual avian collision mortality for communication towers (4 million to 50 million) and buildings and windows (98 million to 980 million) (NWCC, 2001). Early studies of avian collisions with wind turbines involved examining impacts associated with large experimental turbines much like the one proposed at WFF. The studies found mortality rates between 2 and 54 birds per year (NWCC, 2001). It was also found that most wind turbines are less than 106 meters (350 feet) in height (including the diameter of propeller rotation) and do not have guy wires. Communication towers with guy wires and higher structures such as office buildings tend to cause the highest mortalities of birds.

According to the data above, WFF could anticipate between 2 and 54 avian mortalities per year should the proposed wind turbine be implemented. The USFWS is charged with enforcing the MBTA and has released a guidance document titled "Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines." The document outlines voluntary and interim steps that can be taken to avoid or minimize impacts to wildlife. The minimization is achieved through proper evaluation of potential Wind Resource Areas (WRA), proper location and design of turbines and associated structures within WRA selected for development, and pre-and post-construction research and monitoring to identify and/or assess impacts to wildlife.

WFF has begun minimization steps similar to ones listed in USFWS' interim guidelines. In August 2004, Curry and Kerlinger, L.L.C., a wind power industry consultant firm, conducted a Phase I Avian Risk Assessment for the proposed wind turbine locations. The Phase I Avian Risk Assessment found that the wind turbine project at WFF would have a greater collision impact to birds on a per turbine per year basis than has been found at most other wind power projects since Wallops Island is within the Atlantic Flyway and concentrated avian traffic. The Phase I Avian Risk Assessment recommended the following:

- Electrical lines from the turbines to nearby transmission/distribution lines should be placed underground to the degree possible, and all new above ground wires leading from the site and substations should have specifications that follow APLIC (Avian Power Line Interaction Committee) guidelines.
- Permanent meteorology towers, if needed, should be free-standing and have no guyed wires to prevent the potential for avian collisions.
- Turbine pads and roads to those pads should be minimal in size to minimize habitat impact**,** and after construction disturbed habitats should be restored to the extent possible.
- Lighting should be minimal at the turbines and nearby infrastructure to minimize or eliminate attraction of night migrating songbirds and similar species. Sodium vapor lamps and spotlights should not be used near turbines. FAA lighting for night use

should only be flashing lights (L-864 red or white) with the longest possible off cycle permissible and no steady burning (L-810) FAA lights should be used.

- A post-construction study of collision fatalities would be helpful to potential site expansion and future wind power development in coastal areas of the Eastern Shore.
- Because Federal and Virginia listed species occur in the general area, especially at the Wallops Island site, a detailed nesting bird survey and use study should be conducted to determine whether such species might be at risk and estimate the potential risk to those species in terms of biological significance.
- Meet with USFWS (and perhaps Virginia Department of Conservation and Recreation) to determine what they will be requesting/requiring with respect to studies and their new interim and voluntary guidelines for wind power development. Such a meeting would involve potential Section 7 ESA consultation and a discussion of the expected scope of work.
- Locating the turbine on Wallops Mainland site would have less of an impact on avian species than a location on Wallops Island. Location of the turbine on the Main Base would have less of an impact than a location on the Mainland.

Data collection for the wind turbine siting is ongoing. Prior to construction of the proposed wind turbine, WFF would coordinate data with USFWS to obtain site-specific mitigation measures. This coordination and any mitigation measures would be documented in the Site-Wide EA NEPA checklist and within a REC. It is anticipated that the proposed wind turbine would have a moderate but not significant impact on wildlife or migratory birds because of the implementation of approved impact minimization measures. Impacts to the piping plover are discussed in Section 4.3.3, Threatened and Endangered Species.

Demolition

The future demolition of structures at WFF is not anticipated to permanently impact terrestrial wildlife or migratory birds. Temporary disturbances during demolition activities would occur in areas where WFF activities have been dormant and wildlife has moved into the area.

Operational Components

Rockets

The primary impacts to wildlife and migratory birds in the vicinity of WFF rocket launch pads result from exhaust products such as gases and fire, as well as noise. The most sensitive launch areas on Wallops Island, from an environmental perspective, are the launch pads comprising Launch Complex 0. Since the largest rockets launched from WFF leave from Complex 0, the following analysis pertains to that area. Impacts to wildlife and migratory birds at smaller launch complexes would be similar, but less extensive. Impacts to wildlife and migratory birds, resulting from launch activities, can be anticipated within a 1,000-meter (3,280-foot) radius of the launch pad. Temporary impacts to wildlife activities would be expected within this area for 2 to 10 minutes during launch operations. The principal impacts would radiate out approximately 200 to 300 meters (656 to 984 feet) from the combustion path. Injury or death to wildlife and migratory birds could occur within this zone (NASA,

1997a). The fire trench would limit injury and death of wildlife and migratory birds to the beach and open ocean rather than south and west where more suitable habitat exists. It is anticipated that there would be no significant impact to wildlife or migratory birds due to the infrequency of launches at Complex 0.

Noise generated from rocket launches is generally of low frequency and short duration. Temporary interruption of foraging and nesting activities in the immediate area of the launch pad may occur. Due to the short duration of the noise disturbances, no significant impacts are anticipated (NASA, 1997a).

Piloted Aircraft

Birds and wildlife on or near runways pose a significant safety hazard to aircraft operations. Abundant wildlife populations in the Aircraft Operating Area (AOA) at WFF have resulted in several wildlife aircraft strikes and numerous aborted takeoffs and landings. The risk to aviation safety increases as the hazardous wildlife population increases within the AOA. The Federal Aviation Administration (FAA) maintains a "Zero Tolerance" policy for white-tailed deer and birds on or around an active runway (NASA, 2003d). Therefore, WFF hosts a representative from the Wildlife Services (WS) division of the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) to assist in managing wildlife risks to aviation.

WFF has implemented the following wildlife management practices in the AOA:

- Habitat modification, including spraying during the growth phase and controlled burning during the dormant phase of patches of common reed (*Phragmites australis*), within the stormwater outfalls drainage area where deer are known to hide;
- Fencing of the Main Base and the culverts under Route 175 to prevent wildlife from passing from adjacent USFWS land to WFF land;
- Harassment of wildlife in the runway areas with propane cannons, sirens, lights, and pyrotechnics;
- Alteration of habitat by removal of food bearing trees and brush near runways;
- Trapping and removal of raccoons, foxes, feral cats, and birds; and
- Sharpshooting of deer by WS APHIS wildlife biologists.

Since wildlife management is already a component of WFF flight operations, no additional impacts to wildlife or migratory birds are anticipated from future aircraft operations.

Uninhabited Aerial Vehicles

Impacts from UAVs would be similar to those described above for Piloted Aircraft.

Rocket Boosted Projectile Testing

The rocket boosted projectile testing on Wallops Island would cause temporary noise impacts to wildlife and migratory birds. It is not anticipated that this testing would harm or kill wildlife or migratory birds because of the extremely low potential of a rocket boosted projectile to accidentally strike wildlife or migratory birds on its intended trajectory, and the low number of projectiles fired per year.

No Action Alternative

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

4.3.3 Threatened and Endangered Species

General Consequences of the Proposed Actions

Any Proposed Action that may have the potential to negatively affect federally or State threatened or endangered species, or their habitat, would need to be coordinated with the USFWS, NMFS, the Virginia Department of Agriculture and Consumer Services, the Virginia Department of Game and Inland Fisheries, and the Virginia Department of Conservation and Recreation Division of Natural Heritage.

It is anticipated that none of the Proposed Actions within this Site-Wide EA would adversely impact federally or State threatened or endangered species because of the nature and distance of the proposed activities from listed species and their habitat. The most potentially harmful action would be the launch of an Athena-3 class vehicle with 8 Castor 120™ strap-on motors from Launch Complex 0. This launch can have harmful effects on biological resources for a radius of up to 1,000 meters (3,280 feet); however, the closest piping plover habitat is currently about 1,219 meters (4,000 feet) from Launch Complex 0. In addition, the flame trench would ensure that potentially harmful exhaust and flames are not directed toward piping plover habitat. Noise impacts from rocket launches would be temporary.

Mitigation measures currently in place would ensure the continuous completion of the WFF mission and the coexistence of listed species. These mitigation measures include:

- Implementation of a monitoring plan for the first three launches from launch pad O-B that take place between March 1 and September 15 (discussed further under Rockets below);
- Closure of the north and south beaches to vehicle and human traffic during the plover's nesting season of March 15th through September 1st;
- UAV adherence to the 304-meter (1,000-foot) no-fly zone horizontally and vertically from any active plover nesting area; and
- Avoidance of areas known to contain nesting bald eagles and peregrine falcons.

Accidental takes may occur due to collision with launch vehicles, collision with descending payloads, collision with airplanes, or during mission accidents. However, the chance of these accidental takes occurring is negligible and would not threaten the future existence of a listed species. Confirmed instances of accidental takes would be reported to the appropriate agencies.

Consequences Attributable to Specific Proposed Actions

Construction

The construction and implementation of the wind turbine may have the potential to impact the piping plover. Data collection for the wind turbine siting is ongoing. Prior to construction of the proposed wind turbine, WFF would coordinate data with USFWS to obtain site-specific mitigation measures. The construction of a wind turbine that has a breaking system would

reduce the risk of avian mortality. The construction of a wind turbine with a braking system is being considered by NASA. This coordination and any mitigation measures would be documented in the Site-Wide EA NEPA checklist and within a REC. A one year post-construction avian collision monitoring plan would likely be required by USFWS. The results of this monitoring plan may ultimately determine the significance of impact the turbine has on the piping plover and other migratory birds. Through consultation with USFWS, additional mitigation measures would be determined and implemented in accordance with the ESA. It is anticipated that the proposed wind turbine would have a moderate but not significant impact on the piping plover because WFF would implement the approved impact minimization measures and the turbine would not cause the incidental take of enough piping plovers annually to be a threat to their future existence.

