FINAL Programmatic Environmental Assessment (PEA) for Adoption of JSC's Master Plan

Center Operations Directorate (JA)

Availability:

Available only with approval of issuing office: JE

June 2016

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
Houston, Texas

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ABSTRACT

LEAD AGENCY:	National Aeronautics and Space Administration (NASA) Lyndon B. Johnson Space Center (JSC)
PROPOSED ACTION:	Adoption of JSC's Master Plan, including planned infrastructure activities at JSC's Main Campus and its associated installations at Ellington Field, the El Paso Forward Operating Location, the Sonny Carter Training Facility, and the White Sands Test Facility.
FOR FURTHER INFORMATION CONTACT:	JSC, EF, EPFOL, and SCTF: David Hickens, Lead; JSC Environmental Office (Mail Code: JE; Telephone: 281-483-3120; E-mail: david.hickens-1@nasa.gov) WSTF: Tim Davis, WSTF Environmental Manager (Mail Code: RA; Telephone 575-524-5024 E-mail: timothy.j.davis@nasa.gov)
DATE:	June 2016
ABSTRACT:	NASA has prepared this Programmatic Environmental Assessment (PEA) in conjunction with development, approval, and adoption of the JSC Master Plan. The scope of the Master Plan includes the Johnson Space Center Main Campus, NASA-Ellington Field, the El Paso Forward Operating Location, the Sonny Carter Training Facility, and the White Sands Test Facility. NASA policy explicitly requires each Center to develop, maintain, and implement a Master Plan for the orderly management and future development of the Center's real property assets, including land, buildings, physical resources, and infrastructure in support of mission requirements. This PEA includes an environmental analysis of JSC's 20-year revitalization strategy for constructing new state-of-the-art installations, renovating critical infrastructure, and vacating and/or demolishing (deconstructing) non-essential installations in order to support core capabilities, meet mission requirements, and respond effectively to mission changes. Adoption of the revitalization strategy would result in resilient buildings, reliable infrastructure, safe and secure access, and a livable, sustainable campus. Through the NEPA public participation process, JSC provides transparency and solicits input from stakeholders into the decision to adopt the JSC Master Plan. If not adopted, JSC would not achieve conformity with the goals of Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*, and would risk the ability to support funding requests for infrastructure improvements necessary for mission success. The PEA envisions detailed environmental analysis of each of its individual elements (e.g., projects) through a tiered structure. As appropriate, individual projects would be executed in the manner necessary to conform with the Master Plan and comply with NASA's implementing regulations (14 CFR 1216.3)

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FINDING OF NO SIGNIFICANT IMPACT (FONSI)

AGENCY: National Aeronautics and Space Administration (NASA)
Lyndon B. Johnson Space Center (JSC)

ACTION: Finding of No Significant Impact

SUMMARY: Based upon information presented in the DRAFT Programmatic Environmental Assessment (PEA) and comments received during the public comment period, NASA has made a Finding of No Significant Impact (FONSI) for the adoption of the JSC Master Plan for the JSC Main Campus, NASA-Ellington Field, El Paso Forward Operating Location, the Sonny Carter Training Facility, and the White Sands Test Facility. This finding is based upon the National Environmental Policy Act of 1969, as amended (NEPA), NASA's regulations implementing the procedural provisions of NEPA (14 CFR 1216.3), and NASA Procedural Requirement 8580.1.A, *Implementing NEPA and Executive Order 12114.*

The JSC Master Plan is needed for JSC to secure funding to support core capabilities, meet mission requirements, and respond effectively to future mission changes. The overall goals of the Master Plan are to further human spaceflight by developing resilient buildings, reliable infrastructure, safe and secure access, and a livable campus. The Master Plan is a management tool to achieve JSC's vision to develop, operate, and integrate human space exploration activities involving commercial, academic, international, and U.S. Government partners. As such, the JSC Master Plan includes a 20-year revitalization strategy to support redevelopment of JSC's real property assets and comply with Executive Order 13693, *Planning for Federal Sustainability in the Next Decade.*

DATE: June 2016

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Comments received during the comment period will be addressed within the Final PEA, and will be considered in the decision to finalize this FONSI.

SUPPLEMENTAL INFORMATION: To support the decision-making process to adopt and socialize the JSC Master Plan, NASA-JSC prepared and finalized a Programmatic Environmental Assessment (PEA). The PEA represents an accurate and adequate analysis of the associated environmental impacts of the Proposed Action.

Under the No-Action Alternative, NASA would not adopt the JSC Master Plan and JSC would continue to operate and maintain the buildings and infrastructure currently in use. Because of the age and configuration of its installations, many of which are now over 50 years old, JSC would risk the capability of meeting human spaceflight mission requirements. Thus, JSC would not achieve the goals of

developing resilient buildings, reliable infrastructure, safe and secure access, and a livable, sustainable campus as envisioned under Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*.

The revitalization strategy includes a combination of new highly efficient construction, demolition (deconstruction) of inefficient irreparable buildings, infrastructure enhancements to improve energy and water utilization, and other improvements that will result in better safety, security, and communication systems.

The PEA evaluated the environmental consequences of the proposed action on surface water; groundwater; wetlands; floodplains; coastal zone management; noise; air quality; greenhouse gas emissions and climate change; hazardous material uses, hazardous waste generation and pollution prevention; ecosystems (e.g., vegetation; wildlife; endangered species); land use; socioeconomic and cultural resources. Where NASA anticipates that insignificant (minor, temporary and primarily construction-related) impacts may occur, JSC would employ various Best Management Practices and other mitigation measures along with appropriate monitoring activities to reduce adverse impacts during implementation of the JSC Master Plan.

During the public comment period on the DRAFT PEA, JSC received only one comment. Appendix B of the PEA includes the comment letter and JSC's response. In addition, minor changes were made to the text of the PEA, and the long-term plan for NASA-EF was altered to include expansion to the south for a new warehouse.

Implementation of the JSC Master Plan is contingent upon the availability of funding. As such, as individual elements of the JSC Master Plan receive funding, NASA will perform an environmental analysis (per 14 CFR 1216.3) to determine whether the individual element is eligible for a categorical exclusion (per 14 CFR 1216.4(d)), whether a tiered environmental assessment off of the Master Plan PEA is appropriate, or whether a stand-alone environmental document (EA/FONSI or EIS) is necessary. Adoption of the Master Plan would ensure that individual projects do not result in the appearance of segmentation or adverse cumulative effects.

Per its procedural guidelines, NASA has committed to reviewing the JSC Master Plan PEA as significant changes to the JSC Master Plan occur, or at least every five years, to determine whether any changes would necessitate the preparation of a Supplemental PEA. At a minimum, NASA will prepare a Memorandum for the File, documenting the outcome of each JSC Master Plan PEA review.

Based upon the information presented in the PEA, I have determined that the environmental impacts associated with the adoption of the JSC Master Plan would not individually or cumulatively have a significant effect on the human enviroment. Therefore, issuance of a FONSI is warranted, and preparation of an Environmental Impact Statement (EIS) is unnecessary.

Ellen Ochoa

Ellen Ochoa
Director, Johnson Space Center

7/20/16
Date

CHANGE HISTORY LOG

Revision	Date	Originator	Description of Changes
Baseline – Draft	January 2016	David Hickens	Initial Version
Baseline – Final	June 2016	David Hickens	A. Revised text within Section 3.6.2 to address comments from the Texas State Historic Preservation Office (See Appendix B). B. Reorganized Appendix A to enhance readability by grouping the attachments by individual facility. C. Modified Appendix A to show the expansion of the NASA-EF southern property line (i.e., future property acquisition) to accommodate construction of a new warehouse. This property acquisition was not shown in the DRAFT PEA. D. Removed the previous Appendix B (Rare, Threatened and Endangered Species lists for Harris County Texas and Dona Ana County New Mexico) and instead inserted links to the most current lists within the text of Section 3.5.3 for consistency with other referenced requirements. E. Modified the Final Finding of No Significant Impact for the above changes within corresponding changes within the text of the Final JSC Master Plan PEA.

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LIST OF ACRONYMS

ACHP	Advisory Council on Historic Preservation
ADA	Americans with Disabilities Act
AOD	Aircraft Operations Division
BLM	Bureau of Land Management
BMP	Best Management Practice
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CLCWA	Clear Lake City Water Authority
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CoH	City of Houston
CRMP	Cultural Resource Management Plan
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DOD	U.S. Department of Defense
DOE	Department of Energy
DOPAA	Description of the Proposed Action and Alternatives
DP	Discharge Plan
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EMS	Environmental Management System
EMP	Environmental Management Program
EO	Executive Order
EPA	Environmental Protection Agency
ERD	Environmental Resource Document
ESTA	Energy Systems Test Area
EJ	Environmental Justice
FONSI	Finding of No Significant Impact
GHG	Greenhouse Gas
HAPs	Hazardous Air Pollutants
HCFCD	Harris County Flood Control District
HGB	Houston-Galveston-Brazoria
HVAC	Heating, Ventilation, and Air Conditioning
HPO	Historic Preservation Officer

ISS	International Space Station
JER	Jornada Experimental Range
JSC	Johnson Space Center
LEED	Leadership in Energy and Environmental Design
LMF	Light Manufacturing Facility
MS4	Municipal Separate Storm Sewer System
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NASA-EF	Ellington Field and the El Paso Forward Operating
NBL	Location Neutral Buoyancy Lab
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NMED	New Mexico Environment Department
NMFS	National Marine Fisheries Service
NO_x	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NPR	NASA Procedural Requirement
NRHP	National Register of Historic Places
NSR	New Source Review
NWPs	Nationwide Permits
P2	Pollution Prevention
PBR	Permits by Rule
PCB	Polychlorinated Biphenyls
PEA	Programmatic Environmental Assessment
RACT	Reasonably Available Control Technology
RCRA	Resource Conservation and Recovery Act
RCAT	Reciprocating Internal Combustion Engines
SAL	State Archaeological Landmark
SAM	San Andreas Mountains
SCTF	Sonny Carter Training Facility
SDIL	Software Development and Integration Laboratory
SEA	Supplemental Environmental Assessment
SHPO	State Historic Preservation Officer/Office
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SWMP	Storm Water Management Plan

TCAA	Texas Clean Air Act
TCEQ	Texas Council on Environmental Quality
TDRSS	Tracking and Data Relay Satellite System
THC	Texas Historical Committee
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
USACE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
USFWS	U.S. Fish and Wildlife Service
WSTF	White Sands Test Facility
WSMR	White Sands Missile Range

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EXECUTIVE SUMMARY

The National Aeronautics and Space Administration (NASA) Johnson Space Center (JSC) has prepared a Programmatic Environmental Assessment (PEA) to provide transparency, encourage widespread dissemination, and assist in the decision-making process to adopt the JSC Master Plan. JSC has prepared the PEA per the National Environmental Policy Act of 1969 (NEPA), as amended; NASA's NEPA policy and procedures (14 CFR 1216.3); and NASA Procedural Requirements as outlined in NPR 8580.1, *Implementing NEPA and Executive Order 12114*. The PEA considers the environmental impacts of the Proposed Action as compared to the No-Action Alternative.

A public notice, dated February 11, 2016 and published within local newspapers within the potentially affected areas, announced a 30-day public comment period. In addition, JSC contacted tribal nations, local, state, and federal agencies, and other interested parties either directly or through each state's respective NEPA clearinghouse. JSC received only one comment. Appendix B includes the comment letter from the Texas State Historic Preservation Office (SHPO) and JSC's response.

A Finding of No Significant Impact (FONSI) accompanies this PEA for adoption of the JSC Master Plan.

SUMMARY OF THE PROPOSED ACTION

The Proposed Action at JSC is to adopt the JSC Master Plan. This action will align JSC's Main Campus, NASA-Ellington Field (EF) (including the El Paso Forward Operating Location), Sonny Carter Training Facility (SCTF), and White Sands Testing Facility (WSTF) with JSC's overall human space exploration mission and provide for the buildings and infrastructure necessary to support current and future mission requirements. Adopting the JSC Master Plan would enhance the functional and aesthetic value of each of the installations. The proposed JSC Master Plan includes a redevelopment strategy in three phases, implemented over 20 years, that would replace aging buildings in poor condition with new, sustainable water/energy efficient buildings and infrastructure with improved working environments, better functional relationships, and reduced operating costs.

Subsequent implementation of the JSC Master Plan is dependent upon priorities and anticipated funding levels. Master planning is an ongoing process. Therefore, JSC may find it necessary to modify the JSC Master Plan over the next twenty years. JSC will review the Final PEA periodically (and at least once every five years, as required by NASA's procedures) to determine if the Master Plan has substantially changed or if there is new environmental information that would warrant additional environmental review. As appropriate, NASA would supplement the PEA with additional environmental documentation at that time.

NO-ACTION ALTERNATIVE

The No-Action Alternative would maintain existing operations, installations and infrastructure. Because of the age and configuration of its installations, many of which are now over 50 years old, JSC would risk the capability of meeting human spaceflight mission requirements. Thus, JSC would not achieve the goals of developing resilient buildings, reliable infrastructure, safe and secure access, and a livable, sustainable campus as envisioned under JSC 2.0 and as required by Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*.

NASA policy requires each center to have an approved master plan to obtain funding for new buildings and infrastructure improvements. The No-Action Alternative would prevent implementing critical facility modifications at JSC, thus adversely affecting the Center's ability to support human spaceflight mission requirements.

SUMMARY OF ENVIRONMENTAL IMPACTS

For each affected installation, the PEA evaluated the environmental consequences of the Proposed Action on surface water; groundwater; wetlands; floodplains; coastal zone management; noise; air quality; greenhouse gas emissions; hazardous material uses, hazardous waste generation and pollution prevention; ecosystems (e.g., vegetation; wildlife; endangered species); land use; socioeconomic and cultural resources. Where NASA anticipates that insignificant (minor, temporary and primarily construction-related) impacts may occur, NASA would employ various Best Management Practices and other mitigation measures along with appropriate monitoring activities to reduce adverse impacts during implementation of the JSC Master Plan.

Utilizing the NEPA public review process, JSC distributed the DRAFT PEA and preliminary finding of no significant impact to stakeholders and the public. JSC Senior Management reviewed the one comment received prior to proceeding with the proposed action to adopt the JSC Master Plan. After considering direct and indirect environmental impacts, cumulative effects, and mitigation measures necessary to ensure that no significant adverse environmental impacts will occur, JSC concludes that the environmental analysis within the PEA is sufficient and that there are no significant impacts associated with the proposed action. Therefore, preparation of an Environmental Impact Statement in support of the decision-making process is unnecessary.

1.0 INTRODUCTION

Johnson Space Center (JSC) 2.0's vision and goal is to advance human spaceflight by being lean, agile, responsive and adaptive. Consistent with this goal, JSC recognizes the need to manage, and as necessary, upgrade installations and infrastructure to ensure the appropriate support of JSC's missions.

JSC is updating its Master Plan for the installations that comprise the JSC: JSC Main Campus, NASA Ellington Field (including the El Paso Forward Operating Location), Sonny Carter Training Facility, and White Sands Test Facility. NASA has prepared this Programmatic Environmental Assessment (PEA) for the Johnson Space Center Master Plan to evaluate the environmental consequences of adopting and subsequently implementing the JSC Master Plan (i.e., the Proposed Action).

NASA has prepared this PEA per the requirements of the National Environmental Policy Act of 1969, as amended (NEPA) (42 United States Code (U.S.C.) 4321 *et. seq.*), NASA's implementing regulations (14 CFR 1216.3), and NASA Procedural Requirements 8580.1A, *Implementing NEPA and Executive Order 12114*. To the extent practicable, NASA has followed the guidelines published by the Council on Environmental Quality (CEQ) pertaining to preparation and use of Programmatic Environmental Assessments, dated December 18, 2014. Consistent with JSC 2.0, JSC is utilizing the NEPA administrative process to engage stakeholders and the public in this decision-making process.

