National Aeronautics and Space Administration

Agency Master Plan (AMP)
Programmatic Environmental Assessment

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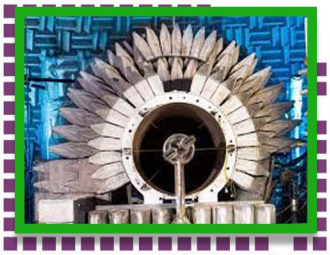




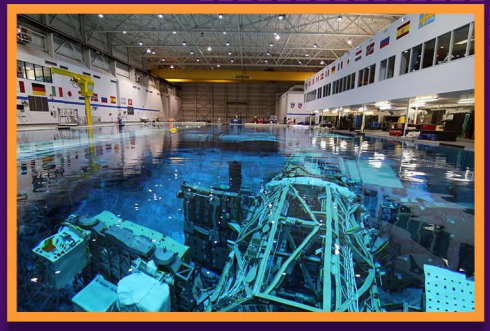


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Abbreviations and Acronyms

Acronym	Definition
AFRC	Armstrong Flight Research Center
AIA	Asset Inventory Assessment
AMP	Agency Master Plan
ARC	Ames Research Center
ATF	Armstrong Test Facility
CAA	Clean Air Act
CatEx	Categorical Exclusion
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIPP	Capital Investment Program Plan
CMP	Center Master Plan
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ERD	Environmental Resource Document
FCI	Facility Condition Index
FDC	Future Development Concept
FONSI	Finding of No Significant Impact
FRED	Facilities and Real Estate Division
GHG	Greenhouse Gas
GISS	Goddard Institute for Space Studies
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
IT	Information Technology
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KSC	Kennedy Space Center
LaRC	Langley Research Center
MDI	Mission Dependency Index
MSFC	Marshall Space Flight Center
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act of 1969

Acronym	Definition
NHL	National Historic Landmark
NOAA	National Oceanic and Atmospheric Administration
NPD	NASA Procedural Directive
NPDES	National Pollutant Discharge Elimination System
NPR	NASA Procedural Requirement
NRHP	National Register of Historic Places
O&M	Operations and maintenance
OSI	Office of Strategic Infrastructure
PEA	Programmatic Environmental Assessment
PM	Particulate Matter
RCRA	Resource Conservation and Recovery Act
REC	Record of Environmental Consideration
ROD	Record of Decision
SDWA	Safe Drinking Water Act
SIP	State Implementation Plan
SSC	Stennis Space Center
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WFF	Wallops Flight Facility
WOTUS	Waters of the United States
WSC	White Sands Complex
WSTF	White Sands Test Facility

SECTION 1: PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1 Introduction

The National Aeronautics and Space Administration (NASA) is preparing this Programmatic Environmental Assessment (PEA) to analyze the general environmental effects of implementing the NASA Agency Master Plan (AMP). The agency is updating its master planning process by developing an Agency Master Plan upon which all 10 of NASA's centers will base their center-specific master plans. Previously, the agency's master planning process was decentralized; each center was responsible for developing its own Center Master Plan (CMP), primarily based on center-specific missions, goals, resources, and needs. The Agency Master Plan will consolidate the framework of the agency's overarching operational needs for the next 20 years, prioritizing current and future NASA requirements and missions. At the Headquarters level, the Agency Master Plan will allow NASA to effectively:

- Manage the entirety of its assets and capabilities from a top-down, mission-driven perspective,
- Provide a unified approach to institutional planning and decision making,
- Allocate resources and funding based on agencywide, prioritized needs to create an affordable infrastructure portfolio,
- Proactively deploy sustainable best practices,
- Reduce current and future infrastructure-related risks and redundancies,
- Ensure future actions take into consideration environmental constraints at the planning level where opportunities to avoid and minimize effects are the greatest, and
- Ensure compliance with applicable federal, state, and local laws and regulations; Executive Orders (EOs); and agency policy directives.

This PEA was prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended (United States Code [U.S.C.] Title 42, Section 4321, et seq.); the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (Code of Federal Regulations [CFR] Title 40, Parts 1500 through 1508), effective May 20, 2022; EO 12114 (Environmental Effects Abroad of Major Federal Actions); NASA's agency-specific NEPA implementing regulations (14 CFR Subpart 1216.3); and NASA's NEPA procedural requirement (NASA Procedural Requirement [NPR] 8580.1A).

CEQ NEPA regulations encourage federal agencies to analyze the potential environmental effects of similar actions in a single programmatic document (40 CFR Section 1500.4). A programmatic document provides a broad NEPA review from which subsequent NEPA documents can be tiered, focusing on the issues specific to the subsequent action. Programmatic NEPA documents may be prepared for broad federal actions, such as a proposed program, policy, plan, or suite of projects that address actions occurring over large areas or systems. Programmatic NEPA documents may also include groupings of similar actions or repeating actions over longer periods of time than other NEPA reviews. In accordance with this directive, NASA has prepared this PEA to provide an efficient analysis under NEPA for implementation of the Agency Master Plan.

1.2 Organization of this Programmatic Environmental Assessment

This PEA is organized as follows:

- **Section 1: Purpose of and Need for the Proposed Action**
  Provides a description of how the document is organized, background information about the Proposed Action, the purpose of and need for the Proposed Action, a description of the programmatic and tiered NEPA evaluation process, and a brief description of public outreach and stakeholders involved.
- **Section 2: Description of the Proposed Action and No Action Alternative**
  Presents detailed descriptions of the Proposed Action and the No Action Alternative.
- **Section 3: Affected Environment**
  Provides a description of the NASA centers, including their contexts and physical settings.
- **Section 4: Environmental Consequences**
  Provides a description of the regulatory setting for each resource, as well as a broad overview of potential effects, by resource, under the Proposed Action and No Action Alternative.
- **Section 5: Distribution**
  Provides a list of internal stakeholders who participated in the development of the Agency Master Plan and who will be receiving the draft PEA for review and comment.
- **Section 6: References**
  Provides a list of references used in preparing this PEA.
- **Section 7: List of Preparers**
  Provides a list of the names and qualifications of the document preparers.

1.3 Background

As early as 2011, NASA began integrating and optimizing operations across centers and mission support facilities (i.e., technical capability facilities) to reduce costs and revitalize the capabilities required to enable NASA's portfolio of missions (NASA 2011, 26). In 2015, the Executive Office of the President distributed Management Procedures Memorandum No. 2015-01, tasking federal agencies to "move aggressively to dispose of surplus properties held by the federal government, make more efficient use of the government's real property assets, and reduce the total square footage of their domestic office and warehouse inventory relative to an established baseline (OMB 2015)." This directive set agency footprint reduction planning goals that were disseminated to centers.

Through the Agency Master Plan process, NASA has identified the need to expand portfolio optimization efforts in addition to footprint reduction goals. To better achieve a mission-driven and affordable portfolio, NASA proposes to implement a centralized and standardized Agency Master Plan administrative process. This Proposed Action would help ensure program management and planning efforts are aligned across all mission areas and geographically separate centers and facilities and would implement a consistent and cost-effective set of processes, systems, and tools for enterprise-wide master planning. The Proposed Action is supported by NASA's 2018 Strategic Plan, which recommended NASA develop an Agency Master Plan that identifies agency facility priorities over a 20-year timeframe (NASA 2018a). The development of an Agency Master Plan

will provide a framework upon which each NASA center would then develop its own CMP, thereby allowing the agency to meet its overall infrastructure management targets, more efficiently (i.e., cost-effectively) achieve its mission, and accomplish sustainment and infrastructure reduction goals.

The NASA 2022 Strategic Plan defines the agency's broad vision, mission, and values, building upon the goals and objectives presented in its 2011 and 2018 Strategic Plans (NASA 2022b). Within the 2022 Strategic Plan, NASA identified four strategic goals to strengthen its ability to accomplish the statutory mission and contribute to maintaining American leadership in space, aeronautics, climate research, and innovation while driving economic growth in the civil space sector (NASA 2022b, 6). These strategic goals are to:

1. **DISCOVER**
   NASA's enduring purpose of scientific discovery
2. **EXPLORE**
   NASA's push to expand the boundaries of human presence in space
3. **INNOVATE**
   NASA's broad mandate to promote the technologies of tomorrow
4. **ADVANCE**
   NASA's capabilities, workforce, and facilities that allow NASA to achieve its mission

NASA's pursuit of implementing a centralized Agency Master Plan upon which future CMPs would be based aligns with the fourth strategic goal to advance capabilities and facilities that allow NASA to achieve its mission. To address challenges associated with aging infrastructure, NASA is aggressively managing its facility portfolio to consolidate and modernize into fewer, more efficient, sustainable facilities. Through a systematic assessment of service areas, NASA is consolidating and improving operations to balance risks across services and activities and provide safe and reliable mission-aligned infrastructure.

NASA's Office of Strategic Infrastructure (OSI) proposes to implement NASA's first mission-driven Agency Master Plan. The Agency Master Plan is tied to the development and execution of a new agencywide Asset Inventory Assessment (AIA) with mission-aligned future state recommendations for all real property assets across NASA's centers and support facilities. The AIA results from each center are rolled into an agency-prioritized database tied to a single Capital Investment Program Plan (CIPP). This prioritization process is intended to form the foundation for the Agency Master Plan's implementation.

NASA has also identified the need to ensure environmental stewardship is incorporated into the Agency Master Plan including NEPA and regulatory compliance in energy and water management, air quality, water resources, hazardous materials, cultural resources, natural resources, sustainability, and climate adaptation. Providing clear environmental guidance in the Agency Master Plan will assist in a consistent execution of the 2022 Strategic Plan across the agency. This PEA will provide center master planners with a framework for subsequent NEPA compliance, identifying the processes and decisions in this PEA as a Tier I parent document from which the centers can prepare subsequent Tier II NEPA compliance documentation.

1.4 Purpose of and Need for the Proposed Action

The *NASA Handbook for Master Planning* defines a CMP as a center's "statement of its concept for the orderly management and future development of the center's real property assets, including land, buildings, physical resources, and infrastructure. It provides a narrative, statistical, and

graphic record of current capabilities and conditions (natural features, buildings, structures, utilities, transportation systems, and other improvements), as well as necessary changes to support program and institutional activities and NASA's strategic and business planning" (NASA 2013a, 1). Centers currently conduct their individual master planning efforts in accordance with center-specific missions. As described in the NASA Handbook, each center's master planning process occurs interactively with NASA Headquarters to synchronize master planning across the agency. Under the previous master planning approach, evaluation of an asset's Mission Dependency Index (MDI) relative to its Facility Condition Index (FCI) helped planners determine the future state of that asset. The difficulty with this approach is the data lacked agencywide stakeholder adjudication and the level of fidelity needed for planners to truly understand the significance and conditions of that asset. Additionally, the needs of support programs and institutional activities were primarily evaluated at the individual center level only, rather than at an overall agency level. Under this previous asset evaluation approach, the MDI did not reflect stakeholder-adjudicated asset use nor future need, and the FCI did not incorporate deferred maintenance and maintenance costs, making the planning effort disjointed and inconsistent.

The previous method of prioritizing operations and maintenance, new construction, and demolition at a center level versus agency level has proved to be inefficient and ineffective due to diminishing funding and competing priorities. The large number of property holdings of the agency, overall aging infrastructure, and a federal funding gap mean that many center planning objectives cannot be met when balanced against the priorities of the agency. Thus, a more integrated approach is needed. Affordability challenges for the agency's current operations and maintenance (O&M) budget limit the amount the agency can allocate to centers. This leaves NASA with a funding gap of approximately $259 million less in maintenance dollars than what is needed to maintain aging infrastructure in support of mission requirements (NASA 2022j).

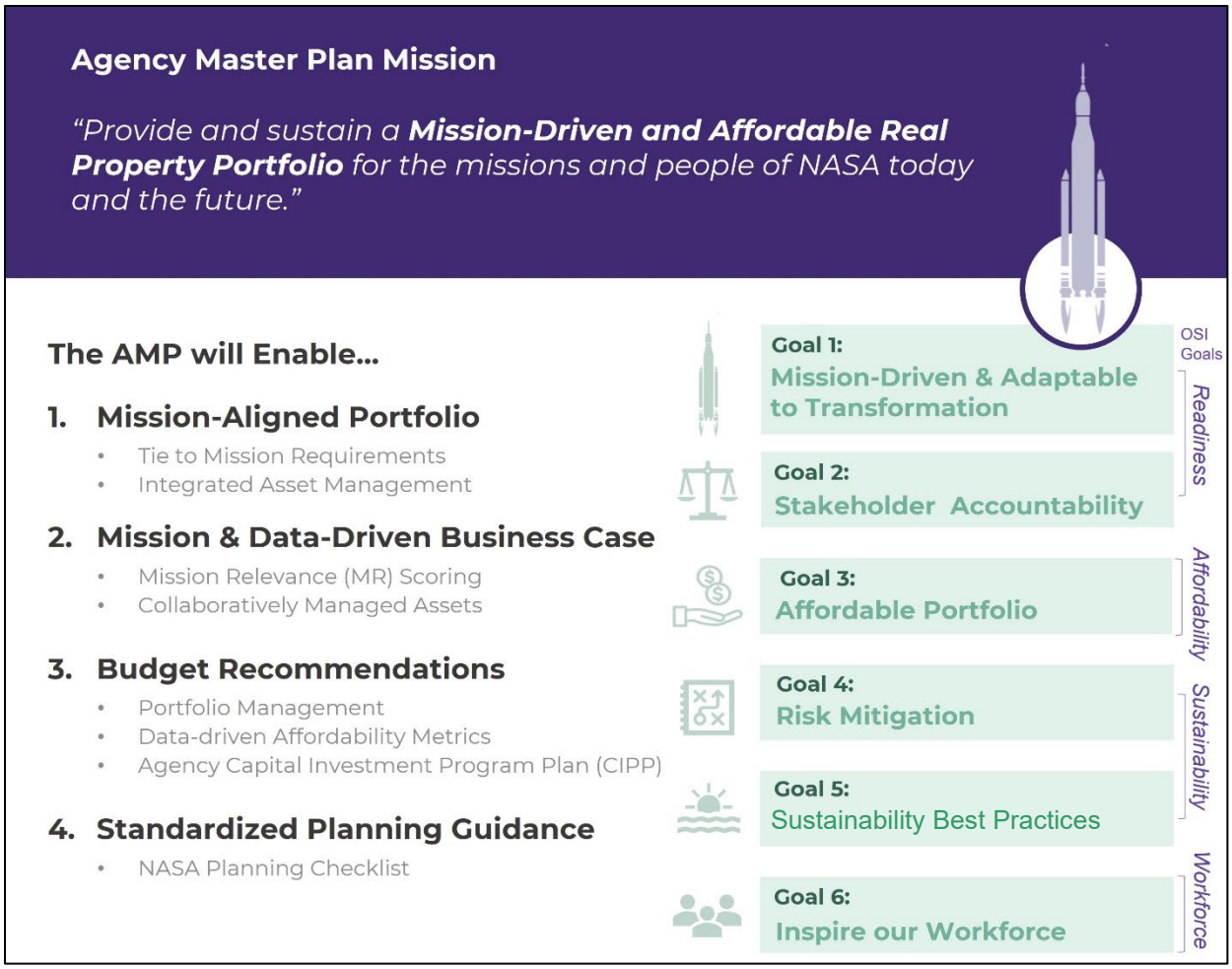
The purpose of the Agency Master Plan is to establish an agencywide and mission-driven approach that ensures critical assets are mission-ready, reliable, and affordable. The Agency Master Plan is needed to align NASA's planning process with its 2022 Strategic Plan, providing a clear path for NASA's future mission success and financial stability over the next 20 years. **Exhibit 1-1** outlines the vision and goals of the Agency Master Plan.

The Agency Master Plan includes all real property assets on NASA's federal property footprint and is based on a data-driven methodology for determining how to address assets in a manner that best supports current and future NASA missions. The Agency Master Plan is intended to serve as the foundation on which NASA's investment allocations support long-term asset health, sustainability, and physical footprint reductions. Because the Agency Master Plan focuses on a mission-oriented approach, using data-driven and risk-informed methodologies, it ensures NASA will have a clearly defined path to fulfill its agencywide priorities of:

- Sustainment of and investment in mission-critical infrastructure by renewing and rebuilding modern and sustainable infrastructure to support future mission success;
- Divestment of unneeded infrastructure by demolishing and eliminating obsolete facilities, thereby reducing overall physical footprint, resource consumption, maintenance costs, and aging infrastructure risk; and
- Leasing of assets to commercial partners to enhance cooperation in space and stimulate commercial activities in low Earth orbit.

The implementation of the Agency Master Plan would enable NASA's mission by providing the facilities, tools, and services required to efficiently manage and sustain the infrastructure necessary to meet agencywide mission objectives.

Exhibit 1-1. Agency Master Plan Mission



(NASA 2023a)

1.5 Tier I Programmatic Environmental Assessment

This PEA is a Tier I NEPA evaluation of the broad effects associated with implementing an Agency Master Plan versus maintaining the status quo of a CMP-specific master planning process. As a Tier I NEPA document, this PEA addresses the broad-scale implications of instituting the Agency Master Plan. Because the Proposed Action is policy and plan-oriented, the effect analysis in this PEA is general and qualitative in nature. NASA is taking a programmatic approach to analyzing the environmental consequences of the proposed development of an Agency Master Plan because of the broad geographic scope and diversity of missions between NASA centers and facilities. This is appropriate as it allows the agency to consider the likely environmental effects of its decision making, but also allows deferment of site-specific environmental effect analysis until such time as specific center-level projects are proposed. This programmatic approach allows for near-term focus on issues ripe for decision making and establishes a foundation for follow-on NEPA document development for future center-specific actions. Depending on NASA's decision related to the Agency Master Plan, future tiered NEPA analysis would occur before center-specific infrastructure development or demolition actions are taken.

In **Section 4, Environmental Consequences**, the typical considerations associated with investment, sustainment, divestment, and outgranting of assets are explored by resource and regulatory requirements. This information sets the stage for subsequent, detailed Tier II NEPA assessments for center- and project-specific actions.

1.6 Future Tier II Project-Specific NEPA Assessments

Future, center-specific actions identified through the Agency Master Plan process may be subject to additional NEPA review. Prior to a center-level decision on the disposition of any specific NASA infrastructure asset, the future action must be considered within the context of NEPA to identify and analyze the site-specific environmental effects of proposed infrastructure management projects.

Future center-level infrastructure management decisions would be informed by site-specific environmental effect analysis that considers the unique conditions that exist at each location (e.g., presence of natural and cultural resources, effects to specific media [air, water], presence of wetlands, activity within designated coastal zone). This analysis could take the form of a Categorical Exclusion (CatEx) with Record of Environmental Consideration (REC) (in cases where the Proposed Action, either individually or cumulatively, normally does not have a significant effect on the human environment), or an Environmental Assessment – Finding of No Significant Impact (EA/FONSI), or an Environmental Impact Statement – Record of Decision (EIS/ROD). The appropriate level of NEPA would be determined on a case-by-case basis considering the site-specific characteristics of the proposed project and its location. For projects located outside the United States, its territories, and possessions, significant effects would be addressed in accordance with EO 12114 (Environmental Effects Abroad of Major Federal Actions).

1.7 Public and Stakeholder Involvement

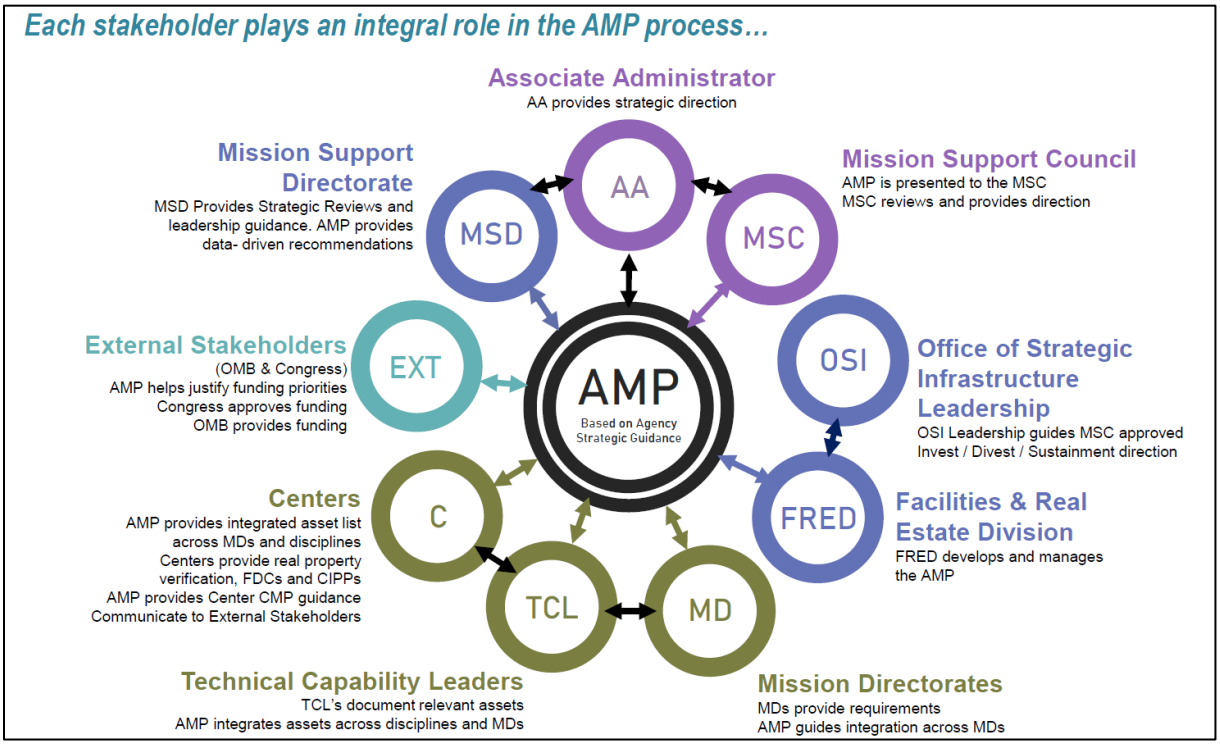
CEQ's guidance on programmatic NEPA documents notes that it may not be appropriate to address certain issues and programs that are included in traditional EAs and EISs (CEQ 2014, 40). For example, necessary information for analysis may not be available or the timing of a Proposed Action is too far in the future. Instead, these issues and programs can be deferred to a subsequent, tiered NEPA analysis where they can be addressed in detail when the Proposed Action is ripe for consideration. These deferred issues may need to be addressed in additional tribal consultations or a National Historic Preservation Act NSection 106 consultation, Endangered Species Act Section 7 consultation, or other determinations and consultations (CEQ 2014, 40). In the case of this PEA, the aforementioned issues and programs would be deferred until subsequent Tier II NEPA reviews are initiated at the center level.