Operational Components

Rockets

Rocket launches have the greatest potential to impact the piping plover. Through Section 7 consultation with USFWS, NASA has developed a monitoring plan to better understand the effects of rocket launches on piping plover behavior. The monitoring of piping plovers on the south end of Wallops Island would occur during the first three launches from launch pad O-B that take place between March 1 and September 15. Monitoring would be conducted daily for 7 consecutive days prior to a launch, during the launch (as dictated by human safety considerations), and for 7 consecutive days after the day of the launch. If it is not possible to monitor during the launch, monitoring would occur immediately before and after the launch. Monitoring would occur for an hour early in the morning and late in the evening when avian species are more active. Depending on the results of the surveys, and at the discretion of the USFWS, additional years of monitoring may be required and new determinations on impacts may be made by NASA and the USFWS.

Until launch pad O-B is used and monitoring data are made available, NASA and USFWS do not anticipate that the proposed action would incidentally take any piping plovers due to the short duration of the disturbance, the long distance between the disturbance and the area used by plovers, the limited number of launches during the nesting season, and the lack of other disturbances (e.g. recreation) to the plovers at this site.

Payloads

Under Section 7 of the ESA, NASA has also consulted with NMFS regarding the potential impacts of Airborne Oceanographic Lidar (AOL3) Big Sky CFR 400 laser use on federally threatened and endangered marine mammals and sea turtles found in coastal and estuarine waters around WFF. NMFS determined that it is unlikely that the laser would damage marine mammal or sea turtle skin, and that the only potential effect would be the impact of radiation on the eyes of marine species. Based on the limited number of flight hours, the density of marine species in the action area, and the ability of the pilots to maneuver the aircraft or block the laser beam with a shutter to avoid marine mammals and sea turtles, NMFS concluded that there is a low likelihood of the laser beam directly encountering a marine mammal or sea turtle eye. Based on this determination, the AOL3 laser system is not likely to adversely affect federally endangered and threatened species under NMFS

jurisdiction and no further consultation with NMFS is required for these operations (Appendix D).

Open Burn Area

The OB Area is adjacent to the piping plover use area on the south end of Wallops Island. NASA has consulted with USFWS to determine what impact open burning of rocket motors would have on the protected species. USFWS determined that NASA could conduct year round burning without impacting the plover (Appendix C).

No Action Alternative

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

4.3.4 Marine Mammals and Fish

General Consequences of the Proposed Actions

The risk of operations at WFF impacting or taking a marine mammal is extremely low. A take would only occur if a launch vehicle failed to achieve orbit, or rocket motors, drones, payloads, or projectiles fell on a marine mammal. These events are very unlikely. In compliance with the MMPA, NASA has conducted coordination with NOAA's National Marine Fisheries Service (NMFS) Office of Protected Resources (OPR). On March 26, 2003, Ms. Carolyn Turner of EG&G, the environmental support contractor for WFF, spoke with Mr. Ken Hollingshead of NMFS OPR. Mr. Hollingshead stated that information in the WFF Memorandum for the Record dated July 5, 2000, *Taking of Marine Mammals Incidental to Rocket Launches from NASA Goddard Space Flight Center's Wallops Flight Facility*, is still applicable (Appendix D). Mr. Hollingshead stated, "WFF is not required to submit an application for the incidental take of marine mammals since the level of impact from WFF activities does not warrant a Letter of Authorization." Therefore, no significant impacts to marine mammals or other marine life are anticipated under the Proposed Actions.

No significant adverse impacts to fish or the Bogues Bay EFH are anticipated since no dredging or activities are proposed for Bogues Bay. Any dredging activity that would occur would be the responsibility of the USACE. No significant adverse impacts to fish or the Atlantic Ocean EFH are anticipated since ocean currents would rapidly dilute any metal ions or other chemical constituents released by failed launch vehicles or destroyed targets. Substantial indirect effects on fish species, as might occur via bioaccumulation of ionic metals from affected benthic organisms to higher order species, are not anticipated given that:

- The area of the destroyed launch vehicle or target is small relative to the surrounding ocean ecosystem;
- Currents continuously disperse and dilute chemical constituents; and
- The number of benthic organisms that could colonize a destroyed launch vehicle (s) or any WFF-introduced debris would be insignificant compared to the mass in the surrounding ecosystem, effectively minimizing any negative effects of bioaccumulation (U.S. Navy, 2003).

Consequences Attributable to Specific Proposed Actions

Operational Components

Rockets

Sonic booms from launches could impact underwater environments and the hearing sensitivity of marine mammals, sea turtles, and other fauna. In terms of underwater impacts, theoretical models for sonic booms generated by a large space launch vehicle (Titan IV) have shown that peak underwater pressures are likely to range from 130 to 140 dB (referenced to 1 micropascal). Sonic booms produced by some target payloads would be expected to range from 117 to 176 dB (referenced to 1 micropascal). The Athena-3 class vehicle is smaller than the Titan IV and would not exceed the Titan IV peak underwater pressure.

The noise level associated with the onset of temporary threshold shift (TTS) is often considered to be the level below which there is no danger of injury to animals. NMFS has defined 218 dB (referenced to 1 micropascal) as a safe outer limit for minimal, recoverable auditory trauma for marine mammals (TSS limit). Studies conducted on the white whale (*Delphinapterus leucas*) and the bottlenose dolphin (*Tursiops truncates*) show no substantial TTS at 221 dB and 226 dB, respectively. Both animals have been used for such studies because they have hearing ranges and sensitivities equivalent to or better than many marine mammals (USAF, 2004).

Based on the above information, a range of 218 to 224 dB was used for determining when the onset of TTS might occur in marine mammals. The underwater pressure caused by a launch vehicle (up to 140 dB) or payload (up to 176 dB) sonic boom at WFF are expected to be less than those of the larger launch vehicles; therefore, the resulting pressure levels should be well below the 218 dB level for causing TTS in marine mammals. Thus, no long-term adverse impacts on protected marine mammals are expected. Temporary impacts to marine mammals from sonic booms would occur but are not considered significant.

As for sea turtles, no specific data are available. However, turtles are less sensitive with respect to hearing than marine mammals and since no effect is anticipated for marine mammals, there should be no effect on sea turtles (USAF, 2004).

Balloons

The NWS and ozosonde balloons launched from WFF are made of latex. These balloons rise to a high altitude where they burst and fall back to earth as small fragments over a wide area. Latex balloon fragments are biodegradable and disintegrate in approximately 6 to 12 months when exposed to the natural elements. Widespread concern and anecdotal statements have discussed the impacts of marine debris, including plastic and latex balloon ingestion and entanglement, on marine mammals and sea turtles. Since these balloons are designed to burst completely, the risk of entanglement is slight. In an effort to determine whether the ingestion of fragments of latex balloons adversely impacts sea turtles or marine mammals, WFF consulted with the following Federal and State agencies, academia, and private industry: National Marine Fisheries Service, Virginia Institute of Marine Science, Virginia Marine Resource Commission, Virginia Marine Science Museum Stranding Center, College of William and Mary in Virginia, University of North Carolina at Wilmington, Florida Atlantic University, and the National Aquarium in Baltimore. None of these authorities could

attribute a marine mammal or sea turtle mortality to latex balloon ingestion. Additionally, a 2003 study investigating gut contents of 199 sea turtles stranded on Virginia beaches over a 20 year time period, found latex fragments in only one animal (College of William and Mary, 2003). Moreover, Dr. William McLellan, a cetacean veterinarian at the University of North Carolina, stated that he had not heard of any cases nor found any evidence of weather balloon ingestion in any of the cetacean necropsies that he had conducted in the past 20 years (Mitchell, pers. comm.). Therefore, no impact is anticipated to marine mammals or sea turtles from either entanglement or ingesting NWS or ozosonde balloons.

Larger science platform balloons may be launched from WFF. Wind conditions are carefully monitored during science balloon missions in order to keep the balloon over unpopulated areas. To terminate the mission, a radio signal command is sent to a small charge on the balloon which punctures the balloon and separates the balloon from the payload. Upon separation, a parachute deploys from the payload. The balloon collapses and falls to the earth in the approximate location of the payload. Both are recovered. Since both are recovered and the balloon would be too large to be ingested, no impact is anticipated to marine mammals or sea turtles from ingesting these large balloons. Moreover, since descent is carefully monitored and the balloon is recovered, no impact from entanglement is anticipated to marine mammals or sea turtles from these large balloons.

Autonomous Underwater Vehicles

It has been documented that the use of high strength sonar (such as that used by the military for submerged target detection) can disrupt the acoustic hearing of cetaceans, causing them to beach themselves in large numbers. Impacts from sonar would be identical to impacts discussed above from rocket sonic booms. Since AUV sonar is used to avoid obstacles and is much weaker than 218 dB level for causing TTS in marine mammals, it is not anticipated that AUVs would adversely impact marine mammals, sea turtles, or fish.

As discussed in a previous section, the loss of an AUV and resulting potential breakdown of metal ions and chemical constituents is not likely to impact marine mammals, sea turtles, or fish. In addition, where practicable, every effort would be made to salvage the AUV.

Payloads

As stated in Section 4.3.3, Threatened and Endangered Species, in compliance with the MMPA, NMFS has concluded that laser use is not likely to adversely affect federally endangered and threatened species under NMFS jurisdiction and no further consultation with NMFS is required for these operations. In a letter dated February 27, 2004, NMFS stated that the use of an airborne laser to measure the productivity of phytoplankton is not likely to adversely affect federally endangered and threatened species under NMFS jurisdiction (Appendix D).