1.1 Location Descriptions

Johnson Space Center Main Campus

JSC Main Campus is located in Harris County, Texas, in the City of Houston (CoH), on 650 hectares (1,620 acres), approximately 40 kilometers (25 miles) southeast of downtown Houston and three kilometers (two miles) northeast of Webster. The area is geographically characterized by the bodies of water in and around it, including Clear Lake (to the east and southeast) Mud Lake (to the northeast), Clear Creek (to the south), and Galveston Bay (to the east). JSC Main Campus is bounded by a mix of residential, commercial, and institutional land uses. To the north is the Armand Bayou Nature Center.

Ellington Field and El Paso Forward Operating Location

Ellington Airport (EFD) is 13 kilometers (eight miles) northwest of JSC Main Campus and 27 kilometers (17 miles) southeast of downtown Houston, in Harris County, Texas. The airport is within Houston's city limits and is near the cities of Pasadena, South Houston, Webster, and Friendswood. Most of the 750-hectare (1,900 acre) airport is owned by the CoH, and tracts are leased to the State of Texas and several fixed-base operators. The U.S. Government owns the six NASA tracts. The Texas National Guard operates military airplanes and helicopters, the CoH directs commercial and general aviation, and NASA-EF operates its training and simulation aircraft. NASA-EF occupies fifteen hectares (37 acres) of Ellington Airport (EFD) on six separate tracts. Two tracts adjoin the apron of Runway 17R-35L. These tracts are fully developed; installations include hangars, offices, warehouses, repair and maintenance installations, and parking lots. Three active runways are used by NASA's aircraft.

The NASA-EF aviation support mission also includes operations that take place at the El Paso Forward Operating Location (EPFOL), a leased area located on the El Paso International Airport in El Paso, TX. During the planning process, JSC determined that changes at EPFOL are not anticipated to occur within the timeframe of the Proposed Master Plan. Therefore, EPFOL is not explicitly included in the JSC Master Plan and will not be discussed further within this PEA.

Sonny Carter Training Facility

The SCTF is located just east of NASA-EF, eight kilometers (five miles) northwest of JSC Main Campus and 27 kilometers (17 miles) southeast of downtown Houston, in Harris County, Texas. SCTF is bounded on the north and west by Ellington Airport (EFD), and to the east and south by residential neighborhoods.

White Sands Test Facility

WSTF is located in New Mexico in Doña Ana County along the western flank of the San Andres Mountains (SAM). The facility entrance is 9.7-kilometers (six miles) north of US Highway 70 and 25.7 kilometers (16 miles) northeast of Las Cruces, New Mexico. WSTF is within the boundaries of the U.S. Department of Defense (DOD), US Army White Sands Missile Range (WSMR). WSTF occupies land as a tenant under the terms of a use agreement with the DOD and Memorandums of Understanding between NASA, DOD, Bureau of Land Management (BLM), and the Department of Agriculture, Agricultural Research Service Jornada Experimental Range (JER).

WSTF is bounded on the north, east, and south by WSMR. WSTF is bounded on the northwest by the JER and on the southwest corner by BLM land. The western boundary is shared with private individuals, BLM, and the JER. Adjacent to the eastern border of WSTF, a large tract in the SAM has been set aside as the San Andres National Wildlife Refuge (SANWR). One centrally located section of New Mexico land has been designated for WSTF's co-use. WSTF proper and co-use areas occupies approximately 91.5 square miles.

1.2 Mission Descriptions

Johnson Space Center

JSC is the base of NASA's human space activities. JSC plans and controls human space missions and trains astronauts. Basic and applied space research conducted at JSC includes development of communications devices, materials testing, lunar sample chemistry, and physiological adaptation to microgravity, remote sensing, and space simulation. JSC is the development center for the International Space Station (ISS) programs and is the research, development, and coordination center for NASA's human exploration of the Moon, Mars, and beyond. JSC hosts visitors who arrive to see displays on mission control, human space flight, spacecraft, moon rocks, and space mementos. Visitors come each year to see the displays on human space flight at JSC through Space Center Houston, the visitor center. Since 1992, this $75 million, 180,000 square foot, 'edutainment' complex has entertained and informed over 15 million guests from every corner of the globe.

NASA-Ellington Field

NASA-EF is the center of aviation-related operations for NASA's human space program. In conjunction with JSC Main Campus, Aircraft Operations Division (AOD) personnel train astronauts and simulate aspects of manned space missions, including microgravity, remote sensing, and spacecraft operation. NASA-EF operations are under the management of JSC, and management directives issued for JSC apply as well to NASA personnel and contractors stationed at NASA-EF. JSC's Environmental Management System and its applicable policies and procedures apply to NASA-EF.

Sonny Carter Training Facility

SCTF consists of three separate units with related, but independent, missions:

A. Within the Neutral Buoyancy Lab (NBL), NASA provides a controlled neutral buoyancy environment to simulate the zero-g, or weightless, condition that is experienced by spacecraft and crew during space flight. It is an essential tool for the design, testing, and development of the International Space Station (ISS) and future NASA programs. For the astronaut, the facility provides important pre-flight training, familiarization with planned crew activities, and with the dynamics of body motion under weightless conditions;
B. Within the Light Manufacturing Facility (LMF), NASA fabricates mock-ups of the Space Shuttle and ISS for use in the NBL. The LMF houses a sheet metal shop, paint booth, woodshop, weld shop, machine shop, electrical wiring layout area, a plasma lab, and a clean room. All of these aid in the production of mock-ups used for training and research at both the SCTF and other installations at the JSC; and
C. Within the Software Development and Integration Laboratory (SDIL), NASA develops, constructs, and tests computer equipment used on the ISS. The SDIL houses several sets of mainframe computer systems as well as micro-station terminals that are devoted to the analysis of space related software.

White Sands Test Facility

WSTF is divided into seven (7) distinct Areas (100, 200, 300, 400, 500, 700, and 800), each with specific missions, including rocket testing; high energy testing; hazardous testing; materials, components, and propulsion system testing; and their support installations. WSTF has identified capabilities that are critical to supporting this mission. Core Technical Capabilities include:

A. Rocket Propulsion Test;
B. Oxygen Systems Testing and Analysis;
C. Propellants and Aerospace Fluids Testing and Analysis;
D. Hypervelocity Impact Testing; and
E. Composite Pressure Systems Testing and Analysis

Technical Capabilities include:

A. Human Space Habitation Environmental Testing and Analysis; and
B. Depot

Other capabilities include:

A. Support Administration;
B. Community Support; and
C. Industrial and Warehouse Support

1.3 Regulatory Background

NEPA (42 U.S.C. §4321 et seq.), and the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR parts 1500 – 1508), direct NASA and other Federal agencies to fully understand and take into consideration during decision-making the environmental consequences of proposed Federal activities (also referred to as projects). NASA's regulations for NEPA compliance are described in 14 CFR §1216.3 and NASA Procedural Requirements 8580.1A. The regulations specify that NASA must complete the NEPA process prior to proceeding with taking a proposed action with the potential to affect the environment. Under these regulations, NASA must use a systematic, interdisciplinary process that includes public involvement to evaluate the potential impacts of its activities on the environment.

Additionally, NASA complies with NEPA for some categories of activities that do not individually or cumulatively have a significant impact on the human environment using several categorical exclusions that were adopted through formal rule-making (see Section 2.4). For all other activities, NASA ensures compliance with NEPA through the preparation of EAs or Environmental Impact Statements (EIS).

The EA is a concise public document that serves to provide sufficient evidence and analysis for determining whether to prepare an EIS or a FONSI. An EA includes a brief discussion of the purpose and need for the proposed action, a range of reasonable alternatives to the proposed action, environmental impacts analysis of the proposed action and its alternatives, and a listing of agencies and persons consulted. NASA must prepare an EIS when significant environmental impacts are anticipated and cannot otherwise be avoided.

1.4 Programmatic Environmental Assessment (PEA) Purpose

This PEA provides a framework to address the environmental impacts of adopting the Master Plan for the JSC Main Campus, NASA-EF, SCTF, and WSTF. This PEA provides stakeholders, the public, and decision-makers with information necessary to understand and evaluate the potential environmental consequences of the activities included under the Proposed Action:

A. Constructing new structures, buildings, fencing, and infrastructure;
B. Renovating or modifying existing installations, fencing, and infrastructure;
C. Demolishing or deconstructing existing installations, fencing, and infrastructure;
D. Improving, maintaining, and expanding security buffers; and
E. Selling or leasing excess buildings and land.

The Council on Environmental Quality published guidance on December 18, 2014 describing how to use a Programmatic EA effectively in the environmental analysis of future related actions. Please refer to https://www.whitehouse.gov/sites/default/files/docs/effective_use_of_programmatic_nepa_reviews_final_dec2014_searchable.pdf. The JSC NEPA Manager and the WSTF Environmental Manager have committed to following these guidelines, as well as NASA's implementing regulations, as individual projects receive consideration for funding.

As priorities dictate and as funding becomes available, JSC will scrutinize individual facility or infrastructure projects for consistency with the Master Plan and the JSC Master Plan PEA. In addition, JSC will evaluate the environmental consequences of the individual projects to determine whether further environmental analysis or additional NEPA documentation is necessary. This documentation could take the form of a Categorical Exclusion or "CatEx" (with or without a Record of Environmental Consideration or REC), a Tiered Environmental Assessment (EA) leading to a FONSI, a Stand-Alone EA, or the need to prepare an Environmental Impact Statement (EIS).

Categorical Exclusions

Under 14 CFR §1216.304(d), NASA has identified 23 types of activities that qualify for a CatEx. Certain actions that would otherwise be categorically excluded may be affected by extraordinary circumstances, as described in 14 CFR §1216.304(c). In such cases, the categorical exclusion may not apply, resulting in the need to prepare a Tiered EA.

Extraordinary Circumstances may exist when an action:

A. Has a reasonable likelihood of having (individually or cumulatively) significant impacts on public health, safety, or the environment;
B. Imposes uncertain or unique environmental risks;

C. Is of significantly greater scope or size than is normal for this category of action;
D. Has a reasonable likelihood of violating Federal, federally recognized Indian tribe, State, and/or local law or requirements imposed for the protection of the environment;
E. Involves impacts on the quality of the environment that are likely to be environmentally controversial;
F. May adversely affect environmentally sensitive resources, such as, but not limited to, federally listed threatened or endangered species, their designated critical habitat, wilderness areas, floodplains, wetlands, aquifer recharge areas, coastal zones, wild and scenic rivers, and significant fish or wildlife habitat, unless the impact has been resolved through another environmental review process; e.g., the Clean Water Act (CWA), the Coastal Zone Management Act (CZMA);
G. May adversely affect known national natural landmarks, or cultural or historic resources, including, but not limited to, property listed on or eligible for the National Register of Historic Places, unless the impact has been resolved through another environmental review process; e.g., the National Historic Preservation Act (NHPA).

Activities Requiring a Stand-Alone Environmental Assessment

This PEA does not apply to activities that do not fall within the types of activities described in **Section 2** or for which the analysis of impacts due to alternatives presented in **Section 3** is inadequate. A Stand-Alone Draft and Final EA may be required whenever:

A. "The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or
B. "There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." (40 CFR §1502.9(c)).

Activities Requiring an Environmental Impact Statement

If NASA determines that the appropriate level of NEPA analysis for an action is an EIS, the action would not be covered by this, or any, PEA. If, in preparing a Supplemental Environmental Assessment (SEA) or a stand-alone EA, NASA concludes that the action has the potential to result in a significant environmental impact and a FONSI cannot be issued, NASA will reevaluate its proposed action, and issue a Notice of Intent to Prepare an EIS.

How the PEA Supports Future Decision-Making

Initiating a project at a JSC facility would follow the below process:

A. Any project or action occurring at a JSC facility would need to be reviewed by JSC's NEPA Manager or WSTF's Environmental Manager to determine whether the action would be covered by a CatEx;
B. If the JSC NEPA Manager or WSTF Environmental Manager determines that an EA is the appropriate level of NEPA documentation required for the project or action (as described in **Section 2**), NASA would use this PEA to determine whether additional site-specific information is needed and if additional environmental analysis and documentation is required for NASA's compliance with NEPA. If the alternatives, level of analysis, findings, and site-specific information of a proposed action are fully and accurately described in this PEA, NASA would document this determination in its administrative record (e.g., Record of Environmental Consideration – JF1119) and no additional public or agency noticing would be completed. Additional environmental requirements including but not limited to obtaining permits and following waste disposal procedures may still apply to the project;

C. If the JSC NEPA Manager or WSTF Environmental Manager determines that the project or action is expected to (1) result in impacts not described in the PEA, (2) result in impacts greater in magnitude, extent, or duration than those described in the PEA, or (3) require additional environmental mitigation measures than those described in this PEA, a Tiered EA would be prepared. The JSC NEPA Manager or WSTF Environmental Manager may also choose to prepare a Tiered EA voluntarily if the purposes of NEPA will be furthered;
D. If the JSC NEPA Manager or WSTF Environmental Manager determines that the project or action is outside of activities covered in this PEA, a separate Stand-Alone EA would be prepared, with the goal of determining whether a FONSI or decision to prepare an EIS is appropriate; and
E. In the unlikely event that a future project would result in significant impacts, NASA would prepare an Environmental Impact Statement following all of NASA's administrative protocols (e.g., scoping, public notice, preparation of the Record of Decision, etc.)

Management Review of the Master Plan and PEA

NASA's Master Planning Policy states "master plans must effectively serve local, Agency, and Federal objectives, be developed in a structured process, develop clear and orderly products, and be based on reliable, consistent, and current information." Per NASA's Master Planning Policy, "Each Master Plan must be updated/validated every five (5) years and reassessed annually." The JSC NEPA Manager and the WSTF Environmental Manager will review any changes made to the Master Plan during these reviews to ensure compatibility with this PEA; these reviews will result in a Memorandum to the File or, if warranted, a REC or Supplemental PEA.

Public Participation in the Decision-making Process

The NEPA process includes notifying the general public, interested parties and stakeholders, and relevant agencies about the project. This PEA will be publicized in area newspapers (in the Houston TX area for JSC Main Campus, NASA-EF, and SCTF and in the Las Cruces, NM area for WSTF) by way of a public notice. The PEA was also made available in area libraries and through the state NEPA Clearinghouse (for federal, state, and local agency review) and through direct communication via the JSC and WSTF mailing list.

For all NEPA-related actions, NASA-JSC maintains a mailing list of other federal, state, and local agencies, as well as interested parties, not specifically listed in the State clearinghouse but who have requested notification of pending actions.

NASA Headquarters also contacted potentially affected tribal nations directly per established protocols.

2.0 PURPOSE AND NEED

The NASA JSC Master Plan addresses land use planning and facility modifications supporting JSC's mission at JSC Main Campus; Ellington Field (NASA-EF); the Sonny Carter Training Facility (SCTF); and the White Sands Test Facility (WSTF), a tenant on the White Sands Missile Range (Appendix A). The purpose of the JSC Master Plan is to enable JSC to support core capabilities, meet mission requirements, and respond effectively to future mission changes. The overall goals of the Master Plan are to further human spaceflight by developing resilient buildings, reliable infrastructure, safe and secure access, and a livable campus. The Master Plan is needed to implement JSC's vision for a sustainable capability to develop, operate, and integrate human exploration activities involving commercial, academic, international, and U.S. Government partners. As such, the Master Plan will provide an effective guideline to support redevelopment of JSC's real property assets.

The Proposed Action includes a 20-year revitalization and building strategy that spans Fiscal Years 2016 through 2036. The Master Plan would be implemented in three phases; a short-term phase (5 to 10 years); a long-term phase (10 to 20 years); and development of ad-hoc capabilities (Capacity Phase, beyond 20 years) to ensure adequate capacity to meet mission research and development requirements. Refer to Appendix A for descriptions of existing conditions, constraints, and proposed development.