A draft of this PEA has not been made publicly available for review and comment. Release of draft EAs is not required by CEQ and NASA's Environmental Management Division (EMD) - Headquarters agreed on not releasing the draft PEA for public comment. Distribution and comment on the Agency Master Plan will be limited to internal personnel at the center and Headquarters levels and includes those who worked on development of the Agency Master Plan (see **Exhibit 1-2**). However, the final PEA and Finding of No Significant Impact (FONSI) will be made available to the public via a Notice of Availability in the Federal Register and on NASA's public facing NEPA website.

Input from more than 600 internal NASA stakeholders, including but not limited to management oversight, mission directorates, technical capability leaders, center leads, and infrastructure stakeholders, helped establish the framework and asset management assignments of the Proposed Action. These stakeholders will continue to be engaged throughout this PEA process and throughout the implementation of the Agency Master Plan, if the Proposed Action is

implemented. Internal stakeholders from across NASA have collaboratively identified assets to be tracked and prioritized as part of the AIA process during data calls, workshops, and community of practice meetings. This collaborative effort has been critical in aligning prior center planning efforts and existing plans with needs and will continue to be critical to achieve long-term consistency and success of the Agency Master Plan.

Exhibit 1-2. Collaboration During AMP Development



(NASA 2022i)

SECTION 2: DESCRIPTION OF THE PROPOSED ACTION AND NO ACTION ALTERNATIVE

2.1 Proposed Action

The Proposed Action analyzed in this PEA is NASA's implementation of the Agency Master Plan. The Agency Master Plan is intended to provide foundational guidance to NASA Headquarters, documenting an agencywide, collaborative assessment of all real property and capability assets across NASA's federal property footprint. At its core, the Agency Master Plan will provide standardized planning guidance for the treatment of infrastructure and assets based on mission-critical needs, resource conditions and readiness, risk minimization, and budgetary constraints for a 20-year period. The Agency Master Plan is intended to be updated every four to five years. With the implementation of the Agency Master Plan, NASA would implement agencywide prioritized investment and divestment lists and recommended actions for each asset across all centers and support facilities. Implementation of the Agency Master Plan would align NASA's statutory mission objectives with NASA's 2022 Strategic Plan and CIPP.

The Agency Master Plan is the product of multiple inputs, asset prioritization efforts, and prioritization metrics for funding allocation and risk minimization, and documents final recommendations for the treatment of each asset. The key actions of the Agency Master Plan development process include, but are not limited to:

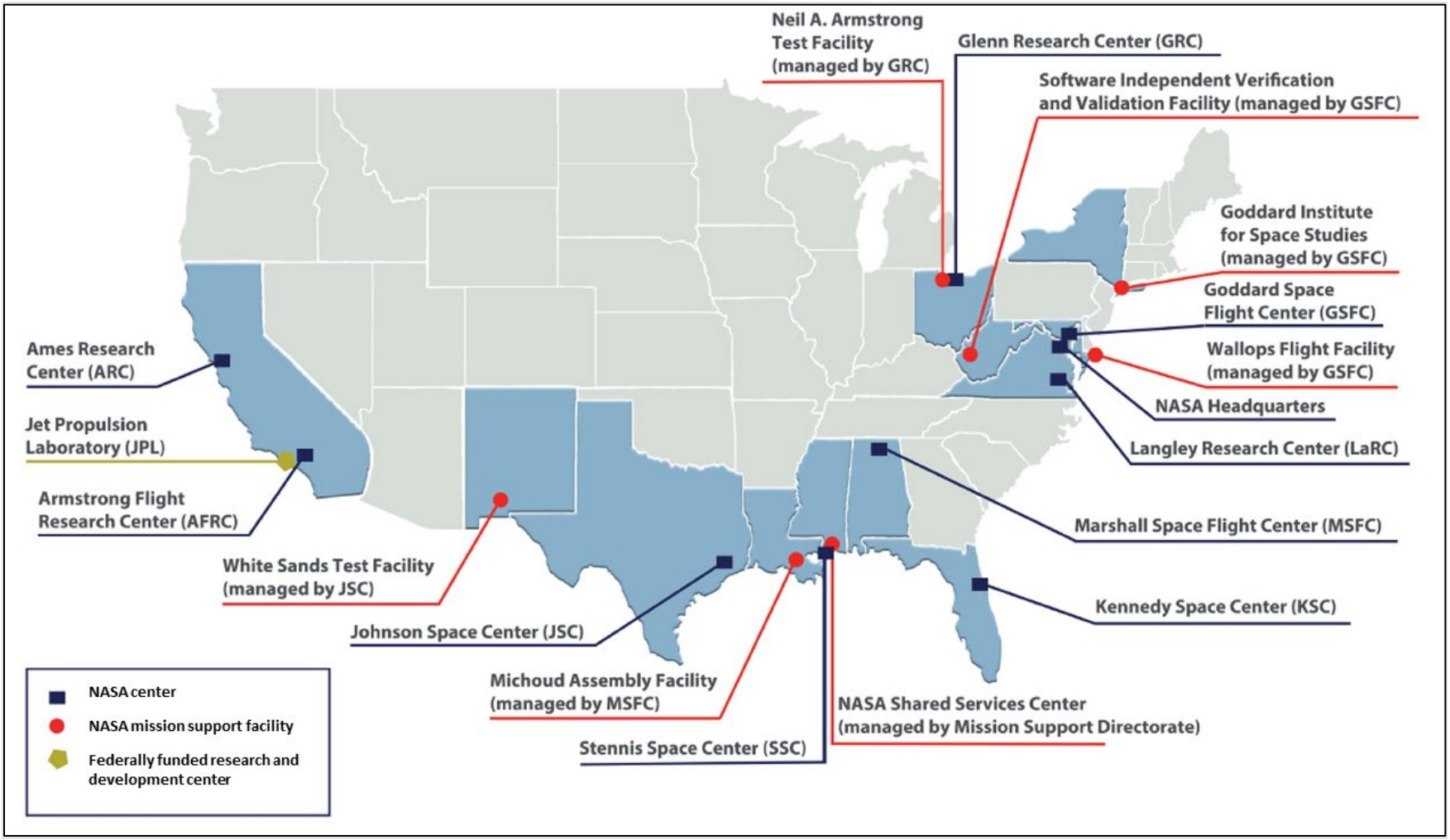
- Gathering asset and mission-related information from NASA centers, support facilities, and mission directorates;
- Considering NASA's planning and systems guidance;
- Understanding NASA's real property categories and assets;
- Developing metrics of prioritization and subsequent bucket actions; and
- Presenting NASA's final AIA and recommendations.

A summary of these actions is presented in this section. Greater detail on the Agency Master Plan development and final recommendations will be available in the Agency Master Plan.

2.1.1 NASA Centers, Support Facilities, and Mission Directorates

As a federal agency, NASA does not operate in a single location with a single mission. Instead, NASA is spread out across the globe with 10 centers in the United States supported by more than five mission support facilities (i.e., technical capability facilities) and six mission directorates; all of which are as diverse as the many different elements of the agency's missions (see **Exhibit 2-1**). Each center and mission support facility are home to different areas of expertise that support different elements of their respective missions. This PEA uses the term "centers" in reference to the 10 NASA centers. All other national and international facilities fall under the leadership of at least one of these centers.

Exhibit 2-1. NASA's U.S. Centers and Mission Support Facilities



(NASA 2022b, 1)

The 10 NASA centers and their primary functions are:

- **Ames Research Center (ARC)**
  Air traffic management, entry systems, advanced computing and IT systems, intelligent/adaptive systems, cost-effective space missions, aerosciences, astrobiology and life sciences, space and earth sciences
- **Armstrong Flight Research Center (AFRC)**
  Flight research and testing
- **John H. Glenn Research Center (GRC)**
  Aeropropulsion and communications technologies
- **Goddard Space Flight Center (GSFC)**
  Earth, solar system, and universe observations, as well as space communications and navigation
- **Jet Propulsion Laboratory (JPL)**
  Robotic exploration of the solar system and Earth observations
  (Note: The JPL is not a NASA center; it is operated under the management of the California Institute of Technology. However, it is frequently included as one of NASA's 10 centers.)
- **Lyndon B. Johnson Space Center (JSC)**
  Human space exploration
- **John F. Kennedy Space Center (KSC)**
  Preparation for and launch of missions around the Earth and beyond
- **Langley Research Center (LaRC)**
  Aviation, space technology, and Earth science
- **George C. Marshall Space Flight Center (MSFC)**
  Space transportation and propulsion technologies
- **John C. Stennis Space Center (SSC)**
  Rocket propulsion testing and remote sensing technology

Expanding on the center functions listed above, NASA clusters its activities into six mission directorates: Aeronautics Research, Science, Space Technology, Exploration Systems Development, Space Operations, and Mission Support.

2.1.2 Plans and Systems Considered in AGENCY MASTER PLAN Development

The Agency Master Plan is incorporating multiple existing plans and systems to manage assets and allocate resources consistently across centers. Implementation of the Agency Master Plan would set forth an agencywide planning and resource allocation process, but centers would still be required to prepare a NEPA document for their CMPs, analyzing environmental impacts on all affected resources for specific projects. Centers could prepare action-specific Tier II NEPA evaluations, as warranted, pulling from this Tier I PEA. This would help meet the proposed Agency Master Plan goal of providing a unified approach to institutional planning and decision making. If the Agency Master Plan is to achieve consistency across all agencywide planning efforts, it will be critical to align existing planning efforts, including CMPs and center CIPPs, under the umbrella of

the Agency Master Plan. The concepts, plans, and systems intended to guide the development of a comprehensive Agency Master Plan are listed below.

- **Agency Capital Investment Program Plan (CIPP).** The Agency CIPP provides a comprehensive list of institutional and programmatic projects aligned with AIA findings, as well as details including costs, schedules, and other business case data that record baselines and outcome projections (see **Section 2.1.5**).

- **Center Framework Presentations (FPs).** Center FPs are interim presentations to NASA Headquarters that centers complete in-house prior to the development of their CMPs. The Center FP is intended to serve as an early blueprint for a CMP, providing an overview of the intended implementation of the Agency Master Plan to achieve mission-driven and affordability metrics and asset disposition results over a 20-year planning horizon.

  Under the umbrella of an implemented Agency Master Plan's asset assignments, centers would tie AIA prioritized assets to projects in their FPs to inform the Agency CIPP. Gaps would be identified and addressed through stakeholder engagement.

- **Existing Center Master Plans (CMPs).** CMPs are the culmination of center-level planning processes. CMPs describe the intent, circumstances, and characteristics of the 5-, 10-, and 20-year real property plan for each center. If the Agency Master Plan is implemented, CMPs would be developed using the framework set forth in this Agency Master Plan PEA, taking into account site-specific environmental baseline conditions (e.g., resources described in the center's natural and cultural resource management plans). CMPs also address the current NASA Strategic Plan, the NASA Asset Management Plan for real property, current NASA policies and guidance, applicable statutory and regulatory requirements, and other federal government performance objectives and initiatives.

  With Agency Master Plan implementation, completed CMPs would be updated accordingly to reflect AIA findings and Agency Master Plan guidance. Full, detailed updates and revisions of CMPs would occur every eight years, unless a mission change warrants a full update sooner. NASA would update NPR and NPD 8810 Master Planning guidance to include agency- and center-level master planning.

- **Climate Action Plan.** NASA facilities, vehicles, equipment, and infrastructure face threats related to climate change. According to the 2021 NASA Climate Action Plan, approximately two-thirds of agency assets, when measured by replacement value, are located within 16 feet of mean sea level along America's coasts (NASA 2021c, 1). Some of these assets are in areas already experiencing high water levels and other effects from sea level rise. Temperature, precipitation, and extreme weather events are expected to affect others (Ibid.). NASA's OSI is working with the Science Mission Directorate to assess the agency's carbon footprint, support center sustainability plans, and track the resilience of NASA infrastructure in the face of climate change (NASA 2023b). The Agency Master Plan would follow the directives of the current and future Climate Action Plans.

- **Agency Resilience Plan.** NASA is developing an Agency Resilience Plan that evaluates risks to mission and identifies mitigation strategies. The Agency Master Plan would integrate any real property-related findings in this plan.

- **Integrated Risk Management Plan.** At the center level, integrated risk management combines risk-informed decision making and continuous risk management to ensure all risks are identified, captured, and communicated in a common way across the center. The integrated risk management process provides bottom-up, detailed, continuous assessment of risk; provides support for the identification and mitigation of institutional risks; and integrates risk management activities within each center while supporting risk-informed decision-making capabilities center-wide.
- **Sustainability Plan.** NASA's plan for sustainability is documented in NASA's 2020 Sustainability Report and Implementation Plan (NASA 2022f). The plan promotes, maintains, and pioneers sustainable practices in all aspects of the agency's mission. Typical Sustainability Plan goals are intended to:
    - Reduce greenhouse gas emissions,
    - Design, build, and maintain sustainable buildings, facilities, and infrastructure,
    - Leverage clean and renewable energy,
    - Increase water conservation,
    - Improve fleet and vehicle efficiency and management,
    - Purchase sustainable products and services,
    - Minimize waste and prevent pollution,
    - Implement performance contracts for federal buildings,
    - Manage electronic equipment and data centers responsibly, and
    - Pursue climate change resilience.

The following systems exist within NASA to compile, assess, and/or assign real property assets and conditions. These are being considered in the development of the Agency Master Plan leverage and integrate existing asset data to develop a strong business case for actions proposed.

- **Real Property Management System.** The Real Property Management System establishes uniformity in maintaining the agency's real property records. The Real Property Management System is the definitive source of NASA real property information and was heavily relied upon during Agency Master Plan development.
- **Deferred Maintenance System.** The Deferred Maintenance System is updated annually to determine the level of deferred maintenance and the Facility Condition Index (FCI) rating for each real property asset within NASA's facilities inventory. In the Agency Master Plan, deferred maintenance and FCI were considered in the overall condition score of an asset and provide meaningful indicators as to the level of stewardship required for real property assets across the agency's portfolio.
- **Mission Relevance System.** The Mission Relevance (MR) System is a numeric score given to all real property assets that is used to gauge each real property asset's mission criticality to NASA. It is derived from utilization (capacity, demand) and requirement (mission need, redundancy, interruptability) data. MR scores are updated with mission changes or every four years.

2.1.3 Asset Categories

This PEA does not consider project-specific activities and does not include a list of mission-critical agency assets. Instead, a list of general asset categories is provided. The following list of asset categories captures all real property at NASA. The list is not intended to identify the specific

projects needed to mitigate deficiencies nor is it a prioritized list. Not all centers have each of the asset categories listed; some have more than others, depending on their size and function. All real property (buildings, vertical infrastructure, and horizontal infrastructure) was assessed in the AIA effort. This PEA evaluates the future state actions ("buckets") assigned to these assets/asset categories if the Agency Master Plan were implemented.

- administrative facilities (office buildings)
- engine testing facilities (test stands)
- fabrication and assembly facilities
- ground improvements facilities (groundskeeping)
- housing and community facilities (amenities)
- launch facilities (launch pads)
- liquid fuel infrastructure and facilities
- maintenance facilities
- operational facilities
- propellant infrastructure and facilities
- research, development, and testing facilities
- storage facilities
- utilities, infrastructure, and facilities (e.g., water, electrical, gas, IT, sewer, storm sewer, roadway)
- wind tunnel facilities

The Agency Master Plan does not consider empty land as an asset; as such, it has not been dispositioned in the AIA process.

2.1.4 AIA Methodology, Bucket Actions, and Metrics

The AIA process involved four phases: data call, asset bucketing, adjudication of selected actions, and NASA stakeholder workshops. **Exhibit 2-2** illustrates the breadth and depth of the collaborative AIA development process. **Exhibit 2-3** illustrates the AIA methodology for prioritizing assets.

2.1.4.1 AIA Phase 1: Data Call

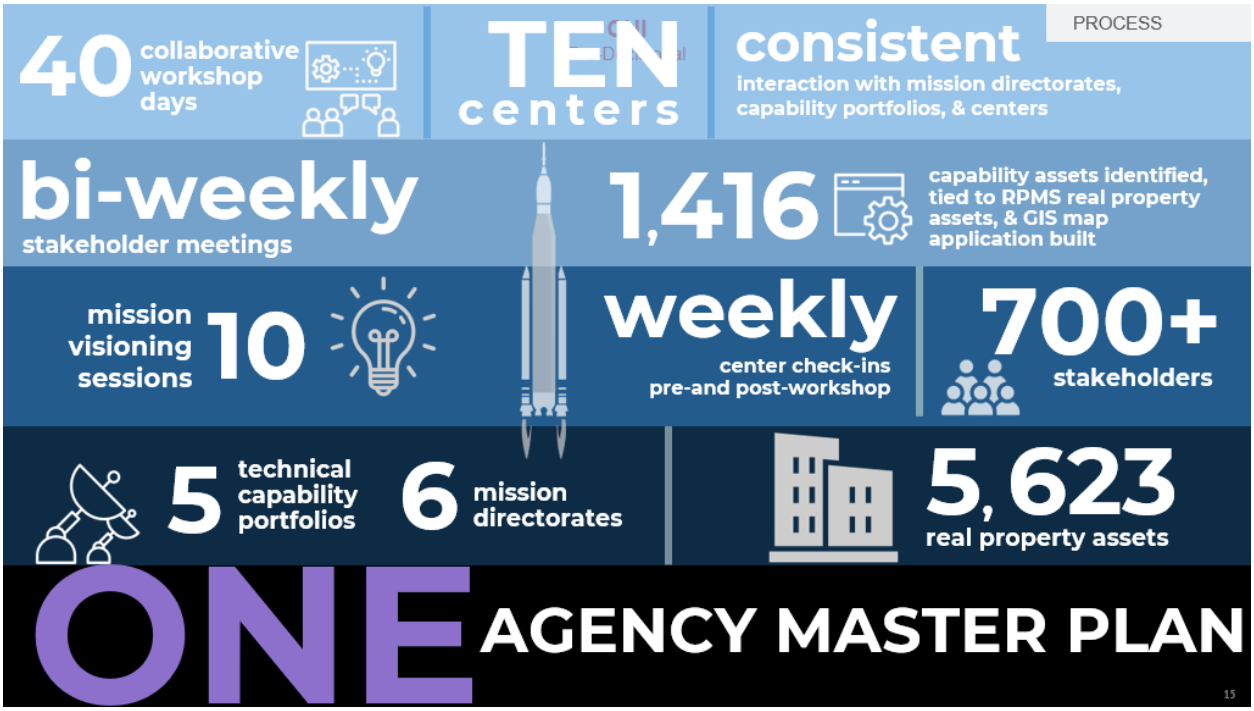
The phase was the AIA data gathering effort: a pre-decisional data call to survey real property assets and gather relevant information. More than 600 internal stakeholders from across NASA collaboratively identified 1,416 capability assets and 5,623 real property assets (e.g., buildings, vertical infrastructure, horizontal infrastructure) to be tracked as part of the AIA process. The key output of the data call phase was completion of updated Center Asset Sheets for the next AIA phase: asset bucketing.

2.1.4.2 AIA Phase 2: Asset Bucketing

In the asset bucketing phase, the AIA team grouped all real property assets into one of four "bucket actions," specifically: invest, sustain, divest, and outgrant. Mission-critical assets were identified by reviewing detailed data behind every asset category listed in **Section 2.1.3** and using existing plans and systems presented in **Section 2.1.2**. Data managers provided the initial asset bucket

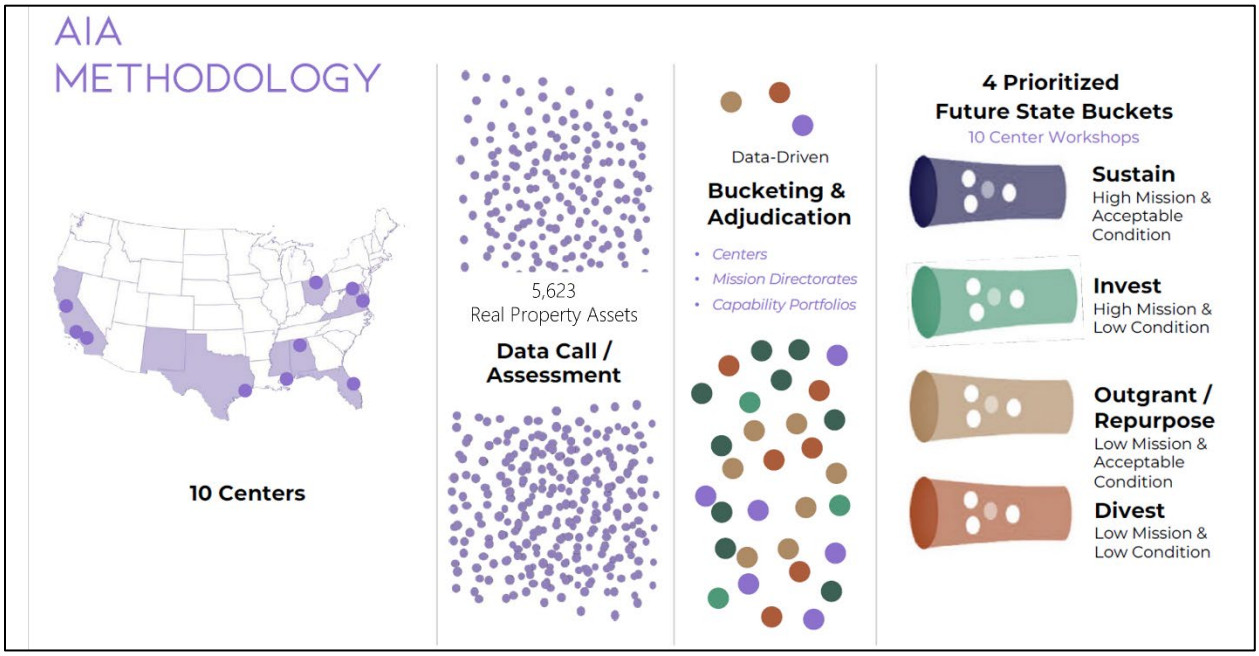
assignments, followed by centers reconciling and revising those assignments. This AIA bucketing effort provided the core data set informing the Agency Master Plan.