No Action Alternative

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

4.4 SOCIAL AND ECONOMIC ENVIRONMENT

4.4.1 Population

General Consequences of the Proposed Actions

Taken together, the Proposed Action for future operations would have minor impacts on the population of the surrounding community. Generally, any population impacts would follow from changes to the employment/work force at WFF. Employment impacts are discussed in more detail in Section 4.4.3. Temporary employment impacts would not be expected to affect the population, while permanent impacts could have some impact on the population. Construction and demolition projects conducted at WFF would not have a permanent impact on employment, and therefore would not be expected to impact the surrounding area population.

Many of the employees of WFF reside in the towns or cities of the Eastern Shore of Virginia and Maryland. Any significant increase in permanent employment could create a similar increase in the population of these areas. As discussed in the Employment and Income section, only actions that permanently increase the operations at WFF would cause a permanent increase in employment and therefore, drive a population increase.

Based on the WFF Master Plan concept, and highlighted in section 4.4.3, WFF is expected to increase contractor employment by up to 500 employees over the next 20 years. The Plan assumes growth would occur from an increase in the contractor support workforce with a relatively stable number of civil service employees. Table 4-6 contains estimates of the employment growth based on data provided in the current Master Plan. The average annual growth for the first 10 years is 30 employees per year, and the average annual growth for the following 10 years decreases to approximately 20 employees per year.

Table 4-6 Expected Employment Growth

	2005-2009	2010-2014	2015-2024
New Contractors	150	150	200
Cumulative Additions	150	300	500
Average Annual New Jobs	30	30	20

This employment growth is anticipated to lead to growth in population in the surrounding community. Table 3-22 in Section 3.4.1 presents the breakdown of county residence for all WFF employees (NASA and contractors shown together). Based on this data, it is reasonable to assume that 63.8 percent of new WFF employees would also choose to reside within Accomack County, Virginia.

Table 4-7 shows the number of new employees (63.8 percent of all new employees) who are expected to reside in Accomack County, Virginia, and therefore contribute to increasing the population base.

Table 4-7 New Employees to Reside in Accomack County

	2005-2009	2010-2014	2015-2024
New Employees	96	96	128

Cumulative Additions	96	192	320
Average Annual New Employees	19	19	16

The new employees that would reside in Accomack County, Virginia, are also expected to contribute to the population base though additional residents (families or other inhabitants of the same residence). Table 4-8 shows the average household size for Accomack County, Virginia, from Census data. This average household size is multiplied by the number of new employees expected to reside in Accomack County, Virginia, in order to estimate the population increase due to proposed future operations at WFF.

Table 4-8 Additional Population of Accomack County

Average Household Size	2.45 (Census 2000)		
	2005-2009	2010-2014	2015-2024
New Residents	235	235	314
Cumulative Additions	235	470	784
Average Annual New Residents	47	47	39

This population increase could lead to the demand for and construction of new housing. As increased employment and population drive housing demand, they would also contribute to the local economy through increased tax base and local purchases. New residents are expected to earn higher than average incomes for the County, and therefore create positive impacts throughout the community. The slow population growth that the Proposed Action would cause is generally manageable for the rural communities surrounding WFF. The expected growth in Accomack County could serve as an engine for economic growth through many avenues, such as population stability and civic involvement.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

In the case where construction at WFF is for the purpose of expanding the operations at the base, there would be minor population increases in the surrounding area, as discussed above.

Operational Components

Rockets

There is a small possibility that WFF's existing and proposed rocket programs could cause some area residents to relocate. Although unlikely, some residents could find that rocket programs create noise or other environmental circumstances that they wish to avoid. As a result, these residents may choose to relocate. It is not anticipated that this type of behavior would occur at rates necessary to have a significant impact on the surrounding community.

Piloted Aircraft

There is a small possibility that WFF's existing and proposed flight programs could cause some area residents to relocate. Although this is not a high probability, some residents could find that flight programs create noise or other environmental circumstances that they wish to avoid. As a result, these residents may choose to relocate. It is not anticipated that this type of behavior would occur at rates necessary to have a significant impact on the surrounding community.

No Action Alternative

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

4.4.2 Recreation

General Consequences of the Proposed Actions

The Proposed Action includes planned and anticipated construction, demolition activities, and the expansion of operations. All of these activities would occur on the grounds of WFF, and are not expected to have significant impacts to recreation in the area. The Wallops Visitors Center could be potentially affected by construction activities from NOAA's Route 175 turnout project (analyzed under a separate Environmental Assessment) if it were necessary to block access to the Center. This could be minimized by careful placement of construction equipment and vehicle staging so as to not hinder traffic and pedestrian flow to the Wallops Visitors Center.

NASA has a positive impact on recreation by staffing the WFF Visitors Center, maintaining an Education Resource Center for use by educators in preparing lessons on scientific topics, and providing educational tours of WFF to area schools.

The construction of infrastructure and facilities to support educational and coastal zone research could have minor, temporary impacts on recreation. Any impacts could be avoided by notifying WFF and Accomack County personnel of anticipated activities and indicating alternate locations for recreational opportunities.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

Planned construction includes a new Project Support Building and M-Area Control Building. These facilities would be constructed in areas designated for there type of uses. No recreational areas would be affected.

There are no additional designed construction projects at the time of this report. However, future anticipated construction at WFF will occur in what is designated as the Core Campus Area and is broken out into five phases. Construction will occur in areas designated for such uses and it is unlikely that any recreational areas would be adversely affected.

Operational Components

Rockets

The launch and retrieval of rockets could have minor, temporary impacts on recreation. However, NASA has established procedures to minimize impacts from rocket launches. For example, rocket launches would not proceed until NASA communicates and coordinates activities with local fisherman and recreational boaters and the designated area has been satisfactorily cleared. The U. S. Coast Guard would issue a Notice to Mariners (NOTMAR), through various public media, prior to launch operations. The NOTMAR would be posted at local docks and boat ramps from Ocean City, Maryland to Wachapreaque, Virginia. Additionally, the FAA would issue a Notice to Airmen (NOTAM) prior to launch operations and activate WFF's special use airspace in the VACAPES OPAREA. NASA's presence, surveillance, and communications in the area provide a positive benefit to boaters because NASA's efficient ship-to-shore communications can provide assistance in emergencies.

No Action Alternative

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

4.4.3 Employment and Income

General Consequences of the Proposed Actions

The assessment of impacts to employment and income depends upon the nature of the Proposed Action at WFF. Ongoing and Proposed Actions are expected to have positive impacts on the employment and income in the surrounding area. The major distinction in assessing the impacts of the Proposed Action is whether a given action is temporary or permanent in nature. A temporary action, in terms of affecting the economy, would include the construction of a new facility. The construction itself is likely to generate business and employment opportunities for local contractors, but this would last only for the duration of the construction period. A permanent action depends on the purpose of that new facility. If the new facility is built for the purpose of expanding the operations at WFF, then it is expected that employment would grow for civil service employees, contractors, or both. If the facility is simply an upgrade or replacement of an existing facility, no permanent impacts would be expected.

Consequences Attributable to Specific Proposed Actions

Temporary actions (for example, construction of a new building) would lead to one-time employment and income benefits to the local contractors involved and potentially to other local businesses that offer services and supplies needed by the contractors. Permanent actions (for example, expansion of operations) would lead to employment and income increases in the local economy, the relative size and significance of which would be determined by the magnitude of the action itself.

Future actions would either expand the overall activity level at WFF or create a shift in the allocation of resources and activities. A true expansion in WFF activities such as sounding rocket mission growth, increased support for Mars missions, or expanding the UAV program would be expected to carry an increase in employment levels. This would lead to similar types of economic benefits as discussed above, with the magnitude dependent upon the size of the

actual expansion. But, if the expansion of activities in one research or operations area occurs at the expense of another WFF program, then the economic impacts would be insignificant. There could be circumstances where a shift of resources generates temporary additional income, but this is unlikely to have much effect on the local economy.

The economic benefits of the Proposed Action can be characterized through an economic impact analysis that shows the direct, indirect, and induced impacts on the local community through input/output modeling. The modeling uses area-specific data, such as current employment and industry structure, to determine the additional benefits that can be generated from an influx of resources. This modeling is used here to quantify the impacts of the construction, demolition, and operations of the proposed future actions. All economic impacts discussed below are for Accomack County, Virginia.

To analyze the economic impacts of the project, this section uses an application of the Implan regional input-output model (Copyright Minnesota IMPLAN Group, Inc., 2003). The Implan model is an economic impact modeling software that allows the user to develop local level input-output models that can estimate the economic impacts of a variety of business activities. Implan is widely used and accepted by government agencies, private consulting firms, and academia. The data driving the economic impacts are compiled by the Minnesota Implan Group, Inc.'s research team and is available at the County level for all U.S. counties.

The three types of impacts (direct, indirect, and induced) that make up the total project impacts are defined as follows:

- **Direct Impact:** This is simply the effect of the project itself. For example, the direct effects of the operations of the project are characterized by the number of employees assumed to be used in that phase of the project and the salaries that these laborers receive.
- **Indirect Impact:** This is defined as the additional impacts on the local community and other industries from business operation associated with the project. For example, the supplies purchased from a local contractor in the construction phase, or the services provided by an engineer in the design of the structure would both be considered indirect impacts.
- **Induced Impact:** This is defined as the additional impact on the local community through household expenditures and redistribution of the incomes generated in the direct and indirect impacts.

All three types of impacts can be shown in terms of employment generated and the dollar value of additional economic activity in the community. The dollar value can be reported in two different ways. The first, "Value Added," is a measure of the payments to the community as a result of the new business activity. The second, "Total Industry Output," is a measure of the total value of production related to the new business activity. This report focuses on "Value Added" because it better represents the net effects of the anticipated Proposed Action on the local community. All dollar figures presented are in 2004 dollars.

