National Aeronautics and
Space Administration

Kennedy Space Center Master Plan

Executive Summary

2012 - 2032

Success: it's our history and our future.

Robert D. Cabana, Director
Kennedy Space Center

Photo: From left to right. Apollo 11 rolls out of the Vehicle Assembly Building before launching to the moon; Space Shuttle Atlantis lifts off from 39A on a mission to service the Hubble Space Telescope; and an artist's concept of the Space Launch System with Orion Multi Purpose Crew Vehicle lifting off from Launch Pad 39-B. *Image Credits: NASA*

The Master Plan's central focus remains in support of NASA achieving its programmatic mission objectives but additionally it is also designed to maximize the provision of excess capabilities and assets in support of non-NASA access to space.

Preparing for the Future

The Kennedy Space Center (KSC) Master Plan describes a 20-year transformation from a single, government user launch complex to a multi-user spaceport. This multi-user spaceport will be developed in concert with NASA's programmatic missions and requirements to explore destinations outside of low Earth orbit.

The Master Plan's central focus remains in support of NASA achieving its programmatic mission objectives, culminating in a manned voyage to Mars in the 2030s. Additionally, the Master Plan is also designed to maximize the provision of excess capabilities and assets in support of non-NASA access to space. This transformation to a multi-user spaceport will allow NASA to subsidize costs of expensive infrastructure and facilities and still maintain the country's ability to push the boundaries of our understanding of the universe.

Due to this added direction, the Master Plan varies from a traditional facility-centric plan and is designed to be a plan that facilitates change. This neo-traditional approach combines the traditional plan attributes, including: land use, facility assets, transportation, and infrastructure but expands the scope to include analysis of space market opportunities and future non-NASA demand. This approach is designed to balance continued support for NASA programs with the ability to fully leverage KSC's unique resources, location, capabilities, and competencies in support of future space market demand. When successful, these strategies will ensure that KSC remains the epicenter of human spaceflight and will continue to support mankind's mission to become a multi-planetary species.

Requirements of the Multi-User Spaceport transition:

- Modifying policies and practices to support a multi-user spaceport on federal property.
- Divesting of assets to encourage non-NASA space growth without diminishing capability to serve government missions and programs.
- Capturing space market share.
- Integration of non-space related commercial opportunities.
- Attracting new business supported by efficient procedures.

NASA Programs and Projects at KSC

The KSC Master Plan's primary objective is to support the fulfillment of current and future NASA requirements and missions while making access to space less costly and more routine. Through the application of KSC's Core Competencies, the Master Plan supports NASA Program objectives while providing for the opportunity for non-NASA entities to utilize excess capabilities not required. This strategy will provide the opportunity for a more diverse marketplace and less costly access to space. Building on 50 years of experience and success, the following NASA programs and projects are vital to the KSC's future as a hub for launch and exploration activities.

KSC Core Competencies

- Acquisition and management of launch services and commercial crew development
- Launch vehicle and spacecraft processing, launching, landing and recovery, operations, and sustainment
- Payload and flight science experiment processing, integration, and testing
- Designing, developing, operating, and sustaining flight and ground systems, and supporting infrastructure
- Development, testing, and demonstration of advanced flight systems and transformational technologies to advance exploration and space systems

Ground Systems Development and Operations Program (GSDO)

http://www.nasa.gov/exploration/systems/ground/

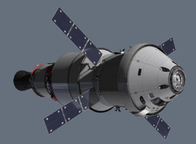
GSDO's primary mission is to process and launch the next-generation vehicles and spacecraft designed to achieve NASA's goals for space exploration. GSDO's program personnel are developing the necessary ground systems while also refurbishing and upgrading infrastructure and facilities to meet tomorrow's demands. A key aspect of the approach to long-term sustainability and affordability is making processing and launch infrastructure available to commercial and other government entities, thereby distributing the fixed cost burden among multiple users and reducing the cost of access to space for the United States. This modernization effort keeps flexibility in mind to accommodate a multitude of government, commercial, and other customers.