Exhibit 2-2. Collaborative AIA Development Process



(NASA 2022i)

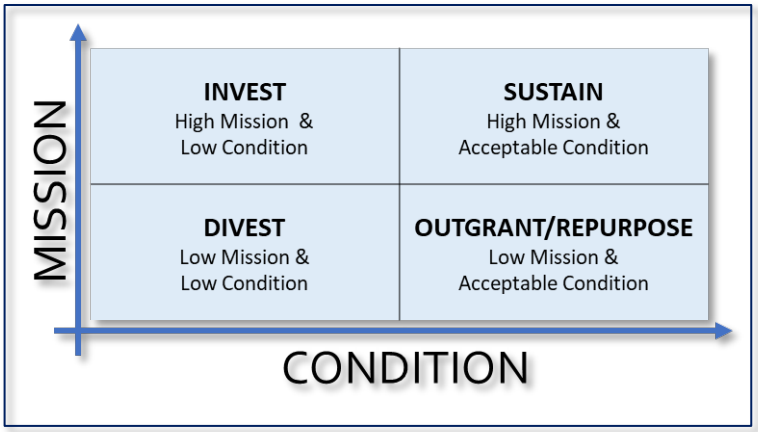
Exhibit 2-3. AIA Methodology



(NASA 2022i)

An asset's assignment to one of the four bucket actions was based on its mission relevance score and condition score (see **Exhibit 2-4**). This differs from the current CMP use of FCI and MDI scores overviewed in **Section 1**. To develop an agencywide prioritized list of assets, a mission relevance score for each asset was calculated by evaluating utilization (capacity, demand) and relevance to mission requirements (mission need, redundancy, interruptability). The resulting mission relevance score provided a gauge of the asset's criticality to achieving NASA's mission. Additionally, each asset was evaluated by a condition score, which included the existing FCI, cost model maintenance costs, and deferred maintenance estimate. A high condition score indicates the asset is in sound shape. A low condition score indicates the asset needs attention. A high mission relevance score indicates the asset is necessary to carry out critical NASA actions. A low mission relevance score indicates the asset is not necessary to carry out critical NASA actions.

Exhibit 2-4. Asset Bucket Assignment – Mission Relevance-Condition Matrix



The four asset bucket actions are not all-inclusive. A decision may be made that is not reflected in the categories below. However, this PEA only evaluates effects of the following bucket actions:

- **Sustain.** Real property assets bucketed as "sustain" have high mission and acceptable condition scores and would be maintained to their current condition.
- **Invest.** Real property assets bucketed as "invest" have a high mission relevance score and a low condition score. These assets need investments beyond planned sustainment to continue to meet mission requirements in the future. Assets most critical to the mission directorates, capability portfolios, centers, and OSI are prioritized for investment. Typical treatment of assets in the invest bucket would involve:

  Repair. Fixing the degraded asset.

  Renovate. Modernizing by revitalizing existing capabilities or recapitalizing by replacing (e.g., demolishing) degraded assets and replacing with new assets.

  New Asset. Constructing new capabilities or assets (e.g., new building).

  To be Determined (TBD). Determining which treatment is best for the asset.

  In the event a renovation project calls for the demolition or divestment of an asset, that asset would be moved to the divest bucket.

- **Divest**. Real property assets bucketed as "divest" have a low mission relevance and low condition scores. This bucket may include demolishing, mothballing, abandoning, or transferring an asset. Demolishing or transferring an asset eliminates or reduces real property assets no longer required by NASA. Mothballing an asset entails providing the least level of maintenance necessary to maintain the functionality of the asset for possible future use. Abandoning an asset entails eliminating any future maintenance of that asset.

Certain historic and potentially historic properties in the divest bucket that may require additional consideration are on the "path to divestment – historic" list. Prior to divestment, any currently unevaluated assets subsequently determined to be historic will be automatically moved to the path to divestment – historic list.

- **Outgrant.** Real property assets bucketed as "outgrant" have a low mission relevance score and an acceptable condition score. Assets in this bucket need further evaluation/discussion through the adjudication process to determine if they should be outgranted, repurposed, consolidated, or sustained. If an outgrant opportunity is not identified within two to three years, the asset should be reevaluated.

  Outgranting is the non-permanent transfer of real property rights from NASA to others by means of lease (or any other form of acceptable legal instrument that recognizes NASA as the landlord and the lessee as the tenant); permit; easement; right of way; license; Space Act Agreement; or agreement such as memorandum of understanding, memorandum of agreement, or concessionaire agreement. In situations where NASA assets are occupied by tenants, the following bucket assignments are applied:

  Path to Divestment. Certain properties that may require additional consideration are categorized as "Path to Divestment". This includes assets with unique functions.

  Existing Tenant (High Condition). Real property assets bucketed as "Existing Tenant (*High Condition*)" are identified as existing outgranted assets that have high condition scores and are recommended to be maintained to their current condition.

  Existing Tenant (Low Condition). Real property assets initially bucketed as "Existing Tenant (*Low Condition*)" are identified as existing outgranted assets that have a low condition score and would benefit from investments to reduce their deferred maintenance, improve their FCI to 3.6 or higher, and/or ensure regulatory compliance.

  Existing Tenant (No Condition). Real property assets initially bucketed as "Existing Tenant (*No Condition*)" are identified as existing outgranted assets that have no condition rating.

- **Asset Bucket TBD.** Assets for which the final disposition have yet to be determined.

The comprehensive development and prioritization of mission-critical agency assets helps meet the Agency Master Plan goal of allocating resources and funding based on agencywide, prioritized needs. The key output of the asset bucketing phase was Bucketed Center Asset Data Sheets for the next AIA phase – data adjudication.

2.1.4.3 AIA Phase 3: Adjudication of Selected Actions

In the adjudication phase, asset rankings and classifications identified in the asset bucketing phase were adjudicated between the centers, mission directorates, and capability portfolios. In this phase, the mission directorates reviewed the mission scoring and bucketing, then the data managers coordinated with capability portfolios and centers to finalize the adjudication outcomes. In addition, with NASA's Institutional GIS and center input, resource constraints (e.g., environmental, historic, energy) associated with each asset were taken into consideration as part of the adjudication effort. The key output of this phase was the completion of Adjudicated Center Asset Data files ready for the stakeholder workshops.

2.1.4.4 AIA Phase 4: Stakeholder Workshops

In the stakeholder workshops phase, all stakeholders met to develop a prioritized assets list based on mission relevance that aligned with prioritization requirements. The key output of this phase was stakeholder agreement on each asset's future state, as well as prioritized invest, divest, and outgrant lists.

2.1.4.5 AIA Follow-on Efforts

The Agency Master Plan effort included a follow-on study to the AIA process. An agencywide Duplicate and Obsolete Capabilities Assessment was conducted to identify additional assets suitable for divestment. A Leadership Summit was held to gain consensus on the divestments. The Agency Master Plan effort also includes Center and Portfolio Framework Plans that illustrate alignment to the AIA bucket assignments and the overarching Agency Master Plan.

2.1.4.6 Stakeholder Collaboration

The AIA methodology was designed to maximize stakeholder collaboration throughout the process, with relevant stakeholders convened for each phase. For the data call and asset bucketing phases, the Agency Master Plan team worked with each center to identify assets and collect condition and mission relevance data, which was used provide an initial future state for each asset based on the collected data. For the adjudication phase, center stakeholders and the Agency Master Plan team were joined by representatives from the Mission Directorates, Capability Portfolios, and Institutional GIS to adjudicate rankings and classifications for the assets. In the final Workshop phase, this larger stakeholder group met again (minus the Institutional GIS representative) to prioritize assets by mission relevancy, resulting in a final list reviewed and agreed upon by all parties: master planners, centers, Mission Directorates, and Capability Portfolios.

The highly inclusive process started with in-depth data calls to the centers, where participants included not just facility managers, but also users. The collaborative adjudication process that followed allowed for inputs and debate from a diverse group of institutional (Capability Portfolio Managers, centers) and programmatic (Mission Directorates, facilities/real property planners) authorities, as well as subject matter experts. The AIA drew on these broad perspectives to identify the data to review, review this data, and voice disagreement or reach consensus, ensuring all options would be evaluated from multiple perspectives and the right one selected.

When asked to provide feedback on the new methodology, participants cited multiple positive evolutions: inclusion of mission relevance, a more engaged Mission Directorate voice, heightened collaboration, and more transparent dialogue. Previously, these functions had been performed primarily by institutional representatives, with programmatic representatives only reviewing the outcomes. The new approach allowed all group members to be involved as participants, not just reviewers. The process also ensured many alternatives were considered, in addition to the initial future state indicated by the facility condition and mission relevance scores. Furthermore, once the result was documented, group members could submit requests for reconsideration if they felt a change to the data or the outcome was warranted. The requested asset would go through the adjudication process again, ensuring full and thorough consideration of all variables that may affect the ideal future state for each asset from multiple relevant perspectives. The feedback provided by participants will allow the Agency Master Plan team to refine the process further for future iterations.

2.1.5 AIA Findings

Bucketing is an ongoing effort for NASA, with asset assignments evolving to meet changing mission needs. The current AIA effort evaluated 5,623 real property assets across all of NASA. Of those, 5,187 assets were assigned to bucket action categories of sustain, invest, divest, or outgrant based on mission criticality, condition, risk, and cost. The final disposition (i.e., bucket assignment) of an additional 77 assets remains TBD. Final disposition of these assets could not be determined during the final center AIA workshops but will be addressed in the future. Bucket assignments for the remaining 359 assets are not possible for a variety of reasons, such as reclassification of the asset as personal property or the asset having been disposed of previously.

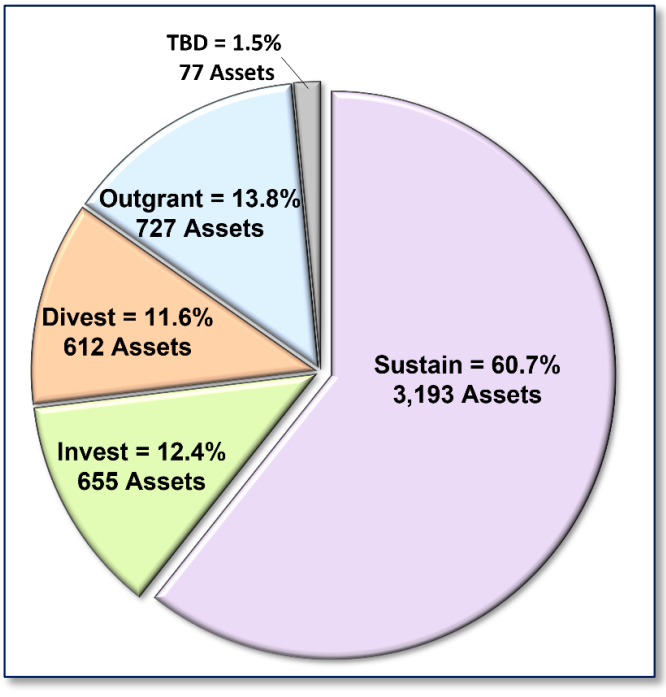
Overall, the results of the AIA effort show the direction of future management of NASA assets. Upon implementation of the Agency Master Plan, agencywide assets would be allocated as shown in **Exhibit 2-5** and **Exhibit 2-6. Exhibit 2-7** lists examples of typical asset treatment by bucket assignment.

Notable results from the AIA effort include:

- Over 60% of all assets were assigned to the sustain bucket.
- Approximately 12% of all assets were assigned to the invest bucket, and these account for 47% of all deferred maintenance.
- 65% of invest bucket assets are horizontal infrastructure.
- $53M+ identified as risk reduction potential through combined divest and outgrant buckets (18%).
- $8M+ in additional FY 2025 outgrant proceeds were identified.

As stated in **Section 1**, the purpose of the Agency Master Plan is to establish an agencywide and mission-driven approach that ensures critical capabilities and assets are mission-ready, reliable, and affordable. The AIA bucket assignments provide all centers with a clear path that will help them develop their respective CMPs to best support current and future NASA missions.

Exhibit 2-5. Agencywide Asset Bucket Assignments



(NASA 2023c)

Exhibit 2-6. Agencywide AIA Bucket Assignments

ASSET BUCKET	BUCKET ACTION	BUCKET ACTION		TOTAL BUCKETS	
		# Assets	% Assets	# Assets	% Assets
SUSTAIN	Sustain	3,193	60.7%	3193	60.7%
INVEST	Invest - TBD	227	4.3%	655	12.4%
	Invest - New Building	42	0.8%		
	Invest - Renovate	35	0.7%		
	Invest - Repair	351	6.7%		
DIVEST	Divest	553	10.5%	612	11.6%
	Path to Divestment - Historic	59	1.1%		
OUTGRANT	Outgrant	172	3.3%	727	13.8%
	Outgrant - Path to Divestment	57	1.1%		
	Tenant - High Condition	316	6.0%		
	Tenant - Low Condition	174	3.3%		
	Tenant - No Condition	8	0.2%		
ASSET BUCKET TBD	Final Disposition Not Determined to Date	77	1.5%	77	1.5%
GRAND TOTAL		**5,264**	**100%**	**5,264**	**100%**

(NASA 2023c)

Exhibit 2-7. Examples of Assets and Asset Bucket Type

Examples of Assets	Sustain	Invest	Divest	Outgrant
Office Complex, Research Complex, Administrative Complex, Laboratory Building	X	X	X	X
Fuel Storage Facility	X			
Avionic Hangar	X			
Aircraft Parking/Airport Parking Aprons	X			
Antennas and Support Structures	X			
Assembly Shops	X			
Battery Buildings	X			
Blast Buildings, Bunkers	X	X		
Boat Basin Bulkhead	X			
Camera Towers, Pads, Platforms	X			
Flammable Storage	X		X	X
Hazardous Material Storage/Staging Facilities	X		X	X
Conex Box/ Shipping Container	X	X	X	
Cooling Tower	X	X		
Substation	X	X		X
Helicopter Pad	X		X	
Water Pump Station/Storage Tank	X	X	X	X
Launch Pad and Support Facilities	X	X	X	X
Telecommunication Shelter and Buildings	X	X		
Recreational – Basketball/Volleyball/Tennis Court	X		X	
Test Facilities and Test Staging Facilities	X	X	X	X

(NASA 2022j)

2.2 No Action Alternative

Under the No Action Alternative, the Agency Master Plan would not be implemented, and centers would continue developing FDCs, CIPPs, and CMPs with limited influence from a top-down planning approach. Without a holistic review of assets across NASA, asset redundancies would likely remain across the agency. Funding for agencywide, mission-critical resources would not be allocated based on a holistic view of critical capabilities, asset conditions, or financial risks and constraints. Under the No Action Alternative, centers would continue to integrate agency guidance to their particular circumstances, environments, resources, and requirements. Finally, with the current bottom-up CMP planning process, Headquarters must understand center proposals in detail to integrate them coherently and must baseline and monitor progress against the agency's objectives and commitments.

Currently, some centers do not have a CMP but perform functions under an FDC and CIPP. This may be due to center size and staffing. For this reason, even though centers consider Headquarters' guidance, there remains inconsistent approaches and uneven planning efforts across centers that may result in unnecessary expenditure of funds or failure to fully consider the mission criticality of an asset on an agencywide scale or agencywide economic and environmental consequences. Continuing the current method of balancing operations, maintenance, repairs, new construction, and demolition would not provide NASA the necessary trade-space to invest in future capabilities.

Center-level planning efforts do not have the capability of achieving what the Agency Master Plan can provide at an agencywide scale. Specifically, center-specific CMPs are ineffective and inefficient at an agencywide level in:

- Managing the entirety of NASA's assets and capabilities;
- Providing a unified approach to institutional planning and decision making;
- Allocating resources and funding based on agencywide, prioritized needs;
- Proactively deploying sustainable practices; and
- Reducing current and future infrastructure-related risks and redundancies.

Center-level planning efforts would not approach planning from an agencywide, mission-aligned portfolio nor would the efforts use integrated asset management. Centers would continue efforts with consideration to Headquarters direction, but ultimately without collaboratively managing assets from an agencywide perspective. For these reasons, the No Action Alternative does not meet the project's purpose and need. However, the No Action Alternative is retained in this PEA to serve as a basis for comparison of potential beneficial and adverse effects.

SECTION 3: AFFECTED ENVIRONMENT

As a Tier I PEA, this document provides, within this section, a broad overview of the affected environment (i.e., location, setting, mission) of each of the 10 NASA centers**. Exhibit 3-1** provides a summary of each center's location, year established, acreage, and number of employees. Detailed descriptions of each center's existing conditions (i.e., affected environment) are documented in the center's respective Environmental Resources Documents (ERDs). **Exhibit 3-2** provides a summary of existing conditions, as reported in each center's most recent ERD. The ERDs are incorporated by reference in accordance with 40 CFR Subpart 1501.12. It should be noted that the language of Subpart 1501.12 states, "Agencies may not incorporate material by reference unless it is reasonably available for inspection by potentially interested persons within the time allowed for comment. Agencies shall not incorporate by reference material based on proprietary data that is not available for review and comment." Due to the sensitive and pre-decisional nature of future Agency Master Plan real property portfolio decision making, NASA has not sought public comment on this Tier I PEA. The information and analysis contained in the PEA uses, at least in part, the information provided in each center's ERD. When center NEPA managers conduct subsequent, project-specific, Tier II NEPA evaluations, NASA expects that a baseline of existing natural and cultural resources in the affected area will be established, and the environmental impacts of the proposed action will be analyzed. Depending on the level of NEPA review required (i.e., CatEx/REC; EA/FONSI; EIS/ROD), public review and comment periods would be provided as appropriate.

Exhibit 3-1. Overview of NASA Centers and Support Facilities

Centers and Facilities (in the United States)		State	Est.	Acreage	# Employees
ARC	**Ames Research Center**	**CA**	**1939**	**1,874**	**1,518**
AFRC	**Armstrong Flight Research Center**	**CA**	**1954**	**838**	**1,250**
GRC	**John H. Glenn Research Center (combined)**	**OH**	**1941**	**7,047**	**3,348**
	• *GRC at Lewis Field Campus*	*OH*	*1958*	*307*	*3,181*
	• *Neil Armstrong Test Facility (ATF) (formerly Plum Brook Station)*	*OH*	*1956*	*6,740*	*167*
GSFC	**Goddard Space Flight Center (combined)**	**Multiple**	**1959**	**8,395**	**10,255**
	• *Greenbelt Campus (GSFC central campus)*	*MD*	*1959*	*1,270*	*8,200*
	• *Wallops Flight Facility (WFF)*	*VA*	*1959*	*6,580*	*1,200*
	• *White Sands Complex (WSC)*	*NM*	*1963*	*50*	*380*
	• *Columbia Scientific Balloon Facility (CSBF)*	*TX*	*1963*	*483*	*70*
	• *Goddard Institute for Space Studies (GISS)*	*NY*	*1961*	*N/A*	*130*
	• *Katherine Johnson Independent Verification and Validation Facility (IV&V)*	*WV*	*1993*	*12*	*275*
JPL	**Jet Propulsion Laboratory (combined)**	**CA**	**1958**	**32,617**	**6,692**
	• *Jet Propulsion Laboratory (JPL)*	*CA*	*1958*	*168*	*6,500*
	• *Goldstone Deep Space Communications Complex (GDSCC)*	*CA*	*1958*	*32,411*	*178*
	• *Table Mountain Facility (TMF)*	*CA*	*1961*	*38*	*14*
JSC	**Lyndon B. Johnson Space Center (combined)**	**Multiple**	**1961**	**28,534**	**11,789**
	• *Johnson Space Center (JSC) - Houston*	*TX*	*1961*	*1,634*	*11,389*
	• *White Sands Test Facility (WSTF)*	*NM*	*1962*	*26,900*	*400*
KSC	**John F. Kennedy Space Center**	**FL**	**1958**	**141,829**	**10,000**
LaRC	**Langley Research Center**	**VA**	**1917**	**767**	**1,651**
MSFC	**George C. Marshall Space Flight Center (combined)**	**Multiple**	**1960**	**2,673**	**10,142**
	George C. Marshall Space Flight Center (MSFC)	*AL*	*1960*	*1,841*	*7,000*
	Michoud Assembly Facility (MAF)	*LA*	*1964*	*832*	*3,142*
SSC	**John C. Stennis Space Center**	**MS**	**1962**	**138,000**	**4,844**

Exhibit 3-2. Existing Conditions Based on Center ERDs

Resource Group and Type		CENTER									
Resource Group	Resource Type	ARC	AFRC	GRC	GSFC	JPL	JSC	KSC	LaRC	MSFC	SSC
Soils & Geology	Low Permeability	Yes	No	Yes	N/A	No	Yes	Yes	No	No	No
	Active Fault Zone	N/A	N/A	N/A	N/A	Yes	Yes	N/A	N/A	Yes	Yes
Air Quality - Compliance	NAAQS Attainment	Nonattainment for ozone	Nonattainment for ozone	Nonattainment for ozone	Nonattainment for ozone, maintenance for carbon monoxide	Nonattainment for lead, ozone	Nonattainment for ozone	Yes	Yes	Yes	Yes
	Attainment for PM, $PM_{2.5}$, PM_{10}	Nonattainment for $PM_{2.5}$, PM_{10}	Unclassified / attainment PM, $PM_{2.5}$, PM_{10}	Yes	Yes	Nonattainment for $PM_{2.5}$	Yes	Yes	Yes	Yes	Yes
	Title V Permit	N/A	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
	SIP Coordination	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Climate Change	GHG and Climate Change Program	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noise	Noise, Sonic Boom, and Vibration	Soundwall between highway and base	Noise levels in nearby residential areas do not exceed land use compatibility standards	Provisions to limit hazardous noise when equal or exceed 80 dBA or <3ft	300 ft from nearest residence, operations are indoors and noise is negligible	Noise levels in adjacent residential areas do not exceed land use compatibility standards	Sensitive receptors onsite, no records of complaint from offsite	Rocket launches, species, and adjacent areas will potentially be exposed to high noise levels	Run-up pad with Joint Base Langley-Eustis use and National Transonic Facility	Sound buffer exists between base and adjacent residential areas	N/A
Hazardous Materials & Waste	Contaminants & Waste (Structures)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes
	Contaminated Areas (Land)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Current CERCLA/Superfund Sites, National Priorities List (NPL)	Yes	Yes - NPL	Yes	Yes	Yes - NPL	N/A	Yes	Yes - NPL	Yes	Yes
	RCRA/Haz Waste Generator Status	N/A	LQG	LQG	LQG	LQG	LQG	LQG	LQG	LQG	Yes
Water, Surface Water, Hydrology, Wetlands, WOTUS	NPDES Permits (Industrial or General)	Yes	N/A	Yes, Rocky River TMDL	Yes, Chesapeake Bay TMDL	Yes	Yes, General Permit	Yes	Yes, Chesapeake Bay	Yes	Yes
	Presence of Wetlands & Streams	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Section 10 Navigable Waterways	N/A	N/A	N/A	N/A	N/A	Yes	Yes, Barge/ Docking Facility	N/A	MSFC and MAF: Yes, Barge/ Docking Facility	Yes, Barge/ Docking Facility

Table continues on following page. Legend provided at end of table.