Institutional Support

Construction

The economic benefits related to the construction of the Project Support Building are derived from a few key assumptions, together with the regional data and the Implan model. The baseline data for construction projects was provided by Mission 2005. The construction costs are based on the 2003 International Building Code construction cost estimates. The cost estimate for this type of building is $94.65 per square foot. Based on the approximate square footage of 10,000 for Project Support Building, the construction cost estimates is $1,500,000. This cost estimate is not to be interpreted as actual costs to perform the work, but simply approximations included for the purpose of this analysis. This information is used on the Implan model to determine the expected number of employees that would be needed for the construction of each project and the expected economic impacts to the local community.

The annual wages for these laborers is estimated through the model, taking into account the regional average wages for similar construction work. Second, it is assumed that 92.3 percent of the labor required for the construction phase of the project is supplied locally. Similarly, it is assumed that 92.3 percent of the supplies for construction can be purchased locally. Both assumptions are supported by the data used in the modeling. Implan uses a Regional Purchase Coefficient (RPC), which estimates how much of the necessary supplies for a given type of economic event can be purchased within the local region. The RPC is 92.3 percent for the construction sector in Accomack County, Virginia.

Table 4-9 details the direct, indirect, and induced impacts on employment in the region resulting from the construction phase of the project. The impacts are reported on an annual basis. The direct jobs are simply the number of jobs that are created for the construction of the project. The indirect jobs are new jobs created as a result of business operations necessary to support the construction. And the induced jobs are new jobs created as a result of the increased economic activity in the area. The total number of annual jobs created in Accomack County, Virginia, as a result of the construction is estimated to be 35.7. These jobs would disappear after completion of the construction phase.

Table 4-9 Expected Construction Employment (Annual Jobs)

	Project Support Building
Direct Impacts	24
Indirect Impacts	5.9
Induced Impacts	5.8
Total Jobs	35.7

Table 4-10 provides the value added, in 2004 dollars, from the construction phase of the project. The direct impacts are simply the value of the project budgeted and contracted to the construction firm. The indirect costs reflect the additional value to the economy from purchases of goods and services necessary for the construction of the project. The induced impacts capture the net gain from the redistribution through the community of income

generated by the project. The total economic output from the construction is estimated to be $2,552,815. The total value added from the construction is estimated to be $910,413.

Table 4-10 Construction Impacts (2004 Dollars)

	Total Output	Value Added
Direct Impacts	1,750,753	439,829
Indirect Impacts	361,947	203,165
Induced Impacts	410,114	267,419
Total Output	2,522,815	910,413

Not enough information was available for the M-Area Control Building to use Implan. It is anticipated that construction of the M-Area Control Building would have the same beneficial impact to employment and income.

Demolition

The economic benefits related to the demolition projects are derived from a few key assumptions, together with the regional data and the Implan model. The baseline data for demolition projects is provided by Mission 2005. This provides a listing of the expected demolition projects and the year that they are expected to take place. The proposed demolition projects through 2009 are listed in Table 2-3, which shows a total of 55 proposed demolition projects. For the purposes of the economic impact model, the demolition projects are grouped by the total expected in each year. Table 4-11 below shows the number of projects and estimated total square feet for demolition by year.

Table 4-11 Expected Annual Demolition Projects

	FY04	FY05	FY06	FY07	FY08	FY09
Number of Sites/Buildings	13	24	9	2	8	1
Total Estimated Square Feet	19,400	41,400	16,800	1,000	13,000	6,000

The employment and economic impacts of the demolition projects are temporary in nature, similar to the construction impacts. There are two major costs associated with demolition projects that WFF would presumably contract out – actual demolition (primarily labor) and disposal. While the costs of both activities can vary depending on the type of material and potential hazardous waste, the estimates provided here are based on average costs for these activities. Therefore, the information on the demolition projects provides estimates of economic impacts for expected volumes of activity.

Based on figures from the Deconstruction Institute (www.deconstrucitoninstitute.com/calculator), disposal fees average $27.56 per metric ton ($25 per ton) of debris and demolition costs average $18.73 per square meter ($1.74 per square foot). Additionally, the Deconstruction Institute estimates that a 185.8-square-meter (2,000-square-foot) home produces 115.21 metric tons (127 tons) of debris. These figures are used to calculate the inputs for the Implan modeling. Table 4-12 lists the expected demolition by year and by activity — demolition or disposal. This information is used on the Implan model

to determine the expected number of employees needed for each project and the expected economic impacts to the local community.

Table 4-12 Expected Annual Demolition Project Costs (2004 Dollars)

	FY04	FY05	FY06	FY07	FY08	FY09
Demolition	30,798	65,723	26,670	1,588	20,638	9,525
Disposal	33,756	72,036	29,232	1,740	22,620	10,440
Total Project Costs	64,554	137,759	55,902	3,328	43,258	19,965

Based on the total project costs, the expected labor force required to perform the demolition projects is estimated in the two tables below. First, the number of equivalent labor days is calculated based on one labor-day per $100 of demolition costs. Second, the number of labor-days is translated into equivalent annual direct jobs by dividing by the number of working days in a calendar year (Table 4-13). The indirect and induced annual jobs are computed by the Implan economic model. And, as is the case with the construction jobs, the jobs created by the demolition projects are temporary for the length of the project.

Table 4-13 Expected Demolition Employment (Direct Impacts)

	FY04	FY05	FY06	FY07	FY08	FY09
Labor Days	646	1,378	559	33	433	200
Annual Jobs	2.48	5.30	2.15	0.13	1.66	0.77

Table 4-14 provides the value added, in 2004 dollars, from the demolition phase of the project. The direct impacts are simply the value of the project budgeted and contractor to the demolition firm. The indirect costs reflect the additional value to the economy from purchases of goods and services necessary for the demolition of the project. The induced impacts capture the net gain from the redistribution through the community of income generated by the project. The total economic output from the demolition is estimated to be $1,097,830, and the total value added from the demolition is estimated to be $396,176.

Table 4-14 Demolition Impacts (Accomack County)

	Total Employment	Total Output (Present Value)	Value Added (Present Value)
Direct Impacts	10.4	761,860	191,322
Indirect Impacts	2.6	157,505	88,410
Induced Impacts	2.5	178,465	116,370
Total Jobs	15.5	1,097,830	396,176

Operational Components

The addition of new operations would likely increase employment by civil service personnel, contractors, or both. Recent trends suggest that the expected increase in employment at WFF would be from contract employees. Over the past two decades, civil service positions at WFF have decreased, while contract employment has either increased or remained relatively fixed. The employment and income impacts to the surrounding community from an increase in employment would be small, as WFF makes up about 5 percent of the work force of Accomack and Northampton Counties.

The operations impacts for the proposed future actions are estimated through the study period. The basis for this analysis is the expected employment growth in the WFF Master Plan (NASA, 2003c). The Master Plan concept contains a graph depicting all expected employment growth at WFF from new contractors. The Master Plan concept assumes growth would occur with a fixed number of civil service employees, but increases in contractor support. Table 4-6 in Section 4.4.1 contains estimates of the employment growth based on the chart in the Master Plan. The average annual growth for the first 10 years is 30 employees per year, and the average annual growth for the following 10 years decreases to 20 employees per year. This permanent increase in employment would create positive economic impacts on the surrounding community. The magnitude of the impacts can be estimated using the Implan model.

Similar to the construction phase, certain assumptions are required to perform an input-output model for operations. First, it is assumed that the facility would create 30 new jobs per year based on the above data for the next 10 years. Second, it is assumed that the majority of the operations workforce would reside locally. According to the Implan model's RPC for the government services sector, the percentage supplied locally would be 66.5 percent.

Table 4-15 details the employment impacts of the proposed future operations of WFF in Accomack County, Virginia, and the Eastern Shore Region. The figures for the operational impacts only account for the first five years of expected employment growth. The direct jobs created, and filled by local employees is approximately 17.5 annually as opposed to the 30 jobs assumed to carry on the additional operations. This is a result of the estimated RPC for this sector in Accomack County. The total number of new jobs created in Accomack County as a result of the annual operations of the project is 151.5.

Table 4-15 Employment Impacts – First Five Years of Operational Growth

	Total Jobs Accomack County, Virginia	Total Jobs Eastern Shore Region*
Direct Jobs	88	150
Indirect Jobs	3.5	6
Induced Jobs	60	102.3
Total Jobs	151.5	258.3

* This column is not computed by Implan. These figures are based on the total jobs added at WFF and the factors generated by Implan for Indirect and Induced jobs.

Table 4-16 provides the total output and value added, in 2004 dollars, from the annual operation of the proposed actions. The direct impacts essentially reflect the labor costs and the proprietary income related to operations. The present value of total output as a result of the proposed

increase in future operations is estimated to be $16,810,808. The present value of value added as a result of the proposed increase in future operations is estimated to be $10,177,147.

Table 4-16 Total Output and Value Added for the First Five Years of Operational Growth (2004 Dollars)

	Total Output (Present Value)	Value Added (Present Value)
Direct Impacts	12,262,194	7,277,021
Indirect Impacts	276,034	142,812
Induced Impacts	4,272,580	2,757,314
Total Output	16,810,808	10,177,147

No Action Alternative

Under the No Action Alternative, activities would remain at present levels and there would be no additional impacts to employment and income. If the use of WFF declines it is anticipated that jobs would be lost. The No Action Alternative may have a negative impact on employment and income over time.