NASA's Next-Generation Crew Vehicle and Launch System

Orion Multi-Purpose Crew Vehicle (MPCV)

http://www.nasa.gov/orion

Orion MPCV will utilize the Space Launch System (SLS) and will serve as both the crew and service vehicle for long duration, deep space missions beyond low Earth orbit (LEO). Orion MPCV also has the capability to be a backup system for International Space Station cargo and crew delivery.



Space Launch System (SLS)

http://www.nasa.gov/sls

SLS is an advanced, heavy-lift launch vehicle designed to carry the Orion MPCV, as well as cargo, equipment and science experiments to deep space. SLS will be the most powerful rocket in history and will expand our reach in the solar system by bringing astronauts to near-Earth asteroids, Lagrange points, the moon, and ultimately Mars.

Photo: A Delta IV Heavy rocket lifts off from Space Launch Complex 37 at Cape Canaveral Air Force Station carrying NASA's Orion spacecraft on an unpiloted flight test. The two-orbit, four-and-a-half hour mission, allowed engineers to evaluate the systems critical to crew safety, the launch abort system, the heat shield, and the parachute system. Assembled at Kennedy Space Center, the Orion spacecraft is designed to journey to destinations never before visited by humans, including an asteroid and Mars. *Image Credit: NASA/George Roberts*

Commercial Crew Program (CCP)

http://www.nasa.gov/exploration/commercial/crew/

NASA's Commercial Crew Program (CCP) was formed to facilitate the development of a U.S. commercial crew space transportation capability with the goal of achieving safe, reliable and cost-effective access to and from the International Space Station (ISS) and low-Earth orbit. In late 2014, CCP awarded contracts to SpaceX and Boeing to provide the initial capabilities for crew transport in support of the ISS mission.

Launch Services Program (LSP)

http://www.nasa.gov/centers/kennedy/launchingrockets/

LSP's responsibility is to act as a broker, matching spacecraft with launch vehicles. Spacecraft destination requirements, coupled with the mass and volume of the spacecraft, determine the launch vehicle required. Once the right vehicle is selected, LSP buys that spacecraft a ride to space and works diligently to ensure mission success. LSP provides technical guidance from pre-mission planning to the post-launch phase of their spacecraft. If not for LSP, customers would be required to provide their own commercial launch license, vehicle provider, research and development, payload processing facility, as well as airspace coordination and monitoring capability.

ISS Ground Processing and Research Project Office

http://abram.ksc.nasa.gov/

The ISS mission is to fully utilize a permanent human outpost in space. The mission of the ISS Ground Processing and Research Project Office (ISSGP&R) is to manage all ISS KSC ground processing requirements and to promote full utilization of the ISS through fundamental biological research capabilities. The ISSGP&R manages the ISS Program and Research activities for KSC. These activities include experiment and orbital replacement unit ground processing in addition to enabling ISS research and National Lab requirements.

Planning Strategy

The KSC Master Plan supports the vision of the Center's transformation to an economically sustainable multi-user spaceport. To achieve this trans-formative vision, the Plan's Core Strategies (below) integrate NASA programming with emerging non-NASA opportunities and utilizes development factors, future land use, and right-sizing initiatives to enable a Center that continues to support the success of NASA missions and the growth and success of non-NASA space initiatives.

Development Factors

The Plan's development approach is to support the highest and best use of land resources incorporating environmental sensitivity, operational requirements, and safety regulations. This approach provides for anticipated NASA and non-NASA development in a way that best preserves KSC's environmentally-sensitive areas.

Future Land Use

The Center's development factors are complemented by a future land use plan that promotes the clustering of compatible uses and the separation of hazardous and non-hazardous operations. This approach encourages synergy between users, efficiency in operations, safety for the multi-user workforce, infill development, and preservation of the critical habitats that make KSC a location for more than spaceflight.

Asset Strategy

Right-sizing initiatives promote a more sustainable Center that supports continuing NASA programs, projected future missions, and identified commercial needs, including out-grants and divestitures. The transition to a multi-user spaceport will require a reduction of aging NASA-funded facilities and infrastructure and a reduced NASA operational footprint that is appropriately sized to accomplish NASA program objectives while supporting the proliferation and relative independence of non-NASA operations.