The Master Plan follows a series of guiding principles and development constraints. The Master Plan is fully responsive to Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*. It fully embraces the concepts and constraints associated with energy and water conservation, renewable energy, climate change resilience, floodplain management, and protection of NASA's rich historical and cultural assets, while ensuring the appropriate level of sensitivity for protection of human health and the environment.

JSC Main Campus

During the master plan development process, the vision for JSC Main Campus was established that states: "Johnson Space Center Master Plan must further human spaceflight by developing resilient buildings, reliable infrastructure, safe and secure access, and a livable campus."

From this planning vision, four planning goals emerged to guide the development process:

Goal 1: Resilient Buildings: JSC Main Campus will build durable, energy efficient installations that are flexible, accommodate multiple uses, and are conducive to modern workforce needs. They will provide natural lighting and views to foster a connection to the environment.

Goal 2: Reliable Infrastructure: JSC Main Campus will create and maintain a reliable and efficient infrastructure, which will minimize disruption to its mission and to those utilizing the installations. JSC Main Campus's infrastructure must incorporate technologies to enable savings and minimize repairs.

Goal 3: Safe & Secure Access: JSC Main Campus will host safe and secure multi-modal transit routes that connect the campus to support a healthy workplace. JSC Main Campus will ensure that the campus is accessible and secure for walking, biking, and driving.

Goal 4: Livable Campus: JSC Main Campus is a sustainable workplace that creates functional neighborhoods and collaborative spaces connected through enhanced green space pathways that are pedestrian and bike friendly. The planned campus creates opportunities for employees to recharge and collaborate while preserving ecosystems and biodiversity.

NASA-EF

During the master plan preparation process, stakeholders developed a planning vision for NASA-EF that states: "In support of the mission, NASA-EF will be one campus for a collocated workplace with energy-efficient administrative buildings, and consolidated hangars that provide space and flexibility for an uncertain future."

From this planning vision, four planning goals emerged to guide the development process:

Goal 1: One Campus: NASA-EF will become a more unified whole with a 5 to 10 minute walk across the campus and stronger perimeter security. Furthermore, this campus will be safe and accessible with integrated pedestrian paths and an increased number of ADA accessible routes.

Goal 2: Energy-Efficient Administration: To increase the energy-efficiency of NASA-EF, new buildings will have narrow wings to encourage natural ventilation, an adequate window-to-wall ratio to provide natural daylighting, and deep overhangs to prevent unnecessary heat gain from the windows.

Goal 3: Consolidated Hangars: By consolidating the hangars at NASA-EF, more land becomes available for future development. This increase of open space also provides the opportunity for outdoor gathering spaces and interconnected green spaces. Additionally, the hangars will front the flight line, have visible entries, and have a maintenance backbone with administration above.

Goal 4: Space and Flexibility: NASA-EF should maintain as much open space as possible to account for unknown future expansion. Existing historical buildings should be maintained and parking should be moved to the periphery of the campus.

SCTF

During the master plan preparation phase, stakeholders established a planning vision for SCTF that states: "In support of the mission, SCTF will be a flexible training and research complex with attractive workspaces, a unique environment for neutral buoyancy, and integrated labs and data centers."

From this planning vision, four planning goals emerged to guide the development process:

Goal 1: Flexible Training and Research Complex: SCTF needs a training and research complex that is flexible to meet the needs of today as well as future needs. This complex should be multi-story, with narrow wings, open floor plans, modular furniture, and covered walkways. Additionally the complex should provide adequate equipment and a large, adjacent laydown.

Goal 2: Attractive Workspaces: In order to provide attractive workspaces for the people at SCTF, new construction should incorporate views, natural lighting, arcades, and varied workstations. Furthermore, buildings should have adequate HVAC and be ADA compliant with direct, efficient sidewalks. Amenities such as gyms and outdoor trails will also increase the appeal of these workspaces.

Goal 3: Unique Environment for Neutral Buoyancy: In order to preserve and improve the existing environment for neutral buoyancy at SCTF, the pool should be more water efficient through the use of more efficient boilers and reduced pumping hours. The pool also needs to maintain clarity for testing at significant depths. The structure to house the pool should be high enough to accommodate large cranes and humidity should be controlled to preserve electrical equipment and create a comfortable environment for the occupants.

Goal 4: Integrated Labs and Data Centers: New labs and data centers at SCTF should integrate raised floors to house cables, generators to provide stable power, and environmental controls to monitor humidity. The data centers should also include collaborative spaces, both inside and out, and provide transportation access to JSC.

WSTF

During the master plan preparation process, stakeholders identified a planning vision to "safely advance WSTF's core capabilities, through environmentally responsible methods, by designating flexible hazardous test areas and efficient administration centers with appropriate buffer zones."

From this planning vision, four planning goals emerged to guide the development process:

Goal 1: Environmentally Responsible Methods: WSTF will determine environmental costs and impacts during the planning phase of all projects/proposals and will communicate with the environmental department, identifying mitigation of all potential environmental impacts before projects/proposals start; strategies will employ all sustainable planning principles concerning energy and water conservation.

Goal 2: Flexible Hazardous Test Areas: WSTF will maintain hazardous test areas that are able to adjust to various test customers with minimal impact to test infrastructure at the best possible cost to customers.

Goal 3: Efficient Administration Centers: Responsive administrative support of hazardous testing operations with clear standardized instructions that facilitate test planning while remaining flexible enough to accommodate unique requirements that support technical knowledge that meets regulatory guidelines while limiting redundant or wasteful actions and focusing on the expertise of leadership in making, risk-informed decisions.

Goal 4: Appropriate Buffer Zones: WSTF will establish internal and external buffer zones. Internal buffer zones will maintain separation between test areas and administrative areas. External buffer zones will prevent the encroachment of regional areas.

2.1 Description of the Proposed Action and Alternatives (DOPAA)

The Master Plan was conceptualized through a series of outreach efforts that solicited inputs from various on-site stakeholders. Alternatives considered, including the No-Action alternative, are described in the following sections.

2.1.1 Proposed Action

The Proposed Action would be the adoption of the Master Plan (refer to the figures in Appendix A) which would involve numerous discrete construction projects and maintenance activities at each of the installations. A summary of the specific activities are outlined in the following sections.

New Construction

General activities associated with constructing new buildings, structures, and infrastructure include site preparation and excavation; construction of the foundation, structural components, and the building shell; completion of the interior spaces, support equipment, and utilities; and final grading and landscaping. The majority of new construction would be concentrated in the existing developed NASA installations on previously disturbed soils or in areas that would require minor mitigation.

New construction would employ sustainable design principles and comply with sustainability standards mandated by Executive Order 13693, *Planning for Federal Sustainability in the Next Decade,* and other Federal, State and local requirements. In addition to incorporating climate change adaptation strategies, new building designs would meet at least the "Silver" standard established by the Leadership in Energy and Environmental Design (LEED) U.S. Green Building Council (USGBC) Rating System. Newly constructed buildings would be designed to be adaptable, flexible, and able to accommodate a variety of potential uses.

New construction would be prohibited within designated floodplains, and new construction would incorporate climate change reselience features, such as elevated foundations, in order to preclude any adverse effects from flooding.

Renovation

Building renovation involves modifications to existing buildings in which major structural components, such as the foundation, structural walls, outer shell, and roof support structure, remain mostly intact. In general, building renovation could include improvements to exterior architecture and interior spaces; replacement of heating, ventilation and air conditioning systems or equipment; and replacement or upgrades of electrical, plumbing, fire alarms, and information technology infrastructure. Building renovations would incorporate climate change adaptation and sustainable design strategies.

Demolition/Deconstruction

Demolition/deconstruction projects typically include identifying hazardous and salvageable/recyclable materials; developing a demolition plan; disconnecting utilities and securing the site; removing and disposing of hazardous chemicals and materials located within the building; draining oil or fluid filled equipment; removal of artifacts (e.g., air and spacecraft models); salvaging any unique architectural elements for future re-use or display; demolishing/deconstructing structures; and performing final site cleanup, grading, and site re-vegetation. Demolition/deconstruction of buildings and structures would incorporate a sustainability approach whereby materials such as concrete, brick, metals, and other building components would be salvaged for recycling or reuse. NASA requires that a minimum of 50 percent of construction and demolition debris be diverted from land disposal through recycling or reuse.

Improving, Maintaining, and Expanding Security Buffers

Improving, Maintaining, and Expanding Security Buffer projects would include actions that fall under construction and demolition and may include site preparation and excavation; identifying hazardous and salvageable/recyclable materials; and performing final site cleanup, grading, and site re-vegetation. These projects would take place on the perimeter of buildings or installations.

Divesting of Excess Buildings and Land

Divesting of excess buildings and land would include the transfer of ownership and or occupancy property from NASA to an outside agency or entity.

JSC Main Campus: At JSC Main Campus, the Proposed Action would include constructing new installations, roads, parking areas, paths, quad areas, and sidewalks. The majority of the planned new construction would be concentrated in areas currently ready to be developed or in areas that would require minor mitigation.

The Master Plan identifies a net increase of approximately 695,000 square feet (sq. ft.). Proposed highly visible changes to the JSC footprint include:

A. Construction of Building 21 (117.000 sq ft), in progress;
B. An Expansion of the Central Heating and Cooling Plant to accommodate the Combined Heat and Power Complex, (5,500 sq ft). in progress;
C. Planned relocation of the Saturn Lane and NASA Parkway Entry Gates and designing an associated pedestrial mall with public access to the Astroanut Memorial Grove;
D. Construction of an Engineering Innovation Complex, including modifications to fabrication and testing facilities
E. Construction of a new Environmental Facility including waste management and recycling accumulation staging areas;
F. Relocation and consolidation of logistics warehouses;
G. Consolidation of testing functions within the current Engineering Systems Test Area (ESTA);
H. Construction of a Scientific Curation Facility
I. Construction of a Collaboration Building near the Saturn V (Building 90) complex
J. Construction of a Collaboration Campus
K. Demolition of over 150 individual buildings and support structures primarily located in the 200, 300, and 400 areas, with the 200 area returning to greenspace to serve as a climate resilience buffer;
L. Construction of a loop that would surround the central mall and provide for parking at the perimeter to reduce vehicular traffic and enhance the pedestrian mall concept.

NASA-EF: At NASA-EF, the Proposed Action would include constructing a main entry quad for administrative personnel with consolidated warehousing, hangars along eastern flight line and an integrated industrial/maintenance support area on the southern extreme of NASA-EF.

The Master Plan identifies a net reduction of just over 101,000 sq. ft. Proposed highly visible changes to the NASA-EF footprint include:

A. Construction of a multi-story logistics warehouses, divesting of the E380 warehouse tract, and acquiring an adjacent area east of Brantley area for the new warehouse;
B. Providing for a new vehicle inspection and delivery entrance to the south of E135;
C. Installing expanded parking areas at the perimeter (west of the Brantley entrance and south E140) installing entry turnstiles, and installing a quadrangle at the main entrance thereby promoting pedestrian walkways and reducing POV traffic/parking within the complex;
D. Relocation of maintenance activities at E990 by reconstruction/upgrades to the E277 "Guppy" Hangar
E. Planned subsequent divestiture of the E990-E994 buildings and parking area tracts;
F. Relocation of the fire suppression tanks and pumps (E245) and subsequent divestiture of this NASA tract; and
G. Demolition of at least five buildings/structures in support of new construction.

SCTF: At SCTF, the Master Plan identifies a net increase of 11,700 sq. ft. Proposed highly visible changes to the SCTF footprint include:

A. Modifying the laydown areas;
B. Constructing an Innovation and Inclusion Facility
C. Reconstruction/renovation of the facility gym;
D. Installation of a trail surrounding the storm water detention basin north of the installation with enhanced accessibility for SCTF residents;
E. Ronovating the mezanine office area;
F. Updating the entranance, signage, and parking lot traffic flow; and
G. Installing tunstile pedestrian entrances and modifying the entry gates to reduce the security-patrolled parking perimeter.

WSTF: At WSTF, the Master Plan identifies a net increase of just under 4,000 sq. ft. Proposed highly visible changes to the WSTF footprint include:

A. Construction of an main quadrangle area to centralize administrative functions;
B. Constructing three new energy efficient buildings to replace outdated buildings;
C. Constructing new parking areas to accommodate centralization of adminstrative functions; and
D. Constructing/renovating infrastructure such a sidewalks and roadways, the water distribution system, and other utilities.

2.1.2 Alternative(s) Considered

During development of the Master Plan, a wide variety of alternatives to the proposed Master Plan were assessed. The procedure included identifying sub-parcels of land within the developable area of each of the installations and evaluating them for issues associated with building or infrastructure construction. Each of the sub-parcels were rated as follows:

Developable Area 1 is comprised of zones that are currently ready to be developed with little to no preparation to the existing site. These sites are essentially "shovel ready" and are the least constrained by existing environmental, operational, and built conditions.

Developable Area 2 is comprised of zones that are ready to be developed after minor mitigation. These zones may be limited by horizontal constraints such as paving or hardstand, recreation, and sports fields. When added to the previous established developable area 1, this stage represents a moderately conservative approach to future development.

Developable Area 3 is comprised of zones that are in need of significant alteration in order to be developed. These development parcels have major constraints such as environmental hazards, steep topography, or old buildings in need of demolition. Combined with earlier stages of developable area, this stage illustrates the most aggressive approach to new development with respect to operational requirements.

Developable Area 4 is comprised of zones that have a hazardous waste testing that exists on the parcel. Development on these parcels will be very difficult due to contamination of the soil. Development in these areas should be limited to hazardous waste testing related functions.

The Proposed Action selected sub-parcels in Developable Areas 1 or 2 for development. However, during the planning process NASA acknowledged that funding constraints, changes in priority or policy, or unforeseen environmental consequences of the proposed action could result in the need to implement an alternative to individual build sites. Alternatives included renovating buildings instead of constructing new buildings, constructing new buildings in alternate locations, repurposing buildings by deconstruction and renovation, or taking no action, amoung others. For any of these alternatives, the types of activities that would be undertaken by NASA would be similar to the types of activities described under the Proposed Action, and the environmental consequences accounted for as described in **Chapter 3**. Developable Area figures for each facility are located in A.

2.1.3 No-Action Alternative

Under the No-Action Alternative, NASA would not adopt the JSC Master Plan. JSC would continue to operate the buildings and infrastructure currently in use at the JSC Installations. The No-Action Alternative was not carried further because it did not address the need for a Master Plan to obtain facility construction funds in support of JSC 2.0 stated goals and failed to comply with EO 13693 *Planning for Federal*

Sustainability in the Next Decade or developing resilient buildings, reliable infrastructure, safe and secure access, and a livable campus.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter provides information on the existing environmental conditions at the installations (JSC Main Campus, NASA-EF, SCTF, and WSTF) and the potential environmental impacts of the Proposed Action and the No-Action Alternative.

3.1 Description of Affected Environment

The affected environment includes those environmental resources potentially subject to impacts related to the adoption of the JSC Master Plan. This chapter summarizes the baseline conditions at each of the installations.

Each installation's Environmental Resource Document (ERD) contains information on each of the installation's environmental resources. Required by NASA Procedural Requirements (NPR) 8580.1A, implementing NEPA and Executive Order 12114, the ERD provides a detailed and comprehensive baseline of environmental conditions at each of the installations. NASA's NEPA Program promotes incorporating ERDs by reference in order to streamline NEPA documentation.

The JSC, EF/SCTF, and EPFOL ERDs are available by contacting the JSC EO (281-483-3120).

The WSTF ERD is available by contacting WSTF EO (575-524-5024).

3.2 Description of Environmental Impacts

For each environmental resource area, an impact assessment is provided for construction activities associated with the various phases of the Proposed Action, which includes new construction, renovation, demolition, selling or leasing property, and other general infrastructure upgrades. The term "Environmental Consequences" is used as a general descriptor for changes associated with the Proposed Action.

Impacts are defined in general terms and are qualified as adverse or beneficial, and as short-term or long-term. For the purposes of this PEA, beneficial impacts would improve resources/conditions and adverse impacts would deplete or negatively alter resources/conditions. In terms of duration, short-term impacts are generally considered to be those impacts that would have temporary effects. Long-term impacts are generally considered to be those impacts that would result in permanent effects.