Resource Group and Type		CENTER									
Resource Group	Resource Type	ARC	AFRC	GRC	GSFC	JPL	JSC	KSC	LaRC	MSFC	SSC
Coastal Zone Mgmt	CZMA Consistency	N/A	N/A	Main site is not within CZMA	N/A	N/A	N/A	Yes	N/A	MSFC: N/A MAF: Yes	N/A
	Coastal Barriers	N/A	N/A	N/A	N/A	N/A	Yes	Yes	N/A	Yes	N/A
Wild & Scenic Rivers	Presence of Wild & Scenic Rivers	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes
Floodplains	100-Year Floodplain Areas	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes
Wildlife/Waterfowl Refuge	Federal or State Refuge	Adjacent to Center	N/A	N/A	Adjacent to Center	N/A	Yes	Yes	N/A	Yes	Yes
Biological Resources	Federal - T/E Species	Yes	Yes	Yes	N/A	Yes	Yes	Yes	N/A	Yes	Yes
	Federal - Critical Habitat	N/A	N/A	Yes	N/A	N/A	N/A	Yes	N/A	N/A	Yes
	State- T/E Species	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Aquatic Preserves	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A	Yes	N/A
	Essential Fish Habitat	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A	Yes	N/A
	Presence of Marine Mammals	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A	N/A
	Presence of Migratory Birds	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	N/A
Cultural Resources *Continues on following page.*	Listed NRHP Bldgs, Structures	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes
	Eligible NRHP Bldgs, Structures	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	NRHP Historic District	Listed	Eligible	Eligible	Listed	Eligible	No	Listed & Eligible	Listed & Eligible	No	Listed
	National Historic Landmarks	Yes	Adjacent to Center	Yes	Yes	Yes	Yes	Yes	Yes	MSFC: Yes	Yes

Table continues on following page. Legend provided at end of table.

Resource Group and Type		CENTER									
Resource Group	Resource Type	ARC	AFRC	GRC	GSFC	JPL	JSC	KSC	LaRC	MSFC	SSC
Cultural Resources *Continues from previous page.*	Potential for Archaeological Sites	Known sites with potential for more	No	Known sites with potential for more	NRHP-eligible sites, with potential for more	No known sites, low potential	JSC: portion of Armand Bayou National Archaeological District WSTF: NRHP-eligible sites with high potential	NRHP-eligible sites, high to moderate potential for more	NRHP-eligible sites, high to moderate potential for more	MSFC: NRHP-eligible sites with potential for more	NRHP-eligible sites with potential for more
Environmental Justice	Low Income Populations	N/A	Yes	N/A onsite, present in adjacent areas	N/A onsite, present in adjacent areas	N/A	N/A onsite, present in adjacent areas	N/A	Yes	Yes	N/A
	Minority Populations	Yes	N/A	N/A onsite, present in adjacent areas	N/A onsite, present in adjacent areas	N/A	N/A onsite, present in adjacent areas	N/A	Yes	Yes	N/A
Recreation	Public Parks or Recreation Areas	Not public	Yes, but Not Public	Yes, but Not Public	Yes, but Not Public	Adjacent to Center	Yes	Yes	Yes, but Not Public	Yes, but Not Public	Yes

Legend:
Yes indicates resource or condition is present, as documented in center's ERD.
No indicates resource or condition is not present, as documented in center's ERD.
N/A indicates the resource category is not applicable to the center or not included in center's ERD.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act (i.e., Superfund)
CZMA = Coastal Zone Management Act
GHG = Greenhouse Gases
LQG = Large Quantity Generator (of hazardous waste)
NAAQS = National Ambient Air Quality Standards
NPDES = National Pollutant Discharge Elimination System
NRHP = National Register of Historic Places
PM = Particulate Matter
RCRA = Resource Conservation and Recovery Act (for proper management of hazardous and non-hazardous solid waste)
SIP = State Implementation Plan (for air quality)
T/E = Threatened or Endangered Species
TMDL = Total Maximum Daily Load
WOTUS = Waters of the United States

3.1 Ames Research Center

ARC is home to unique facilities and capabilities including the world's largest wind tunnel, NASA's fastest supercomputers, NASA's only arc jet facility for re-entry testing, and the world's largest motion-based flight simulator. ARC has led NASA in conducting world-class research and development in nanotechnology, information technology, fundamental space biology, biotechnology, thermal protection systems, and human factors research. ARC is a world-class research and development campus with partners from academia, industry, and non-profit corporations.

Located in California's Silicon Valley, ARC is 40 miles south of San Francisco and 12 miles north of San Jose. ARC, including Moffett Federal Airfield on the southeasternmost reach of San Francisco Bay, is directly bordered to the north by experimental salt ponds of the Don Edwards San Francisco Bay National Wildlife Refuge and the Stevens Creek Shoreline Nature Study Area Preserve. The center is surrounded to the southeast, south, and southwest by urban land use typical of Bay Area communities, including dense urban residential and commercial development. **Exhibit 3-3** provides an aerial image of the ARC campus.

Exhibit 3-3. Ames Research Center

(NASA 2012a)

Within the ARC are federally protected species and habitat, wetland areas, and 100-year floodplains, and the site is underlain by extensive contamination plumes. Also within the ARC are two Historic Districts listed in the National Register of Historic Places (NRHP). Multiple buildings and structures are individually listed or eligible for listing in the NRHP and/or contributing elements to one of the Historic Districts. ARC also has four designated National Historic Landmarks (NHLs). Known archaeological sites are located at ARC, and although these have been evaluated as ineligible for listing in the NRHP, the potential exists for future archaeological discoveries. A full description of all existing resources at ARC is provided in the ARC's ERD, incorporated here by reference (NASA 2015b).

3.2 Armstrong Flight Research Center

AFRC is NASA's primary center for atmospheric flight research and test projects. AFRC's mission is to advance technology and science through flight which includes the following mission elements: perform flight research and technology integration to revolutionize aviation and pioneer aerospace technology; validate space exploration concepts; and conduct airborne remote sensing and science missions. AFRC is a civilian tenant organization within the boundaries of Edwards Air Force Base in the western Mojave Desert, approximately 100 miles northeast of Los Angeles, California. **Exhibit 3-4** is an aerial image of AFRC. AFRC is surrounded by Edwards Air Force Base and abuts Rogers Dry Lake Preserve to the east. Edwards Air Force Base is in the Antelope Valley, a 3,000-square-mile high desert closed basin. With the San Gabriel Mountains to the south and the Tehachapi Mountains to the west, the lakebeds are among the lowest points in the Antelope Valley. A wide range of plants and animals inhabit the area.

Rogers Dry Lake, within Edwards Air Force Base, is a 44-square-mile playa lake used for aviation research and test operations. AFRC has one NRHP-eligible Historic District and one individually NRHP-eligible asset. Rogers Dry Lake, outside of but adjacent to the eastern boundary of AFRC, has been designated an NHL and is listed on the NRHP because of its role in the development of the nation's space program and in the development of aerospace systems. AFRC has no identified NRHP-eligible archaeological sites. A full description of the existing environment at AFRC is provided in AFRC's ERD, incorporated here by reference (NASA 2017a).

Exhibit 3-4. Armstrong Flight Research Center

(NASA 2022g)

3.3 Glenn Research Center

The GRC's mission is to drive research, technology, and systems to advance aviation, expand human presence across the solar system, enable exploration of the universe, and improve life on Earth. Its laboratories, test facilities, and capabilities provide the program, technical, and mission support leadership necessary to meet these challenges. The GRC comprises two facilities: the NASA GRC located at Lewis Field (referred to as the Lewis Field Campus) in Cleveland, Ohio (**Exhibit 3-5**), and the Neil A. Armstrong Test Facility (formerly known as Plum Brook Station), located in Sandusky, Ohio, approximately 47 miles west of the Lewis Field Campus.

Exhibit 3-5. Glenn Research Center – Lewis Field Campus

(NASA 2022d)

The Lewis Field Campus is the main GRC campus. It is approximately 6 miles south of Lake Erie, bounded to the north and west by the deciduous woodlands surrounding the Rocky River and the Rocky River Reservation. It is bounded to the south and east by the Cleveland Hopkins International Airport. As is typical of urban settings, dense residential and commercial land uses dominate the surrounding area. Within the Lewis Field Campus, there are multiple sites where remedial action is occurring to address environmental contamination. Portions of the campus are within 100-year flood zones. A portion of the GRC is an NRHP-eligible Historic District with multiple assets that qualify as individually eligible as well as contributing elements. One building in the Historic District is also a designated NHL. There are identified archaeological sites at GRC, but they have not been evaluated for NRHP eligibility. A full description of the existing environment at GRC's Lewis Field Campus is provided in the GRC's ERD, incorporated here by reference (NASA 2018b).

The Armstrong Test Facility (ATF), formerly the Plum Brook Station, is a remote test facility for the GRC Lewis Field Campus (**Exhibit 3-6**). It houses the largest and most powerful space simulation and spacecraft test facilities in the world. It is also a multi-tenant facility surrounded by rural agricultural land to the east, south, and west and suburban land use associated with the community of Sandusky to the north. The area is dominated by a mix of woodlands, scrub-shrub vegetation, and fields. Within the facility's boundary, multiple bird, turtle, snake, moth, and rare plant species are located as are multiple sites where remedial action is occurring to address environmental contamination. Several buildings are individually eligible for listing in the NRHP, and one property is a designated NHL. Archaeological, primarily prehistoric, sites have been identified at ATF. A full description of the existing environment at GRC's ATF is provided in the GRC's ERD, incorporated here by reference (NASA 2018b).

Exhibit 3-6. Glenn Research Center – Armstrong Test Facility (Plum Brook Station)

(NASA 2019b)

3.4 Goddard Space Flight Center

GSFC in Greenbelt, Maryland, plays a pivotal role across all aspects of the agency's missions, from development to de-orbit. GSFC's missions support multiple scientific disciplines, including Earth science, solar science, the Sun-Earth environment, planetary studies, and astrophysics. GSFC includes six campuses and multiple remote sites that contribute to the GSFC mission. Each of these campuses/facilities is described in the text that follows.

3.4.1 Greenbelt Campus

Located in Greenbelt, Maryland, in Prince George's County, approximately 6.5 miles northeast of Washington, D.C., the Greenbelt Campus is the main campus of GSFC (**Exhibit 3-7**). It is home to the nation's largest organization of scientists, engineers, and technologists who build spacecraft, instruments, and new technology to study the Earth, Sun, our solar system, and the universe (NASA 2022a). It is also the operational home of the Hubble Space Telescope.

The campus is convenient to NASA Headquarters and other allied professional organizations and

Exhibit 3-7. GSFC – Greenbelt, MD

(NASA 2021e)

universities. It consists of 1,270 acres within five distinct land areas and uses, situated in a natural setting marked by gently rolling topography and woodlands. Within the boundaries of the Greenbelt Campus are large areas of wetlands and areas within a 100-year flood zone. GSFC has one designated NHL and one asset that is individually eligible for listing in the NRHP. Numerous buildings, facilities, and structures are contributing elements to the NASA GSFC Historic District. One NRHP-eligible pre-historic archaeological site is present at GSFC. A full description of the existing environment at GSFC's Greenbelt Campus is provided in the GSFC's ERD, incorporated here by reference (NASA 2018c).

3.4.2 Wallops Flight Facility

Wallops Flight Facility (WFF) maintains a diverse tenant agency population consisting of scientific research, commercial industry, and military mission activities. Located on the Eastern Shore of Virginia, in Accomack County, the WFF Campus provides launch capability for NASA and other U.S. government and commercial partners (**Exhibit 3-8**).

Exhibit 3-8. GSFC – Wallops Flight Facility

(NASA 2021e)

WFF consists of three campuses adjacent to the woodlands and saltmarshes of the Wallops Island National Wildlife Refuge and open ocean areas along the Eastern Shore. The natural areas of the three campuses are dominated by saltmarshes with pine, scrub-shrub, and maritime grasslands present primarily along the shoreline. Federally endangered sea turtles and their nests occur along the shoreline. Multiple bald eagle nesting sites are present. The natural setting allows access to open oceanic areas compatible with its operational role. A large number of buildings have been identified as having asbestos-containing materials, and there are multiple hazardous waste storage locations and disposal sites within the WFF boundaries. The 1936 Wallops Beach Life Saving Station and associated observation tower are eligible for listing in the NRHP. WFF has identified NRHP-eligible archaeological sites and there are areas of the center where additional intact archaeological sites may be present. A full description of the existing environment at WFF is provided in the GFSC's WFF ERD, incorporated here by reference (NASA 2017b).

3.4.3 White Sands Complex

NASA's White Sands Complex (WSC) comprises facilities operated by GSFC (NASA's JSC in Houston manages the White Sands Test Facility [WSTF] within the WSC) and serves as one of NASA's ground stations for the Tracking and Data Relay Satellites and ground-based antennas for the critical link between Earth and space. The WSC is 11 miles from Las Cruces, New Mexico. The WSC sits in the Chihuahuan Desert, in the foothills of the Organ Mountains (**Exhibit 3-9**). Major vegetation in the area includes a combination of woody shrubs and grasses characteristic of the Chihuahuan Desert Scrub Biotic Community. A description of the existing environment at the WSC is provided in the WSTF ERD, incorporated here by reference (NASA 2015c).

3.4.4 *Columbia Scientific Balloon Facility*

The Columbia Scientific Balloon Facility provides NASA centers and universities around the world the services of launching large, unmanned, high altitude research balloons and tracking and recovering the scientific experiments suspended beneath them. The facility is adjacent to the Palestine Municipal Airport, approximately 5 miles from the community of Palestine, Texas (**Exhibit 3-10**). The surrounding environment consists primarily of rolling sandy hills dominated by Post Oak Savannah Ecoregion with primary land uses of mixed rural and agricultural activities and harvested timberlands. A rich variety of wildlife can be found within the area.

3.4.5 *Goddard Institute for Space Studies*

Research at the Goddard Institute for Space Studies (GISS) emphasizes a broad study of global change and an interdisciplinary initiative addressing natural and man-made changes in the environment affecting the habitability of Earth. GISS occupies five of seven floors in Columbia University's Armstrong Hall in Manhattan's Morningside Heights neighborhood (**Exhibit 3-11**).

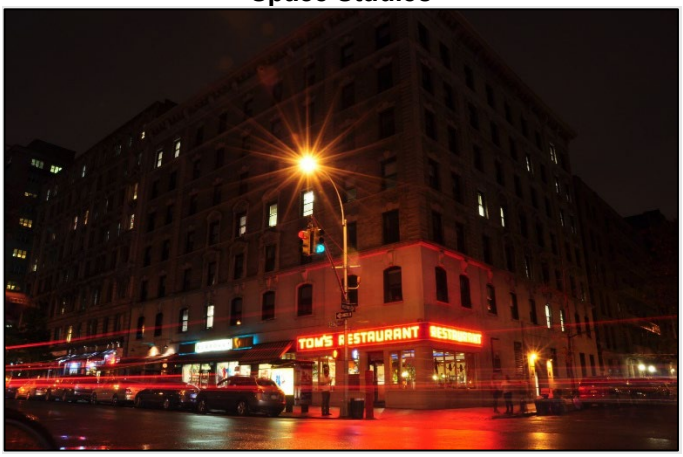
Exhibit 3-9. GSFC – White Sands Complex

(NASA 2021e)

Exhibit 3-10. GSFC – Columbia Scientific Balloon Facility

(NASA 2015d)

Exhibit 3-11. GSFC – Goddard Institute for Space Studies



(NASA 2021e)

3.4.6 *Katherine Johnson Independent Verification and Validation Facility*

The Katherine Johnson Independent Verification and Validation program is responsible for ensuring NASA's safety- and mission-critical systems and software operate reliably, safely, and securely. The facility is in the Monongahela Valley in Fairmont, West Virginia (**Exhibit 3-12**). The facility consists of a single, NASA-owned building situated in a business park setting, surrounded by rural and suburban land uses.

Exhibit 3-12. GSFC – Katherine Johnson Independent Verification and Validation Facility

(NASA 2021e)

3.4.7 *GSFC Foreign Facilities*

- Antarctica Long Duration Balloon Facility (McMurdo Station, Antarctica)
- Ascension Island Bilateration Ranging Transponder Facility (Atlantic Ocean)
- Australia Balloon Launch Facility (Alice Springs, Australia)
- Australia Yarragadee Mobile Laser Site (Dongara, Australia)
- Wanaka Balloon Launch Facility (Wanaka, New Zealand)
- Bermuda Spaceflight Tracking/Data Network Station (Cooper's Island Nature Reserve, Bermuda)
- Tahiti Mobile Laser Site (Papeete, Tahiti)

3.5 Jet Propulsion Laboratory

The JPL is NASA's only research and development center federally funded by NASA but managed by the California Institute of Technology. The JPL is in the City of La Cañada Flintridge, California, at the southern foot of the San Gabriel Mountains, approximately 5 miles northwest of the city of Pasadena (**Exhibit 3-13**). To the east and south, the JPL is adjacent to the Hahamongna Watershed Park, a natural park between mountain and plain. To the west, south, and east beyond the park, dense suburban land use stretches into the matrix of dense suburban communities north of Los Angeles. JPL has two

Exhibit 3-13. Jet Propulsion Laboratory

(NASA 2016a)

NHLs, several individually NRHP-eligible buildings, and an NRHP-eligible Historic District. The archaeological potential at JPL is low.

3.5.1 Goldstone Deep Space Communications Complex

The Goldstone Deep Space Communications Complex (GDSCC) is in the Mojave Desert, near Goldstone, California. The giant dish antennas of NASA's Deep Space Network (DSN)—built and managed by the JPL—send and receive data from nearly all spacecraft traveling beyond the Moon. The DSN includes one designated NHL and one individually NRHP-eligible structure. A full description of the existing environment at the JPL is provided in the JPL's ERD, incorporated here by reference (NASA 2015a).

3.5.2 Table Mountain Facility

The Table Mountain Facility is an asset of the JPL. At an elevation of 7,500 feet, the facility is located near the town of Wrightwood, CA, in the San Gabriel Mountains within Angeles National Forest, approximately 1.5 hours-drive from the main JPL lab in Pasadena (**Exhibit 3-14**). Its remote location, altitude, climate, and lack of light contamination make it one of the best places in the United States for cloudless nighttime skies. Scientific and engineering research at the facility includes astronomy, atmospheric remote sensing, light detection and ranging (LiDAR), and related projects for universities and colleges (NASA 2023d).

Exhibit 3-14. Table Mountain Facility

(NASA 2023d)

3.5.3 JPL Foreign Facilities

- Canberra Deep Space Communications Complex (Tidbinbilla, Australia)
- Madrid Deep Space Communications Complex (Madrid, Spain)

3.6 Johnson Space Center

The JSC is the home of NASA's Mission Control Center and astronaut training (**Exhibit 3-15**). It serves as the lead NASA center for the International Space Station, is home to NASA's Astronaut Corps, and is responsible for training space explorers from the United States and space station partner nations. It is the principal training site for astronauts for NASA and commercial space companies. JSC leads NASA's flight-related scientific and medical research efforts. Additionally, the center manages the development, testing, production, and delivery of hardware supporting spacecraft functions including life support systems and all human spacecraft-related functions. The latter include life support systems, power systems, crew equipment, electrical power generation and distribution, navigation and control, cooling systems, structures, flight software, robotics, and spacesuits and spacewalking equipment.

JSC is in Houston, Texas. To the west, south, and east, the JSC is surrounded by dense suburban and commercial development. Also to the east is Clear Lake, which connects to Galveston Bay, providing access to the Gulf of Mexico. To the north, land use is a mix of woods, fields, and pastures. Forested wetlands are present near the Center's northern boundary. The easternmost portion of JSC is within a special flood hazard area. The entirety of the JSC campus in Houston is a designated NRHP Historic District. Within the Historic District, two buildings are NHLs and numerous buildings, structures, and facilities are individually eligible for the NRHP. JSC is considered to have a low potential for intact archaeological sites. A full description of the existing environment at JSC is provided in the JSC ERD, incorporated here by reference (NASA 2019a).

Exhibit 3-15. Johnson Space Center

(NASA 2022h)

3.6.1 White Sands Test Facility

The WSTF is a self-contained facility with medical, fire, and hazardous rescue personnel. It houses unique and comprehensive testing and analysis capabilities for evaluating material, component, and system behaviors in hazardous environments. Testing and evaluations include composite pressure systems, propellants and aerospace, and materials flight acceptance (**Exhibit 3-16**). While WSTF is a tenant of the WSC in Las Cruces, New Mexico, it is a component of the JSC.

Exhibit 3-16. JSC – White Sands Test Facility

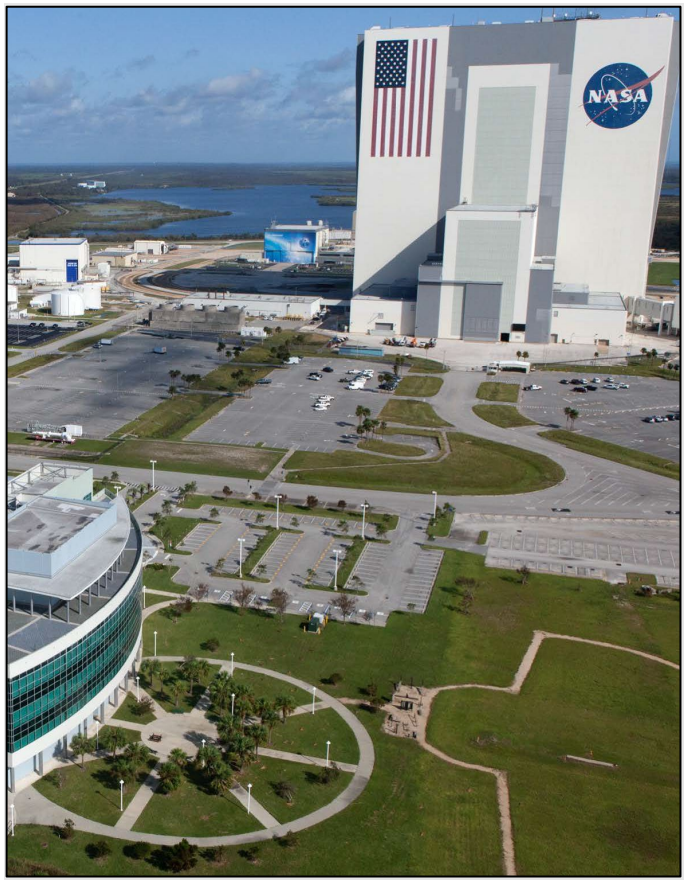
(NASA 2022c)

The affected environment of the WSTF is similar to the WSC. The WSTF is 11 miles from Las Cruces, New Mexico, in the Chihuahuan Desert, in the foothills of the Organ Mountains. Major vegetation in the area includes a combination of woody shrubs and grasses characteristic of the Chihuahuan Desert Scrub Biotic Community. A large pollution plume is in the western portion the WSTF. WSTF has two NRHP-eligible Historic Districts. Additional buildings are individually eligible and/or contributing elements to the WSTF Historic District. WSTF is particularly rich in archaeological sites—95 sites have been identified at the Center, some of which are NRHP-eligible. A description of the existing environment at the WSTF is provided in the WSTF ERD, incorporated here by reference (NASA 2015c).

3.7 John F. Kennedy Space Center

KSC is NASA's premier multiuser spaceport with more than 90 private-sector partners and nearly 250 partnership agreements (NASA 2020a). KSC is NASA's main launch site and is home to facilities that research and develop innovative solutions for government and commercial space ventures. Located on Merritt Island, Florida, KSC is north and west of Cape Canaveral. The two locations are primarily separated from each other by the Banana River. To the east, a portion of KSC is bounded by the Atlantic Ocean and to the west by the Indian River. KSC is about an hour's drive from Orlando on Florida's eastern coast (**Exhibit 3-17**).