Transformation

The Master Plan includes a description of the necessary stages identified to facilitate the transition to a multi-user spaceport. These operational stages will enable the success of NASA objectives and create an environment where non-NASA objectives can be equally successful.

Master Plan Core Strategies

The Master Plan's Core Strategies require success at all phases to facilitate KSC's transformation, including:

- **Supporting NASA Missions and Programs:** Ensure NASA activities are operational and have capable facilities, assets, and resources to ensure success
- **Going Leaner and Greener:** Maximize the value of resources by promoting operational, fiscal, and environmental sustainability
- **Divesting Without Diminishing:** Strategically reduce NASA liability without diminishing capabilities to serve government and commercial missions
- **Enhancing the Multi-User Spaceport:** Continue to promote KSC's unique location, infrastructure, and capabilities to further support Non-NASA access to space

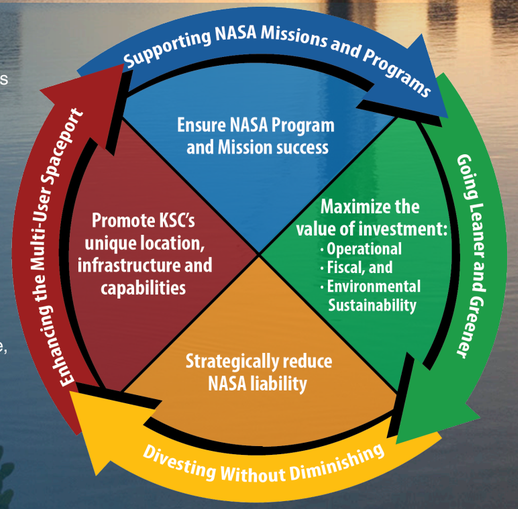


Photo: NASA's Mobile Launcher casts a reflection on the surface of an inland waterway in this sunrise photograph at Kennedy Space Center. The Ground Systems Development and Operations Program at Kennedy is overseeing upgrades and modifications to the Mobile Launcher so it can carry the agency's Space Launch System and Orion Spacecraft to Launch Pad 39B. *Image credit: NASA/Ben Smegelsky*

Emerging Opportunities

The emerging commercial space flight market offers an opportunity for KSC to take advantage of its established history and demonstrated capabilities to capture this market as it develops. To position KSC at the forefront of space commerce, the following key concepts should be considered to take advantage of emerging opportunities in the overall global space market:

Market Position

KSC should promote itself as a multi-user spaceport with unmatchable advantages. Implementing a strategy as a low cost, differentiated service provider will position KSC well in the space flight market. NASA programs operating alongside non-NASA space transportation and technologies, satellite systems and payloads, ground and operations support systems, adventure tourism, and next-generation renewable energy projects, will provide a solid base of economic activities for KSC.

Design Reference Market Focus

The Design Reference Mission should become the Design Reference Market for the emerging space flight industry. Markets and customer relationships must be sustained as KSC provides technological and launch service expertise to customers to promote and support ongoing, evolving relationships as the dynamic market develops.

Space Achievement Leader

The space flight industry is at an important crossroads and market participants are waiting for significant market movements to indicate a change in the economic environment. Until a dramatic technology breakthrough, an operationally-focused price change, or unforeseen demand occurs, the market will grow cautiously. KSC must develop needed technological improvements and foster customer-focused pricing to push this market forward toward its potential.

Market Strategies

Based on identified movements, forecasts, and benchmark data, the following key market strategies will promote KSC's success in the commercial space flight market:

- Leverage human capital; people are the critical path
- Support commoditized launches
- Transition culture to a Design Reference Market from a Design Reference Mission
- Refine space flight market manufacturing data
- Create an assembly of Ground Support Operations
- Partner with Economic Development Organizations

Space Market Summary

- The commercial space flight market is emerging, complex in its nature, and waiting for technological and demand unknowns.
- The KSC competitive position is based on market research, KSC strengths, risks, other market participants, and customers.
- KSC's competitive position at the beginning of the commercialization process must be refined as planning efforts progress and the market continues to evolve.
- KSC has the potential to be a leading market participant and a catalyst moving the space flight market forward.