3.3 Resources Eliminated from Further Analysis

Resources determined unlikely to be impacted by the adoption of either the Proposed Action or No-Action Alternative were not evaluated. Those resources include:

Soils and Geology. The No-Action Alternative would have no impact on soils. The majority of the activities associated with the Proposed Action would involve previously developed areas and disturbed soil. Common impacts to soil such as erosion and compaction are regulated and mitigated using BMPs It is anticipated that there would be no impacts or negligible impacts to soils and geology.

Population. The No-Action Alternative would have no impact on the population of the communities surrounding the installations. No change in population is anticipated as a result of the Proposed Action at any of the installations.

Environmental Justice. The No-Action Alternative would have no impact on the potential Environmental Justice populations of the communities surrounding the installations. Impacts associated with the Proposed Action are not anticipated to be substantial or result in the disproportionate impacts to any community surrounding the installations. No change in population or land use would occur for the adoption of the Proposed Action.

Coastal Zone Management. The No-Action Alternative would have no impact on the Texas Coastal Management Zone. The activities associated with the Proposed Action would not impact any of the 16 coastal natural resource areas for which the Texas General Land Office reviews actions and activities. These coastal natural resource areas include waters of the open Gulf of Mexico, waters under tidal influence, submerged lands, coastal wetlands, submerged aquatic vegetation, tidal sand and mud flats, oyster reefs, hard substrate reefs, coastal barriers, coastal shore areas, Gulf beaches, critical dune areas, special hazard areas, critical erosion areas, coastal historic areas, and coastal preserves. Coastal zone management is irrelevant at WSTF.

Wild and Scenic Rivers. None of the waterways at the installations are listed as Wild and Scenic Rivers. Therefore, the No-Action and Proposed Action Alternatives would have no impact on Wild and Scenic Rivers.

3.4 Physical Environment

3.4.1 Surface Water

Affected Environment

JSC Main Campus: JSC Main Campus is set in a landscape with many tidal streams and estuaries of Galveston Bay and is within the Clear Creek and Armand Bayou watershed. Clear Lake is at the southeast corner; Mud Lake and Armand Bayou are northeast; Cow Bayou is southwest; and Horsepen Bayou is north of JSC Main Campus. Galveston Bay is recognized by the U.S. Environmental Protection Agency (USEPA) as an estuary of national significance and was included in the National Estuary Program in 1989.

JSC has applied for and received a site-specific Municipal Separate Storm Sewer System (MS4 permit; Permit No. TXR040214). State law requires that storm water be discharged separately from sanitary wastewater. In conjunction with the MS4 permit, JSC Main Campus has developed a Storm Water Management Plan (SWMP) under the National Pollution Discharge Elimination System (NPDES) which is issued under the Texas Pollutant Discharge Elimination System (TPDES), , to reduce adverse impacts to water quality and aquatic habitat by instituting controls on storm water discharge. Storm water is drained from JSC Main Campus by underground conduits and ditches. Most storm water collects in four main ditches; two ditches discharge to Mud Lake and the other two discharge to Cow Bayou and Horsepen Bayou. Clear Lake and ultimately Galveston Bay receive all drainage from JSC Main Campus. Cow Bayou, Horsepen Bayou, and Clear Lake are all listed as impaired waterways by the Texas Commission on Environmental Quality (TCEQ).

In conjunction with the MS4 permit, JSC Main Campus' SWMP includes an education program and implementation of Best Management Practices (BMPs) for discharges to the storm water system, including sedimentation and erosion control during construction and maintenance activities involving disturbance of soil (e.g., digging permits).

JSC Main Campus utilizes equipment and procedures to minimize or eliminate the potential of a spill or release to reach navigable waters. JSC maintains and implements an Integrated Spill Prevention Control and Countermeasure (SPCC) and Hazardous Waste Contingency Plan.

NASA-EF: NASA-EF is part of the Armand Bayou watershed. Horsepen Bayou, to the southeast of Ellington Field, is a tributary of Armand Bayou (previously Middle Bayou). At NASA-EF, Horsepen Bayou is non-tidal. Horsepen Bayou is listed as an impaired waterway by the TCEQ.

Storm water drainage at the NASA-EF facility is collected in a system of below-grade storm sewer lines and earthen trenches. These lines and trenches discharge from the NASA properties into a conveyance system maintained for the entire airfield by the City of Houston. Storm water from the airfield is discharged into Horsepen Bayou, the headwaters of which are located south and east of NASA EF's tracts.

NASA-EF operates and discharges under a TPDES General Permit. This general permit provides authorization for point source discharges of storm water associated with industrial activity to waters of the state (including direct discharges and discharges to a municipal separate storm sewer system). NASA-EF maintains and implements an Integrated Spill Prevention Control and Countermeasure (SPCC) and Hazardous Waste Contingency Plan.

SCTF: Like NASA-EF, SCTF is part of the Armand Bayou watershed. Horsepen Bayou, to the south of SCTF, is a tributary of Armand Bayou and is non-tidal in this area. Horsepen Bayou is listed as an impaired waterway by the TCEQ. SCTF is located immediately southwest of a Harris County Flood Control District (HCFCD) detention pond. The detention pond collects storm water runoff from Ellington Field. Storm water flows from the SCTF pavement via a system of grates and culverts directed into the HCFCD ditch, North Fork, which flows into Horsepen Bayou southeast of SCTF.

SCTF does currently have to apply for a storm water permit. The TCEQ allows installations to certify that a condition of no potential pollutant to storm water exposure exists, and therefore does not need to obtain a storm water permit. Each year, a survey is performed to confirm that the necessary conditions are maintained for the no exposure exclusion from storm water monitoring and permitting. SCTF maintains and implements an Integrated Spill Prevention Control and Countermeasure (SPCC) and Hazardous Waste Contingency Plan.

WSTF: WSTF has no natural permanent water bodies and no continuous streams. Near the site, the surface slopes between three and five degrees and is dissected by widely spaced, parallel, westward-trending arroyos, typically dry stream beds that temporarily or seasonally fill and flow after sufficient rains. The closest perennial surface water is the Rio Grande, about 15 miles to the west. Storm water runoff is controlled around construction sites and roads using storm water best management practices and maintaining existing ephemeral streams (arroyos) wherever possible. WSTF maintains and implements Spill Prevention Control and Countermeasure (SPCC) and Hazardous Waste Contingency Plans.

Environmental Consequences

Proposed Action: The Proposed Action could cause short-term, adverse impacts to surface water due to the operation of heavy equipment, disturbance of soils during construction and demolition activities at JSC Main Campus, NASA-EF, and SCTF. No construction, demolition, renovation activities are planned to take place within any waterways. NASA would employ environmental mitigation measures, as necessary, to limit these impacts. Environmental mitigation measures consist of one or more of the following: developing and implementing a site-specific storm water pollution prevention plan and an erosion and sedimentation control plan; employing best management practices (BMPs) using silt fences, hay bales, and similar measures to prevent contaminated runoff from entering water bodies; re-vegetating disturbed soils to provide stability and runoff filtration after construction activities are complete; and maintaining soil stockpiles in good condition when adjacent to waterways. During construction, installation environmental managers would closely monitor the contractors to ensure that the implementation and continued effectiveness of BMPs.

NASA must comply with any storm water or effluent permitting requirements under Section 401 and 402 of the Clean Water Act (CWA), such as NPDES. Depending upon the acreage disturbed, NASA would apply for and obtain the necessary permits from the State before initiating any work. NASA would implement specific environmental mitigation measures for activities that do not require NPDES permits and that would take place in or adjacent to an impaired water body, as described under Section 303(d) of the CWA. These environmental mitigation measures would eliminate the potential for construction activities to result in the release of pollutant(s) that have impaired the water body.

Long-term beneficial impacts are anticipated with the adoption of the Proposed Action. Storm water run-off reduction goals are part of the JSC Master Plan for each of the installations and includes strategies such as increasing pervious surface, tree planting, wetland construction, and engineered bioswales. Any new systems or equipment that consume water and/or generate wastewater would be evaluated prior to their installation and would ensure that all new water discharge sources would be compliant with applicable regulations and permits. LEED certification encourages the use of innovative measures to reduce storm water runoff, including installation of collection systems and installation of enhanced infiltration measures (e.g., low impact development (LID) for new parking areas). Implementation of the Master Plan would reduce storm water generation by at all of the facilities (between 23 and 77 percent at JSC Main Campus, between three and 34 percent at WSTF, and between 99 and 100 percent at NASA-EF and SCTF).

As described in the master plan, building sites being demolished would, for the most part, be replaced with green space. This is particularly true at the JSC Main Campus, as areas that currently house buildings in the 200 and 300 area would be demolished and returned to green space.

3.4.2 Groundwater

Affected Environment

JSC Main Campus: Groundwater is found in soil strata under JSC Main Campus. The groundwater table is usually found about two to three meters (eight to eleven feet) below the ground surface. The water table fluctuates with weather and may reach the ground surface during wet periods. Several strata of soil contain silty and sandy zones; these zones may contain perched groundwater. The uppermost groundwater aquifer under JSC Main Campus is a confined sand layer approximately 18 meters (60 feet) below the surface. This artesian aquifer is contained by a clay barrier layer at a depth of 26 meters (85 feet). The upper clay layer is stiff, plastic and impermeable. The clay under the aquifer is hard, very plastic, and even less permeable than the upper clay layer.

Two important fresh water aquifers, the Chicot and the Evangeline, are located under the Houston area. Both aquifers are comprised of discontinuous sand, silt and clay. In southern and eastern parts of the region the aquifers are artesian; that is, they are under pressure and tend to rise in wells. At JSC Main Campus, the base of the Chicot aquifer is between 180 and 210 meters (600 and 700 feet) below the surface, and the base of the Evangeline aquifer is between 790 and 910 meters (2,600 and 3,000 feet) below the surface.

JSC Main Campus does not routinely use groundwater for potable water; JSC Main Campus purchases approximately 300,000,000 gallons of potable water each year from the Clear Lake City Water Authority (CLCWA). Two water wells (Wells No. 2 and 4) are maintained at JSC Main Campus for contingency and emergency use only. JSC operates a potable water treatment system that is regulated by the State.

JSC Main Campus has been working with the TCEQ to complete cleanup of groundwater associated with past practices within the Energy Systems Test Area. JSC has one active bioremediation cleanup in progress in the general area north of Building 358. NASA routinely monitors and reports progress on the effectiveness of this system.

NASA-EF: NASA-EF is located in the Houston area and located above the Chicot and the Evangeline fresh water aquifers. Both aquifers are comprised of discontinuous sand, silt and clay. In southern and eastern parts of the region the aquifers are artesian; that is, they are under pressure and tend to rise in wells. At NASA-EF, the base of the Chicot aquifer is between 180 and 210 meters (600 and 700 feet) below the surface, and the base of the Evangeline aquifer is between 790 and 910 meters (2,600 and 3,000 feet) below the surface.

At NASA-EF, groundwater is not for potable uses. NASA-EF uses the Houston municipal water supply, most of which comes from surface water. One deep groundwater well owned and operated by the CoH is used to supply non-potable water for a fire suppression tank on an emergency basis.

SCTF: SCTF is in the Houston area and two important fresh water aquifers, the Chicot and the Evangeline, lie under the area. Both aquifers are comprised of discontinuous sand, silt and clay. In southern and eastern parts of the region the aquifers are artesian; that is, they are under pressure and tend to rise in wells. The base of the Chicot aquifer is between 180 and 210 meters (600 and 700 feet) below the surface, and the base of the Evangeline aquifer is between 790 and 910 meters (2,600 and 3,000 feet) below the surface.

SCTF has never used groundwater for water supply. Water at SCTF is supplied by the CLCWA, which draws its supply from surface water.

WSTF: All water used by WSTF is from underground sources. Groundwater aquifers of the Southern Jornada del Muerto Basin (SJMB) are primarily recharged by runoff from the adjacent San Andres Mountains (SAM). Although the volume of recharge is relatively small, the SJMB is essentially a closed basin and mountain-front recharge is the only source of aquifer replenishment. The groundwater table in the central portion of the Basin is approximately 400 feet below grade.

WSTF historical operations created a groundwater contaminant plume, the majority of which lies beneath land for which NASA maintains administrative control. WSTF began a groundwater contamination investigation in 1985 to determine the type, distribution, and concentration of groundwater contaminants. On-going groundwater monitoring activities are conducted in accordance with the WSTF Groundwater Monitoring Plan, which was developed in accordance with the site's Hazardous Waste Permit. In addition to established drinking water and wastewater programs, WSTF performs groundwater monitoring. WSTF utilizes 122 active groundwater monitoring wells with approximately 205 discrete sampling locations in its groundwater monitoring program. Current WSTF operations have no impact on groundwater quality, as there are no longer any ongoing releases of hazardous constituents.

Environmental Consequences

Proposed Action: The Proposed Action could cause short-term impacts to groundwater due to the operation of heavy equipment, disturbance of soils, and the potential for unintentional release (spills) of hazardous materials during construction and demolition activities, since groundwater recharge would occur in lieu of runoff. NASA would employ environmental mitigation measures, as necessary, to limit these impacts. Environmental mitigation measures could consist of one or more of the following: developing and implementing an erosion and sedimentation control plan; using silt fences, hay bales, and similar measures to prevent soils from entering water bodies; re-vegetating disturbed soils to provide stability and runoff filtration after construction activities are complete; and maintaining soil stockpiles in good condition when adjacent to waterways. During construction, installation environmental managers would closely monitor the contractors to ensure that the implementation and continued effectiveness of BMPs.

Long-term beneficial impacts are anticipated with the adoption of the Proposed Action. Increased pervious surfaces and tree plantings would increase groundwater filtration. Any new systems or equipment that

consume water and/or generate wastewater would be evaluated prior to their installation. NASA must ensure that all new water discharge sources are compliant with applicable regulations and permits.

3.4.3 Wetlands

Affected Environment

JSC Main Campus: NASA conducted an onsite wetland survey in 2012. Five palustrine emergent wetlands, one palustrine forested wetland, and four palustrine unconsolidated bottom wetlands are indicated within JSC Main Campus on National Wetlands Inventory mapping. Several site-specific wetland surveys have been conducted at JSC. Eleven additional wetland areas not depicted on the USFWS NWI maps were identified.

In June 2015, the U.S. Army Corps of Engineers (USACE) prepared a jurisdictional determination for the former Houston Lighting and Power (HL&P) cooling water canal that transects the southern-most property line (basically parallel to NASA Parkway). The USACE concluded that the area east of the weir is non-jurisdictional, and the water body flowing from the weir to Clear Lake (under NASA parkway) is jurisdictional.

In 2013, JSC received two nationwide permits (NWPs) from the USACE. NWP 27 allows for implementing a voluntary program to improve the wetlands along the northernmost portion of the JSC property by removal/treatment of invasive species, such as Chinese tallow trees. NWP 38 provides for mitigation associated with the construction of an innovative passive groundwater remediation "biowall" system. Upon completion, they will result in the net improvement of approximately 20.2 acres of forested wetlands.

NASA-EF: NASA-EF areas are completely developed and no wetlands are present. NWI maps show several mapped areas that are classified as emergent or shrub/scrub wetlands primarily in the southeast portion of the CoH Ellington Airport (EFD), but none are within the boundaries of NASA-EF.

SCTF: SCTF is completely developed and almost entirely covered by pavement. The remainder of the property is landscaped with ornamental trees, shrubs, and lawn. SCTF is adjacent to the HCFCD storm water detention basin, which is listed as a wetland. Based upon a review of the NWI, no other identified wetlands are located within 1,000 feet of SCTF. SCTF does not discharge any site effluent directly into the HCFCD storm water detention basin.

WSTF: According to an investigation conducted by the USACE Albuquerque District in 1982, no wetlands are present in the vicinity of operations at WSTF.