4.4.4 Health and Safety

General Consequences of the Proposed Actions

Accidents, spills, or leaks associated with various operations at WFF could impact the health and safety of the public, WFF personnel and contractors, and the environment. The WFF Fire Department, health services staff, and security force are available to provide the necessary assistance when such events occur. To minimize the chance of such an event, WFF complies with the guidelines established in the following safety documents:

- Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF), Range Safety Manual (RSM-2002), 2002;
- Wallops Flight Facility, Wallops Safety Manual (WSM-2002), 2002;
- Wallops Flight Facility and Surface Combat Systems Center, JDP 3006, Hurricane Preparation and Recovery, 2002;
- NASA Integrated Contingency Plan (ICP), 2001;
- NASA Hydrazine Response Plan, 2004c; and
- NASA Aviation Safety Policy, NPD 7900.4A.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

Proposed construction activities could present safety risks to construction personnel and WFF personnel, contractors, and/or guests in nearby facilities. To minimize risks to safety and human health, all construction activities would be performed by qualified personnel who

are trained to safely operate the appropriate equipment. Additionally, all activities would be conducted in accordance with Occupational Safety and Health Administration (OSHA) regulations and Virginia OSHA regulations. Appropriate signage and fencing would be placed to alert pedestrians and motorists of project activities, as well as any changes in traffic patterns. Health and Safety plans would be submitted by contractors for approval by Code 803 (Range and Mission safety) prior to work onsite. A safety briefing would be held at the pre-construction meeting with Code 228 and all contractors and subcontractors.

Demolition

Health and safety impacts for proposed demolition activities would be similar to impacts discussed above for proposed construction activities.

Transportation Infrastructure

Proposed construction activities associated with the upgrade, removal, or installation of transportation infrastructure at WFF would have similar health and safety impacts to those discussed above for proposed construction activities.

Payload Processing

Processing of routine payloads involves the handling of toxic and hazardous propellants including hydrazine, mono-methyl hydrazine (MMH), and nitrogen textroxide (NTO). Hydrazine and MMH are strong irritants that may damage eyes and cause respiratory tract damage. Exposure to high vapor concentrations can cause convulsions and possibly death. Repeated exposures to lower concentrations may cause toxic damage to liver and kidneys, as well as anemia. The EPA classifies hydrazine and MMH as probable human carcinogens. Both are flammable and could spontaneously ignite when exposed to an oxidizer. NTO is a corrosive oxidizing agent. Contact with the skin and eyes can result in severe burns. Inhalation of vapors can damage the respiratory system. NTO ignites when combined with fuels and may promote ignition of other combustible materials. Fires involving NTO burn vigorously and produce toxic fumes.

Health and safety impacts to personnel involved in propellant loading operations at the PPF would be minimized by adherence to OSHA regulations. These regulations require use of appropriate protective clothing and breathing protection. Toxic vapor detectors would be used in the facilities to monitor for leaks and unsafe atmospheres.

Spills, fires, and explosions would be possible outcomes from accidents during payload processing. A violent fire or explosion could result in severe injuries or even death. A catastrophic accident of this type during payload processing would be extremely unlikely. Most propellant spills would be contained within the processing facility with no health impacts to personnel. The most likely consequence of a severe accident during processing would be some level of damage to the payloads and the immediate liquid propellant transfer area. Injuries would not be anticipated if facility personnel follow emergency procedures. If human error (e.g., not following procedures or not wearing protective clothing or breathing equipment) occurs at the time of the accident, personnel may be exposed to toxic propellant vapors. This would result in some level of short-term adverse health impact and an incremental increase in the chance of the exposed individual(s) developing cancer.

Extremely small quantities of toxic propellant vapors would be emitted from payload processing facilities during propellant loading operations. These small emissions would not impact the health of the public or on-site personnel. The Toxic Hazard Assessment for the facility would provide additional protection by identifying the safety areas to be cleared of unprotected personnel during propellant operations.

Fueling

Flammable fuels used at WFF could cause fires or explosions if incorrectly used or stored. To minimize the risk of fire or explosion, all fuels would be stored and used in accordance with Federal and State regulations. NASA would comply with the fuel storage guidance provided in the ICP. In addition, all WFF personnel and contractors who perform fueling operations would be properly trained to safely use and store fuels. Fueling is not anticipated to affect the health and safety of WFF personnel or the surrounding public.

Storage

The improper storage of hazardous materials and fuels could result in health and safety impacts to WFF personnel, contractors, and guests. To minimize the risks associated with the storage of hazardous materials and fuels, NASA would comply with all applicable Federal and State regulations regarding the use and storage of such materials. NASA would comply with the fuel storage guidance provided in the ICP and OSHA hazardous material storage guidelines. In addition, all WFF personnel and contractors who work with hazardous materials and fuels would be properly trained to safely use and store such materials. With the appropriate safety measures above, storage activities at WFF are anticipated to have no impact on health and safety of WFF staff or the surrounding public.

Safety and Security

Security

Implementation of security programs at WFF would result in a beneficial impact to the health and safety of WFF personnel, contractors, and guests by protecting WFF from a variety of dangers. Security activities could, however, present safety risks to security personnel. To minimize risks, all security personnel would be properly trained and provided appropriate protective equipment.

Fire Suppression

Implementation of the fire prevention and protection program would result in a beneficial impact to the health and safety of WFF personnel, contractors, and guests by preventing and protecting against uncontrolled fires. Fire fighting activities could, however, present safety risks to WFF Fire Department personnel. To minimize risks, all members of the WFF Fire Department would be properly trained and required to wear personal protective equipment during fire fighting activities.

Operational Components

Rockets

Inherent risks associated with rocket launch operations could impact public safety and the safety of WFF personnel and contractors. NASA has established ground and flight safety

guidelines to minimize these impacts. WFF's Safety Office is responsible for implementing these safety guidelines. NASA document RSM-2002, *Range Safety Manual for Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF)* outlines ground and flight safety requirements, range user and tenant responsibilities, and safety data requirements to which all range users must conform.

To ensure the safety of personnel, property, and the public, WFF requires all range users to submit formal documentation pertaining to their proposed operations for safety review. Mission-specific safety plans are prepared by WFF's Ground and Flight Safety Groups. These plans address all potential ground and flight hazards related to a given mission in accordance with the Range Safety Manual. It is the responsibility of the Safety Office to coordinate review of the proposed operations with all applicable organizations. Risks to human health and safety must be thoroughly addressed and managed by the plans.

The Ground Safety Plan outlines operational management procedures for minimizing risks to human health and the environment. Ground safety focuses on potential hazards associated with activities such as fueling, handling, assembly, and checkout for all pre-launch activities. System designs and safety controls are established to minimize the potential hazards associated with the operations of a launch range. The Ground Safety Plan specifically addresses the following areas:

- Hazardous materials handling;
- Explosive safety;
- Personal protective equipment;
- Health and safety monitoring;
- Training; and
- Operational security, controls, and procedures.

The Flight Safety Plan outlines flight management procedures for minimizing risks to human health and the environment. Flight safety focuses on the flight of the launch vehicle. WFF coordinates all operations with the FAA, U.S. Navy, Coast Guard, and other organizations as required in order to clear potential hazard areas. Notice to mariners (NOTMARS) and airmen (NOTAMS), which list restricted or hazardous areas, are announced at least 24 hours prior to a launch. All launch limitations are published in the Flight Safety Plan.

To protect the public, range participants, and property from risks associated with rocket launch operations conducted at WFF, certain risk criteria have been established. The following risk criteria shall not be exceeded for any mission, unless supported by an approved Safety Analysis Report:

- Casualty expectation for all mission activities shall be less than 1 in 1,000,000;
- Probability of hitting a ship shall be less than 1 in 100,000; and
- Probability of hitting an aircraft shall be less than 1 in 10,000,000.

A preliminary flight trajectory analysis is completed prior to each launch to define the flight safety limits for guided and unguided systems. Vehicle systems with Flight Termination Systems will be terminated by destruction of the vehicle if the flight is deemed erratic or

transverses the established destruct boundary. All stages are required to be equipped with flight termination systems unless the maximum range of the vehicle is less than the range to all protected areas or the vehicle is determined to be inherently safe.

Flight termination boundaries are designed to ensure that vehicle destruction occurs within a predetermined safety zone. This safety zone is established for the protection of the public, personnel, and the environment. While failures have occurred in the past, there has been no evidence of acute or cumulative safety impacts as a result of launch failures.

Balloons

Balloon operations pose a risk to property and public safety if a balloon (with its associated payload) does not make it to its target location and instead lands in an inhabited area. To minimize the risks associated with balloon operations, WFF personnel would comply with the balloon flight requirements outlined in RSM-2002, *Range Safety Manual for Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF).* The RSM-2002 states that all balloon operations must be conducted within approved operational areas. In addition, in most cases, a flight termination system is required for balloons. A functional test of the flight termination system is conducted prior to launch.

Piloted Aircraft

Inherent risks associated with aircraft operations could impact public safety and the safety of WFF personnel and contractors. To minimize impacts, WFF has established an Aviation Safety Program. The main elements of the Aviation Safety Program include:

Aviation Safety Training, Education, and Awareness

Aviation Safety Survey and Inspection – A comprehensive aviation safety survey and inspection is conducted bi-annually by the Aviation Safety Officer (ASO). This survey identifies potential aviation hazard areas, isolates inadequate aviation policies for elimination or correction, and documents recommendations that could help prevent aviation mishaps. The survey is intended to complement the formal safety survey and inspection by the NASA Headquarters Intercenter Aircraft Operations Panel, which is conducted in alternating years.

Aviation Safety Council – A council consisting of personnel representing senior management, aviation management, airport management, test range management, aviation safety, the WFF Safety Office, and occupational health/industrial safety meets quarterly, at a minimum, to review aviation safety policy and issues. The Council functions to promote mishap prevention through exchange of ideas, discussions, and review of potential hazards or deficiencies. The ASO is authorized to set the Council agenda. The agenda may be supplemented as deemed necessary by the attendees. Council meetings normally include additional personnel who may be party to particular safety issues.

Aviation Safety Meetings – Meetings are conducted on a monthly basis to focus on specific safety topics and overall safety awareness. These meetings may be part of regular aircraft operations and maintenance meetings.

Aviation Safety Education and Training – Safety education for aviation safety officers includes attendance at a recognized aviation safety officer's training course

and participation in a continuing education program to ensure adequate knowledge to discharge the duties of the Aviation Safety Officer's position. Safety training is a part of indoctrination for all new aviation and project personnel.