Development Factors

Since its inception, NASA has worked to balance the needs of space flight with the protection of natural resources. Today, approximately 7,500 acres of land are actively used to support space mission operations, leaving approximately 95 percent of KSC's 141,829-acre land area relatively undisturbed from its natural condition. NASA's commitment to conservation has created the largest undisturbed coastal area and longest undeveloped beach on Florida's east coast and is managed in partnership with the United States Fish & Wildlife Service (USFWS) as the Merritt Island National Wildlife Refuge (MINWR) and by the National Park Service (NPS) as the Canaveral National Seashore (CNS).

Identifying areas for future development is a requirement to support KSC's growth as a multi-user spaceport. Maintaining the balance of future space flight development and conservation of natural resources is central to the future development factors outlined in the Master Plan. Developable land was identified by removing areas that were considered unsuitable for development including, water, wetlands, land within an existing QD arc, critical wildlife habitat, areas at risk of sea level rise, and roads. When removing these areas from consideration, about 8,000 acres of land is suitable for new development without mitigation measures or other restrictions. Including existing development only about 15,294 acres (10% of land holdings) is suitable for development (identified in the map to the right).

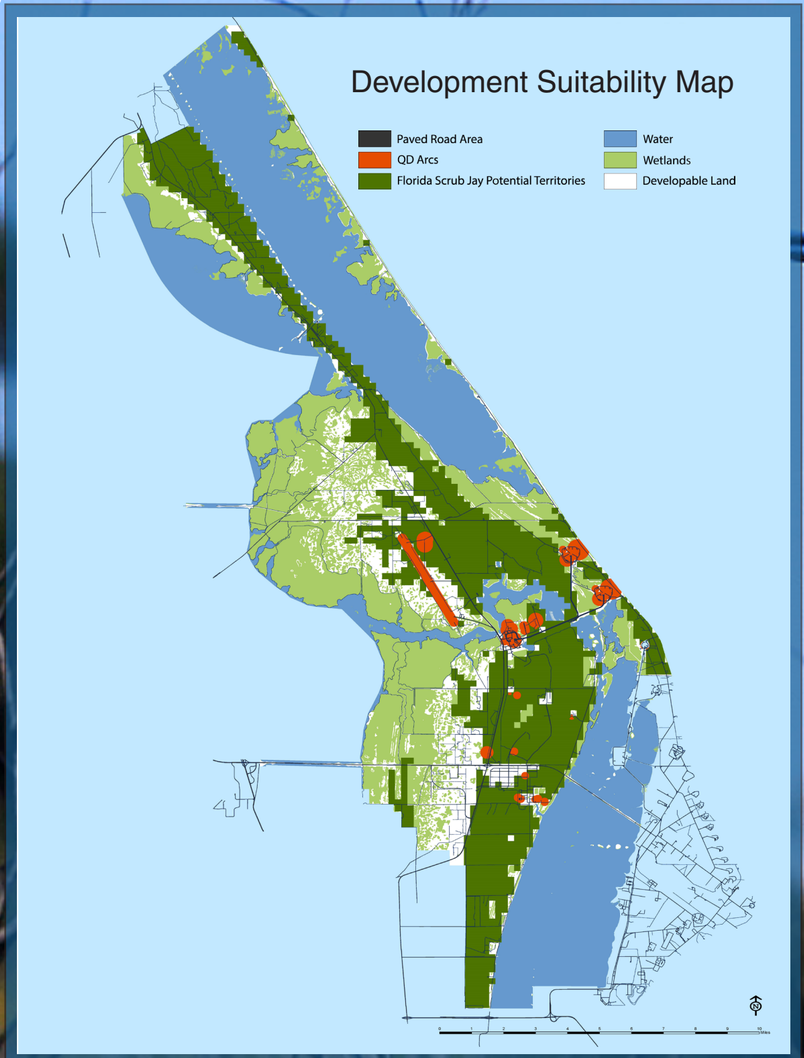
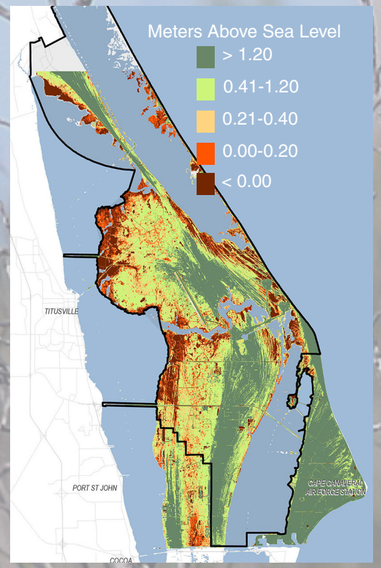