Environmental Consequences

Proposed Action: The Proposed Action would not have any adverse impacts on wetlands at JSC Main Campus due to construction, demolition, or renovation within or near wetlands. No wetlands have been identified at the other installations. Demolition of buildings and infrastructure near wetlands would potentially have a long-term beneficial impact by reducing flow through greater pervious surface area.

Under the Proposed Action, no construction, demolition, or renovation is anticipated within areas currently designated as having wetlands. If areas containing wetlands are discovered in the future and an action would take place within or affect a wetland, NASA would ensure that the action complies with EO 11990 and 14 CFR 1216.2, and obtain relevant permits from the USACE and State agencies. Such an action would only be selected if no practicable alternative to the action exists. Under EO 11990, NASA would notify the

public, and minimize potential impacts. NASA would adhere to all permitting conditions and develop a mitigation monitoring plan to ensure mitigation sites are successfully established.

NASA would conduct the public notification required under EO 11990 during its NEPA site-specific compliance process. For activities requiring an Initial Public Notice, the notice could be sent to all interested parties and NASA would post the notice in a local newspaper. For applicable activities, a Final Public Notice would be provided for public review (e.g., posted in a local newspaper). If a FONSI is prepared for an action, the FONSI would include the Final Public Notice.

The Proposed Action would likely have a long-term, beneficial impact on wetlands at JSC Main Campus due to the protection or enhancement of wetlands and an increase in pervious surfaces due to building demolition.

3.4.4 Floodplains

Affected Environment

JSC Main Campus: The northeastern corner of JSC Main Campus near the intersection of NASA Parkway and Space Center Boulevard and a section located along a tributary to Mud Lake are within the 100-year floodplain according to FEMA Flood Insurance Rate Map (FIRM). Extending further into the campus, a large portion of JSC Main Campus eastern and northern portions of its campus are located within the 500-year floodplain (Appendix A).

JSC Main Campus has undertaken an aggressive multi-year program to demolish and remove mission-critical buildings located within the flood-prone portions of the site and returning the area to a more natural vegetated buffer zone. This activity is consistent with EO 13653, "Preparing the U.S. for the Impacts of Climate Change" by relocating critical mission and facility support activities out of low-lying areas that could be potentially inundated by flooding associated with heavy rains or storm surge.

NASA-EF: NASA-EF is not located within either the 100-year or the 500-year floodplains (Appendix A). However, portions of NASA-EF may be inundated during a hurricane due to poor drainage and/or storm surge associated with Horsepen Bayou.

SCTF: Most of SCTF is located within the 100-year flood plain (Appendix A). The southeastern corner of the SCTF property is within the 500-year flood plain. Despite this location, there is no history of flooding at the SCTF. Due to the SCTF's proximity to the Gulf of Mexico, the general area is subject to storm surge associated with a hurricane or tropical storm.

WSTF: Although no FIRMs have been produced for WSTF, the USACE Albuquerque District evaluated the flood potential for the active areas of WSTF in 1982. Area 100 is in closest proximity to the USACE delineated floodplain, with some buildings occupying flood prone areas. Levees have been constructed east of Area 100, and also around three nearby sewage lagoons to reduce the risk of flood damage. In 2015, WSTF connected to the Las Cruces POTW, so the sewage lagoons are in the process of being closed.

Environmental Consequences

Proposed Action: The Proposed Action could have a short–term, adverse impact on floodplains. The Proposed Action would include demolition and renovation within floodplains at JSC Main Campus and SCTF.

Actions that would take place within or affect identified floodplain, NASA would ensure that the action complies with EO11988 and 14 CFR 1216.2 (NASA regulations on Floodplain and Wetland Management). Under EO11988, NASA would conduct a detailed engineering analysis of floodplain changes, obtain concurrence from affected communities, individually notify all property owners affected by increases in flood elevations, and request that National Flood Insurance Program maps be updated to reflect changes in flood hazard information.

NASA would coordinate with the Federal Emergency Management Agency (FEMA) and conduct the public notification required under EO 11988 during its site-specific NEPA compliance process. For activities requiring an Initial Public Notice, the notice would be sent to all interested parties and NASA would post the notice in a local newspaper. For applicable activities, a Final Public Notice would be provided for public review (e.g., posted in a local newspaper). If a Tiered EA and FONSI are prepared for an action, the FONSI would include the Final Public Notice.

Demolition of buildings and infrastructure within the floodplain at JSC Main Campus would have a long-term beneficial impact. These areas would be returned to green space. The reduced impervious area resulting from demolition and removal of buildings and infrastructure would improve filtration and reduce the potential adverse effect of floodwaters. In addition, implementation of the Master Plan would effectively reduce storm water discharges at each of the facilities (between 23 and 77 percent at JSC Main Campus, between three and 34 percent at WSTF, and between 99 and 100 percent at NASA-EF and SCTF).

3.4.5 Noise

Affected Environment

JSC Main Campus: There are six main noise sources at JSC Main Campus. Three of these sources are utilities: Central Heating and Cooling Plant (Building 24) and cooling tower, Auxiliary Chiller Facility (Building 28) and cooling tower, and Emergency Power Building (Building 48). The other sources are the Vibration and Acoustic Test Facility (Building 49), the Atmospheric Re-entry Materials and Structures Evaluation Facility (Building 222), and the Propulsion Test Facility (Building 353).

JSC Main Campus noise sources do not exceed typical conversation levels of 65 dB(A) at receptors outside JSC Main Campus property lines. The Child Care Facility (Building 210) receives up to 73 dB(A) discontinuously from noise sources; this noise level could occasionally disturb its activities. JSC Main Campus has no records of complaints from offsite receptors associated with noise associated with onsite testing activities

NASA-EF: Noise is generated at NASA-EF by equipment and by airplanes. Stationary noise sources include the Engine Test Complex and Sound Suppression Facility. The closest noise sensitive receptors, at a commercial development, are located 200 meters (670 feet) and 396 meters (1,300 feet) away respectively, so it is unlikely that an offsite receptor would be adversely affected by this noise. Aircraft operations at Ellington Field include general aviation, commercial, and military aircraft. NASA aircraft at Ellington Field include twenty-eight T-38A trainers for astronaut training, four shuttle training Gulfstream G-2 airplanes, two high-altitude research WB-57F airplanes, one zero-gravity training C-9 airplane, one administrative program Gulfstream airplane, and an occasional stop-over of the shuttle carrier B-747 airplane. The existing noise contours are largely influenced by the tactical jet operations conducted by the Texas Air National Guard and NASA. Per the City of Houston's Ellington Airport (EFD) Master Plan, forecasted growth in aviation activity would not result in a "significant" increase in noise exposure as defined by federal guidelines.

SCTF: Normal operations at SCTF produce relatively low noise levels, especially when compared to EF flight operations, which are the dominant noise levels in the vicinity. Most of the land immediately

surrounding the site is undeveloped with no sensitive site receptors, although housing encroachment has occurred. The Northfork housing subdivision is separated from the SCTF by an open field and a wooden fence.

WSTF: There is a 4.5 mi buffer zone between WSTF's developed area and the nearest private home. There are no sensitive receptors in proximity to WSTF. Noise generated by operations is attributed to the following sources in order of volume: test operations, vehicular traffic, heavy equipment/construction, building air handlers, aircraft movements, and miscellaneous testing/disposal.

Infrequently, detonation occurs in Townships 20S and 21S, Range 3E at the Explosion Characterization Facility. The facility is prepared to perform liquid propellant and detonation testing including space flight propulsion systems, and is limited to a maximum 500-pound TNT equivalent explosion per test. Occasionally sonic booms occur over or near WSTF; however, this occurrence is uncommon.

A number of permanent and temporary measures are taken to reduce noise levels at WSTF. WSTF noise abatement measures for testing and general operation include property acquisition for use as a buffer zone for nearby private properties; noise insulation of buildings; permanent noise barriers; and scheduling of a specified activity to eliminate or alleviate noise impacts during critical periods.

Environmental Consequences

Proposed Action: The Proposed Action could have a short–term, adverse impact on noise at all of the installations. Construction activities would typically result in temporary noise increases from use of construction equipment and the increased sound associated with work crews/personnel and demolition, construction, renovation, and hauling activities. However, activities would comply with local noise ordinances and State and Federal standards and guidelines. The high noise levels would be intermittent over a long-term. Potential mitigation measures and precautions, which NASA would implement, may include special work hours, public notification, and environmental mitigation measures related to maintaining mechanized equipment in good working order.

Following completion of construction activities, noise levels would likely be consistent with current levels. Construction of new installations and consolidating buildings and activities may introduce new noise sources into a location, including transportation (cars and pedestrian) noise or noise at different times of day. New projects or activities that have the potential to generate high noise levels would be reviewed by JSC or WSTF environmental and staff prior to project startup. NASA would comply with applicable State and Federal standards and guidelines for potential impacts caused by constructing noise-generating installations, including providing appropriate controls, buffers, and abatement measures into individual projects.

3.4.6 Air Quality

Affected Environment

JSC Main Campus: JSC Main Campus has a Federal Clean Air Act (CAA) Title V operating permit issued in accordance with and subject to the Texas Clean Air Act (TCAA), Chapter 382 of the Texas Health and Safety Code and Title 30 Texas Administrative Code Chapter 122 (30 TAC Chapter 122), Federal Operating Permits. Currently, JSC Main Campus is classified as a major source for stationary onsite emission sources, which include boilers, heating, ventilation and air conditioning systems, generators, painting processes, ventilation exhausts from research laboratories, and test equipment. The boilers, power generators, and test equipment located center-wide represent the largest actual emission sources at JSC Main Campus.

All of the steam plant boilers are subject to the nitrogen oxides (NO_x) Reasonably Available Control Technology (RACT) and oil limits.

JSC Main Campus is located in Houston, Harris County, and must comply with the Houston-Galveston-Brazoria (HGB) National Ambient Air Quality Standards (NAAQS) for the eight-hour ground-level ozone. Mobile pollution sources include motor vehicles and construction equipment.

Table 1
JSC Point Source Emissions: 2013 and 2014

Criteria Pollutant	CY2013 (TPY)	CY2014 (TPY)
$PM_{2.5}$	1.40	1.29
PM_{10}	12.63	14.19
SO_2	0.04	0.02
NO_x	7.26	6.07
CO	3.13	2.37
VOC	10.69	15.53

NASA-EF: NASA-EF operates under a New Source Review Permit and several Permits by Rule authorizations. These permits limit the amount emissions that can be produced by specific stationary air pollution sources.

NASA-EF is classified as an "area source" (non-major source) of hazardous air pollutants (HAPs) as defined in the CAA, Section 112 – National Emission Standards for Hazardous Air Pollutants. In the Texas State Implementation Plan (SIP), NASA-EF is classified as a minor source.

Stationary sources of air pollutants at EF operations include aircraft engine testing, coatings of aircraft, fuel storage tank transfers (including fueling and defueling) vapor losses, degreasing, power generation, and fugitive emissions due to chemical products usage at various locations. In addition to stationary sources, NASA-EF mobile sources of air pollution include Aircraft, automobiles and mobile equipment.

According to the EF Airport Master Plan prepared by the City of Houston Airport System, NASA's contribution to overall emissions from aircraft operations for the Ellington Field airport is estimated to be approximately 20 percent of the total. The EF Master Plan has concluded that Ellington Field's operations are not considered a significant contributor to air pollution concerns (primarily formation of ground level ozone) as determined by comparison to the State Implementation Plan's guidelines.

Table 2 NASA-EF Point Source Emissions 2013 vs. 2014		
Criteria Pollutant	**CY 2013 (TPY)**	**CY 2014 (TPY)**
$PM_{2.5}$	0.23	0.14
PM_{10}	0.23	0.53
SO_2	0.08	0.06
NO_x	0.81	0.66
CO	6.93	4.22
VOC	5.30	4.28

Table 3 NASA-EF's Criteria Air Pollutant Mobile Source Emissions (Generated by NASA Aircraft 2013)		
Criteria Pollutant	**Emissions Rate (grams/operation)**	**Emissions (TPY)**
CO	13,473	93.5
Hydrocarbons (as VOC)	3,438	23.9
NO_x	19,254	133.6

NASA-EF is located in Houston, Harris County, and must comply with the HGB NAAQS for ground-level ozone. HGB is considered a marginal nonattainment area and does not meet the eight-hour ozone NAAQS.

SCTF: SCTF operates under Permits by Rule. These authorizations limit the amount emissions that can be produced by specific stationary air pollution sources. Stationary sources of air pollutants at SCTF operations include wood working machinery, the vapor degreaser, natural gas boilers that heats pool water for the NBL, and emergency generator (operates intermittently less than 860 hours per year) and Space heaters (operated seasonally). SCTF is exempt from the requirement to file an annual air emissions inventory, since none of the criteria pollutant quantity thresholds for reporting are exceeded.

Table 4 SCTF Point Source Emissions 2013 and 2014		
Criteria Pollutant	**CY2013 (TPY)**	**CY2014 (TPY)**
$PM_{2.5}$	0.18	0.19
PM_{10}	0.66	0.19
SO_2	0.01	0.01
NO_x	1.44	1.51
CO	2.04	2.12
VOC	0.94	0.40

The primary mobile sources of air pollutant emissions at the SCTF are employee vehicles. SCTF is located in Houston, Harris County, and must comply with the HGB NAAQS for ground-level ozone. HGB is considered a marginal nonattainment area and does not meet the eight-hour ozone NAAQS.

WSTF: Doña Ana County is in attainment for all criteria pollutants except for PM_{10} http://www.epa.gov/oaqps001/greenbk/ancl.html. The non-attainment area is limited to an area around the city of Anthony, NM, located about 40 miles south of WSTF. New Mexico standards are more stringent than the NAAQS federal standards. New Mexico also has requirements for registering and permitting certain air pollution sources.

WSTF currently has air quality permits for the 300 and 400 Areas Altitude Simulation Systems, the 700 Area explosion characterization facility, and Test Cell 844. Gases released into the atmosphere during normal operations at WSTF include oxygen, nitrogen, helium, ammonia, chlorofluorocarbons and hydro-chlorofluorocarbons, trichloroethylene, alcohols, and combustion products, including raw propellant of the altitude simulation systems and test articles (i.e., CO, CO_2, PM, NO_x, SO_2, and VOCs).

Due to WSTF's operational control of air pollutants, remote site location, and the climatology of the area, there have not been any significant deterioration of air quality.

Table 5
WSTF's Point Source Emissions (2008 – 2011)

Criteria Pollutant	CY 2008 (TPY)	CY 2009 (TPY)	CY 2010 (TPY)	CY 2011 (TPY)
PM_{10}	0.41	0.65	0.24	0.17
SO_2	1.12	1.15	0.80	0.37
NO_x	7.76	10.98	4.74	3.47
CO	19.96	42.02	34.73	11.70
VOC	7.53	18.91	15.62	4.66

Environmental Consequences

Proposed Action: The Proposed Action could cause short-term adverse impacts to air quality during construction, demolition, and renovation activities; however, the activities would be intermittent and staggered over a long period. Local impacts to air quality from construction activities would likely include fossil-fuel use for construction equipment, use of materials containing VOCs, and fugitive dust emissions from soil disturbance and demolition. Fossil-fuel use for construction equipment would produce emissions of CO, NO_x, SO_2, VOCs, PM_{10}, $PM_{2.5}$, and hazardous air pollutants. VOCs and hazardous air pollutants emissions could also occur at construction sites from the use of paving materials, paints, thinners, solvents, and other materials. Activities at JSC Main Campus, NASA-EF, and SCTF would be subject to the General Criteria Rule (GCR) because they are located in a non-attainment area. The GCR does not apply to any Federal action occurring in an area designated as attainment for all criteria pollutants.

NASA would apply for and obtain construction and operation permits required under New Source Review and Prevention of Significant Determination review, if required. Regardless of whether a permit is needed, NASA would employ environmental mitigation measures to limit construction emissions, including watering disturbed areas, maintaining and covering soil piles, scheduling staging area siting to minimize fugitive dust, covering truck beds when hauling debris, and keeping construction equipment properly tuned.