Aviation Medical Program and Aviation Life Support Equipment – The aviation medical program, as well as Aviation Life Support Equipment (ALSE), are important parts of aviation safety awareness. Safety briefings for all project flight crewmembers include medical requirements and the proper use of ALSE.

Aviation Safety Publications –Aviation managers ensure that aviation publications are distributed to appropriate personnel.

Aviation Safety Awards – Aviation managers periodically use safety incentives and awards to motivate and maintain safe behavior.

Aviation Safety Bulletin Boards – Current aviation safety bulletin boards are maintained in high visibility locations where aviation activities are conducted.

Hazard Reporting, Investigation, and Control

The primary means of reporting close calls and hazards is through the online Goddard Problem Reporting System which can be accessed at http://gprs.gsfc.nasa.gov/. Reporting may also be done verbally or in writing to management or the GSFC ASO. The FAA/NASA Aviation Safety Reporting System (ASRS) can also be used. The ASRS can be accessed online at http://asrs.arc.nasa.gov/. Managers using aviation assets must ensure the timely investigation and proper control of all reported hazards.

Mishaps and Near Miss Reporting, Investigation, and Prevention

NASA publications NPD 8621.1 and NPG 8621.1 provide policy and guidelines for NASA mishap reporting and investigation. Aviation managers and the ASO are knowledgeable of current procedures and guidelines. Pre-mishap planning requirements are outlined in the Aircraft Mishap Response Plan for GSFC/WFF (803-PLAN-0001).

Risk Management, Risk Assessment, and Hazard Analysis

Risks associated with aviation activities are identified, assessed, planned for, tracked, and controlled. Risk assessment documentation is presented to all readiness review panels and senior management for review and approval prior to flight.

Project and Program Safety Plans

All GSFC aviation projects and programs are required to submit written safety plans. These plans are documented in an Operations and Safety Directive or equivalent. This documentation is reviewed and approved by project management, the appropriate safety office, the GSFC ASO, and senior management.

Airworthiness Review of Engineering Design and Aircraft Configuration Changes

All flight operations are conducted in accordance with a thorough review and approval process. All projects flown on NASA aircraft assigned to GSFC are required to have Airworthiness Review Board approval.

Flight/Mission Readiness Reviews

All GSFC airborne science projects require review and approval by a management appointed flight/mission readiness review panel prior to flight (NASA, 2001d).

WFF aviation personnel must also comply with all other applicable NASA and FAA aviation safety guidance to minimize risks associated with aircraft operations.

Uninhabited Aerial Vehicles

Risks and safety measures for UAVs would be similar to those described above for Piloted Aircraft.

Payloads

Payloads may contain materials (i.e., lasers, radioactive materials, and biological agents) that present health and safety risks to the public and WFF personnel and contractors. Use of these materials would comply with all applicable regulations and risks would be minimized as discussed below for each material. Compliance with the following regulations and safety protocols would ensure that no significant health and safety impacts result from the use of payloads.

Lasers

Potential human health effects associated with the use of lasers include eye damage, skin damage, and thermal damage to body tissue. To minimize the risk of injury, only trained personnel would operate laser systems at WFF. When necessary, personnel operating lasers or personnel in close proximity to laser activities would wear appropriate personal protective equipment. Laser use must adhere to ANSI Z136.1-2000 (American National Standard for Safe Use of Lasers) and ANSI Z136.6-2000 (Safe Use of Lasers Outdoors), as well as applicable Federal and Virginia OSHA regulations regarding laser use.

ANSI standards outline permissible exposure limits needed to avoid eye and skin injury from lasers and to safely use visible lasers outdoors. In addition to eye and skin hazards, ANSI Z136.6-2000 also requires visible lasers, used outdoors, to not cause interference with spacecraft and aircraft operations. For visible lasers, the FAA must provide a letter of non-objection for outdoor scientific laser use. This requirement is needed to protect potentially exposed persons from hazardous reactions to bright light. Hazards include transient visual effects of laser beams such as flash blindness, afterimage, glare, and startle.

Radioactive Materials

Some payloads could use small amounts of radioactive materials as scientific instrument components. The amount of radioactive material that can be carried is strictly limited by the approval authority delegated to the NASA NFSAM. As part of the approval process, the program manager must prepare an RMR that describes all of the radioactive materials to be used and then submit that documentation to the NFSAM for review.

The amount of radioactive materials used on routine payloads would be limited to small quantities, typically a few millicuries, and the materials would be encapsulated and installed prior to arrival at the launch site. Due to the small amount of material used and

the safety precautions in place, the use of radioactive materials in payloads in not expected to result in significant health and safety impacts.

Biological Agents

The use of biological agents on payloads is limited to materials with a safety rating of "Biosafety Level 1." This classification includes defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy human adults. Personnel working with Biosafety Level 1 agents follow standard microbiological practices including the use of mechanical pipetting devices, no eating drinking, or smoking in the laboratory, and required hand-washing after working with agents or leaving a lab where agents are stored. Personal protective equipment such as gloves and eye protection is also recommended when working with biological agents.

Chemical Release Agents

TMA is pyrophoric and spontaneously combusts on contact with air or water. TMA would be stored in a flammables storage building. Only personnel employed by Clemson University and trained in the handling, transportation, loading, and disposal of TMA would perform these tasks. When handling TMA, these personnel would adhere to the following: *TMA Disposal Procedures* (6 February 2004), *TMA Loading Procedures* (10 January 2003), *TMA Payloads:Piston Removal and O-Ring Replacement Procedure* (10 January 2003), and *TMA Unloading Procedures* (10 January 2003). Proper safety procedures would be followed for any other chemical used for release. Due to the safety precautions in place, no significant impacts to health or safety are anticipated from chemical release agents.

Tracking and Data Systems

Various tracking and data systems at WFF utilize radar, telemetry, and transmitters that could potentially impact the health and safety of the public, as well as WFF employees, contractors, and guests. To ensure that health and safety risks are minimized, NASA would only use tracking and data systems that present no known radiation hazard to populated regions of the Earth or its atmosphere.

NASA operations are within the accepted levels for human exposure to radio frequency electromagnetic fields (3 kHz to 300 GHz), described in the "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz" (IEEE C95.1-1991). IEEE C95.1-1991 is an ANSI-recognized standard. IEEE C95.3-1991 "IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave," also recognized as an ANSI standard, provides formulas necessary to determine the fields associated with RF and microwave sources.

Compliance with the IEEE standards would ensure that no significant health and safety impacts result from the use of tracking and data systems.

Scientific Research Programs and Facilities

All research and laboratory activities conducted at WFF follow appropriate safety precautions and comply with applicable OSHA standards to ensure that the health and safety

of the public and WFF employees and contractors is protected. Compliance with safety protocols and applicable regulations would ensure that no significant health and safety impacts result from research and laboratory activities at the facility.

Open Burn Area

Operation of the OB area could result in injuries to personnel involved in burning activities. To minimize risks, appropriate safety precautions would be followed. Only essential, properly trained personnel would be in the OB area during rocket motor burns. Appropriate personal protective equipment would be worn during operations. Additionally, personnel would be located a safe distance from the actual burn during all operations. Compliance with these safety precautions would ensure that no significant health and safety impacts result from OB activities.

Rocket Boosted Projectile Testing

Rocket boosted projectile testing at Wallops Island could result in health and safety impacts to the general public, as well as WFF employees, contractors, and customers (U.S. Army or U.S. Navy staff). Appropriate safety precautions would be followed during all testing activities to minimize risks. The U.S. Army or U.S. Navy would work with the U.S. Coast Guard to ensure that the impact area is cleared prior to operations. All staff operating the rocket boosted projectile tests would be properly trained, and non-essential personnel would be cleared from the area prior to operations. Appropriate personnel protective equipment, such as ear protection, would be required.

No Action Alternative

Under the No Action Alternative, activities at WFF would remain at current levels and there would be no additional health and safety impacts.

4.4.5 Cultural Resources

General Consequences of the Proposed Actions

Direct physical impacts could occur when historic structures are demolished, modified, upgraded, realigned, or relocated. These impacts could occur not only to buildings but also to historic roads, runways, pipelines, and other facilities, structures, and landscapes. The original setting, design, and construction materials of such facilities may be affected. Indirect impacts to historic properties could occur when nearby facilities are modified or relocated or when temporary facilities are constructed. Direct physical impacts could occur to subsurface historic and prehistoric archaeological sites when new buildings are constructed, when existing buildings are demolished, or when other ground-disturbing activities are conducted. If, during the course of construction or demolition, unanticipated archaeological resources are uncovered, NASA would consult with the VDHR regarding appropriate treatment measures. The construction is not anticipated to impact historic structures.

The *Historic Resources Survey and Eligibility Report for Wallops Flight Facility* (NASA 2004a) would serve as the baseline for understanding the cultural resources at WFF and their treatment. The document identifies one resource, the Wallops Beach Lifeboat Station (VDHR #001-0027-0100; WFF# V-065) and its associated Coast Guard Observation Tower (001-0027-0101; WFF# V-070), eligible for individual listing in the National Register of Historic Places. No buildings

built between 1955 and 2005 have achieved exceptional importance which would make them eligible for individual listing in the NRHP under Criterion Consideration G.

For all existing and future actions which impact those cultural resources determined to be eligible for listing or listed in the National Register, NASA would be responsible for complying with Section 106 and Section 110 of the NHPA. NASA would consult with the VDHR and any other interested parties for actions that would impact NRHP-listed or eligible resources to identify the area of potential effect, the presence or absence of cultural resources, the effects the action would have on cultural resources, and the appropriate measures to avoid or mitigate impacts to cultural resources.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Construction

The proposed locations of the Project Support Building and M-Area Control Building are in areas that has been identified as having the low prehistoric and historic archaeological sensitivity (Figures 15 and 16). Therefore, construction of the Project Support Building and M-Area Control Building is not anticipated to impact archaeological resources. If, during the course of construction, unanticipated archaeological resources are uncovered, NASA would consult with the VDHR regarding appropriate treatment measures. The construction is not anticipated to impact historic structures.