Photo: Two of the roughly 300 Florida scrub jays that call the 140,000 acre Merritt Island National Wildlife Refuge home. The only species of bird endemic to Florida, the scrub jay is listed as a threated species due largely to habitat loss. Efforts to preserve, restore, and maintain the birds habitat is central to guiding future development at Kennedy Space Center. *Image Credit: NASA/Dan Casper*

Climate Change

Much of KSC land areas are low-lying, poorly drained, and vulnerable to inundation by periodic storm events. These low-lying areas are also most at risk to be affected by global climate change in future decades. Areas of existing facilities or structures that are in 0-1.20 meters NAVD (North American Vertical Datum) should be assessed relative to anticipated future climate and weather conditions. Where practical, the function within existing facilities should be relocated to ground 1.82 meters (approximately 6 feet) or above where required. Future critical facilities shall be constructed outside the 500-year flood plain. Where practical, existing critical facilities should be hardened to withstand a 500 year flood event, or their functions moved to an area outside the 500-year flood plain.



Sea Level Risks to KSC Property

Future Land Use

The Future Land Use Plan is the basis of the planning framework supporting continuing NASA Programs and future non-NASA opportunities. It promotes compatible relationships between adjacent land uses, encouraging infill development, consolidation of NASA operations, and preserving environmentally-sensitive areas.

The Future Land Use Plan outlines where development can occur, how land can be used, and how strategic capabilities can be expanded to support KSC's evolution to a multi-user spaceport. Right-sizing NASA operations and the attraction of non-NASA investment is enabled by the expanded operational autonomy resulting from the Master Plan. Consolidation of NASA operations into a smaller, more-efficient, geographic footprint is a major component of the Master Plan.

The Central Campus concept supports efforts to slowly, but strategically, re-capitalize dispersed non-hazardous functions and capabilities into more efficient facilities with a smaller operational footprint. Likewise, directing future NASA and non-NASA operations into functional areas with well-defined activities will streamline safety and security considerations while promoting the maximum use of KSC's horizontal infrastructure.

The Master Plan also supports the expansion of the Center's quinti-modal capabilities to provide increased support for all users of the multi-user spaceport, including expanded rail network connectivity.