Older structures often contain lead-based paint or asbestos. Additionally, roadway shoulders can contain lead that was deposited from past leaded fuel vehicle emissions. These substances can become airborne when disturbed. Any activities associated with the modification of installations or ground disturbance along roadway shoulders would be done by NASA in accordance with Federal and State laws and regulations regarding the handling and disposal of hazardous materials, such as lead-based paint and asbestos-containing materials and soil contaminated with aerially deposited lead.

The Proposed Action could result in long-term beneficial effects to air quality. Older equipment, such as boilers or units operating with ozone depleting substances will be removed and replaced with equipment with state-of-the-art emission control systems. Newly constructed and renovated buildings would incorporate green building technologies and be more energy efficient thereby resulting in significantly less air emissions then current buildings.

3.4.7 Greenhouse Gas Emissions and Climate Change

Affected Environment

JSC Main Campus: The Mandatory Reporting of Greenhouse Gases (GHGs) rule, 40 CFR 98, requires annual reporting for installations that exceed 25,000 metric tons per year of Carbon Dioxide Equivalent (CO_2e) emissions. GHGs were evaluated for JSC Main Campus in 2015 to determine if it was subject to the Mandatory GHG Reporting Rule. JSC Main Campus's 2014 CO_{2e} emissions totaled 20,343 metric tons; therefore, JSC Main Campus is not required to report the annual CO_{2e} emissions to the USEPA.

JSC has ensured that resilience and climate adaptation strategies are incorporated into JSC's Master Plan and revitalization initiatives. Reduction of energy consumption, a major factor in GHG emissions, is a goal of the NASA Strategic Sustainability Plan. If fully implemented, reduction strategies in the Master Plan would reduce energy consumption between 46 and 50 percent. In addition, new construction and renovation will incorporate green building technologies and be more energy efficient.

NASA-EF: GHGs were evaluated for NASA-EF in 2015 to determine if it was subject to the Mandatory GHG Reporting Rule. NASA-EF 2014 CO_{2e} emissions totaled 594 metric tons; therefore, NASA-EF is not required to report the annual CO_{2e} emissions to the USEPA. The Master Plan strategies and policies would reduce energy consumption at NASA-EF by 43 percent. The energy use goals of NASA-EF are to "Strive for Net Zero Energy" by 2040 through passive load reduction, optimized efficiency, and cost-effective renewable energy generation.

SCTF: GHGs were evaluated for SCTF in 2015 to determine if it was subject to the Mandatory GHG Reporting Rule. SCTF's 2014 CO_{2e} emissions totaled 2,793 metric tons; therefore, SCTF is not required to report the annual CO_{2e} emissions to the USEPA. The Master Plan strategies and policies would reduce energy consumption at SCTF between 27 and 29 percent. The energy use goals of SCTF are to "Strive for Net Zero Energy" by 2040 through passive load reduction, optimized efficiency, and cost-effective renewable energy generation.

WSTF: GHGs were evaluated for WSTF in 2010 to determine if it was subject to the Mandatory GHG Reporting Rule. WSTF 2010 CO_{2e} emissions totaled 2,652 metric tons; therefore, WSTF is not required to report the annual CO_2e emissions to the USEPA. In addition, NMED regulations state that annual reporting of GHG are required for facilities that produce 10,000 metric tons of CO_{2e}. WSTF is also well below this threshold. The Master Plan strategies and policies would reduce energy consumption at WSTF between 14 and 21 percent. The energy use goals of WSTF are to "Strive for Net Zero Energy" by 2040 through passive load reduction, optimized efficiency, and cost-effective renewable energy generation.

Environmental Consequences

Proposed Action: The Proposed Action could have a short-term adverse, localized impact to GHG emissions at all the installations. Construction, demolition, and renovation activities would likely include fossil-fuel use from heavy equipment, which would produce GHG emissions. NASA would employ environmental mitigation measures to limit emissions, including keeping construction equipment properly tuned.

The Proposed Action would result in a long-term, beneficial effect by reducing GHG emissions. New construction would result in LEED energy efficient buildings, which, according to the US Green Building Council, have consistently resulted in at least a 10 percent greater energy efficiency than that of conventional construction. Many of the buildings selected for demolition as part of the Master Plan are metal buildings; and an even greater percentage of energy efficiency is anticipated. Replacing, renovating, and consolidating installations would result in the use of more energy efficient systems (such as air conditioners and lighting), which could result in a long-term, beneficial effect by reducing GHG emissions.

NASA has set reduction targets in energy usage as a key management focus. NASA will install electric meters on buildings, and therefore will be able to track and report net energy savings through its energy dashboard. All four installations are currently under the 25,000 CO_{2e} and the Master Plan has set measures and goals in place that would result in reducing the overall energy usage, and therefore net GHG emissions, steadily over the next 20 years.

3.4.8 Hazardous Materials, Waste, and Pollution Prevention

Affected Environment

JSC Main Campus: JSC Main Campus generates and stores large quantities of industrial solid and hazardous wastes and is registered by the TCEQ as a Large Quantity Generator. Various toxic substances, which include a variety of chemicals used in maintenance and research, are present at JSC Main Campus. These include asbestos, pesticides, lead paint, and numerous cleaning and caustic solutions.

JSC Main Campus has various systems in place that cover the storing, tracking, response, and cleanup of hazardous materials. Hazardous wastes are managed at the Hazardous Waste 90-day Accumulation Facility (Building 358) which is the central storage site for hazardous waste. Waste is generated at various points around JSC Main Campus and is transferred to this building to be prepared for shipment to disposal sites. Transport vehicles take the wastes to Federal/State and NASA approved/audited private hazardous waste disposal operations. An inventory of toxic substances and hazardous materials by building is performed annually by NASA through the Occupational Health Office.

The TCEQ also regulates the generation and disposal of nonhazardous industrial solid waste. Nonhazardous municipal-type solid waste, including construction and demolition debris (e.g., concrete, scrap metal), paper, cardboard, wood, and plastic refuse. Those types of solid wastes are picked up by a commercial transporter and transported for recycling or disposal as appropriate.

Several types of wastewater are generated at JSC. These include domestic sewage, plating shop rinse water, laboratory wastewater, blow-down water from cooling towers and boilers, wastewater from the ESTA, and oily wastewater from the vehicle garage and maintenance shops. The sanitary sewer system receives wastes from lavatories, food preparation areas, and process discharges. JSC Main Campus discharges its sanitary wastewater to the Clear Lake City Water Authority.

Pollution Prevention (P2)–Federal and State regulations require that JSC prepare a five-year P2 Plan to set waste reduction goals and report annually on activities to prevent pollution. The 2009-2013 P2 goals for JSC Main Campus included reducing paint waste by 5 percent, increasing used oil recycling by 10 percent, and reducing total hazardous waste generation by 2 percent.

JSC Main Campus has already made significant progress in reducing the amount of waste generated. Since 1987, JSC Main Campus has reduced overall hazardous waste quantities from 42,862 tons to approximately 2,862 tons in 2007, a 93 percent reduction. Hazardous waste generation quantities in 2007 were 62 percent less than 2003 waste quantities. Since 2012, the JSC Main Campus has consistently diverted well over 50 percent of all solid wastes (combined industrial, municipal, and construction/demolition) generated at JSC Main Campus from disposal in landfills.

JSC Main Campus has submitted and is currently working under its most recent P2 Plan for 2014-2018. JSC's pollution prevention goal is to reduce hazardous waste generation continually through process improvement, source reduction, and recycling. JSC has the following hazardous waste reduction goals for the 2014 through 2018 planning period:

A. A two percent reduction in laboratory chemical waste generation, approximately 205 pounds;

B. A 75 percent decrease in waste solvent generation, approximately 925 pounds; and

C. A 15 percent reduction in waste oil generation, approximately 472 pounds.

In addition to the P2, the installation is covered by an Environmental Management System (EMS) Environmental Compliance Procedures, and a Spill Prevention Control and Counter measures Plan that establish the framework to control or prevent releases of toxic substances into the environment.

NASA-EF: NASA-EF is registered by the TCEQ as a large quantity generator. NASA-EF generates hazardous and industrial solid wastes that are conveyed to permitted and NASA-authorized offsite treatment, storage and disposal and recycling installations. NASA-EF has procedures in place to minimize how much waste is produced, control its handling, and avoid environmental pollution. .

Hazardous wastes are accumulated at the southwest corner of the Maintenance Hangar (Building E135), the northeast corner of the Aircraft Corrosion Control Facility (Building E136), the southwest corner of the Maintenance Hangar (Building E276), the northwest corner of the Aircraft Ground Support Equipment Facility (Building E278) and the northwest corner of the Maintenance Hangar (Building E990). Drums of waste are stored in the "less than 90 day" accumulation facility (Building E152) located on the east side of the Maintenance Hangar (Building 135). Waste is then shipped directly to a permitted NASA-approved treatment, storage, disposal or recycling facility. No solid wastes are treated on site at NASA-EF.

Toxic substances are present at NASA-EF and include items such as asbestos, oil, and cleaning solutions. Toxic substances are stored inside buildings in small quantities, in covered boxes that are capable of containing a spill of their contents. An annual inventory of toxic substances by building is performed and maintained by NASA's Industrial Hygiene and Occupational/Environmental Health Support Contractor.

The sanitary sewer system receives wastewater from NASA-EF operations, which includes sewage, oil/water separator (wastewater) effluent, and wash rack wastewater. NASA-EF conveys its wastewater to a sewage treatment plant owned by the Metro Central Advisory Committee, located southeast of the Ellington Airport. The plant is operated by the Gulf Coast Waste Disposal Authority. Effluent from the plant flows into Horsepen Bayou south of the plant.

Pollution Prevention - Federal and State rules and regulations require that NASA-EF prepare a five-year P2 Plan to set waste reduction goals and report annually on activities to prevent pollution. The P2 goal for NASA-EF is to reduce hazardous waste generation continually through process improvement, source reduction, and recycling. The P2 Plan for 2015-2019 includes goals for NASA-EF as well as SCTF and are as follows:

A. A 10 percent reduction in cadmium wastewater, approximately 395 pounds
B. A three percent reduction in CCSW, approximately 39 pounds
C. A three percent reduction in small quantity chemicals, approximately 27 pounds
D. A 50 percent reduction in contaminated rags, approximately 120 pounds
E. A 50 percent reduction in aerosol can waste volumes, approximately 106 pounds
F. A two percent reduction in solvent, approximately three pounds

NASA tracks and routinely reports progress on achieving these goals.

SCTF: NASA operations at SCTF generate relatively small quantities of hazardous and industrial nonhazardous solid wastes. SCTF accumulates hazardous waste streams in appropriately labeled 55-gallon satellite accumulation drums. Once a satellite accumulation drum is completely filled, it is transported to the less than 90-day accumulation unit at NASA-EF (Building E152). Upon arrival at NASA-EF, containerized hazardous and Class 1 industrial non-hazardous waste from the SCTF are subject to all of the waste management requirements in effect for the NASA-EF facility.

The most significant quantities of hazardous substances in use at SCTF are associated with the treatment of the pool water. Sulfuric acid and sodium hypochlorite are used as treatment chemicals; tanks are located within secondary containment areas to preclude a release to the environment.

Domestic and industrial wastewater at the SCTF includes domestic sewage, backwash filter water from the SCTF pool, cooling tower blow-down, and other small industrial processes. The SCTF discharges its wastewater to the Metro Central Waste Treatment Plant, southwest of the facility. The plant is operated by the Gulf Coast Waste Disposal Authority. Treated effluent from the plant flows into Horsepen Bayou, south of the SCTF.

3.4.9 Pollution Prevention

WSTF: Hazardous waste management activities are performed under the USEPA RCRA Permit Identification Number NM8800019434 issued on December 2009. Hazardous wastes generated at WSTF are managed by the contractor environmental organization under the supervision of the NASA Environmental Office. The Permit requires frequent waste stream review and characterization. These activities have promoted a closer look at waste generation and minimization at WSTF; modification of the hazardous waste generation process, improvement of waste determinations, and generator attention to waste stream constituents and concentrations continue to reduce waste.

WSTF operates one permitted hazardous waste management unit for the storage, treatment, and disposal of hazardous waste; namely the Fuel Treatment Unit. On January 17, 2012, WSTF submitted a Closure Plan for the on-site solid waste management facility to NMED, and it was approved for implementation on June 19, 2012.

WSTF is in compliance with all applicable federal and state regulations. WSTF has renovated equipment, such as transite pipe and ovens, to assist in eliminating site asbestos. WSTF has controlled polychlorinated biphenyl PCB use within transformers, capacitors, oils, and light ballasts and is working to eliminate PCBs

on site. An annual PCB report is generated each year; this report tracks PCBs shipped off site for disposal or currently awaiting off-site disposal.

Previously, wastewater and sewage were sent to a number of sewage lagoons and overflow lagoons or to septic tanks. The discharges from these sewage units are controlled under the New Mexico Water Quality Ground and Surface Water Protection Regulations (20.6.2 New Mexico Administrative Code [NMAC]). WSTF operates under a discharge plan (DP) labeled DP-392 for its 100, 200, and 600 Areas sewage lagoon systems, and DP-584 for the STGT sewage lagoons. In 2015 WSTF completed installation of a new wastewater system that connects WSTF to the City of Las Cruces' publicly owned treatment works. Therefore, the lagoons are being closed and removed following NMED-approved closure plans.

Other wastewater in the test areas, primarily heat exchanger cooling water, is discharged through drain lines to the concrete lined collection flumes or into a holding pond. In the event of contamination with propellant, waste is managed per federal and state hazardous waste regulations. WSTF operates under discharge plans labeled DP-697 for the 300 Area Small Altitude Simulation System condenser pond, and DP-1170 for the 400 Area Altitude Simulation System evaporation ponds.

WSTF – Federal and State regulations require that WSTF set waste reduction goals and report annually on activities to prevent pollution. WSTF's most recent report is the Hazardous and Solid Waste Amendments 2014 Waste Minimization Plan. The plan describes WSTF policies and programs (which includes the ISO14001-2004 EMS and the WSTF Sustainability Program) and their goals and objectives.

WSTF uses Environmental Management System (ISO 14001:2004) procedures to evaluate the environmental aspects of site activities, products, and services to determine their environmental impacts. Environmental impacts of each aspect are ranked and those with significant impacts are established as "significant aspects." An Environmental Management Program (EMP) is established for each significant aspect. Each EMP outlines objectives and targets developed to lessen the environmental impact and reduce the consumption of natural resources at WSTF. The FY 2014 significant aspects and associated EMPs were:

A. Water Quality – to ensure that WSTF does not lose its water (drinking) storage capacity;
B. Water Quality-Cross Connection Control – to maintain the quality of drinking water at WSTF by preventing drinking water contamination from non-potable water sources;
C. Air Emissions-Refrigerant Management – developed to strengthen the refrigeration management program and develop one procedure for management on site;
D. Water Conservation – WSTF has set a goal to reduce water use by 2 percent per year; and
E. Wastewater Management – In 2015, WSTF successfully connected its sanitary wastewater system to the Las Cruces Publicly-Owned Treatment Works (POTW) and closed the surface impoundments previously used for sanitary sewage wastewater treatment.

Other plan components include Training and incentive programs, Source reduction and recycling measures among others. The plan also lists past years waste source reduction, recycling, and reduction/recycling future plans. The 2015 Waste Minimization plan reinforces the significant aspects/impacts and targets that were identified as EMPs in 2014. WSTF reviews its aspects/impacts and identifies targets and impact reduction initiatives on an annual basis.

Environmental Consequences

Proposed Action: The Proposed Action could cause short-term adverse impacts to hazardous materials, waste, and pollution. Construction, demolition, and renovation activities may disturb hazardous materials present at the site of an action. Construction activities typically use petroleum-powered equipment.

Improper use and storage of this equipment or inappropriate handling of petroleum could result in an accidental release of petroleum materials.