Exhibit 3-17. Kennedy Space Center



(NASA 2020a)

The area is geographically characterized by its low elevation and its mix of land and lagoon waters. Within its boundaries, KSC contains the Merritt Island National Wildlife Refuge. Most of Canaveral National Seashore is located on the northern part of Merritt Island, on the east coast of Central Florida. KSC has a varied habitat including coastal dunes, saltwater estuaries and marshes, freshwater impoundments, scrub, pine flatwoods, and hardwood hammocks. These habitats provide refuge to more than 1,500 species of plants and animals. Of these, there are 33 animals that are federally and/or state listed as threatened or endangered and 39 plants listed as threatened, endangered, or species of special concern within KSC boundaries. Most of KSC is within a 100-year floodplain.

KSC contains multiple historic properties including historic buildings, structures, districts, objects, and sites that are listed in or eligible for listing in the NRHP. Historic property types include buildings, launch pads, and objects that are on display at the KSC Visitors Center. KSC also owns a few historic properties within the adjacent Cape Canaveral Air Force Station NHL Historic District. Many NRHP-eligible archaeological sites have been identified at KSC, but most of the land remains unsurveyed. Archaeological probability models created in the 1990s and early 2000s aid in the identification of areas with high or moderate potential for archaeological sites. A full description of the existing environment at the KSC is provided in the KSC ERD, incorporated here by reference (NASA 2020b).).

3.8 Langley Research Center

LaRC supports NASA's goals for aeronautics exploration, science, and space technology with a variety of flight simulators, wind tunnels, labs, and computational software. LaRC is in the City of

Hampton, Virginia, adjacent to Joint Base Langley-Eustis on the Chesapeake Bay (**Exhibit 3-18**). It is the oldest of NASA's centers.

The surrounding land use is primarily suburban with interspersed woodlands to the southwest. Vegetation is a mix of maintained grass, shrubbery, and woodlands. Large areas of forested, estuarine, and marine wetlands are present. Most of LaRC is within a special flood hazard area. Branches of the Back River directly border LaRC and Joint Base Langley-Eustis to the northeast and east. The center is a NRHP-listed Historic District. Three NHLs are located at LaRC and there are many built resources contributing to the historic district and individually eligible for listing on the NRHP. The adjacent Langley Air Force Base is eligible as a Historic District. Historic-era and pre-historic era archaeological sites are present at LaRC, including sites eligible for listing and listed on the NRHP. A full description of the existing environment at the LaRC is provided in the LaRC ERD, incorporated here by reference (NASA 2021b).

Exhibit 3-18. Langley Research Center

(NASA 2012b)

3.9 George C. Marshall Space Flight Center

MSFC's core capabilities and services include providing propulsion technology and testing, materials and testing, space transportation systems, space systems, and scientific research (**Exhibit 3-19**). Situated in Huntsville, Alabama, the MSFC is encompassed by the 38,300-acre U.S. Army Redstone Arsenal (RSA). On site, MSFC is bordered to the west and south by the sprawling Wheeler National Refuge and Wheeler Lake (a.k.a., Indian Creek), portions of which are within the MSFC. Redstone Army Airfield is to the north of the center. Oak-hickory forests dominate the wooded areas. To the north of MSFC, suburban land use becomes increasingly urban from west to east, culminating in the small urban center of Huntsville. Portions of MSFC are within a 100-year floodplain. Within MSFC's boundaries there are multiple hazardous material areas, several potential contamination points, and several sites where remedial action is occurring to address environmental contamination. MSFC has four designated NHLs and additional assets that are individually NRHP-eligible. NRHP-eligible archaeological sites are also present at MSFC. A full description of the existing environment at the MSFC is provided in the MSFC ERD, incorporated here by reference (NASA 2017c).

Exhibit 3-19. Marshall Space Flight Center

(NASA 2021a)

3.9.1 Michoud Assembly Facility

Exhibit 3-20. Michoud Assembly Facility

(NASA 2010)

A component of MSFC, the Michoud Assembly Facility (MAF) is one of the largest manufacturing facilities in the world at 829-total acres, with 43 acres of manufacturing space under one roof and a working port with deep-water access that enables transportation of large space systems and hardware. Having previously served both the Apollo and Space Shuttle programs, the facility has adapted to support all of NASA's human space flight missions. Today, MAF is manufacturing and assembling the core stages for NASA's Space Launch System. The MAF site is in southeastern Louisiana, 16 miles east of downtown New Orleans. The Gulf Intracoastal Waterway bounds MAF to the south, the Michoud Canal to the east, warehouse and industrial development to the north, and a commercial electricity generating facility and the U.S. Coast Guard Base New Orleans to the west. Solar panels cover more than 100 acres of the site near its southern and eastern boundaries.

As shown on **Exhibit 3-20**, much of the land at the MAF site has been disturbed, with land use consisting primarily of buildings, parking lots, solar fields, and mowed grass. Most of MAF is outside of a 100-year floodplain and more protected than areas surrounding MAF due to the drainage canals. As a manufacturing facility, a variety of wastes are generated at MAF, including hazardous, non-hazardous, and industrial solid waste. Multiple pollution sites are located throughout the MAF, including sites where remedial action is occurring to address environmental contamination. Multiple assets are individually NRHP-eligible. A full description of the existing

environment at the MAF is provided in the MAF ERD, incorporated here by reference (NASA 2016b).

3.10 John C. Stennis Space Center

The SSC is a multidisciplinary facility comprised of NASA and more than 40 other resident agencies engaged in space, environmental programs, and national defense, including the U.S. Navy's world-class oceanographic research community. Located on the border of Louisiana and Mississippi in Hancock County, Mississippi, SCC is a multi-tenant facility (**Exhibit 3-21**). It is adjacent to the Pearl River, a tributary of the Mississippi River, and surrounded by wooded and agricultural land use. Water access provides SSC with the essential ability to transport large rocket stages, components, and propellant loads. The Pearl River Wildlife Management Area borders the facility directly to the west. The large tracts of forest surrounding the center and considered a national asset, provide the 13,800-acre test facility with an acoustical buffer zone of close to 125,000 acres. Large areas of forested wetlands are present throughout the area, and within the SSC boundaries there are 100-year floodplains.

Multiple pollution sites are located throughout the SSC, including sites where remedial action is occurring to address environmental contamination such as monitoring wells, landfills, and National Pollutant Discharge Elimination System (NPDES) sites. SSC has one designated NHL District, the Test Complex, which includes several contributing properties. SSC also has identified NRHP-eligible archaeological sites. A full description of the existing environment at the SSC is provided in the SSC ERD, incorporated here by reference (NASA 2016c).

Exhibit 3-21. Stennis Space Center

(NASA 2004)

SECTION 4: ENVIRONMENTAL CONSEQUENCES

On May 20, 2022, the CEQ issued its update of the NEPA Implementing Regulations (40 CFR Parts 1500-1508), including its guidance on determining the significance of a Proposed Action. In accordance with 40 CFR Part 1501.3, agencies are instructed to analyze the potentially affected environment and the degree of the effects of the action. Agencies are also instructed to consider connected actions consistent with 40 CFR Part 1501.9(e)(1). CEQ further defines the updated approach to determining effects as follows:

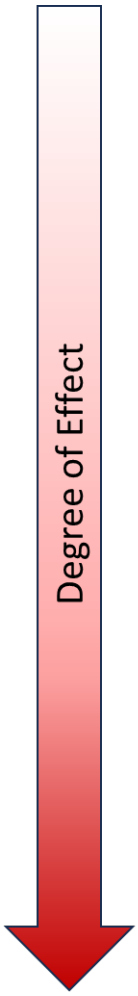
> *(1) In considering the potentially affected environment, agencies should consider, as appropriate to the specific action, the affected area (national, regional, or local) and its resources, such as listed species and designated critical habitat under the Endangered Species Act. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend only upon the effects in the local area.*
>
> *(2) In considering the degree of the effects, agencies should consider the following, as appropriate to the specific action:*
>
> > *(i) Both short- and long-term effects.*
> >
> > *(ii) Both beneficial and adverse effects.*
> >
> > *(iii) Effects on public health and safety.*
> >
> > *(iv) Effects that would violate Federal, State, Tribal, or local law protecting the environment (40 CFR 1501.3).*

The purpose of NEPA is to inform decisionmakers of the likely environmental consequences of a Proposed Action. Similarly, while NEPA does not apply extraterritorially, NASA analyzes the effects of major federal actions abroad under EO 12114 (Environmental Effects Abroad of Major Federal Actions). Consistent with these requirements, this section identifies the anticipated effects of the No Action Alternative and the Proposed Action. The analysis of resource effects focuses on environmental issues in proportion to the degree of effect anticipated with actions typical under each bucket assignment: sustain, invest, divest, outgrant. Environmental consequences or effects described in this PEA are evaluated in terms of the likely or anticipated degree of effect (no effect, negligible, minor, moderate, or significant). In the absence of specific projects to be implemented (e.g., construction of a new building), it is not possible to provide a quantitative assessment of effects. Therefore, the potential effects presented are theoretical and qualitative. These terms are further defined in **Exhibit 4-1**.

At the Tier II level, when specific projects are proposed, center-level NEPA managers would need to determine whether the proposed action falls within the scope of a pre-determined CatEx (14 CFR 1216.304) or requires preparation of an EA or EIS. To aid in their determination, center-level NEPA managers may use the tools and resources (provided via hyperlinks) in **Exhibit 4-2**. Regardless of NEPA Tier I or Tier II level of analysis, the center NEPA manager should work with the project proponent to consider alternatives that could minimize and/or mitigate potential significant effects below the significant threshold, where practicable.

To the extent applicable to the NASA facility, center NEPA managers would need to consider state and local regulatory requirements related to each resource discussed in this PEA.

Exhibit 4-1. Potential Effect Rating Scale



No Effect (NE)	There would be no environmental effect resulting from the action.
Negligible (N)	A temporary or permanent environmental effect that is so small, it would be difficult to observe, and its effects on human health, cultural resources, or the environment would be considered inconsequential.
Minor (m)	A temporary or permanent environmental effect that is observable, yet is unlikely to noticeably affect human health, cultural resources, or the environment.
Moderate (M)	A temporary or permanent environmental effect that is observable and/or may noticeably affect human health, cultural resources, or the environment, yet is below regulatory, industry, and commonly accepted thresholds for significance.
Significant (S)	A temporary or permanent environmental effect that is observable and/or could cause a major and lasting impact to human health, cultural resources, or the environment. If significant impacts are identified, an EIS may need to be completed prior to implementing the action. The NEPA process may identify mitigation measures which would serve to avoid or minimize environmental impacts to a level less than significant impact. To the extent mitigation measures are used to reduce a proposed action to a level below significant impact (i.e., a mitigated FONSI), those measures must be capable of being implemented, monitored, and enforced under existing legal authority (e.g., design review board, construction permitting, other approvals or authorizations as required).

Exhibit 4-2. NASA NEPA Resources Links

External (Public)
CEQ NEPA Regulations
Public NEPA Library
Public NASA Environmental Tracking System (NETS)
Internal (NASA Only)
NASA NEPA Desk Guide
NASA Environmental Review Form (NERF)
Internal NEPA
NETS Module
Environmental Resources Documents (ERDs)
Integrated Cultural Resources Management Plans (ICRMPs)
NASA's Natural Resource Management Plans (NRMPs)

For the Proposed Action, potential effects relate to the types of actions associated with each of the AIA bucketing categories: invest, sustain, divest, and outgrant (**Exhibit 4-3**). For the No Action Alternative, potential effects relate to similar actions, but in the absence of agencywide mission criticality prioritization and condition scores.

Exhibit 4-3. Proposed Action – Typical Actions by Bucket Type

Sustain
For Assets with High Mission Relevance and Acceptable Condition Scores
• Maintain current asset condition. • Maintain current operational activities. • Ground-disturbing activities are not common.
Invest
For Assets with High Mission Relevance and Low Condition Scores
• Repair degraded asset. • Renew by modernizing or replacing degraded asset. Renovation can occur within or outside a particular building or facility. • Ground-disturbing activities are possible for assets requiring repair or renewal. • Infrastructure improvements can involve installation of new utilities and roadways, removal of old utility lines and roads, or improvements to existing utility lines and roadways. • Build new facilities and structures. Typically involves some amount of ground disturbance (e.g., land clearing, grading, pavement removal/addition) depending on the scope and location of the new asset. These activities may also involve heavy equipment.
Divest
For Assets with Low Mission Relevance and Low Condition Scores
• Demolish by eliminating or reducing asset or equipment no longer required by NASA. Facility demolition includes removal of part or all of a building or facility, up to and including the foundation. This activity may involve land disturbance to some extent, as well as the use of heavy equipment. • Mothball provides the least level of maintenance required to maintain functionality for possible future use of the asset. Very little, if any ground-disturbing activity is involved. • Abandon by eliminating any future maintenance of the asset. No ground-disturbing activity is involved.
Outgrant
For Assets with Low Mission Relevance and Acceptable Condition Scores
• These assets need further evaluation to determine final bucketing assignment (outgranted, repurposed, consolidated, or sustained). • Outgranting is the non-permanent transfer of rights by NASA of real property to others by means of lease (or any other form of acceptable legal instrument that recognizes NASA as the landlord and the lessee as the tenant); permit; easement; right of way; license; Space Act Agreement; or agreement such as a memorandum of understanding or concessionaire agreement. • If the asset is outgranted, the lessee could sustain the facility, invest in the existing facility, or construct a new facility and/or structure. • Ground-disturbing activity could be possible.

4.1 Potential Environmental Consequences of the No Action Alternative

Under the No Action Alternative, NASA would not implement an Agency Master Plan and would continue center development actions and operations in accordance with each center's existing and future CMPs. Potential environmental effects would generally be similar to those described under the Proposed Action, given that projects implemented under the No Action Alternative would be similar to those implemented under the Proposed Action. The main differences between the No Action Alternative and the Proposed Action are:

- The No Action Alternative would be less efficient and result in a less effective allocation of funding from an agencywide perspective. Institutional funding allocation and which projects are implemented would be based on center-driven mission criticality (No Action Alternative) versus agency-driven mission criticality and asset condition (Proposed Action).
- The No Action Alternative could result in potential redundancy in asset funding and treatment across centers while the Proposed Action could potentially reduce redundant facility costs.

From a programmatic perspective, center-specific regulatory requirements (federal, state, local), center-specific resource constraints, and the degree of effect on resources from asset construction, demolition, renovation, maintenance of existing and future operational activities, and/or outgranting would be similar under the No Action Alternative or the Proposed Action. The range of potential effects would be the same as that of the Proposed Action (from no effect to significant effect), and appropriate NEPA follow-on studies would be subject to the same criteria, regardless of alternative.

4.2 Potential Environmental Consequences of the Proposed Action

The following subsections summarize potential effects by resource to ensure the decision-maker understands the potential consequences of implementing the Proposed Action. Regulatory requirements, potential mitigations, and best management practices are also identified for each resource area. Because potential effect determinations in this PEA are notional (as are potential projects within asset buckets), discussions of effects are qualitative in nature. **Exhibit 4-4** provides an overview of the likely range of potential effects to each resource category relative to the typical actions anticipated for each asset bucket assignment. Greater detail of potential effects is provided, by resource type, in the text that follows.

Exhibit 4-4. Potential Effects by Bucket Type

Resource Category	Bucket Type and Typical Actions						
	Sustain	Invest		Divest			Outgrant
	Maintain Asset/ Maintain Operational Activity	Repair, Renovate	Newly Created	Demolish	Mothball	Abandon	Rights Transfer, Easement, Right of Way
Land Use	NE, N	NE, N, m	m, M, S	m, M, S	NE, N	NE, N	NE, N, m, M, S
Soils and Geology	NE, N	NE, N, m	m, M, S	m, M	NE, N	NE, N	NE, N, m, M, S
Air Quality	NE	NE, N, m	N, m, M	N, m, M, S	NE	NE	NE, N, m, M
Climate Change & Greenhouse Gas	NE, N	NE, N, m	N, m, M	NE, N	NE, N	NE, N	NE, N, m, M
Noise, Sonic Boom, Vibration	NE, N	NE, N, m	NE, N, m, M, S	m, M	NE	NE	NE, N, m, M, S
Hazardous Materials & Waste	NE, N, m	m, M	m, M	N, M, S	N, m	N, m	NE, N, m, M, S
Transportation	NE	NE, N, m, M	m, M, S	NE	NE	NE	NE, N, m, M, S
Utilities	NE, N	NE, N	m, M, S	NE	N	NE	NE, N, m, M, S
Water Resources	NE, N	NE, N, m, M, S	NE, N, m, M, S	m, M, S	NE, N, m	NE, N, m	NE, N, m, M, S
Coastal Zone Management	NE, N	NE, N	m, M, S	NE, N	NE, N	NE, N	NE, N, m, M, S
Biological Resources	NE	NE, N	NE, N, m, M, S	NE, N, m, M, S	NE	NE	NE, N, m, M, S
Cultural Resources: Above Ground Structures	NE, N, m	NE, N, m, M,	NE, N, m, M,	NE, N, m, M,	NE, N, m	NE, N, m, M, .	NE, N, m, M,
Cultural Resources: Archaeology	NE, N	NE, N, m	NE, N, m, M,	NE, N, m	NE, N	NE, N	NE, N, m, M,
Environmental Justice	NE	NE	NE, N, m	NE	NE	NE	NE, N, m
Socioeconomic	NE	NE	NE, N, m, M, S	NE, N, m, M, S	NE	NE	NE, N, m, M, S

Potential Effect Rating:
NE = No Effect; N = Negligible Effect; m = Minor Effect; M = Moderate Effect; S = Significant Effect

4.2.1 Land Use

Land use comprises natural conditions or human-modified activities occurring at a particular location. Management plans and zoning regulations determine the type and extent of land use allowable in specific areas and are often intended to protect specially designated or environmentally sensitive areas. Adverse environmental effects related to land use should be minimized or mitigated through consistency with each center's environmental stewardship objectives.

4.2.1.1 Regulatory Setting

Outside of the context of management of federal lands under the Federal Land Policy and Management Act (43 U.S.C 1701 – 1782), there is no overarching federal land use law. As discussed in **Section 4.2.2.1**, the federal government regulates real property development activities which may occur on NASA centers through a variety of statutory and regulatory authorities (e.g., the Clean Water Act [CWA], the Endangered Species Act, the Coastal Zone Management Act [CZMA]). In some cases, implementation of these authorities is delegated to the states (e.g., permitting under the CWA; consistency with approved state coastal management programs). Centers should be mindful of local, municipal, and state land use/zoning regulations and requirements that may apply to areas on- or off-center, but which, either directly or indirectly, are related to the Proposed Action.

4.2.1.2 Potential Consequences

Centers should develop an understanding of their developable and non-developable land and environmentally sensitive areas in the consideration of construction, operation, or maintenance activities that have the potential to affect existing and future land use. Centers should work closely with adjacent land use partners to determine the appropriate methods for, locations of, and mitigation options pertaining to proposed projects.

Sustain
Potential effects from actions in the sustain bucket would likely range from no effect to negligible effect. Maintaining an asset's current condition and/or maintaining current operational activities would have little, if any, effect on existing and adjacent land uses.

Invest
Potential effects from actions in the invest bucket could range from no effect to significant effect, depending on the size and scope of the proposed action. Repairing and/or renewing an asset would likely have no effect to minor effect, whereas a newly created asset could have minor to significant effects on land use, depending on the size and scope of the proposed action. For example, construction of a new facility could result in direct effects to adjacent wetlands or runoff caused by the addition of impervious surfaces (e.g., parking lots, sidewalks, installation of associated utility infrastructure).

Divest
Abandoning and/or mothballing an asset would likely range from no effects to negligible effects to center and adjacent land uses. Demolishing an asset could have a minor to significant effect on future land use; the previously used area could be available for future development in a manner not consistent with the original facility or structure. The consolidation of operations into a smaller geographic footprint would likely, over time, allow NASA to restructure functions and capabilities

into more efficient facilities on a smaller footprint. Some possible land use and land cover changes would be minor or moderate in scope and beneficial overall.

Outgrant
Depending on the action proposed under an outgrant scenario, potential effects to land use could range from no effect to significant effect. If an outgranted asset is sustained by the lessee, little if any effect to land use would occur. If a lessee invests in an existing asset or constructs a new facility/structure, there could be a moderate to significant effect similar to what could occur under the invest or divest buckets.

4.2.2 Soils and Geology

Soils and geological resources typically consist of surface and subsurface materials and their inherent properties, such as erosion potential, compaction rates, drainage, and other properties that may influence design, construction, and project activities.

4.2.2.1 Regulatory Setting

In the context of this PEA, issues related to redevelopment of NASA facility infrastructure and its effects on soils and geology would most likely be addressed through construction-related permit requirements (e.g., CWA Section 402 permit for stormwater discharges from a construction activity; CWA Section 404 permit for disposal of dredge fill material into Waters of the United States [WOTUS] including wetlands).

4.2.2.2 Potential Consequences

The U.S. Department of Agriculture's Natural Resources Conservation Service has soil maps and data available online. Proposed development should evaluate soil stability, as well as infiltration rates, compaction rates, erosion rates, and overall soil health. Best management practices would need to be implemented during project activities to prevent or reduce soil erosion and minimize adverse soil effects. Disturbed areas would likely need to be re-sodded and revegetated with grasses or other vegetation to further minimize erosion over the long-term. Depending on project type and size, each center's natural resource management protocols and/or NPDES stormwater construction permit requirements would need to be followed, where applicable.

Development activities could result in effects on soils and geology from clearing, grubbing, grading, excavating, filling, etc. Ground-disturbing construction activities could occur in some areas where soils have been previously disturbed, but activities could also occur in previously undisturbed areas. In these disturbed areas, adverse effects on soils would be considered minimal as soil structure and function have already been destroyed or altered. Where disturbance of intact natural soils may occur because of project activities, the effects would be greater. The use of heavy equipment would be short-term during project activities, and the degree of soil effects would depend on the types of soils occurring onsite (e.g., disturbed versus natural, highly permeable, hydric), site topography, and the size of the project area. Soil erosion from use of heavy equipment could occur, leading to detachment of soils and transport of freshly disturbed surfaces in wind and storm flow runoff. Severe soil compaction could also inhibit revegetation in denuded areas. Potential indirect effects of soil destabilization and erosion would be dust generation and offsite deposition. Additionally, tires and tracks of heavy equipment may potentially erode soils and carry sediment from construction sites to paved areas, which would drain into ditches and catch basins during rain events or cause dust during dry periods. Disturbance of soils could also create habitat

for colonization by invasive species. Finally, spills and leaks of hazardous materials from vehicles or equipment during construction could lead to soil contamination and toxicity.

Impacts of proposed project activities on soils and geology could be short-term and/or long-term, direct, adverse, and minor-to-moderate, depending on the extent of the project, site topography, types of soils occurring onsite, and whether impervious surfaces would be placed over soils and geological materials. Depending on project size and each center's natural resource management EO 13112, Invasive Species obligations, centers would re-sod disturbed areas and revegetate them with non-invasive species of grasses or other vegetation to further minimize erosion over the long-term.