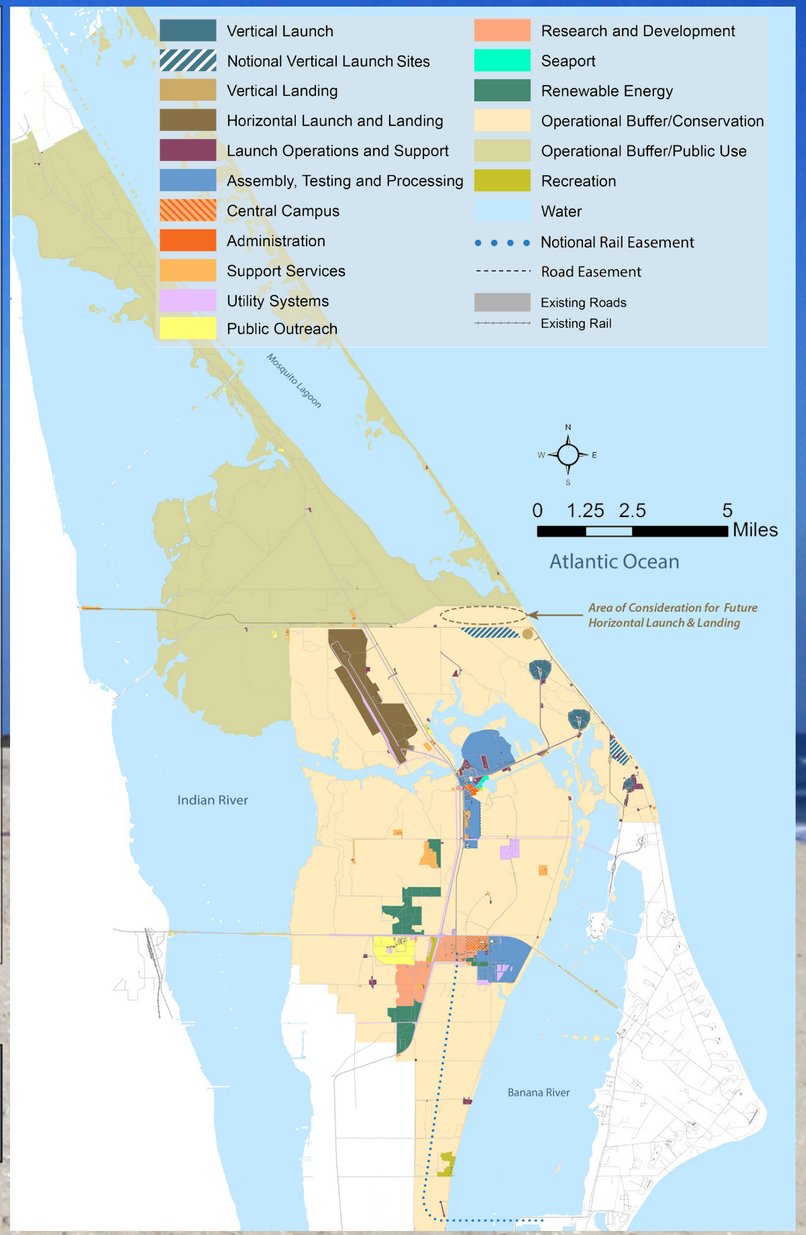


Photo: A sand dune restoration project was recently completed along a mile of the Atlantic Ocean shoreline between Launch Pads 39A and 39B in an attempt to protect those facilities from storm surges and rising tides. *Image Credit: NASA/ Dan Casper*

Expanded Launch Capabilities

Two areas have been identified that could accommodate new vertical launch pads. A new vertical launch complex (LC), designated LC-49, could be sited north of the existing LC-39B. Another launch complex, designated LC-48, could be sited south of LC-39A and north of LC-41, consistent with a 2007 KSC Vertical Launch Site Evaluation Study.

Additionally, an area has been identified to support vertical landing capabilities and if the market necessitates an expansion of horizontal launch and landing capabilities, an area for consideration has been identified just south of Beach Road.

Shuttle Landing Facility (SLF)