NASA would follow local, State, and Federal regulations for the handling and disposal of hazardous materials or for removing USTs. NASA would coordinate with the, USEPA, and State agencies that regulate hazardous materials, as appropriate. The removal and proper disposal of the materials would result in a beneficial effect to the site and community.

NASA would follow their established procedures for handling asbestos while performing maintenance and while renovating or demolishing buildings located in JPR 1700. Proper asbestos control procedures, including filing the required 10-day pre-construction notification of asbestos abatement and demolition projects per 40 CFR 61 and corresponding state rules must be followed.

NASA would implement environmental mitigation measures to limit the effects of any accidental release. These environmental mitigation measures could include inspecting of equipment for signs of fuel or fluid (e.g., hydraulic fluids) leaks; establishing areas for refueling with appropriate emergency cleanup gear for spills (spill containment and absorption materials); and immediately cleaning up leaks, drips, and other spills. The implementation of environmental mitigation measures would make hazardous material releases or accidents unlikely and would ensure that any accidental release would be finite, and localized.

At WSTF, hazardous materials must be stored away from all arroyo drainages, catchment basins, and low-lying grassland habitat. Fuels, oils, or other chemicals must not be poured or drained onto ground surfaces nor dumped into drainages. Any chemical spills must be immediately cleaned up and containment devices placed around these materials in the event of spills. Any dumping of human refuse must be prohibited in and around the property and along existing roadways. All dumping and storage of trash, garbage, metal, bottles, and other waste are strictly prohibited within the property at all times. Natural watering areas, arroyos, sewage lagoons, and artificial water pooling areas (e.g., water tanks, evaporative cooling run off, etc.) provide a source of free water for wildlife in the surrounding area.

NASA would also comply with any storm water or effluent permitting requirements under Section 401 and 402 of the Clean Water Act (CWA), such as NPDES. NASA would apply for and obtain the necessary permits from the State before initiating any work. NASA would implement specific environmental mitigation measures for activities that do not require NPDES permits and that would take place in or adjacent to an impaired water body, as described under Section 303(d) of the CWA. These environmental mitigation measures would eliminate the potential for construction activities to result in the release of pollutant(s) that have impaired the water body.

Long-term impacts related to the potential generation of pollution are not anticipated. Existing measures and procedures are currently in place and would continue after the Proposed Action. Any new systems or equipment that consume water and/or generate wastewater would be evaluated prior to their installation and NASA would ensure that all new water discharge sources would be compliant with applicable regulations and permits.

The adoption of the Master Plan would incorporate by reference current measures to reduce the generation of waste at all of the facilities (e.g., for the current pollution prevention and waste minimization plans, these include a 72% reduction at JSC Main Campus, a 33% reduction at WSTF, and a 62% reduction at NASA-EF and SCTF).

3.5 Biotic Resources

3.5.1 Vegetation

Affected Environment

JSC Main Campus: Agriculture, grazing, fire suppression and urbanization have affected plant communities at JSC Main Campus. Development has removed native plants and replaced them with cultivated turf, ornamental shrubs and trees. Undeveloped areas are maintained to keep them free of woody plants that would otherwise invade these open grasslands. Tall prairie grasses often dominate these open areas, occurring with several flowering plants. Exotic plant species such as Chinese tallow tree (*Sapium sebiferum*) have invaded native communities.

The north part of JSC Main Campus is wooded. North of the Energy Systems Test Area (ESTA) is a stand of willow oak (*Quercus phellos*), invaded by Chinese tallow saplings in the understory. Smaller woods, surrounded by open grassland, are in the east part of JSC. The dominant tree is post oak (*Quercus stellata*). JSC is currently implementing a program, with the approval of the U.S. Army Corps of Engineers (USACE) under Nationwide Permit (NWP) 27, to remove Chinese tallow trees and saplings as well as other invasive non-native plant species by means of mechanical removal and herbicide application. A pecan (*Carya illinoensis*) orchard is located in the east part of JSC Main Campus. It has mature trees up to 20 meters (60 feet) tall. Several saplings have been planted to replace dead trees, and the grass under the trees is mowed annually.

A Sustainable Landscape Pilot Project began in 2005, with a grant provided to JSC from the Lady Bird Johnson Wildflower Center to assess the effectiveness of using regionally appropriate native plants to reduce landscape maintenance costs while enhancing biological diversity and wildlife habitat. This project is a test site for a new program being developed jointly by the Lady Bird Johnson Wildflower Center (Wildflower Center) and the American Association of Landscape Architects called "Sustainable Landscapes." Many of the currently mowed fields at JSC Main Campus are being converted to lower maintenance, higher diversity meadows, and a mulching and composting program has recently been implemented.

Aquatic plants are present along the drainage ditches at JSC Main Campus. The aquatic flora of several drainage ditches in the north include filamentous algae, cattails (*Typha latifolia*), sedges (*Cyperus* sp.), and false loosestrife (*Ludwigia* sp.).

NASA-EF: No plant communities are present at NASA-EF.

SCTF: No plant communities are present at SCTF.

WSTF: The biotic resources on WSTF are typical of that found in the arid southwest, a desert area with low rainfall and sparse vegetation. Overall, vegetative species diversity is low. WSTF implements a grounds maintenance program at some testing locations to keep the site scraped and virtually free of vegetation. This program also includes erosion control and ditch maintenance. Landscaping in the developed areas consists of low-maintenance desert vegetation such as yuccas (*Yucca sp.*), century plants (*Agave sp.*), ocotillos (*Fouquieria sp.*), Afghan pines (*Pinus eldarica*), locust trees, and Mexican alders (*Alnus jorullensis*). A rock ground cover is used around buildings; lawns are avoided due to excessive maintenance costs and water use.

Environmental Consequences

Proposed Action: The Proposed Action could cause short-term adverse impacts to vegetation at the JSC Main Campus. Construction and demolition activities undertaken in previously undisturbed areas, such as realignment or relocation of installations or construction of temporary or permanent installations, could adversely affect vegetation. Vegetation would be removed. NASA would minimize impacts to vegetation through proper siting and design. Except for staging areas on hardened surfaces, NASA would seed or sod staging areas with native vegetation. Long-term adverse impacts to vegetation would occur in areas currently vegetated that would be converted to building or infrastructure.

Non-native and invasive species could become established on disrupted soils common during construction activities. To minimize impacts associated with invasive species, NASA would ensure that any disruption of soils and existing vegetation would be stabilized or reseeded with a native seed mix or allowed to re-vegetate with native plants. BMPs would be implemented to avoid tracking in and /or dispersing existing invasive plant materials during construction, demolition, and renovation. Activities with the potential to impact trees would be reviewed by JSC environmental staff to ensure appropriate protection measures are employed. NASA would implement environmental mitigation measures, as appropriate, to prevent the introduction of invasive species at the construction site or the spread of invasive species from the construction site.

Long-term beneficial effects would be expected at JSC Main Campus in the areas previously occupied by relocated installations, as these areas are restored to natural conditions once demolition is complete. The JSC Master Plan directs planting plans to include species native to the area. This would include ornamental plantings at all four installations.

3.5.2 Wildlife

Affected Environment

JSC Main Campus: Most of JSC Main Campus is kept open, with little cover and food for wildlife. Large ambulating animals from Armand Bayou Nature Center, located to the north and northeast, are prevented from crossing Space Center Boulevard and entering JSC Main Campus by a 2.5-meter (eight-foot) perimeter fence. In the developed areas, traffic and routine activities also discourage wildlife.

Animals that may be found at JSC Main Campus include but not limited to mammals such as white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*) nutria (*Myocastor coypus*); eastern cottontail (*Sylvilagus floridanus*); and migratory and non-migratory birds such as red-tailed hawk (*Buteo jamaicensis*), blue jay (*Cyanocitta cristata*), cardinal (*Cardinalis cardinalis*). Reptiles and amphibians that are native to the Gulf Coast are present at JSC. Although snakes, turtles, lizards, and skunks occur throughout the site, they are most abundant in undeveloped areas.

Mosquitofish (*Gambusia affinis*) and Blanchard's cricket frog (*Acris crepitans blanchardi*) are present, and there are shells of crabs and crawfish. The central mall has three connected artificial ponds. The free-form ponds are aerated, lined with concrete, banked with random-sized New Mexican river-worn rock, and surrounded with cement. Water flows continuously from the site's water supply, drains through grates under the ponds and recycled so that make-up water requirements are significantly reduced. Koi and goldfish (*Carassius auratus*) swim in the three ponds.

NASA-EF: Wildlife is generally not present at NASA-EF. The open land surrounding Ellington Field is habitat for deer, small mammals, birds, reptiles, and amphibians that are adapted to suburban and rural environments. Migratory birds may occasionally utilize Ellington Field for relatively brief periods.

However, the presence of wildlife is discouraged at Ellington Field to reduce the risk of collisions with airplanes. A fence at the airport perimeter excludes large animals. No aquatic habitat is present at NASA-EF.

SCTF: The open land surrounding the SCTF is habitat for deer, small mammals, birds, reptiles, and amphibians that are adapted to suburban and rural environments. The SCTF is highly developed and has minimal habitat area suitable for wildlife. A fence at the northern and eastern property boundaries prevents large animals from entering the property from surrounding undeveloped areas.

WSTF: The area around WSTF is largely in conservation management and remains little affected by human development. The WSTF facility may support transient individuals or populations of songbirds, quail, rabbits, deer, coyotes, bobcats, badgers, and foxes. Indigenous migration reptiles, mainly lizards and snakes, are frequently found on site, mostly in the undeveloped areas, and occasionally in or near buildings. Over the last decade, WSTF management has made every effort to preserve the natural conditions and desert environment through facility design and operations. Because of the lack of ponds, streams, and wetland habitat, the number of amphibians is low.

Although the WSTF lies outside the concentrated migratory routes of the central flyway, migratory birds are present at the installations, especially during the August, September, and October migration. The most common species of birds include the house finch (*Haemorhous mexicanus*), black-throated sparrow (*Amphispiza bilineata*), mourning dove (*Zenaida macroura*), northern mockingbird (*Mimus polyglottos*), white-winged dove (*Zenaida asiatica*), and the western kingbird (*Tyrannus verticalis*). Several species of raptors were also identified in proximity to WSTF, including Golden Eagle (*Aquila chrysaetos*). Previous studies at WSTF indicate the Merriam's kangaroo rat (*Dipodomys merriami*), the Ord's kangaroo rat (*Dipodomys ordii*), and the whitethroated woodrat (*Neotoma albigula*) appear to be the most prolific and wide-spread mammals at the site. Other common species of mammals include the desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), mule deer (*Odocoileus hemionus*) and the banner-tailed kangaroo rat (*Dipodomys spectabilis*).

Environmental Consequences

Proposed Action: The Proposed Action could have a short-term adverse impact on wildlife at all the installations. The ingress and egress of equipment and personnel during construction could adversely affect wildlife resources close to the activities due to increased human presence, removal of habitat, and increased noise. Potential impacts would be short-term and could include displacement or mortality of individual wildlife.

If the action has the potential to affect Golden Eagle, migratory birds, or species protected under the State or local regulations, NASA would coordinate with the U.S. Fish and Wildlife Service, or State or local agency, as appropriate. In the event that construction activities encountered any bird nesting activity, work would be stopped and NASA environmental staff would contact the local U.S. Fish and Wildlife Office. NASA would consult with the U.S. FWS, or applicable State agency(ies) (as appropriate) to develop measures to mitigate action-related losses of fish and wildlife resources.

The Proposed Action could have long-term beneficial impacts on wildlife at JSC Main Campus and WSTF in the areas previously occupied by relocated installations that are restored to natural conditions once demolition is complete.

3.5.3 Endangered Species

Affected Environment

JSC Main Campus: Recent studies suggest that undeveloped, areas of JSC Main Campus contained suitable habitat for several of Harris County, Texas-listed rare, threatened, and endangered (RTE) species, but site reconnaissance did not indicate any evidence of the listed species within any habitat type. A list of endangered species in Harris County, TX can be viewed at http://tpwd.texas.gov/gis/rtest/.

The critically endangered population of Atwater's Prairie Chicken (APC) is being restored by the Houston Zoo at a captive breeding facility located within JSC Main Campus. Through a Space Act Agreement, JSC licensed 1.7 acres of land to the Zoo to move their captive breeding program from the zoo to JSC Main Campus. The zoo is fully responsible for the operation and maintenance of the program under a permit with the USFWS.

NASA-EF: There are no records of endangered species having been observed on or around NASA-EF's tracts; however, habitat adjacent to NASA's tracts is considered conducive to the Texas prairie dawn. The endangered species list for Harris County, TX is applicable to NASA-EF.

SCTF: According to the USFWS and TPWD, no critical habitat for threatened or endangered species exists at SCTF.

WSTF: The night-blooming cereus is the only Federal-listed threatened or endangered species that has been observed at WSTF. The occurrence of these populations have been surveyed and well documented in proximity to the active WSTF area. Refer to http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=NM&status=listed for a list of Federal- and state-listed species that may also occur as transient individuals or populations within Dona Ana County, NM.

During a 1996 study conducted by the University of New Mexico, no habitat critical to the survival or reproduction of any listed species of plant or animal was observed on or in the immediate vicinity of the WSTF property.

Environmental Consequences

Proposed Action: For all activities, NASA is responsible for evaluating presence of federally listed or proposed threatened or endangered species, their habitat, and/or their proposed or designated critical habitat, in the area in which the action is implemented. If NASA determines that species that are federally listed or proposed to be listed, their habitat, or proposed or designated critical habitat has the potential to be affected by an action, NASA would coordinate with the USFWS and comply with Section 7 of the ESA, as appropriate.

Some activities could impact threatened and endangered plant populations such as Federal or State threatened and endangered plants in the vicinity of construction activities. These activities would be designed to avoid threatened and endangered plant species populations and individuals to the extent feasible.

3.6 Social and Economic Environment

3.6.1 Land Use

Affected Environment

JSC Main Campus: JSC Main Campus occupies approximately 656 hectares (1,620 acres). JSC Main Campus conducts operations in four main quadrants of the Center's property boundary. The activities performed in each quadrant are similar in nature.

Area I, located in the southeast quadrant of JSC Main Campus, includes the main facility complex. These installations house the administrative, training, operational, major testing, engineering development, sciences, management, engineering development services, mission operations, training, major testing, and science research programs.

Area II located in the northeast quadrant of JSC Main Campus contains technical support functions that serve the Main Facility Complex in Area I. Installations in the southern portion of Area II include administration and testing support installations.

Area III is located in the northwest quadrant of JSC Main Campus contains the Energy Systems Test Area. ESTA is where hazardous operations take place. Area III serves as a hazardous material storage, explosives storage, and fire training area. The northern half of the Center Support Installations Area, in the southwest corner of Area III, houses the maintenance shops, central waste collection, service contractor construction services, and warehousing installations.

Area IV, in the southwest sector of JSC, is reserved for large land area requirements to support special systems testing and development. Additional warehousing installations, shipping and receiving, motor pool, logistics support, and other housekeeping functions are located in the northwest corner of Area IV. The extreme southwest section of JSC is reserved for Space Education Development, including partnerships with the Clear Creek Independent School District.

Easements for non-NASA entities cover 81 hectares (200 acres) of JSC Main Campus. These easements include rights-of-way for:

A. Utilities: Storm sewers, cooling water canals, electrical transmission lines, gas pipelines, and telecommunications cables.
B. Oil extraction: Exxon Oil Company has an easement for oil drilling on eight hectares in the northwest part of the site.
C. Attwater Prairie Chicken: NASA granted an easement in 2005 to the Houston Zoo within the 400 area for erection of an Attwater Prairie Chicken Captive Breeding Area.