Demolition

The *Cultural Resources Assessment* included as Appendix E, identified areas of low, moderate, and high archaeological sensitivity for both prehistoric and historic archaeological resources. While the majority of structures selected for demolition are located in areas of low archaeological sensitivity, some structures are located on or adjacent to areas with a higher level of archaeological sensitivity. These include two locations on the Main Base:

- A-027. The Pistol Range is located adjacent to an area that has high prehistoric and moderate historic archaeological sensitivity; and
- N-168. The ADAS TRKG Antenna is located adjacent to an area identified as having high historic archaeological sensitivity.

and two locations on Wallops Island:

- V-130. The wooden tower is located on an area of high historic archaeological sensitivity and adjacent to areas of high prehistoric archaeological sensitivity; and
- Z-042. The South Launch Pad Terminal Building is located adjacent to Site 44AC159, a historic archaeological site.

Demolition of these four properties would necessitate due care to ensure that any below ground archaeological resources are not disturbed. Should archaeological resources be uncovered during the demolition or removal of material, NASA would consult with the VDHR regarding the appropriate treatment measures. Demolition of the structures included on the list is not anticipated to impact the structures determined as historic by the *Historic*

Resources Survey and Eligibility Report (NASA, 2004a). Should an impact occur, NASA would consult with VDHR to determine appropriate mitigation strategies.

Routine Site Activities

Impacts and appropriate mitigation measures relating to cultural resources for this action would be the same as those discussed under General Consequences of the Proposed Actions.

No Action Alternative

Under the No Action Alternative, no cultural resources review would be required under Section 106 of the NHPA or the appropriate Programmatic Agreement.

Historic structures would be maintained or repaired as needed, and no impacts are anticipated. Existing archaeological resources or those associated with built environment resources, or coincidentally in proximity to such resources, would not be affected because no ground disturbance would occur.

4.4.6 Environmental Justice

General Consequences of the Proposed Actions

In compliance with EO 12898, WFF has organized a standing Environmental Justice Coordination Committee (EJCC) that has developed an Environmental Justice Implementation Plan (EJIP). The EJIP has evaluated the impacts of Federal actions at WFF and found that these actions do not disproportionately or adversely affect low-income and minority populations (NASA, 1996b).

This Site-Wide EA examines the various impacts of the Proposed Action to determine if any impact from the activities would be experienced disproportionately and adversely by minority or low-income communities within geographic areas in which the activities occur. Each environmental attribute addressed in this Site-Wide EA has been scrutinized from an environmental justice perspective. For example, if significant levels of air pollution resulted from the Proposed Action, the question, from the environmental justice perspective, would be whether this pollution would disproportionately and adversely impact areas in which minority or low-income populations reside in proportions greater than the general population.

Consequences Attributable to Specific Proposed Actions

There are minority and low-income communities in the vicinity of WFF; however, it is not anticipated that the Proposed Action would adversely affect these communities. As found in the EJIP, current WFF actions do not disproportionately affect low-income or minority populations. Since the Proposed Action is best summarized as the current activities and future expansion of existing research and operations at the base, it follows that the Proposed Action would also not disproportionately affect these populations.

No Action Alternative

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

4.4.7 Transportation

General Consequences of the Proposed Actions

In general, the implementation of the Proposed Actions could result in minor impacts to transportation and/or infrastructure. WFF operations include regularly scheduled infrastructure updates, improvements, and repairs, and these are not expected to have significant impacts to infrastructure or transportation. Any impacts that do occur could be minimized by adherence to the same procedures mentioned above.

Consequences Attributable to Specific Proposed Actions

Institutional Support

Traffic lanes could be temporarily closed or rerouted during construction and demolition activities, construction equipment and staging could interfere with pedestrian and vehicle flow, and construction activities near residential areas could interfere with residents' daily activities. To minimize these potential impacts, NASA would provide adequate advance notification of upcoming activities for all impacted areas, 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, and minimize the use of construction vehicles in residential areas. In the case of using or moving hazardous materials during construction activities, there are established facilities and procedures already in place at WFF to mitigate any potential impacts.

Operational Components

The road to the OB area on Wallops Island has been improved for use as a small runway for UAVs. If construction activities were to occur on this road, it is likely that UAVs could not use it as a runway during that time and an alternate runway would have to be designated. This impact is not considered to be significant.

The transportation of rockets and fuel are subject to both Federal and State regulations, including handling, labeling, and routing requirements. Targets such as the AQM-37 can be shipped overland in specially designed DOT-approved containers to protect the target in case of accident. The National Highway Traffic Safety Administration statistics show that the fatal accident rate for large trucks is one accident in every 59 million kilometers (37 million miles), making it a very rare occurrence.

No Action Alternative

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

4.5 CUMULATIVE EFFECTS

In accordance with NEPA and to the extent reasonable and practical, this Site-Wide EA considers the overall cumulative impact of the Proposed Action and other actions (both on and off WFF) that are related in terms of time or proximity. According to CEQ regulations, cumulative impacts represent the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions,

regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7)."

To address cumulative impacts, this section examines NASA actions occurring or proposed at WFF, as well as non-NASA actions occurring or proposed in the vicinity of WFF. The combined effects of these actions are evaluated to determine if they could result in any cumulative impacts. Resources not expected to have any cumulative impacts are not discussed in this section.

NASA ACTIONS

The Proposed Action consists of continuing the existing operations at WFF and expanding facilities and operations as necessary to meet the WFF mission. Most current and future operations at WFF can and will be covered under this Site-Wide EA. Certain current and future projects, though, are or will be analyzed in separate NEPA documentation.

A separate EA for construction of the Engineering Building on the Main Base has been prepared by NASA. The Engineering Building is part of the Phase I campus core construction. Construction of the Engineering Building will occur in an already developed area of the facility.

NASA is also proposing to develop a "Research and Education Park" on the Main Base. The Commercial Park would include various new buildings and roads necessary to meet the WFF mission. Although it is in the conceptual phase it is expected that construction of the Commercial Park would occur in both undeveloped and previously disturbed areas of the facility. NASA would complete separate NEPA documentation for this project.

NON-NASA ACTIONS

Due to low land prices and recently reduced tolls across the Chesapeake Bay Bridge-Tunnel (reduced from $10 to $4 for a return trip within 24 hours), development on the eastern shore of Virginia, including Accomack County, is growing and may increase significantly in the future. Houses are already being built closer to the borders of WFF and in nearby towns.

The airspace and ocean area within the VACAPES OPAREA are used by the U.S. Navy and other military units to conduct operations, training, and research and development activities; and to test and evaluate military hardware, personnel, tactics, munitions, explosives, and electronic combat systems. Specifically, the VACAPES OPAREA in the vicinity of WFF could be used for air-to-air, air-to-surface, surface-to-air, and surface-to surface missile, gunnery, and rocket exercises, as well as electronic warfare, super-sonic target, and carrier flight operations. The VACAPES OPAREA is not limited to these activities; these are only examples of the types of operations that may occur.

Commercial and recreational fishing occurs, and will continue to occur into the reasonably foreseeable future, in the bays, rivers, and Atlantic Ocean in the vicinity of WFF.

CUMULATIVE IMPACT ANALYSIS

Land Resources

Debris from various WFF operations (i.e., spent rockets, payloads, drones, and rocket boosted projectiles) lands in the Atlantic Ocean and eventually settles on the ocean bottom. This debris may consist of a variety of components including metals, batteries, electrical components, and

propellants. The combined effects of these materials entering the marine environment could result in cumulative impacts to the Atlantic Ocean substrate. The cumulative impacts of these actions could be compounded by other uses of the VACAPES OPAREA, which may result in the introduction of ordnance or other materials into the ocean. Additionally, the U.S. Navy is currently evaluating the suitability of the VACAPES OPAREA in the vicinity of WFF as a future shallow water training area for naval operations. Although the VACAPES OPAREA is not the preferred alternative at this time, it is one of only two action alternatives being considered by the Navy. The shallow water training area would be used by the Navy to train personnel to operate submarines, surface ships, and aircraft and their associated weapon systems. Infrastructure associated with the shallow water training range includes undersea cables, undersea acoustic transducer devices, and one small on-shore building. The effects of the shallow water training range operations, combined with the Proposed Action, could result in additional impacts to the substrate.

New construction covered under this Site-Wide EA combined with development and construction in other parts of the eastern shore, could result in cumulative impacts to land resources.

Water Resources

New construction on WFF and in the vicinity of WFF could result in increased stormwater runoff to local water bodies. These surface waters could be degraded due to the cumulative impact of increased runoff from NASA (WFF) and non-NASA sources.

Debris from various WFF operations (i.e., spent rockets, payloads, drones, and rocket boosted projectiles) lands in the Atlantic Ocean. This debris may consist of a variety of components including metals, batteries, electrical components, and propellants. The combined effects of these materials entering the marine environment could result in cumulative impacts to water quality and aquatic life. The cumulative impacts of these actions could be compounded by other uses of the VACAPES OPAREA, which may result in the introduction of ordnance or other materials into the ocean. Additionally, the U.S. Navy is currently evaluating the suitability of the VACAPES OPAREA in the vicinity of WFF as a future shallow water training area for naval operations. Although the VACAPES OPAREA is not the preferred alternative at this time, it is one of only two action alternatives being considered by the Navy. The shallow water training area would be used by the Navy to train personnel to operate submarines, surface ships, and aircraft and their associated weapon systems. Infrastructure associated with the shallow water training range includes undersea cables, undersea acoustic transducer devices, and one small on-shore building. The effects of the shallow water training range operations, combined with the Proposed Action, could result in additional water quality and aquatic life impacts.