Sustain
Potential effects from actions in the sustain bucket would likely range from no effect to negligible effect. Maintaining an asset's current condition and/or maintaining current operational activities would have little, if any, effect on soils and geology.

Invest
Potential effects from actions in the invest bucket could range from no effect to significant effect, depending on the size and scope of the proposed action. Repairing and/or renewing an asset would likely have no effect to minor effect as ground-disturbing activity would be limited. However, a newly constructed asset could have significant effects on soils and geology, depending on the size and scope of the proposed action, as well as the amount of ground-disturbing activity, extent of heavy equipment use, the presence of contaminated soils, or the amount of earthwork involved.

Divest
Abandoning and/or mothballing an asset would likely range from no effects to negligible effects to center soils and geology. Demolishing an asset could have a minor to moderate effect, depending on the extent of heavy equipment use, the presence of contaminated soils, or the amount of earthwork involved.

Outgrant
Depending on the action proposed under an outgrant scenario, potential effects to soils and geology could range from no effect to significant effect. If an outgranted asset is sustained by the lessee, little if any effect to soils and geology would occur. If a lessee invests in an existing asset or constructs a new facility/structure, there could be a minor to significant effects, depending on the extent of heavy equipment use, the presence of contaminated soils, or the amount of earthwork involved.

4.2.3 Air Quality

Air quality is the measure of how clean or polluted the air is in a particular location. A region's air quality is influenced by many factors, including the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions.

4.2.3.1 Regulatory Setting

The Clean Air Act (CAA), as amended, requires the Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) to protect public health and welfare. The EPA established the first set of primary and secondary NAAQS for six air pollutants that are common in outdoor air and are considered harmful to public health and the environment. These six "criteria" air pollutants are: ozone (O_3), nitrogen dioxide (NO_2), particulate matter (PM), sulfur dioxide (SO_2), carbon monoxide (CO), and lead (Pb). In accordance with the CAA, all areas within the United

States are designated with respect to the NAAQS. EPA states that, “If the air quality in a geographic area meets or is cleaner than the national standard, it is called an attainment area (designated “attainment/unclassifiable”); areas that don't meet the national standard are called nonattainment areas. In some cases, EPA is not able to determine an area's status after evaluating the available information and those areas are designated "unclassifiable." (EPA 2022j). States are responsible for designating areas that are attainment, non-attainment, or maintenance for each of the criteria pollutants. States are required to develop EPA-approved plans, called State Implementation Plans (SIPs), to achieve or maintain the NAAQS within timeframes set under the CAA (40 CFR 50).

Title V of the 1990 CAA Amendments is a program administered by the EPA to standardize air quality permits and the permitting process for major sources of emissions across the country. Title V only applies to “major sources.” EPA defines a major source as a facility that emits or has the potential to emit any criteria pollutant or hazardous air pollutant at levels equal to or greater than the major source thresholds (40 CFR 70). As shown in **Exhibit 3-2**, most NASA centers hold Title V permits.

4.2.3.2 Potential Consequences

As shown in **Exhibit 3-2**, compliance with air quality standards and the status of Title V permits vary across the centers. Any future development activities that include additional stationary sources of air emissions (e.g., boilers, generators) would need to be added to the center’s Title V permit and would have to meet all requirements therein. In addition, new air emission sources would be subject to New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants requirements. At centers in non-attainment or maintenance areas, where future bucket action projects may generate air emissions, a general conformity analysis would be required. In such instances, centers would need to demonstrate that the proposed project would not inherently lead to a violation of any federal, state, or local air regulation.

Sustain
Maintaining an asset’s current condition and/or maintaining current operational activities would likely have no effect on current air quality levels.

Invest
Repairing and/or renewing an asset would likely have no effect to minor effects on air quality (e.g., installing new boilers and generators) and could see a beneficial effect with the replacement of more efficient emission-producing equipment and facilities. A newly created asset could have negligible to moderate effects to air quality (e.g., new facility that generates additional emissions or more launches and test flights) depending on the size and scope of the proposed investment, as well as the potential for reduced emissions (e.g., more efficient generators), and the degree of ground-disturbing activity and short-term use of heavy equipment. Compliance with applicable air quality regulations and permitting requirements must occur prior to constructing, demolishing, operating, or modifying any air emission source. This may include obtaining a construction permit or modifying a center's Title V Air Operation Permit prior to commencing that activity. Such permits include measures for dust control and other air emission controls.

Divest
Abandoning and/or mothballing an asset would likely have no effect, if not an improvement to air quality, if the asset had been an emissions generator. Demolishing an asset could have a negligible to significant (albeit temporary) effect, depending on the extent of heavy equipment use (short-term effect), as well as a beneficial effect to air quality by taking a previous source of air pollutants permanently offline. Compliance with applicable air quality regulations and permitting

requirements must occur prior to constructing, demolishing, operating, or modifying any air emission source. This may include obtaining a construction permit or modifying a center's Title V Air Operation Permit prior to commencing that activity. Such permits include measures for dust control and other air emission controls.

Outgrant

Depending on the action proposed under an outgrant scenario, potential effects to air quality could range from no effect to moderate effect. If an outgranted asset is sustained by the lessee, little if any effect to air quality would occur. If a lessee invests in an existing asset or constructs a new facility/structure that generates additional emissions, there could be a minor to moderate effect to air quality.

4.2.4 Climate Change and Greenhouse Gases

Global climate change effects include overall warmer temperatures, rising sea levels, a melting polar ice cap, changes in rainfall patterns, a greater frequency of extreme weather events (e.g., droughts, deluges, severe storms, floods, prolonged heat waves), and other associated, and often interrelated, effects. The EPA states that greenhouse gases (GHG) from human activities are the most significant driver of observed climate change since the mid-20th century (EPA 2022g). The EPA also states that transportation is the largest source of GHG emissions in the United States, followed by electricity generation (EPA 2022g).

NASA considers both the impact of climate change on its assets and the impact of its actions on climate change. NASA's 2021 Climate Action Plan states:

> *A significant portion of NASA's infrastructure is in low-lying areas along coastal areas of the continental United States. Climate change is driving increased exposure to rising sea levels, and storm surge and precipitation are causing higher water levels during major storm events. Several Centers have already taken action through elevation of assets, adjusting new construction siting, and other adaptation measures. Flooding and other natural forces exacerbated by climate change continue to pose significant risk to NASA's launch infrastructure and mission. Shorelines continue to erode due to these natural forces. (NASA 2021c, 3)*

Many of these assets cannot be relocated due to their size, specialized characteristics, or strict launch safety requirements, which include maintaining adequate distance from communities and other safety measures and necessitate the use of coastal or other locations significantly affected by climate change (NASA 2021c,1).

4.2.4.1 Regulatory Setting

On December 8, 2021, President Biden authorized EO 14057 on catalyzing American clean energy industries and jobs through federal sustainability and approved the accompanying Federal Sustainability Plan. The Federal Sustainability Plan establishes federal agency policy, programs, operations, and infrastructure to implement adaptive and resilient strategies for future climate effects. Federal agencies are now required to develop climate adaptation and resilience plans that evaluate the most significant climate-related risks and vulnerabilities for agency operations and missions and to identify actions to manage those risks and vulnerabilities (CEQ n.d.). In response to the requirements of EO 14057, NASA developed its Climate Action Plan with five Priority Adaptation Actions (NASA 2021c, 3):

- Priority 1: Ensure Access to Space
- Priority 2: Integrate Climate Adaptation into Agency and Center Master Plans
- Priority 3: Integrate Climate Risks into Risk Analysis and Agency Resilience Planning
- Priority 4: Update Climate Modeling to Better Understand Agency Threats and Vulnerabilities
- Priority 5: Advance Aeronautics Research on Technologies and Processes that Reduce Contributors to Climate Change

4.2.4.2 Potential Consequences

Based on NASA's Climate Action Plan Priorities 2 and 3, the AIA process considered climate adaptation and the resilience needs of assets when making asset bucket assignments. This effort would result in agencywide, beneficial effects on assets because risks would be identified at the planning stage, enabling NASA to more efficiently accommodate future hardening, relocation, or required asset redundancy for inclusion in the Agency Resilience Framework. Relative to climate change, the assignment of assets to be sustained, invested, divested, or outgranted was done to reduce and/or eliminate risks to assets from existing and future climate change risks.

Sustain
Maintaining an asset's current condition and/or maintaining current operational activities would likely have no effect to negligible effect on current GHG emissions and contributions to climate change. This is based on the assumption that mission-critical assets threatened by climate change are not included in this bucket, as they would instead fall under the invest or divest buckets.

Invest
Repairing and/or renewing an asset would likely have no effect to minor effects on GHG emissions and global climate change, whereas a newly created asset could have negligible to moderate effects, depending on the size and scope of the proposed action, as well as the frequency, volume, and type of new emissions. Part of the AIA process included the identification of mission-critical assets whose locations are at risk from climate change. At-risk assets in the invest bucket would receive funding to reduce or minimize risks from climate change.

Divest
Demolishing, abandoning, and/or mothballing an asset would likely have no effect to negligible effect on GHG emissions. Such actions could result in a reduction of overall GHG emissions, contributing to an improvement in global GHG levels because the asset would no longer be operational (i.e., no longer generating GHG emissions).

Outgrant
Potential effects to GHG emission levels could range from no effect to moderate effect. If an outgranted asset is sustained by the lessee, little if any effect on GHG emissions would likely occur. If a lessee invests in an existing asset or constructs a new facility/structure, there could be a minor to moderate increase in GHG emissions or there could be a reduction if equipment installed is more efficient and effective in capturing emissions. New construction by the lessee would be required to comply with NASA's Climate Action Plan, thereby eliminating or minimizing risks associated with climate change.

4.2.5 Noise, Sonic Boom, and Vibration

Noise is defined as unwanted or annoying sound that interferes with or disrupts normal human activities and wildlife. Inadequately controlled noise presents a growing danger to the health and welfare of the nation's population, particularly in urban areas. Under certain conditions, noise may cause hearing loss, interfere with human activities, and affect the health and well-being of a community. Types and levels of noise can have a damaging effect on natural resource populations as well (e.g., avian reproduction and bat sonar). For NASA, major sources of noise include but are not limited to transportation vehicles and equipment, machinery, operations, launches and landings, rocket engine testing, and test flights.

4.2.5.1 Regulatory Setting

To encourage the control of noise, Congress passed the Noise Control Act of 1972 (42 U.S.C. 4901) (EPA 2022h). The Noise Control Act establishes a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. While the primary responsibility for control of noise rests with state and local governments, federal action is essential to deal with major noise sources. EPA is directed by Congress to coordinate the programs of all federal agencies relating to noise research and noise control (EPA 2022h).

Noise may be a concern when determining potential effects on several resources. These resources may include, but are not limited to, onsite employees, wildlife, as well as adjacent parks and recreation areas, schools, hospitals, residential areas, and historic and cultural sites.

4.2.5.2 Potential Consequences

The most common generators of noise are related to vehicle/equipment use during development activities and operations. Short-term noise effects could be associated with the continuation of many types of operations presently occurring at various centers (e.g., launches, landings, flight tests, general operations, support activities). Short-term increases in noise could also result from the use of heavy equipment during construction and demolition. Long-term effects would result from the addition of stationary sources of noise (e.g., standby generators, changes in vertical and horizontal launch activities). Additionally, increases in traffic volumes and changes in traffic patterns could result in higher noise levels; however, these effects would be insignificant when compared to the overall noise environment.

Noise levels generated by individual launches, landings, or test flights would vary, depending on the type of vehicle, its trajectory, and weather conditions during launch or flight. Launch noise would be from the initial rocket ignition and sonic booms as the launch vehicle ascends. Noise levels from rocket ignition and test flights could be characterized as very loud in some areas; however, launches and test flights are not continual and individual exposure to noise in general and sonic booms in particular are very short in duration. Typically, the sonic boom would last no more than a few hundred milliseconds. Although the exact nature of future vertical launch and landing activities is unknown, future location of operational components, such as launch and landing sites, as well as substantive changes in launch platforms or operational tempo, would need to be evaluated to identify areas with sensitive noise receptors to determine land use compatibility and potential for noise levels loud enough to impact sensitive receptors. It is not expected that future vertical launch activities would violate any federal, state, or local noise ordinance, create incompatible land uses for nearby areas, or be loud enough to harm human health.

Sustain
Maintaining an asset's current condition and/or maintaining current operational activities would likely have no effect to negligible effect on current noise levels and sensitive receptors.

Invest
Repairing or renovating an asset would likely have no effect to minor effects on noise levels and sensitive receptors, depending on the type of investment action. For instance, installation of new equipment (e.g., larger generators or machinery) within an existing facility could increase ambient noise levels but not appreciably. Construction of a new asset (e.g., new building) could have no effect to significant effects, depending on the proposed action, the existing ambient noise levels, and the proximity of sensitive receptors. A new facility could increase traffic volumes or change travel patterns, likely creating a minor to moderate increase in noise volumes. Construction of new assets (e.g., test flight facilities or launch pads) could have moderate to significant effects, depending on the type of new asset. In the case of test flights or rocket launches and landings, the increased noise levels would likely be limited in frequency and duration, but significant when happening.

Divest
Demolishing, abandoning, and/or mothballing an asset would likely reduce overall noise levels because the asset would no longer be operational and generating noise. In the short-term, demolition of assets could increase noise levels from heavy equipment moving materials at the site. Depending on the location of adjacent sensitive noise receptors (i.e., locations potentially sensitive to noise and vibration like schools, hospitals, residential areas, natural areas, and public rights of way), as well as the location of the demolition activity, this temporary increase in noise could range from minor to moderate in its effect.

Outgrant
Depending on the action proposed under an outgrant scenario, potential effects to noise levels could range from no effect to significant effect. If an outgranted asset is sustained by the lessee, little if any effect to noise levels would likely occur. If a lessee invests in an existing asset or constructs a new facility/structure, there could be a minor to significant increase in noise levels. For example, commercial space operations could create new launch and landing facilities and/or increase the frequency of launches and landings. In either scenario, noise levels would increase significantly for the temporary duration of the launch or landing.

4.2.6 Hazardous Materials and Waste

EPA defines hazardous waste as a waste with properties that make it dangerous or capable of having a harmful effect on human health or the environment. Hazardous waste is generated from many sources, ranging from industrial manufacturing process wastes to batteries and may come in many forms, including liquids, solids gases, and sludges (EPA 2022d).

Hazardous materials are defined as substances with strong physical properties of ignitability, corrosivity, reactivity, or toxicity, which may cause an increase in mortality, serious irreversible illness, or incapacitating reversible illness, or pose a substantial threat to human health or to the environment. Hazardous wastes are defined as any solid, liquid, contained gaseous, or semisolid waste or any combination of wastes that pose a substantial present or potential hazard to human health or to the environment (EPA 2022c).

4.2.6.1 Regulatory Setting

There are many regulations associated with the management of hazardous materials and waste, with applicability dependent on the types and amounts of hazardous materials and waste associated with the specific processes related to a proposed action. The two main regulations of focus relative to this PEA are the Resource Conservation and Recovery Act (RCRA) and the Emergency Planning and Community Right-to-Know Act. RCRA is the public law that creates the framework for the proper management of hazardous and nonhazardous solid waste and is the primary regulatory requirement associated with management of hazardous waste. The Emergency Planning and Community Right-to-Know Act imposes requirements for federal, state, and local governments, tribes, and industry for emergency planning and "Community Right-to-Know" reporting on hazardous and toxic chemicals. Its provisions help increase the public's knowledge and access to information on chemicals at individual facilities, their uses, and releases into the environment. States and communities, working with facilities, can use the information to improve chemical safety and protect public health and the environment. This requirement would apply specifically to NASA facilities that store any listed hazardous materials in quantities exceeding reportable thresholds. Future Tier II center-specific actions would be expected to follow all local, state, and federal regulations for use and disposal of hazardous materials and waste.

All NASA facilities that currently treat, store, or dispose of hazardous wastes or plan to do so must obtain an RCRA permit. If the permitting authority has been delegated by the EPA, RCRA permits are issued by state authorities and prescribe responsibilities, policies, and procedures for managing hazardous waste at each center. An RCRA permit is a legally binding document that establishes the waste management activities a facility can conduct and the conditions under which it can conduct them. The RCRA permit includes applicable EPA regulations from 40 CFR Parts 260 through 270 (EPA 2022f).

The Occupational Safety and Health Administration is responsible for enforcement and implementation of federal laws and regulations pertaining to worker health and safety under 29 CFR Part 1910 and includes the regulation of hazardous materials in the workplace and ensures appropriate training in their handling.

4.2.6.2 Potential Consequences

The use of hazardous materials and the generation of associated wastes are typically related to equipment use during development activities and operations. Examples of such materials include many types of solvents, surface coatings, propellants, and fuels. Potential effects associated with the increased or decreased use of hazardous materials and generation of both non-hazardous and hazardous waste could be beneficial or adverse depending on the nature of the proposed Tier II action.

Hazardous material (e.g., fuels) handling and storage and hazardous wastes (e.g., waste paint, adhesives, solvents) generation at industrial facilities are subject to applicable management requirements. These include meeting reporting requirements under the Emergency Planning and Community Right-to-Know Act and management and disposal requirements under RCRA. Although the frequency with which hazardous materials and waste are used, handled, transported, etc., may increase, every center has procedures for handling, transporting, storing, and disposing of hazardous materials and waste. These procedures are regularly reviewed and updated to ensure they capture current operations, regulatory requirements, and changes to best practices. Additionally, emergency response plans, such as a center's Spill Prevention, Control, and Countermeasure Plan, would need to be updated to reflect new conditions. While the probability of an accidental release may increase due to increased activities and quantity of materials, use of

best management practices would ensure this risk is small, with the probability of a major spill kept at a minimum. Following these measures, the severity of an unplanned event is unlikely to increase. Overall, adverse effects resulting from implementation of any of the asset bucket assignments, as related to hazardous materials and waste management, would be negligible to minor in magnitude. Adherence to proper safety procedures would continue to be a top priority for future operations to minimize the risks of accidental release and personnel exposure. Additionally, implementation of new or existing engineering and administrative controls would minimize the risks associated with the presence of these materials.

Sustain

Potential effects from actions in the sustain bucket would likely range from no effect to minor effect. Maintaining an asset's current condition and/or maintaining current operational activities may include replacing a roof or treated wood, repairing or replacing a storage tank, or repainting. These and other sustainment process may produce dangerous waste products, lead, or asbestos and should be carefully assessed prior to acting. Maintenance of current, applicable permits would be necessary.

Invest

Potential effects from actions in the invest bucket would likely range from minor to moderate. Investing in an asset through repair, renewal, or new development may include removal or repair of dangerous materials like lead, asbestos, polychlorinated biphenyls, mercury-containing fluorescent lights, or leaking storage tanks with hazardous contents. When renovating a building that contains these materials, centers will need to consider if certain permits are needed and ensure responsible disposal methods are arranged prior to acting.

Divest

Potential effects from actions in the divest bucket would likely range from negligible to significant effect. Demolishing an asset may have the greatest effect (i.e., significant) to the environment and to staff and should include a full property assessment that tests individual waste streams. Demolition actions have the potential to produce the most waste and, therefore, hold the greatest risk for possible contamination of soil or water resources and hazardous chemical exposure to the surrounding area. Mothballing or abandoning an asset would likely have negligible to minor effects given the limited degree of disturbance associated with each. Before an asset is mothballed or abandoned, the asset should be assessed to ensure hazardous materials and wastes are properly treated.

Outgrant

Depending on the action proposed under an outgrant scenario, potential effects could range from no effect to significant effect. If an outgranted asset is sustained by the lessee, little if any effect to hazardous materials or the use of hazardous materials would occur. If a lessee invests in an existing asset or constructs a new facility/structure, there could be a significant effect if the asset contains hazardous materials, newly generates hazardous materials, or disturbs hazardous materials during construction of a new facility/structure. The lessee would need to determine if certain permits are needed and ensure responsible disposal methods prior to acting.

4.2.7 Transportation

Impacts to transportation and circulation and must be considered when rendering decisions on projects that include construction, operation, or maintenance activities that have the potential to affect traffic and circulation. Transportation users include walkers, cyclists, drivers (cars, trucks), boats, rail, and air.

4.2.7.1 Regulatory Setting

While not a regulatory standard, NPR 6200.1D, NASA Transportation and General Traffic Management, sets forth transportation and general traffic management responsibilities and procedures governing the use of commercial and government transportation resources (NASA 2014, 3). It establishes NASA's overall transportation responsibilities across centers.

4.2.7.2 Potential Consequences

The primary transportation effects would likely be related to vehicle/equipment use during development activities and operations. Proposed activities would likely result in the continuation of many transportation modes presently occurring at the centers, but potentially in greater or lesser amounts, depending on the nature of the proposed Tier II action. Short-term increases in traffic could occur during construction activities. These effects would be primarily due to construction worker commutes and delivery of equipment and materials to and from the construction sites. In addition, road closures or detours to accommodate utility system work may occur. Some construction activities could affect the level of service at intersections or roadways both on and off the facility; however, each center's Transportation Office/Transportation Manager would be involved to ensure NASA's roadway infrastructure would be sufficient to support the increases from construction vehicle traffic.

Long-term effects would be primarily due to additional worker commutes and potential traffic associated with new facility construction, increased launch activities (e.g., more people driving on the center to view the launches), and changes in traffic patterns resulting from new buildings and facilities. The number of people authorized to access the center to observe launch activities is inherently limited. While more launches could result in greater traffic density, the overall increase would be negligible. If additional transportation infrastructure (such as future roadways, access control points, etc.) would be required, further analyses such as traffic studies may also be necessary. The degree of effect on existing and future traffic volumes could range from minor to significant, depending on new traffic generators, traffic density, and the existing transportation network's ability to accommodate the increased traffic volumes. Increased traffic volumes and changes in traffic patterns could have minor to moderate effects on traffic levels of service, depending on changes in traffic density.

Sustain

Potential effects from actions in the sustain bucket would likely have no effect on transportation resources or a center's existing transportation system. Because this bucket calls for maintaining an asset or operational activity, it is unlikely that additional traffic would be generated or that traffic patterns would change.

Invest

Potential effects from actions in the invest bucket could range from no effect to significant. Repairing and/or renewing an asset would likely have a minor to moderate short-term effect if construction interrupts the flow of traffic or use of transportation facilities. A newly created asset (e.g., new facility) could have moderate to significant direct and indirect effects on existing traffic circulation depending on the size, scope, and location of the new asset. A new transportation asset (e.g., road, bridge) could provide beneficial, long-term consequences if it provides a more efficient route for users or provides for alternative transportation methods where none previously existed. A new building could generate additional traffic volumes and increase travel times as more workers commute to the new building.

Divest
Under a divest scenario, changes to transportation resources would likely have no long-term negative effects. Demolishing, mothballing, or abandoning an asset would likely improve the physical condition of transportation assets and improve traffic flow as the asset would no longer be generating traffic.