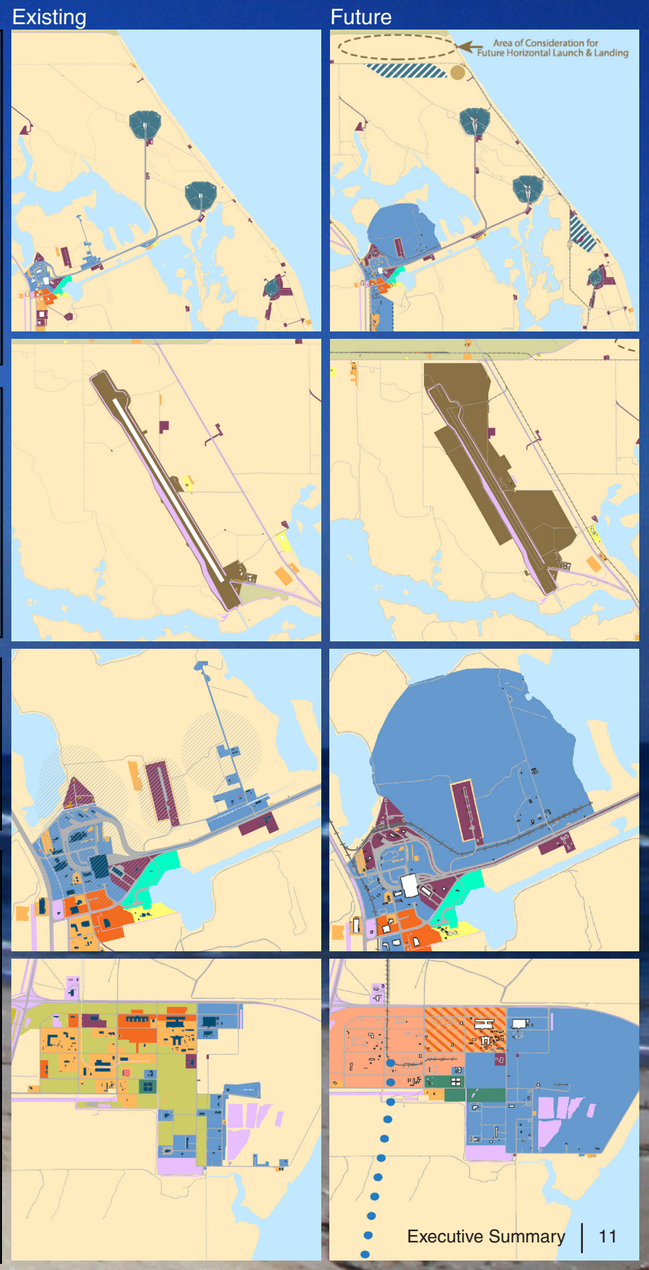
Apron areas and associated support facilities supporting the SLF can be expanded to accommodate future horizontal launch and landing activities and customers. Initial development will be focused on the east side of the runway and future development, if required, will be accommodated to the west side.

VAB Area

Additional land area is designated as Assembly, Testing and Processing areas to provide support for anticipated increased future launch activity. Construction of sea walls will mitigate a potential rise in sea level.

Central Campus and Industrial Area

Central Campus will include new non-hazardous NASA development in support of NASA programs and/or as part of the recapitalization process. Facilities to be relocated to Central Campus through recapitalization efforts can include Administration, Research and Development, and non-hazardous Support Services functions. Criteria for these relocations will include age-related operational inefficiencies, susceptibility to sea level rise, consolidation of redundant/duplicative operations, excessive maintenance requirements, and decreased operational square footage goals. Additional land is provided for expanded research and development and assembly, testing and processing needs. Expanded areas for alternative energy production are also identified.



Asset Strategy

A primary objective of the Asset Strategy is to reduce facility inventory to an economically sustainable state. Historically, the metric used to gauge economic sustainability within the Agency is the aggregate Current Replacement Value (CRV). CRV is indicative of the extent of real estate holdings and the corresponding costs to operate and maintain these facilities.

Though CRV reductions have been an influential data point in determining the fiscal health of the Agency and Center, KSC believes that the CRV methodology and subsequent goals only tell a partial story in the work that KSC is doing to evolve to a multi-user spaceport. Traditionally, the only way to reduce CRV is through demolition. While KSC recognizes that there are many facilities that need to be shed, many of the assets are one of a kind, and demolition is not the only solution to right-size KSC's asset base. KSC will pursue transformation through the consolidation of NASA operations, asset partnering, and agreements development in order to preserve the Center's and nation's crucial launch infrastructure.

Future NASA dedicated assets will be evolvable to be able to meet the needs of the current mission as well as future missions. This multi-use space infrastructure will be developed to minimize unique program-specific capabilities and instead be developed to ensure that each mission leaves something behind to support the success subsequent missions.

The KSC multi-user spaceport will be composed of NASA and Non-NASA operated facilities. Facilities and infrastructure will be funded through a mix of federal, state, and commercial dollars. Federal, state, and private investments will all be used in concert with one another for the benefit of the spaceport.