Air Quality

Increases in the number of rocket launches and air flights over continuous years may have a cumulative impact on air quality. Numerous studies have been completed on the worldwide cumulative effects of rocket launches. Based on the conclusions of studies performed in the U.S., Europe, and Russia, it appears that launch vehicle emissions have minor cumulative effects on stratospheric ozone depletion, acid rain, toxicity, air quality, and global warning; however these impacts are extremely small compared to other anthropogenic impacts (USDOT/FAA, 2001). Cumulative impacts of worldwide launches are still being studied by several joint programs.

Noise

Noise levels from both institutional components (construction and demolition) and operational components (aircraft and rocket launches) are expected to increase. Cumulatively, the noise impact from these various sources would be greater than the impact from each of these sources evaluated separately. As development increases around WFF, there will likely be more sensitive receptors of this noise, although ambient noise levels would also be expected to increase due to additional traffic and commercial activity, which would be expected to minimize the public's sensitivity to noise generated at WFF.

Terrestrial Wildlife and Migratory Birds

New construction covered under this Site-Wide EA combined with development and construction in other parts of the eastern shore, could result in cumulative impacts to terrestrial wildlife and migratory birds by reducing the amount of suitable habitat in the area.

Marine Mammals and Fish

Operations at WFF, including rocket launches, payloads, drones and missiles, and rocket boosted projectile testing have the potential to adversely impact marine mammals and sea turtles if these operations were to result in a strike. As discussed in Section 4.3.4, sonic booms from rocket launches and the use of sonar in AUVs also have the potential to impact marine mammals and sea turtles. Based on available information and consultation with NMFS, NASA determined that WFF operations would not result in significant impacts to marine mammals or sea turtles. WFF operations combined with other VACAPES operations could, however, increase the chance for the incidental taking of a marine mammal or sea turtle. Additionally, the use of commercial fishing equipment is known to result in impacts to marine mammal species.

List of URS and EG&G preparers:

Rosa Gwinn, PhD, PG, Principal Geochemist – URS Project Manager

Shari Silbert, Environmental Scientist, EG&G Project Manager and Technical Reviewer

Ryan Thompson, Senior Environmental Planner, URS NEPA Task Leader, Prepared Proposed Action and Biological Resources

Fred Holycross, Senior Architectural Historian, URS Cultural Resources Task Leader, Prepared Cultural Resources and the Historic Resources Survey and Eligibility Report

Pieter deJong, Project Environmental Planner, URS Independent Technical Reviewer

Angela Chaisson, Senior Ecologist, URS Independent Technical Reviewer

Emlen Myers, URS Cultural Resources Group Leader, URS Independent Technical Reviewer

Janet Frey, Principal Environmental Planner and URS NEPA Group Leader, Prepared the NASA Wallops Flight Facility Site-Wide EA NEPA Checklist

Craig Tuminaro, Architectural Historian, Prepared Cultural Resources and the Historic Resources Survey and Eligibility Report

Kim Collini, Environmental Scientist, Prepared Water Resources, Biological Resources, Health and Safety, and Cumulative Impacts

Laurie Lemieux, Environmental Scientist, Prepared Air Quality and Noise

Carol Maggio, Project Urban Planner, Prepared Land Use, Transportation and Recreation

Brian Diepold, Economist, Prepared Population, Employment and Income and Environmental Justice

Jenny Raczko, Project Environmental Engineer, Prepared Hazardous Materials and Hazardous Waste, and Radiation

Mark Cecchini, Geologist, Prepared Land Resources

Initial coordination letters were sent to the following agencies:

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Attn: Mr. Robert Grabb, Assistant Commissioner
P.O. Box 756
2600 Washington Avenue
Newport News, VA 23607
(757) 247-2200

Virginia Department of Forestry
Attn: Mr. Michael Foreman
900 Natural Resources Drive, Suite 800
Charlottesville, VA 22903
(434) 977-6555

County Offices:

Accomack County Administration
Attn: Mr. R. Keith Bull,
County Administrator
P.O. Box 388
Accomack, VA 23301
(757) 824-5444

Accomack-Northampton Planning District Commission
Attn: Mr. Paul F. Berge
Executive Director
P.O. Box 417
Accomack, VA 23301
(757) 787-2936

The following organizations were sent copies of the Draft Site-Wide EA

Chesapeake Bay Local Assistance Department
Department of Agriculture and Consumer Services
Virginia Department of Transportation
Virginia Department of Health
Department of Conservation and Recreation
Virginia Marine Resources Commission
Department of Historic Resources
Department of Game and Inland Fisheries
Department of Environmental Quality
Department of Environmental Quality
U.S. Fish and Wildlife Services
Virginia Department of Forestry
NASA Headquarters
Department of Mines, Minerals, and Energy
U.S. Army Corps of Engineers
Virginia Institute of Marine Science
Virginia Department of Health
Virginia Senate
Accomack County Board of Supervisors
Accomack County Board of Supervisors

Accomack County Board of Supervisors
United States Senate
United States Senate
United States Senate
House of Representatives
Accomack County Board of Supervisors
Accomack County Board of Supervisors
Surface Combat Systems Center
Accomack County Board of Supervisors
House of Representatives
Accomack County Board of Supervisors
U.S. Coast Guard
United States Senate
Mayor of the Town of Chincoteague
Chinoteague Town Council
Trails End Campground
Accomack County Board of Supervisors
Marine Science Consortium
The Nature Conservancy
Chinoteague Chamber of Commerce
Accomack County Farm Bureau
Accomack County Administration
Accomack-Northhampton Planning District Commission
Eastern Shore Chamber of Commerce
Virginia House of Delegates
Accomack County Board of Supervisors
Citizens for a Better Eastern Shore
National Oceanic and Atmospheric Administration

NASA is the lead Federal agency for conducting the NEPA compliance process for this Site-Wide EA at Wallops Flight Facility. The lead agency's goal is to expedite the preparation and review of NEPA documents while meeting the intent of NEPA and complying with all NEPA provisions including NHPA, EO 12114, EO 11988, EO 11990, Clean Air Act, Clean Water Act, and Resource Conservation and Recovery Act.

The draft Site-Wide EA was made available for public review between November 10 and December 10, 2004, at the following locations:

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

Eastern Shore Public Library
23610 Front Street
Accomac, Virginia 23301
Hours: Mon, Tues, Wed, Fri:
9 a.m. - 6 p.m.
Thurs: 9 a.m. - 9 p.m. Sat: 9 a.m. - 1 p.m.

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

The following Public Notice advertising the availability of the Draft Site-Wide EA was placed in the Eastern Shore News, the Eastern Shore Post, the Chincoteague Beacon, and the Salisbury Daily Times on November 10, 2004.

NASA solicited public and agency review and comment on the environmental impacts of the proposed action through:

1. A notice of availability of the draft Site-Wide EA published in the Eastern Shore News, the Salisbury Daily Times, the Chincoteague Beacon, and the Eastern Shore Post on November 8, 2004;
2. Publication of the draft Site-wide EA on the WFF Environmental Office website;
3. Employee presentation meeting on November 18, 2004;
4. Consultations with local, state, and federal agencies; and
5. Direct mailing of the draft Site-Wide EA to interested parties.

Comments received were taken into consideration in the final EA. No public comments were received. The Final Site-Wide EA can be viewed on the WFF Environmental Office website: http://www.wff.nasa.gov/~code250/Documents/Site-Wide_FEA.htm

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

Mr. William B. Bott, P.E.
Wallops Flight Facility, Code 250.W
Wallops Island, VA 23337
Phone: (757) 824-1103
FAX: (757)824-1819

PUBLIC NOTICE
Notice of Availability
DRAFT SITE-WIDE ENVIRONMENTAL ASSESSMENT
WALLOPS FLIGHT FACILITY

NASA has prepared a draft Site-Wide Environmental Assessment (Site-Wide EA) for recurring activities and proposed future actions at Wallops Flight Facility (WFF). NASA has decided to analyze and address the potential impacts of current and future activities at the WFF site in one National Environmental Policy Act (NEPA) document in an effort to create a more integrated review and analysis. This document will facilitate NASA's compliance with NEPA by providing a framework within which to address the environmental impacts of typically occurring actions and planned future actions at WFF.

The Proposed Action is the typical recurring actions undertaken by NASA and NASA customers, as well as reasonably foreseeable future actions at WFF. At WFF, NASA supports its own operations and facilities, other NASA organizations and facilities, other government organizations, commercial industry, and academia through flight projects, mission operations, and the use of infrastructure, people, and equipment.

The draft EA is available for review between November 10, 2004 and December 10, 2004. Comments must be submitted by December 10, 2004. Comments may be sent electronically to William.B.Bott@nasa.gov; Subject: Site-Wide EA. Written comments should be submitted to:

William B. Bott, P.E.
Wallops Flight Facility
Code 250.W/Site-Wide EA
Building F-160, Room W-159
Wallops Island, VA 23337
Fax – 757-824-1819

The draft EA may be viewed on-line at http://www.wff.nasa.gov/~code250/Documents/documents.htm
The draft EA is available for review at the following locations:

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

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

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

For further information contact Keith Koehler with the Wallops Flight Facility Office of Public Affairs at (757) 824-1579. Copies of the draft EA are available by contacting William B. Bott at (757) 824-1103

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Appendix A

NASA WFF Site-Wide EA NEPA Checklist

Appendix B

Agency Coordination

Appendix C

U.S. Fish and Wildlife Coordination on Piping Plover Habitat on Wallops Island

Appendix D

National Marine Fisheries Service Coordination On Marine Mammals

Appendix E

Cultural Resources Assessment

The Cultural Resources Assessment is presented in the attached CD-ROM.

Appendix F

Historic Resources Survey and Eligibility Report

The Historic Resources Survey and Eligibility Report is presented in the attached CD-ROM.