Outgrant
Depending on the action proposed under an outgrant scenario, potential effects to transportation resources could range from no effect to significant effect. If an outgranted asset is sustained by the lessee, little if any effect to transportation would occur. If a lessee invests in an existing asset or constructs a new facility/structure, there could be a significant effect if those developments need additional parking or access. New construction could also result in increased traffic generation by the lessee and offsite visitors.

4.2.8 Utilities

NASA utility infrastructure is an important consideration for future decision making related to agency and center master planning. Types of utility services NASA may receive include water, electrical power, natural gas, wastewater collection and treatment, and communications services. Generally speaking, these utility services are provided by publicly held utilities from which NASA receives the service in return for payment on a regular billing cycle.

4.2.8.1 Regulatory Setting

A number of applicable statutes and regulations affect the rates, distribution, and development of utilities and associated infrastructure (e.g., the Public Utility Regulatory Policies Act of 1978). These authorities are administered by a variety of federal agencies (e.g., Department of Energy/Federal Energy Regulatory Commission, EPA, Federal Communications Commission) and State Public Service Commissions. NASA is not responsible for utility rate setting or overall distribution of the resource in question but may have responsibilities to ensure appropriate infrastructure is available on a particular center (e.g., metering, pipelines, cable conduits).

4.2.8.2 Potential Consequences

Under the Proposed Action, NASA is required to consider the current and future status of real property infrastructure, including utility services. When deciding whether to sustain, invest, divest, or outgrant properties, centers should consider whether any improvements to utility infrastructure are needed to support that action. Depending on the bucket the action is placed in, the environmental impacts of utility infrastructure installation, removal, or leave-in-place alternatives may range from no effect to significant effect with short duration/transient impacts to permanent adverse or beneficial impacts, depending on the resource affected.

Overall, impacts from the installation or expansion of utility systems are anticipated to be beneficial due to increased efficiency. The magnitude and extent of the impacts would depend on the specifics of the utility systems installed and the extent of use. Impacts would be expected to be long-term, lasting the duration of the utility system until removed or upgraded.

Sustain
Potential effects from actions in the sustain bucket would likely range from no effect to negligible effect. Maintaining an asset's current condition and/or maintaining current operational activities would have little, if any, effect on existing utility systems.

Invest
Repairing or renovating utilities would likely have no effect to negligible effect as the action would be limited to the existing resource. Construction of new or expanded facilities could result in minor to significant effects. The effects of investment in new or expanded utilities could range from minor to significant, depending on the extent of the improvement. For example, new utilities could require additional rights of way, installation of new utility lines or extensions for power, water, and telecommunications, and installation or modification of stormwater management systems. The effect of such development is typically associated with increased consumption. However, new construction and asset renewal could also result in benefits associated with use of renewable energy sources and increased energy efficiency.

If newly constructed facilities require the addition of new or improved stormwater management systems, they may require modification of a center's NPDES stormwater permit for industrial activities and associated Stormwater Pollution Prevention Plan. The land clearing, trenching, excavation, and other activities associated with the preparation of rights of way and installation of utilities could have direct and indirect environmental impacts associated with ground disturbance and vehicle/equipment use. Over time, the site may consume less energy and water due to the achievement of greater efficiency and right-sizing. Centers would need to determine if the capacity of existing utility service providers would be exceeded. Decisions pertaining to the expansion or creation of utility corridors would need to be made in accordance with each center's respective energy management policy and planning process.

Divest
Demolishing, abandoning, and/or mothballing an asset may result in a substantial reduction of demand on a center's utility system. All divestment activities would likely result in the cessation or minimization of utility services at these locations. Therefore, such actions would likely range from no negative effect to negligible effect.

Outgrant
For outgranted assets that are sustained by the lessee, there would be no effect to negligible effect on a center's utility system as energy demands would likely remain the same. Should a lessee invest in an existing asset by way of expanding or building new facilities, the effect on a center's utility system would be similar to the invest scenario, with effects ranging from minor to significant.

4.2.9 Water Resources

Water resources analyzed in this section relate to drinking water, surface water, groundwater, water quality, and floodplains. Surface water resources include lakes, rivers, streams, and wetlands.

4.2.9.1 Regulatory Setting

Safe Drinking Water Act
The Safe Drinking Water Act (SDWA) was enacted in 1974 "to protect public health by regulating the nation's public drinking water supply" (EPA 2023a).

> *"The law was amended in 1986 and 1996 and requires many actions to protect drinking water and its sources—rivers, lakes, reservoirs, springs, and ground water wells. (SDWA does not regulate private wells which serve fewer than 25 individuals.) SDWA authorizes the United States Environmental Protection Agency (US EPA) to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that*

may be found in drinking water. US EPA, states, and water systems then work together to make sure that these standards are met." (EPA 2023a)

Clean Water Act

The CWA establishes the basic structure for regulating discharges of pollutants into the WOTUS and regulating quality standards for surface waters. Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters (EPA 2022e). The CWA makes it unlawful for any person to discharge any pollutant from a point source into navigable waters unless an NPDES permit is obtained.

Section 404 of the CWA establishes a program to regulate the discharge of dredged or fill material into WOTUS including wetlands. Activities in WOTUS regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and mining projects. Section 404 requires a permit before dredged or fill material may be discharged into WOTUS (EPA 2022e). The U.S. Army Corps of Engineers (USACE) is responsible for permit decisions.

Section 401 of the CWA provides states and authorized tribes an important tool to help protect the water quality of federally regulated waters (i.e., WOTUS) within their borders, in collaboration with federal agencies. Under Section 401 of the CWA, a federal agency may not issue a permit or license to conduct any activity that may result in any discharge into WOTUS unless a Section 401 water quality certification is issued, or the certification is waived.

Wetlands

EO 11990, Protection of Wetlands, requires each federal agency to "take action to minimize the destruction, loss, or degradation of wetlands, unless there is no practicable alternative, and then the Proposed Action must include all practicable measures to minimize harm to wetlands." Federal agencies must provide an opportunity for early public review of any plans or proposals for new construction in wetlands. In accordance with Section 404 of the CWA, the USACE requires a permit for all activities involving the discharge of dredged or fill material in WOTUS, as well as compensatory mitigation.

Section 10 of the Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the Secretary of the Army, acting through the USACE, for the construction of any structure in or over any navigable WOTUS (33 CFR Part 322). Structures or work outside the limits defined for navigable WOTUS require a Section 10 permit if the structure or work affects the course, location, or condition of the water body. The law applies to any dredging or disposal of dredged materials, excavation, filling, rechannelization, or any other modification of a navigable WOTUS, and applies to all structures, from the smallest floating dock to the largest commercial undertaking. It further includes, without limitation, any wharf, dolphin, weir, boom breakwater, jetty, groin, bank protection (e.g., riprap, revetment, bulkhead), mooring structures such as pilings, aerial or subaqueous power transmission lines, intake or outfall pipes, permanently moored floating vessel, tunnel, artificial canal, boat ramp, aids to navigation, and any other permanent or semi-permanent obstacle or obstruction (USACE n.d.).

Section 438 of the Energy Independence and Security Act of 2007

Section 438, Storm Water Runoff Requirements for Federal Development Projects, contained in the Energy Independence and Security Act identifies requirements to limit the offsite impacts of stormwater runoff. Its Section 438 guidance is applicable if more than 5,000 square feet of land is being redesigned, reconfigured, or reconstituted in any manner that diverges from the area's present-day use and composition. Maintenance activities, such as pavement resurfacing, parking

restriping, or similar activities conducted to ensure that facilities are in good working condition, are excluded from complying with this standard.

Floodplains
EO 11988, Floodplain Management, defines a floodplain as "the lowland and relatively flat areas adjoining inland and coastal water including flood-prone areas of offshore islands, including at a minimum, that area subject to one percent or greater chance of flooding in any given year." That area is referred to as the base flood or 100-year floodplain. Floodplains are delineated by a flood stage elevation on maps prepared by the Federal Emergency Management Agency.

The review of a proposed action undertaken that potentially affects floodplains must include an evaluation that is consistent with EO 11988. The objective of EO 11988 is to preserve and restore the natural and beneficial values floodplains provide. It directs federal agencies to take actions to reduce the risk of flood loss, minimize flood impacts on human safety, health, and welfare, and restore and preserve floodplain natural and beneficial values. To do this, EO 11988 bans approving activities in a floodplain unless no practicable alternative exists and measures to minimize unavoidable short-term and long-term impacts are included.

4.2.9.2 Potential Consequences

Water resources are most affected by ground disturbance and vehicle/equipment use associated with development activities and operations. Non-point sources could potentially impact surface and groundwater quality, such as oil and grease from paved street and road surfaces that wash into a water body or are absorbed into the water table. Strict adherence to best management practices would minimize effects to surface waters. An increase in impervious or semi-impervious surfaces could contribute to more surface drainage than currently exists. Section 438 of the Energy Independence and Security Act identifies requirements to limit the offsite impacts of stormwater runoff. Impacts on water resources from development activities would be minimized with implementation of Stormwater Pollution Prevention Plan requirements and adherence to NPDES construction permit conditions. Prior to any ground-disturbing activity, any dredge or fill activities into WOTUS and wetlands would require avoidance and minimization efforts demonstrating the proposed activity is the least environmentally damaging practicable alternative, acquisition of and strict adherence to CWA Section 404 permits from the USACE and Section 401 certification from the appropriate state agency, as well as compensatory mitigation of impacts such as construction of new wetlands to replace lost wetlands.

Sustain
Potential effects to water resources would likely range from no effect to negligible as assets in this bucket would be maintained to current conditions and there would be no encroachment into floodplains or disturbance of WOTUS or wetlands.

Invest
Potential effects could range from no effect to significant effect, depending on the investment option of repairing/renovating versus new construction. The use of heavy equipment for new construction could result in substantial ground disturbance, increasing the potential for soil erosion and sediment delivery to nearby surface waters and wetlands. Repeated disturbance of vegetation and soils (i.e., due to vehicle passes) during project activities may also cause surface erosion. Elevated levels of turbidity from erosion could lead to decreases in primary production and dissolved oxygen levels. There could also be a short-term increase of fine sediment and loss of benthic food resources. The effects to local water quality and hydrology during construction would likely be short-term, ranging from no effect to significant effect. The degree of effect would depend on the extent of the disturbance and proximity to water, as well as the use of best management

practices. Depending on size and scope, construction projects may require NPDES Stormwater Construction Permits. These permits typically require employment of best management practices such as silt fences, turbidity barriers, and stormwater management systems to reduce impacts to surface waters and offsite runoff to wetlands. A CWA Section 404 permit may be necessary if the action involves dredge and fill activities in WOTUS or wetlands.

Divest
Demolishing an asset could have minor to significant effects on water resources. For example, depending on the asset and location, permits may be required for pier or pipeline removal, for stormwater discharge, and/or for impacts to adjacent waterways and wetlands resulting from demolition. The long-term, beneficial effect to water resources would be the reduction in impervious surface area, thus improving water quality. If appropriate planning takes place, the action of demolition would likely cause minimal effect. Overall benefits to floodplains would occur if the previously used areas were converted into a natural floodplain buffer and returned to a natural state, thereby minimizing risks to adjacent assets. Abandoning and/or mothballing an asset would likely range from no effect to minor effects to existing floodplains.

Outgrant
Depending on the action proposed under an outgrant scenario, potential effects could range from no effect to significant effect. If an outgranted asset is sustained by the lessee, little if any effect to water resources would occur. If a lessee invests in an existing asset or constructs a new facility/structure, then effects similar to “invest – newly created” would likely occur (i.e., minor to significant effects).

4.2.10 Coastal Zone Management

Coastal zones are those waters and their bordering areas in states along the coastlines of the Atlantic and Pacific Oceans, the Gulf of Mexico, and the shorelines of the Great Lakes. These zones include islands, beaches, transitional and intertidal areas, and salt marshes. The Coastal Zone Management Act (CZMA) of 1972 applies to a project that would affect coastal uses or resources, even if it falls outside of a state’s designated coastal zone.

4.2.10.1 Regulatory Setting

The CZMA, administered by the National Oceanic and Atmospheric Administration's (NOAA’s) Office of Coastal Management, is a national policy designed to preserve, protect, develop, restore, and enhance the resources of the nation’s coastal zones. Section 307 of the CZMA and its implementing regulations, 15 CFR Part 930, stipulate that all federal agency activities that affect any land or water use or natural resource of the coastal zone must be consistent, to the maximum extent practicable, with the enforceable policies of the state’s federally approved management program. A Coastal Zone Consistency Determination is prepared by the center proposing an action. During the planning stage of project development, centers must determine the applicability of the National Coastal Zone Management Program to their areas by contacting their respective state coastal management authority.

4.2.10.2 Potential Consequences

Sustain
Potential effects from actions in the sustain bucket would likely range from no effect to negligible effect. Maintaining an asset’s current condition and/or maintaining current operational activities would have little, if any, effect on existing and adjacent coastal zones.

Invest
Depending on the action proposed under an invest scenario, potential effects could range from no effect to significant effects. Repairing or renovating an asset would likely have no effect to negligible effect on coastal zones. However, if new development (e.g., construction of a new structure or facility) takes place within a coastal zone, minor to significant effects could occur and would require alignment with the state coastal zone management program and issuance of a consistency determination.

Divest
Abandoning and/or mothballing an asset would likely range from no effect to negligible effects to coastal areas. Demolishing an asset could have no effect to significant effect on coastal zones. If appropriate planning takes place, the action of demolition would likely have a negligible effect. Overall benefits to the coastal area would occur if the previously used area were converted into a natural transition zone between the coast and adjacent upland development.

Outgrant
Depending on the action proposed under an outgrant scenario, potential effects could range from no effect to significant effects. If an outgranted asset is sustained by the lessee, little if any effect to coastal zones would occur. If a lessee invests in an existing asset or constructs a new facility/structure, the effects would be similar to that of "invest – newly created" (i.e., no effect to significant). A CZMA consistency certification could be required depending on the location of the action (e.g., within the limits of a coastal zone boundary) and the degree of impact.

4.2.11 Biological Resources

Biological resources include native or naturalized plants and animals and the habitats in which they occur. This includes plant and animal species federally and/or state listed as threatened or endangered, as well as designated critical habitat.

4.2.11.1 Regulatory Setting

There are multiple federal laws protecting biological resources, including the Endangered Species Act, the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, the Marine Mammal Protection Act, the Magnuson-Stevens Fishery Conservation and Management Act, and the National Marine Sanctuaries Act. Strict adherence to all applicable federal and state laws and regulations is required.

Endangered Species Act of 1973
The Endangered Species Act is administered by the U.S. Fish and Wildlife Service (USFWS) and NOAA Fisheries (formerly known as the National Marine Fisheries Service). The act requires federal agencies to ensure their actions do not jeopardize the continued existence of any federally listed endangered or threatened species or adversely modify designated critical habit of such species. If federally protected species are present, NASA must consult with the USFWS or NOAA Fisheries, as applicable, to determine if a proposed action would affect federally listed endangered or threatened species and/or habitat critical to that species (critical habitat). Similar protections exist at the state level, with the presence of state-listed rare or unique species or their habitats requiring similar coordination and consultation efforts.

Migratory Bird Treaty Act
The Migratory Bird Treaty Act establishes federal responsibilities to protect migratory birds. Under this act, nearly all species of birds occurring in the United States are protected and it is illegal to take (hunt, pursue, wound, kill, possess, or transport by any means) listed bird species or their

eggs, feathers, or nests unless otherwise authorized. Numerous common land and shore birds are present at center facilities and are protected under this act.

Bald and Golden Eagle Protection Act

The USFWS states the Bald and Golden Eagle Protection Act prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald or golden eagles, including their parts (including feathers), nests, or eggs (50 CFR 22). The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." Regulations further define "disturb" as,

> *"to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." (50 CFR 22.6)*

Furthermore, the act also covers effects that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death, or nest abandonment.

Executive Order 13186

EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, provides further direction to federal agencies on carrying out the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, the Fish and Wildlife Coordination Act, the Endangered Species Act, and NEPA. The order states that each federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations is directed to develop and implement, within two years, a memorandum of understanding with the USFWS that shall promote the conservation of migratory bird populations.

Marine Mammal Protection Act

The Marine Mammal Protection Act prohibits, with certain exceptions, the take (harass, hunt, capture, collect, or kill) of marine mammals in WOTUS and by U.S. citizens on the high seas, which includes protections for marine mammals may populate the coastal and lagoon waters of some center facilities. Three federal entities share responsibility for implementing this act:

> *"NOAA Fisheries is responsible for the protection of whales, dolphins, porpoises, seals, and sea lions; the USFWS is responsible for the protection of walrus, manatees, sea otters, and polar bears; and the Marine Mammal Commission provides independent, science-based oversight of domestic and international policies and actions of federal agencies addressing human impacts on marine mammals and their ecosystems." (NOAA Fisheries 2023)*

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act is the primary law that governs marine fisheries management in U.S. federal waters. The act governs fisheries management in the U.S. Exclusive Economic Zone (up to 200 miles offshore). NOAA Fisheries is responsible for the stewardship of the nation's ocean resources and their habitat (NOAA Fisheries n.d.).

National Marine Sanctuaries Act

The National Marine Sanctuaries Act authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or esthetic qualities as national marine sanctuaries. Day-to-day management of national marine

sanctuaries has been delegated by the Secretary of Commerce to NOAA's Office of National Marine Sanctuaries. The primary objective of this act is to protect marine resources, such as coral reefs, sunken historical vessels, or unique habitats (NOAA n.d.).

4.2.11.2 Potential Consequences

Effects to biological resources would primarily be related to ground-disturbing activities and vehicle/equipment use during development activities and operations. Disturbance from construction may allow invasive plant establishment, soil erosion or compaction, a lessened litter layer, decreased soil microbial activity, reduced plant biomass and cover of native species, decreased reproductive success, changes in genetic structure of plant populations, and alteration of wildlife habitats. Impacts of proposed activities on native upland vegetation could be short-term and/or long-term, direct, adverse, and negligible to moderate, depending on whether the site is already disturbed or not, extent of the project area, and type of vegetation occurring onsite.

Impacts of proposed project activities on native wetland vegetation would be short-term and/or long-term, direct and indirect, and minor to moderate. Actions involving impacts to wetlands and WOTUS would fall under Section 404 of the CWA. The USACE, which holds permitting authority, would require avoidance or compensatory mitigation for construction that results in dredge or fill activities in wetlands. Construction in previously undisturbed areas could result in removal of native vegetation communities (both upland and wetland) and wildlife habitat, where present. Reduction of habitat quality could result where new facilities are sited in previously unbroken areas of uniform habitat. Fragmentation would be greatest where linear features such as roads or pipeline/cable rights of way are cut through larger areas of relatively uniform habitat. Special status terrestrial and aquatic species may be adversely impacted by new construction. All applicable consultation requirements and permits would be required prior to any ground-disturbing activity.

Sustain
Maintaining an asset's current condition and/or maintaining current operational activities would likely have no effect on existing and adjacent biological resources.

Invest
Repairing and/or renewing an asset would likely have no effect to negligible effect, whereas a newly created asset could have effects ranging from no effect to significant effect to biological resources, depending on the size and scope of the proposed action under consideration.

Divest
Abandoning and/or mothballing an asset would likely have no effect on biological resources. Demolishing an asset could have no effect to significant effect on biological resources if the proposed action involves tree removal or is located within the range of a sensitive species or their critical habitat area (e.g., disturbance of sea turtle habitat). Reducing the overall footprint of infrastructure through demolition could be beneficial in reestablishing habitat.

Outgrant
If an outgranted asset is sustained by the lessee, biological resources would likely experience no effect to negligible effect. If a lessee invests in an existing asset or constructs a new facility/structure, there could be a significant effect, similar to those associated with newly created resources in the invest bucket (i.e., effects ranging from no effect to significant effect).

4.2.12 Cultural Resources

The National Register of Historic Places (NRHP) is administered by the National Park Service, which defines a cultural resource as, “An aspect of a cultural system that is valued by or significantly representative of a culture or that contains significant information about a culture. A cultural resource may be a tangible entity or a cultural practice. Tangible cultural resources are categorized as districts, sites, buildings, structures, and objects eligible for the NRHP and as archaeological resources, cultural landscapes, structures, museum objects, and ethnographic resources for [National Park Service] management purposes (National Park Service 2023).” Tangible cultural resources include historic properties as defined by the National Historic Preservation Act, cultural items as defined by the Native American Graves Protection and Repatriation Act, archaeological resources as defined by the Archaeological Resources Protection Act, sacred sites as defined by EO 13007, to which access is afforded under the American Indian Religious Freedom Act, and collections and associated records as defined by 36 CFR 79.

In the United States, effect assessment tends to focus on physical or tangible cultural resources, but due to the leadership of international organizations including the United Nations Educational, Scientific, and Cultural Organization, there is an increasing awareness of intangible cultural heritage being “traditions or living expressions inherited from our ancestors and passed on to our descendants, such as oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts” (United Nations Educational, Scientific and Cultural Organization 2003).

4.2.12.1 Regulatory Setting

Consideration of cultural resources under NEPA includes the necessity to independently comply with the applicable procedures and requirements of other federal and state laws, regulations, EOs, and presidential memoranda. The National Historic Preservation Act of 1966, as amended (54 U.S.C. §300101 et seq.) is the primary legal driver for the identification and management of cultural resources in the United States, having established the Advisory Council on Historic Preservation, the State Historic Preservation Offices, and the NRHP. The NRHP is a federally maintained list of historic properties significant in American history, prehistory, architecture, archaeology, engineering, and culture. Section 106 of the National Historic Preservation Act requires that federal agencies take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation an opportunity to comment. The implementing regulations for Section 106 are found in 36 CFR Part 800, which defines the process by which federal agencies are to consider these effects. Other laws that govern the treatment of cultural resources in the United States include: the Archaeological Resources Protection Act of 1979, the Native American Graves Protection and Repatriation Act of 1990, the American Indian Religious Freedom Act of 1978, and the Historic Sites Act of 1935.

NASA has in place several Section 106 agreements that may come into play as part of the implementation of an Agency Master Plan. Five centers have Section 106 programmatic agreements that apply to the entire center (i.e., GRC-ATF, KSC, LaRC, MSFC, WFF). These legally binding agreements stipulate processes that depart from standard Section 106 processes, and in most cases, apply to built assets, as well as archaeological sites. JSC has a programmatic agreement in place that applies to a subset of assets found to be historically significant within the context of the Space Shuttle Program. NASA is in the process of developing an agencywide programmatic agreement that would apply to those centers not

having a centerwide programmatic agreement in place. NASA also has one agencywide programmatic agreement that applies when an undertaking affects an NHL.

Additionally, each center's Integrated Cultural Resources Management Plan, prepared in consultation with the State Historic Preservation Office, provides detailed guidelines and procedures to enable NASA to meet legal responsibilities for identification, evaluation, and treatment of historic properties under its jurisdiction in accordance with applicable federal and state regulations affording protection to cultural resources.