NASA-EF: The Ellington Airport (EFD) covers 750 hectares (1,900 acres) of which 15 hectares (37 acres) are six NASA-owned and operated tracts. The largest tract (10 hectares or 24.7 acres) is at the south end of the airport and contains the majority of NASA activities and airplane parking. Adjoining this tract are small tracts used for fire protection and for automobile parking. Fifteen hundred meters (one mile) north of the southern tract is the second largest tract (four hectares or ten acres) containing the Maintenance Hangar (Building 990), the Aircraft Operations Building (Building 993), the Aircraft Maintenance Support Building (Building 994) and airplane parking. The two remaining tracts hold the Supply and Maintenance Warehouse (Building 380) and automobile parking. NASA-EF is almost entirely developed and paved. The NASA-EF tracts have several sanitary sewer and other utility easements.

SCTF: SCTF is located on an 8.17-hectare (20.19-acre) property to the south of Houston, Texas. The main structure, Building 920, occupies 23,372-square meters (251,579-square feet) of the lot. The building is divided into three units, the NBL (920N), the LMF (920L), and the SDIL (920A). Other structures at SCTF include the breathing gas equipment area, located directly north of the LMF, and the pool equipment area, located directly north of the NBL. Two storage sheds designated as hazardous material storage areas are also located north of the SDIL and NBL.

SCTF property utilities include sanitary sewer, water, telephone, natural gas, and electricity, which are shown on the original survey plat. No other easements are identified within the SCTF property.

WSTF: At WSTF, the land under NASA control totals approximately 237 km^2 (91.5 mi^2). WSTF is divided into seven major land use areas. These areas serve as a basis for the Facility Numbering System utilized by the installation. WSTF land usage has a direct effect on about 2,104 hectare (5,200 acres) of the approximately 11,331 hectare (28,000 acres) of land. This is the acreage developed or allocated for current testing, support, and administration. It does not include the water remediation and monitoring well areas as they are neither developed nor actively used for testing.

In addition to these major land use areas, there are certain ingrants and outgrants (also called easements) from other state and federal agencies which are utilized by WSTF. Other right-of-way easements have been established for an access road from the remote location of the developed portion of the site to the nearest public highway; and a road from the developed area of the site to the remote location of the WSTF underground water supply sources and groundwater plume remediation systems.

The major facility settings, groupings, and/or separations currently in force are as follows: The installation's administrative, management, engineering, logistic, medical, firefighting and facility support functions are located in close proximity to one another to facilitate efficient control and coordination. In addition, these installations are clustered in a manner to form a distinct grouping and land use element (100 Project Control Area) which is positioned at the WSTF main entrance for easy access by the installation's work force, visitors, suppliers, etc. The 100 Area is separated from test and checkout areas by distances necessary for personnel and property protection from explosion over pressure, fragment impingement, and noise.

Installations for the checkout, repair, and modification of test articles are grouped in the 200 Area. This land use element is located such that access to the 200 Area by visitors and suppliers is allowed but controlled. The distance of the 200 Area from the nearby test areas is sufficient for acoustic attenuation, blast pressure decay, and adequate reduction of fragment impingement hazard. At the same time, the distance is not so great as to prohibit transport of test articles to and from the test areas.

Generally, test stands and related support complexes are located in areas that have sufficient terrain relief to enable test stand work surfaces and exhaust vents to be at grade level. These positions take maximum advantage of natural terrain features and have resulted in operational efficiency and construction economy. The test installations are also located, separated and/or constructed with due regard to noise abatement; rocket engine exhausts produce high noise levels covering a very large portion of the audio spectrum with a high percentage of low frequency components.

Rocket engine fuels are highly flammable and the oxidizers support combustion. In many cases, their individual and/or combined burning rates are sufficiently rapid enough to warrant them being considered as explosive. Therefore, in the 500 Storage Area, 700 Test Area, 800 Material Test Area, 300 Propulsion Test Area, and 400 Propulsion Test Area are separated from each other and from other structures by distances sufficient to protect personnel and property from injury or damage in the event of incidents resulting in ignition of either the fuel or fuel and oxidizer combined. In addition, these installations are designed to withstand the pressure impulses and impingements of fragments which result from rapid

combustion of the fuel and/or fuel and oxidizer mixtures. Each of the aforementioned areas is also separated from other major land use areas of the site for the same reasons.

Approximately 10 acres located just south of the 100 Area have been allocated for Tracking and Data Relay Satellite System (TDRSS). This location was chosen for this facility because of its isolation, limited access, and generally excellent weather conditions. All support activities, such as fire protection and warehousing, provided to TDRSS by WSTF, are located nearby in the 100 Area.

Environmental Consequences

Proposed Action: The Proposed Action could have a short-term adverse impact on land use. Land use immediate adjacent to construction activities would be impacted by modified parking, vehicular and pedestrian detours, and increased noise.

Before implementing any action, NASA would review to ensure that the action is compatible with the Master Plan. If the action is not compatible with the Master Plan, NASA would update the Master Plan and determine whether the update results in any environmental impacts not previously addressed within the PEA. Depending upon the environmental review, NASA would issue a Memorandum to the File, a Record of Environmental Consideration, a tiered EA, or a supplemental PEA in support of this PEA. The JSC Master Plan does not envision increasing the amount of land at any of the installations; in fact, the EF Master Plan envisions excessing the E990 tract and associated parking area and consolidating activities within the southern portion of the airport.

The Proposed Action could have a long-term beneficial impact on land use. Adoption of the JSC Master Plan would consolidate buildings and uses, remove aging building and infrastructure in floodplains, and increase pervious surfaces and green space, thereby decreasing storm water runoff.

3.6.2 Cultural Resources

Cultural resources are historic assets as defined by the following legislation and guidelines:

A. National Historic Preservation Act (NHPA);
B. Cultural items as defined by the Native American Graves Protection and Repatriation Act (NAGPRA);
C. Archaeological resources as defined by the Archaeological Resources Protection Act (ARPA);
D. EO 13007 *Sacred Sites* to which access is afforded under the American Indian Religious Freedom Act (AIRFA);
E. Collections and associated records as defined by 36 CFR 79 and 36 CFR 800; and
F. NASA policy and procedural requirement, as described in NPR 8510.1, Cultural Resources Management.

Affected Environment

A number of Historic Landmarks and NRHP-eligible buildings are present at JSC Main Campus, NASA-Ellington Field, the Sonny Carter Training Facility and at the White Sands Test Facility. Many of these at JSC and NASA-EF are included within preliminarily described historical districts.

The JSC Historic Preservation Officer (HPO) evaluates buildings against the criteria for the NHRP as follows:

A. Criterion A, "Events" – the property must make a contribution to the major pattern of American history (i.e., space exploration);
B. Criterion B, "Person" – the property is associated with significant contributors of the American space program;
C. Criterion C, "Design/Construction" – the property has definitive characteristics by its architectural features and/or construction methods, including great artistic value or the work of a renowned master; and
D. Criterion G, "Properties that have achieved significance within the past fifty (50) years."

Refer to Appendix A for an overview of the historical landmarks, NRHP-eligible buildings, and historical constraints associated with future development.

JSC Main Campus: In 2013, JSC Main Campus retained a consultant to complete an onsite archeological survey. Investigators conducted pedestrian and reconnaissance surveys, supplemented with shovel testing. The JSC Main Campus survey focused on all unpaved and undeveloped areas of the campus (approximately 850 acres). One shovel test was positive for cultural materials and was identified as a cache of mid-twentieth-century apothecary/chemist glass jars; it is considered an isolated find with no feature, architectural, or archaeological associations, and was recommended as ineligible to the National Register of Historic Places (NRHP) or as a State Archeological Landmark (SAL), and for no further archaeological investigations.

The NRHP-listed Armand Bayou Archaeological District overlaps the northernmost part of JSC (near Building 207). Investigators found no evidence of cultural resources in the NRHP-listed areas. Investigators revisited the location of one previously recorded site, 41HR96. The location of 41HR96 (commonly referred to as the JSC barge dock) was considered completely disturbed. Investigators observed no trace of the previously identified site within the surveyed area.

JSC has two Programmatic Agreements (PA) in place with the Texas State Historic Preservation Office (SHPO):

A. The Apollo Era PA (09/18/1999) establishes the Apollo Mission Control Room (B30) and the Space Exploration Simulation Laboratory (B32) and NHLs;
B. The Shuttle Era PA (06/30/2011) identifies shuttle resources that are subject to additional controls as JSC transitioned from the Space Shuttle program.

NASA EF: In 2006, the Texas Historical Commission (THC) recognized the contributions of Ellington Field to the World War I and particularly World War II aviation training programs. At the dedication ceremony, THC Commissioner and architect of the "Texas in World War II Initiative," Thomas Alexander stated, "The Ellington Field marker dedication is especially significant. Ellington Field's record of service has ranged from World War I to the present, and yet until last year, the airfield remained officially unrecognized in terms of its contributions to America's war effort." A historical marker is permanently and prominently displayed at the entrance to Ellington Field in recognition of the role Ellington Field played in WWI and WWII.

The JSC Master Plan envisions incorporating two tracts at NASA-EF within the proposed JSC historic district: one encompassing E990 and the second encompassing the NRHP eligible buildings E135, E136, and E140. In total, there are five individual buildings at NASA-EF considered NRHP-eligible (Appendix A). There are no known archeological resources at NASA-EF.

SCTF: The JSC Master Plan envisions envisions incorporating one tract at SCTF within the proposed JSC historic district: Building S920 is NRHP-eligible (Appendix A). There are no known archeological resources at SCTF.

WSTF: NRHP evaluations were conducted for WSTF according to the above criteria in the context of the Apollo (1962 to 1972) and Space Shuttle (1969 to 2011) programs in the area of space exploration. The NASA Historic Preservation Working Group used the above criteria for the Space Shuttle Program related structures to evaluate WSTF properties. Based on background research, field surveys, and interviews, the Working Group recommended that the 300 and 400 Propulsion Test Areas are eligible as historic districts, and Buildings 200, 201, and 203 (known as the 200 Preparation Area) are eligible as a NRHP historic district. In a letter dated November 13, 2013, the New Mexico Historic Preservation Division concurred that the WSTF properties meet these criteria. Since the 200 Preparation Area was built in three phases between 1964 and 1966, they are treated as one building, instead of a historic district.

Past site surveys have identified 94 archeological sites at WSTF. Sixteen of the sites are historic, 75 are prehistoric, and three sites have both prehistoric and historic components. National Historic Landmarks and NRHP-eligible buildings at WSTF are shown in Appendix A.

Environmental Consequences

Proposed Action: The Proposed Action could have a short-term and long-term adverse impact on cultural resources due to construction, renovation, and demolition activities. Many historic properties would be renovated, demolished, or are in close proximity to historic properties that would be renovated or demolished.

Direct physical impacts could occur when historic properties are renovated, demolished, modified, or upgraded. The original setting, design, and construction materials of such installations may be affected. Direct physical impacts could occur to subsurface historic and prehistoric archaeological sites when ground-disturbing activities are conducted. Indirect impacts to historic properties could occur when nearby installations are modified or relocated or when temporary installations are constructed, resulting in indirect changes, such as visual or noise impacts, that change the context of the historic setting and are typically an adverse effect pursuant to 36 CFR §800.5(2).

Master Plan actions that have the potential to impact historic properties must follow the following coordination process:

A. Any activity that can potentially result in modification to an NHL, an NRHP (listed or eligible) building, or any disturbance within or around the boundaries of the JSC Historic District or within or around the Armand Bayou Archaeological District, must be coordinated with the JSC Historic Preservation Officer (HPO) prior to any modifications occurring. A current list of landmarks, buildings, and designated boundaries for historic districts is available by contacting the JSC HPO.
B. No changes may occur until the JSC HPO approves the activity. As necessary, the JSC HPO will coordinate with the SHPO to determine whether any specific project is considered an undertaking, and will follow the associated coordination and consultation requirements (i.e., per NHPA Section 106).

This process serves to address and mitigate any potential adverse effects to any identified cultural resources or effects within a historical district. Tribal consultation will occur on a project-by-project basis, as part of the Section 106 process. NASA JSC consults with Native American Tribes in accordance with 36 CFR 800, Executive Order 13175, the 1994 Presidential Memorandum "Government-to-Government Relations with

Native American Tribal Governments," and NASA Procedural Requirement (NPR) 8510.1, NASA Cultural Resources Management.

The JSC HPO is currently in the process of preparing and negotiating additional Programmatic Agreements that will simplify and expedite the Texas SHPO coordination process.

4.0 CUMULATIVE EFFECTS AND MITIGATION MEASURES

4.1 Cumulative Effects

The CEQ regulations require that all Federal agencies include an analysis of potential cumulative effects within their environmental analyses. Cumulative effects result from the incremental effect of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. This includes those that may be "individually minor but collectively significant actions taking place over time."

There are two approaches to analyzing cumulative impacts. The first is the list approach, which requires identification of specific past, present, and reasonably anticipated future projects producing related or cumulative impacts. The second is the summary approach wherein the relevant projections contained in adopted general plans or related planning documents designed to evaluate regional or area-wide conditions are summarized. Since the Proposed Action is a long-term, multi-decade project, other plans, projects and programs could be implemented; but their timing is unknown and their effects cannot be precisely determined or quantified at this time. Appendix A includes a listing of reasonably anticipated future projects and activities that would be implemented as funding and mission priorities dictate.

The following regional or adjoining jurisdiction planning documents were reviewed in assessing whether cumulative effects of adopting the JSC Master Plan might be considered significant:

A. Nassau Bay Master Plan:
   http://www.nassaubay.com/index.aspx?nid=87
B. Webster Comprehensive Plan:
   http://www.cityofwebster.com/index.aspx?nid=449
C. Ellington Airport Master Plan:
   http://fly2houston.com/efd-master-plan
D. White Sands Missile Range Handbook:
   http://www.wsmr.army.mil/pdf/CompositeRCH2011.pdf

The CoH does not have zoning, and therefore does not have a Master Plan that addresses land use or other long-range development initiatives.

In June 2015, the Federal Aviation Administration issued a commercial operating license for the Houston Spaceport that will begin construction and operational activities at Ellington Airport. Prior to issuing the license, the FAA completed an EA leading to issuance of a FONSI. NASA participated in preparation of this EA as a cooperating agency. The Final EA and FONSI for the Houston Spaceport are available: http://www.faa.gov/about/office_org/headquarters_offices/ast/environmental/nepa_docs/review/operator/media/final_ea_fonsi_rod_for_houston_spaceport_vol_i.pdf. Although the Master Plan was only approximately 60% complete at the time of the FONSI, both NASA and the FAA had sufficient information to assess cumulative effects associated with the proposed Spaceport, and subsequently concluded that there were no significant cumulative effects.

Based upon the foregoing, NASA has concluded that no significant cumulative effects will occur associated with adopting the JSC Master Plan.

4.2 Mitigation Measures

In conjunction with adopting this JSC Master Plan, NASA is committed to conforming to all applicable federal and state regulations, Executive Orders, and management policies and directives. This commitment includes complying with regulatory agency permits and associated permit conditions, such as implementing applicable Best Management Practices (BMPs) to prevent pollution.

As required, NASA will commit an appropriate level of resources to perform monitoring and inspections to ensure conformity, and will undertake corrective and preventive actions should any non-conformity issues arise. The NASA Environmental Management System (EMS), and its associated JSC and WSTF local EMS, provide the backbone to ensure environmental considerations have been fully integrated into the adoption of the JSC Master Plan.

5.0 LIST OF REFERENCES, PREPARERS AND REVIEWERS

5.1 References

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Note: Please refer to Chapter 4 for links to regional and nearby jurisdictional planning documents that were used in assessing cumulative effects.

5.2 Preparers and Reviewers

Organizations listed below contributed to the preparation and review of this document by writing portions of the text, contributing background and supporting information, or providing technical review/comments on the PEA.

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C. NASA-HQ Cultural Resources Manager
D. NASA-HQ General Counsel
E. NASA-HQ NEPA Manager
F. NASA-JSC Environmental Office
G. NASA-JSC Facilities Management and Operations Division
H. NASA-JSC Planning and Integration Office – Historic Preservation Officer
I. NASA-JSC Planning and Integration Office – Master Planner
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