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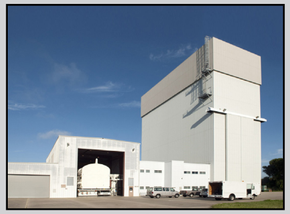
Photo: A Falcon 9 rocket stands ready for liftoff at the Kennedy Space Center's Launch Complex 39A. The February 19, 2017 launch was the first launch from the complex since STS-135 on July 8, 2011, the last flight of the Space Shuttle program. SpaceX's use of LC-39A was a landmark agreement that allowed NASA to divest of an asset, no longer required for NASA use, without diminishing KSC's capability to support launch operations. *Image Credit: NASA/ Kim Shiflett*

NASA Dedicated Assets

Central Campus Headquarters Building



Launch Abort System Facility

Non-NASA Dedicated Assets

Commercial Crew Cargo Processing Facility

Launch Complex 39A

Multi-Use Assets

Launch Complex 39B

Vehicle Assembly Building

State Assets

Space Life Sciences Laboratory

Shuttle Landing Facility

Photo: An artist depiction of the future Kennedy Spaceport. The image represents the full realization of the multi-user spaceport; balancing the launch operations of NASA, the Department of Defense, and commercial partners. *Image Credit: NASA*

The transition from one stage to the next is not time-specific, but is largely dependent on federal funding, economic influences, and financial commitment from non-NASA entities.

Transformation

Pre-2012	Near Term	Medium Term	Long Term	Future: Beyond 2032
Dedicated NASA Programs **Theme:** Focused support for NASA Programs KSC is sustaining continuing NASA Programs with diminished federal funding while planning for a future that includes commercial partnerships with non-NASA organizations. KSC has begun this process by either out-granting or divesting real property not needed to support NASA Programs to commercial entities and by planning for increased commercial activities in the future. The asset strategy also includes preserving capability that may be needed in the future by temporarily maintaining facilities in a mothball status and demolishing obsolete facilities.	**NASA Programs with Increasing Commercial Users** **Theme:** Focused Support for Continuing NASA Programs with Emerging Commercial Integration; Economic Sustainability KSC will continue to support NASA Programs while capitalizing on the emerging space market with: expanded launch and landing capabilities; expanded assembly testing and processing areas; upgraded roadway and utilities infrastructure; continued leveraging of assets to accommodate commercial integration, expanded research and development; leveraging of KSC's unique quinti-modal transportation network, and a more business friendly environment supported by dedicated commercial zones.	**NASA Programs with Emerging Multi-User Spaceport** **Theme:** Continuing Support for NASA Programs with Balanced Commercial Integration KSC will augment the support of NASA Programs with revenue from growing commercial integration. Launch and landing, assembly, testing and processing, and research and development areas will continue to be expanded proportional to market demand. Economic sustainability will be achieved via continued out granting and divestiture of assets, with commercial zones being self-supporting through a streamlined contracting process, and market-based pricing. KSC will fund and operate program-specific facilities.	**Multi-User Spaceport/NASA Programs Integrated** **Theme:** Continued Support for NASA Programs; Fully Leverage All Assets and Land Area Resources; Optimized and Diversified Commercial Integration KSC will be a fully-operational, self-sustaining multi-user spaceport with a balance of federally funded NASA Programs and diversified commercial activities. Similar to other transportation hubs, such as airports and seaports, the Kennedy Spaceport could be operated by a Spaceport Authority. The Spaceport Authority will have the ability to execute contracts and raise capital to benefit the spaceport. The highest and best use of all assets and land resources will be achieved by fully leveraging all available facilities and developable land to promote diversified development opportunities.	

For time and the world do not stand still. Change is the law of life. And those who look only to the past, or present, are certain to miss the future.

John F. Kennedy

In the Neil Armstrong Operations and Checkout Building high bay at KSC, former NASA Administrator Charlie Bolden delivers an address with KSC Center Director Bob Cabana looking on, at right. On display in the background, from left, are Boeing's CST-100 Starliner, NASA's Orion and the SpaceX Dragon spacecraft, all destined to play a role in the agency's exploration objectives. *Image credit: NASA/Gianni Woods*

Current State

- Development Conditions
- Pre-2012 Land Use
- Core Strategies
- Utilities
- Current Market
- Current Transportation

Implementation

- Dedicated NASA Programs
- Increasing Commercial Users
- Emerging Multi-User Spaceport
- NASA Programs & Spaceport Integrated

Future State

- Development Strategy
- Land Use
- Utilities
- Market
- Transportation

For more information, please visit our website at:
http://masterplan.ksc.nasa.gov

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