4.2.12.2 Potential Consequences

Potential impacts to cultural resources from proposed activities may occur by physically altering, damaging, or destroying a cultural resource. Generally, the severity of the impact of activities on cultural resources (i.e., historic properties) is commensurate with the scale of physical impact to the asset. Minor changes to a historic building, for example, would be on the negligible-to-minor end of the spectrum, and complete demolition of a building would likely fall into the significant category. A high-level assessment of the potential for the various asset paths to adversely impact cultural resources is provided below. The treatment of any historic property, regardless of bucket assignment, would require compliance with Section 106 of the National Historic Preservation Act. Compliance includes consideration of options to protect and preserve the historic property, such as assessing alternatives that would avoid adverse effects (e.g., the permanent transfer of historic property to another entity). Consideration of options such as the permanent transfer of historic property typically occurs at the planning stage of a proposed action.

Sustain

Activities carried out to sustain NASA assets include routine repair and maintenance. The effects on above ground structures would likely range from no effect to minor effect. For archaeological resources, routine repair and maintenance would likely result in little to no ground disturbance; thus, effects would likely range from no effect to negligible effect.

Invest

Investment activities include major repair, major modification, rehabilitation, and construction of new facilities and structures. These activities may affect the historic fabric and character-defining features of a historic building or structure. While the asset would remain in active use, the impact of repair or renewal on above ground historic properties is expected to range from no effect to minor effect but could range up to significant depending on the extent of the repair or renewal. Effects to archaeological resources would likely involve limited ground-disturbing activity in areas previously disturbed during original construction activities. Therefore, the effect on archaeological resources from repair or renovation activities would likely have no effect to minor effect.

The invest category also includes recapitalizing by replacing degraded assets. Replacement of historic properties (i.e., demolition of old and replacement with new) could range from no effect to significant effect, depending on the extent of replacement and the type of historic property. If investment requires ground disturbance, as in the case of the construction of additions or newly created facilities and structures, the potential for archaeological historic properties to be adversely affected would also range from no effect to significant, depending on the potential for archaeological resources to be present and the extent of ground disturbing activities in previously undisturbed areas.

Divest

Divestment is likely for those assets that have low mission and low condition scores. Because the age of an asset is a consideration in determining these scores, and assets 50 years of age and

older are more likely to be historic properties, divestment is the path with the greatest potential to adversely impact NASA's historic buildings and structures. The effect of demolition, permanent transfer, or abandonment (which may result in demolition by neglect) ,permanent transfer of above ground historic structures could range from no effect to significant, depending on the proposed action. The impact of mothballing above ground structures may be less, but the effect would likely be noticeable and, as such, would likely range from no effect to minor.

If an asset is demolished, there is the potential the effect of ground disturbance affecting archaeological resources could range from no effect to minor, given that original construction activities likely disturbed archaeological resources, if present. Mothballing or abandoning an asset would likely have no effect to negligible effect on archaeological resources given that ground-disturbing activities would be minimal for these two actions, if at all.

Outgrant

Outgrant involves the utilization of an asset by an entity other than NASA and that entity may elect to carry out activities to sustain or invest in the asset. Because the potential use of the asset permitted by NASA ranges from no alteration to demolition, the impact to a historic building or structure, or to archaeological sites, could range from no effect to significant effect.

Individual projects arising from the implementation of the Agency Master Plan would be subject to review under Section 106 of the National Historic Preservation Act and appropriate treatment measures developed through the consultation process to resolve adverse effects. Treatment measures, however, cannot fully offset the diminishment or loss of historic properties because a historic property cannot be recreated. In most cases, NASA's historic buildings and structures are best preserved when they remain relevant and in active use, which requires regular upkeep (i.e., sustain) and modification (i.e., invest). Archaeological sites are best preserved through avoidance. When adverse effects cannot be avoided, they are resolved through completion of the Section 106 process. The objective of the Section 106 process is to reduce the impacts to cultural resources to "less than significant" under NEPA.

4.2.13 Environmental Justice

Environmental justice is defined as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (EPA 2023b).

4.2.13.1 Regulatory Setting

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, directs each federal agency to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations," including tribal populations (EPA 2022a).

EO 13985, Advancing Racial Equity and Support for Underserved Communities Through the Federal Government, states the federal government, "should pursue a comprehensive approach to advancing equity for all, including people of color and others who have been historically underserved, marginalized, and adversely affected by persistent poverty and inequality […] Because advancing equity requires a systematic approach to embedding fairness in decision-making processes, executive departments and agencies (agencies) must recognize and work to redress inequities in their policies and programs that serve as barriers to equal opportunity."

4.2.13.2 Potential Consequences

Compliance with EO 12898 and EO 13985 requires federal agencies to analyze how their actions affect low-income and minority populations. Centers should determine whether Tier II proposed actions would have disproportionately high and adverse effects on minority populations, low-income populations, and/or Indian tribes and indigenous communities. Where available, centers can find guidance on how to carry out an environmental justice analysis via center-specific Environmental Justice Implementation Plans. If center-specific guidance is not available, the Stennis Space Center has a plan that provides guidance on appropriate methodologies, procedures, outreach, and mitigation (NASA 2022d).

Given that centers are primarily self-contained, and that future treatment of assets would occur within a center's boundary, it is unlikely that disproportionately high and adverse effects would directly affect these populations. However, indirect effects from noise, pollution, and the effects of climate change could occur to these populations.

Sustain
Maintaining an asset or operational activity would likely have no effect (disproportionately or adversely) on low-income or minority populations.

Invest
Repairing or renewing an asset would likely have no direct effect. Construction of a new facility or structure would likely have no direct effect but could have an indirect effect ranging from no effect to minor. Such situations could involve additional exposure to noise and pollutants to low-income and/or minority populations that may be adjacent to a center.

Divest
Demolishing, mothballing, or abandoning an asset would likely have no effect on low-income and/or minority populations. Actions in this bucket would occur within center boundaries and could result in beneficial effects with the decommissioning of noise- or pollution-generating assets.

Outgrant
Outgranting an asset could have no effect to minor effects on low-income and/or minority populations. If a lessee sustains a resource, there would be no effect. If a lessee expands or constructs a new facility, then the potential effects would be similar to those associated with invest activities (i.e., no effect to minor effect).

4.3.14 Socioeconomics

Socioeconomics typically refer to the basic attributes and resources associated with the human environment, particularly population and economic activity. Human population is affected by regional birth and death rates as well as net in- or out-migration. Economic activity typically comprises employment, personal income, and industrial growth. Impacts on these fundamental socioeconomic indicators can also influence other components such as housing availability and public services provision.

4.3.14.1 Regulatory Setting

This resource category does not require federal permits, certifications, or approvals.

4.3.14.2 Potential Consequences by Proposed Bucket Action

At the Tier II stage, the analysis of socioeconomics for a proposed action should contain evidence of coordination with potentially affected jurisdictions and other interested parties located in the affected area. It should provide meaningful data on existing local population distributions, infrastructure, utilities, and economic factors that form the basis for analysis.

NASA must evaluate proposed actions to determine the potential to cause induced or secondary socioeconomic impacts on surrounding communities. When NASA determines a potential for such impacts exists, the environmental document should describe how the proposed project would affect communities by addressing shifts in patterns of population movement and growth, public service demands, changes in business and economic activities, or other factors identified by the public.

Sustain
Maintaining an asset or operational activity would likely have no direct or indirect effect on socioeconomic conditions in surrounding areas.

Invest
Repairing or renewing an asset would likely have no effect on an area's socioeconomic condition. Depending on the extent of new construction, the effects of a new facility or complex could range from no effect to significant. Construction of a new facility or structure could have beneficial and/or negative effects, related to new employment opportunities, additional tax revenue generated by community expansion to surrounding communities, or other consequent effects. However, new construction could also generate additional noise or pollutants. Additional employment at a center could indirectly result in increased external (non-center) community demands for services and resources (e.g., schools, hospitals, emergency response providers, parks, public water supplies, utilities, transportation, communication networks).

Divest
Demolishing, mothballing, or abandoning an asset would occur within center boundaries with the effects ranging from no effect to significant effect, depending on the socioeconomic setting of the area and the type of asset constructed. Assets in this bucket would be taken offline and possibly decommissioned. Divesting of an asset could negatively impact employment opportunities if the asset currently is an on-going center operation that is not replaced elsewhere on the center.

Outgrant
Outgranting an asset could have no effect to significant effects on the socioeconomic resources of a center's surrounding communities. If a lessee sustains a resource, there would be no effect. If a lessee expands or constructs a new facility, then the potential effects would be similar to those associated with invest activities (i.e., no effect to significant effect).

4.3 Cumulative Impacts

Cumulative impacts are defined in 40 CFR Part 1508.1(g)(3) as the "…effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time."

Cumulative impacts are most likely to arise when a relationship exists between a proposed action and other actions expected to occur in a similar location or during a similar time period. Actions overlapping with or in close proximity to a proposed action would be expected to have more

potential for a relationship than those more geographically separated. Similarly, relatively concurrent actions would tend to offer a higher potential for cumulative impacts. Consideration of other regional development plans (e.g., road expansions, new development adjacent to centers) provides a more robust understanding of potential cumulative impacts.

Cumulative impacts may occur from multiple actions occurring contemporaneously at centers. Potential cumulative impacts will be evaluated at the center level. Centers will strive to avoid environmentally sensitive areas such as threatened and endangered species habitat and wetlands. When sensitive areas cannot be avoided, centers will consult with the appropriate federal and state agencies to mitigate impacts

The Proposed Action is a policy decision: whether or not to implement an agencywide master plan approach to the treatment of assets and prioritization of projects based on mission criticality and asset condition. From a policy perspective, the cumulative effect of the Proposed Action would result in:

- Managing the entirety of NASA assets and capabilities from a top-down, mission-driven perspective.
- Providing a unified approach to institutional planning and decision making.
- Allocating resources and funding based on agencywide, prioritized needs to create an affordable infrastructure portfolio.
- Proactively deploying sustainable best practices.
- Reducing current and future infrastructure-related risks and redundancies.
- Ensuring future actions take into consideration environmental constraints at the planning level where opportunities to avoid and minimize effects are the greatest.
- Ensuring compliance with applicable federal, state, and local laws and regulations; EOs; and agency policy directives.

4.4 Net Effects

Because the proposed action is a policy change that will affect decision making across many centers and facilities in potentially unpredictable ways, it is not possible to determine with certainty the precise environmental impacts that will result. Therefore, this PEA has primarily summarized the potential effects that could result from notional facility decisions, providing a baseline for centers to use when conducting PEAs for specific proposed actions. At a high level, however, NASA believes the transition to the Agency Master Plan will result in more efficiency and less redundancy, as stated above. Therefore, it is possible to speculate that over time, enhanced efficiency could result in some net effects. While some may disagree on whether these effects will occur, or the extent thereof, a few net effects can likely be anticipated. Namely, increased efficiency may result in cost avoidance, which could increase availability of funds for deliberate facility actions vs. maintenance and sustainment costs. This may favor some facility actions vs. their no action alternatives:

- Increased ability to repair, renovate or newly create vs. sustain, and
- Increased ability to divest via demolition vs. mothballing or abandonment.

Although it is difficult to anticipate the specific impacts of individual decisions and implementation decisions may also mitigate or enhance observed effects, the overall effect of increased efficiency

may be that assets that would have been otherwise sustained, mothballed, or abandoned due to lack of funds can now be repaired, renovated, or demolished. It should be noted that the former can be considered to have lower environmental impact (primarily no, negligible, or minor effects), while the latter may be higher-impact outcomes (more instances of minor, moderate, or significant effects) per Exhibit 4-4.

This trend toward higher-effect actions may be to some extent mitigated when considering long-term vs. short-term impacts. While short-term environmental impacts may be higher with increased investment, such investment may also allow for more energy-efficient buildings, leading to improvements in the climate change- and greenhouse gases-related effects. Similarly, newly created buildings or facilities may have greater up-front environmental impacts that are outweighed by the decreased environmental footprint resulting from more efficient and eco-friendly design. The Agency Master Plan process could also foster better integration of green building and environmentally conscious decision-making principles, reducing environmental impacts even with increased investment.

SECTION 5: DISTRIBUTION

The following individuals were provided the final draft Agency Master Plan PEA document for review and comment.

- Tina Norwood, Environmental Program Manager, NASA Headquarters
- Amy Keith, NEPA Manager, NASA Headquarters
- Curtis Borland, Attorney/Advisor, NASA Headquarters
- Steven Gilmore, Deputy Agency Master Planner, NASA Headquarters
- Carol Caldwell, Chief of Strategic Planning at NASA, NASA Headquarters
- Rebecca Klein, Federal Preservation Officer, NASA Headquarters
- Rena M. Schlachter, Agency Master Planner, NASA Headquarters
- Christopher Canaday, Strategic Integration Program Manager, NASA Headquarters
- Kristy Thompson, Realty Specialist, NASA Headquarters
- Gemma Flores, Executive Officer, Office of Strategic Infrastructure, NASA Headquarters
- Jeff Haught, Deputy Director, Facilities and Real Estate Division, NASA Headquarters
- Erik Weiser, Director of Facilities and Real Estate Division, NASA Headquarters
- Aga Goodsell, Center Operations Director (Acting), ARC
- Soheila Dianati, Center Planner, ARC
- Don Chuck, Center Director, Environmental Management Division, ARC
- Andres Estrada, Center NEPA Program Manager/Natural Resources Manager, ARC
- MaryEllen Ramsey, Center Planner, GSFC/GISS/WFF
- Braulio Ramon Center Planner, GSFC/GISS/WFF
- Justin Taylor, Center Planner, MSFC/MAF
- John Green, Center Planner, MSFC/MAF
- Byron Williams, Center Planner, MSFC/MAF
- Mike Uyeki, Center Planner, JPL
- Maia Durant, Center Planner, JPL
- Jose Flores, Center Planner, JPL
- David Thorpe, Center Planner, KSC
- Jennifer Krouchick, Center Planner, KSC
- Heath Ford, Center Planner, JSC
- Perry Bennett, Center Planner, JSC
- Tom Yohe, Center Planner, GRC
- Salah Ahmed, Center Planner, GRC
- Rachel Harrison-Woodard, Center Planner, SSC
- Timothy Pierce, Center Planner, SSC
- Matt Kenney, Center Planner, WSTF
- James T. Kaufman, Center Planner, WSTF
- Peter Castricone, Center Planner, AFRC
- Dan Mullen, Real Property Accountable Officer, AFRC
- Pete Van Dyke, Center Planner, LaRC
- Holly Workman, Planner, The Urban Collaborative, LLC
- Mark Gillem, Director, The Urban Collaborative, LLC
- Zoe Anton, Program Director, The Urban Collaborative, LLC

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SECTION 7: LIST OF PREPARERS

The NASA NEPA staff and contractors responsible for preparing this document are listed in **Exhibit 7-1**.

Exhibit 7-1. List of Preparers

Name	Role	Experience
National Aeronautics and Space Administration (NASA)		
Tina Norwood	NASA Headquarters NEPA Lead	M.S. Ecology; B.S. Animal Science; 37 years of experience
Amy Keith	NASA NEPA Manager	M.S. Environmental Engineering; B.S. Electrical Engineering; 36 years of experience
Curtis Borland	NASA Headquarters Environmental Attorney	LL.M. Environmental Law; J.D. Doctor of Law; B.A. History; 30 years of experience
Rena Schlachter	NASA Headquarters Master Planner	M.S. Landscape Architecture; B.S. Fine Arts and Biology; 15 years of experience
Christopher Canaday	NASA Headquarters Strategic Integration Program Manager	B.S. Mechanical Engineering; M.S. Marine Sciences – Physical Oceanography; 3 years of experience
Herndon Solutions Group (HSG)		
Susan Manes	NEPA Technical Lead	M.S., Natural Resources; B.A., Economics; 35 years of NEPA document experience
Kelley Junco	NEPA Specialist	B.A., Technical Writing; M.S., Graduate Certificate for National Environmental Policy Act; 4 years of NEPA experience
Jennifer Bailey	NEPA Specialist	M.S. Environmental Geography; B.S. Biology; 3 years of NEPA experience
Vicki White	Project Manager	M.B.A. Business Administration, B.S. Business Administration and Management; 30 years of experience
Emily Dabashinsky	NEPA and NASA Technical Expert	B.S. Biology; 6 years of NEPA experience
Leidos		
Carmen Ward, P.E., PMP	Reviewer, NEPA Subject Matter Expert	M.S., Environmental Engineering; B.S., Chemical Engineering; 30 years of NEPA experience
Gray & Pape, Inc.		
Carrie Albee	Cultural Resource Specialist	M.A., Architectural History; B.A., History; 25 years of Cultural Resource experience
WordStyle, Inc.		
Suzanne Leonard	Technical Editor	M.A. and B.S. in English, 24 years of technical editing experience
ANSER		
Frances Veasey	Technical and Copy Editor	M.S., Biohazardous Threat Agents and Emerging Infectious Diseases, B.S., Biology; 21 years of technical writing and copy-editing experience; 6 years of experience with NASA real property planning

APPENDIX A: AMP/AIA OVERVIEW PRESENTATION

APPENDIX B: REGULATIONS, GUIDANCE, AND POLICY

Additional procedures and guidance documents can be found under the Emergency Management Directorate's Functional and Principal Area webpages.

NASA Procedural Directives (NPDs) and NASA Procedural Requirements (NPRs)

- NPD 1000.0C NASA Governance and Strategic Management Handbook (Effective Date: January 29, 2020; Expiration Date: January 29, 2025)
- NPR 1000.3E The NASA Organization w/Change 96 (Effective Date: April 15, 2015; Expiration Date: April 15, 2026)
- NPD 1001.0D 2011 NASA Strategic Plan (Effective Date: March 28, 2022, Expiration Date: March 28, 2027)
- NPR 4310.1A Identification and Disposition of NASA Artifacts (Effective Date: May 12, 2014; Expiration Date: May 12, 2024)
- NPR 8000.4C Agency Risk Management Procedural Requirements (Effective Date: April 19, 2022; Expiration Date: April 19, 2027)
- NPD 8500.1C NASA Environmental Management (Effective Date: December 2, 2013; Expiration Date: December 2, 2023)
- NPR 8530.1B Affirmative Procurement Program and Plan for Environmentally Preferable Products (Effective Date: August 29, 2016; Expiration Date: August 29, 2023)
- NPR 8553.1C NASA Environmental Management System (Effective Date: July 20, 2020; Expiration Date: July 20, 2025)
- NPR 8570.1B Energy Efficiency and Water Conservation (Effective Date: July 20, 2020; Expiration Date: July 20, 2025)
- NPR 8580.1A Implementing the National Environmental Policy Act and Executive Order 12114 (Effective Date: August 1, 2012; Expiration Date: August 1, 2023)
- NPR 8590.1A NASA Environmental Compliance and Restoration (ECR) Program (Effective Date: July 18, 2011; Expiration Date: July 18, 2023)
- NPR 8810.1A NASA Center Master Planning (Effective Date: February 13, 2013; Expiration Date: November 23, 2023)
- NPD 8810.2A Master Planning for Real Property (Effective Date: December 9, 2009; Expiration Date: November 23, 2023)
- NPR 9260.1A Revenue, Unfunded Liabilities and Other Liabilities (Effective Date: February 09, 2015; Expiration Date: February 09, 2025)

Federal Laws

- 43 U.S.C. 2101 et seq. Abandoned Shipwreck Act of 1987
- H.R. 2454 American Clean Energy and Security Act of 2009

- 16 U.S.C. 431-433 American Antiquities Act of 1906
- 42 U.S.C. 1996 American Indian Religious Freedom Act of 1978
- 16 U.S.C. 469-469c Archaeological and Historic Preservation Act of 1974
- 16 U.S.C. 470aa-470mm Archaeological Resources Protection Act of 1979
- 42 U.S.C. 7401 et seq. Clean Air Act
- S.1733 The Clean Energy Jobs and American Power Act
- 33 U.S.C. 1251 et. seq. Clean Water Act
- 42 U.S.C 9601 Comprehensive Environmental Response, Compensation, and Liability Act
- 42 U.S.C. 11001 et seq. Emergency Planning and Community Right-to-Know Act (EPCRA)
- 16 U.S.C. 1531 et seq. Endangered Species Act
- PL 110-140 Energy Independence & Security Act (EISA) of 2007
- 42 U.S.C. 13201 et seq. Energy Policy Act of 2005
- 7 U.S.C. 136 et seq. Federal Insecticide, Fungicide, and Rodenticide Act
- H.R.5037 National Energy Conservation Policy Act
- 42 U.S.C. 4321 et seq. National Environmental Policy Act of 1969
- 16 U.S.C. 470-470w-6 National Historic Preservation Act of 1966
- 25 U.S.C. 3001-3013 Native American Graves Protection and Repatriation Act of October 1990
- 29 U.S.C. 651 et seq. Occupational Safety and Health
- 33 U.S.C. 2701 et seq. Oil Pollution Act
- 42 U.S.C. 6901 Resource Conservation and Recovery Act
- 42 U.S.C. 300f et seq Safe Drinking Water Act
- 15 U.S.C. 2601 et seq. Toxic Substances Control Act

Federal Regulations

- 10 CFR 433, 435, 436 Building Efficiency Design Performance and Life-Cycle Costing
- 36 CFR Part 65 National Historic Landmarks Program
- 36 CFR Part 67 Standards for Evaluating Significance within Registered Historic Districts
- 36 CFR Part 79 Curation of Federally Owned and Administered Archaeological Collections

- 36 CFR Part 800 Protection of Historic Properties
- 40 CFR Protection of Environment
- 41 CFR Part 102-38-295 Public Contracts and Property Management
- 43 CFR Part 7 Protection of Archaeological Resources
- 43 CFR Part 10 Native American Graves Protection and Repatriation Regulations
- 48 CFR Part 23 Environment, Energy and Water Efficiency, Renewable Energy Technologies, Occupational Safety, And Drug-Free Workplace
- 48 CFR Subpart 23.9 Contractor Compliance with Environmental Management Systems
- FAR Case 2004-032 Biobased Products Preference Program
- FAR Subpart 23.4 Use of Recovered Materials

Executive Orders

- EO 13834 Efficient Federal Operations
- EO 13432 Cooperation Among Agencies in Protecting the Environment with Respect to Greenhouse Gas Emissions from Motor Vehicles, Nonroad Vehicles, and Nonroad Engines
- EO 13423 Strengthening Federal Environmental, Energy, and Transportation Management

    Instructions for Implementing EO 13423
    - Establishing Baseline and Meeting Water Conservation Goals of EO 13423

- EO 13175 Consultation and Coordination with Indian Tribal Governments
- EO 13016 Amendment to EO 12580 Concerning Exercise of Authority Under CERCLA Section 106
- EO 13007 Indian Sacred Sites
- EO 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
- EO 12580 Superfund Implementation
- EO 12088 Federal Compliance with Pollution Control Standards

CEQ Guidance

- Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings