PACIFIC SPACEPORT COMPLEX – ALASKA

SPACEPORT MASTER PLAN

2020 - 2030

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Aerospace Corporation
AADC	Alaska Aerospace Development Corporation
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
ADF&G	Alaska Department of Fish and Game
ADQ	Kodiak Airport
ADIZ	Alaska Air Defense Identification Zone
ADOT	Alaska Department of Transportation
ADS-B	Automatic Dependent Surveillance Broadcast
AFB	Air Force Base
AFI	Air Force Instruction
AFMAN	Air Force Manual
AFUB	Auxiliary Field Utility Building
AIDEA	Alaska Industrial Development and Export Authority
AIS	Automatic Identification System
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Land Conservation Act
ARTCC	Air Route Traffic Control Center
AS	Alaska Statute
AST	FAA Office of Commercial Space Transportation
CCTV	Closed Circuit Television
CDS	Command Destruct System
CE	Categorical Exclusion
CFR	Code of Federal Regulations
CIP	Capital Improvement Plan
COTS	Commercial Off the Shelf
C/AW	Caution and Area Warning
COMSTAC	Commercial Space Transportation Advisory Committee
CSLA	Commercial Space Launch Act
CUP	Conditional Use Permit
CZMA	Coastal Zone Management Act
DCCED	Department of Commerce, Community, and Economic Development
DMVA	Department of Military and Veterans Affairs
DNR	Department of Natural Resources

DOD	U.S. Department of Defense
DOT	U.S. Department of Transportation
DPS	Western District Population Segment
EA	Environmental Assessment
ECM	Earth Covered Magazine
ECP	Entry Control Point
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EMC^2	Expanded Mission Control Center
EMT	Emergency Medical Technician
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FAWS	Flight Analyst WorkStation
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
FPPA	Farmland Protection Policy Act
FRF	Fire Response Facility
FSO	Facility Security Officer
FWCA	Fish and Wildlife Conservation Act
GAAP	Generally Accepted Accounting Principles
GCI	General Communications, Inc.
GMT	Greenwich Mean Time
GPS	Global Positioning Satellites
GSE	Ground Support Equipment
GSO	Ground Safety Officer
GMT	Greenwich Mean Time
GPS	Global Positioning Satellites
HCI	Hydrochloric Acid
HVAC	Heating, Ventilation, and Air Conditioning
HVDS	Hazardous Vapor Detection System
IDIQ	Indefinite Delivery Indefinite Quantity
ILD	Intra-Line Distance
ILMA	Interagency Land Use Management Agreement
IPF	Integration and Processing Facility
JSpOG	Joint Space Operations Group
KANA	Kodiak Area Native Association

KEA	Kodiak Electric Association
KIB	Kodiak Island Borough
KLC	Kodiak Launch Complex
KMA	Kodiak Management Area
KNCL	Kodiak Narrow Cape Lodge
KRSTMP	Kodiak Road Systems Trails Master Plan
KW	Kilowatt
LAN	Local Area Network
LCC	Launch Control Center
LCP	Lane Closure Permit
LEB	Launch Equipment Building
LED	Light-Emitting Diode
LEO	Low Earth Orbit
LEV	Launch Equipment Vault
LOCC	Launch Operations Control Center
LORAN	Long Range Navigation
LOX	Liquid Oxygen
LSA	Life Support Area
LSS	Launch Service Structure
LWO	Launch Weather Officer
MARS	Mid-Atlantic Regional Spaceport
MBTA	Marine Bird Treaty Act
MDA	Missile Defense Agency
MFCO	Mission Flight Control Officer
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MSF	Maintenance and Storage Facility
NAAQS	National Ambient Air Quality Standards
NAS	National Airspace System
NEC	National Electrical Code
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Standard
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airman
NOTMAR	Notice to Mariner

NPDES	National Pollutant Discharge Elimination System
NRHP	National Registry of Historical Properties
NSS	National Security Strategy
NSSS	National Security Space Strategy
NWS	National Weather Service
OD	Operations Director
O&M	Operations and Maintenance
OIS	Operational Intercommunications System
OHA	Alaska Office of Historic and Archeology
OSHA	Occupational Safety and Health Administration
PBX	Private Branch Exchange
PILOT	Payment in Lieu of Taxes
PPF	Payload Processing Facility
PSCA	Pacific Spaceport Complex – Alaska
P/AW	Paging and Area Warning
QD	Quantity Distance
RCC	Range Control Center
RCO	Range Control Officer
RF	Radio Frequency
RMSF	Rocket Motor Storage Facility
ROM	Rough Order of Magnitude
ROS	Range Operations Supervisor
RREB	Range Radar Equipment Building
RP-1	Rocket Propellant
RSTS	Range Safety and Telemetry System
SATCOM	Satellite Communication
SCAPE	Self-Contained Atmospheric Protection Ensemble
SCAT	Space Craft Assembly and Transfer Facility
SCIF	Sensitive Compartmented Information Facility
SDI	Space Data Integrator
SHPO	Alaska State Historic Properties Office
SOA	State of Alaska
SPAG	Spaceport Planning Advisory Group
STEM	Science, Technology, Engineering, and Mathematics
STIM	Space Transportation Infrastructure Match Grant Program
TCC	Tech Control Center

TFMS	Traffic Flow Management System
TFR	Temporary Flight Restricted
TOD	Time of Day
UAO	Upper Air Observer
UHF	Ultra-High Frequency
UKNATS	United Kingdom National Air Traffic Services
ULA	United Launch Alliance
UPS	Uninterrupted Power Supply
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VHF	Very High Frequency
VIF	Vehicle Integration Facility
WHA	Wildlife Hazard Assessment
WHMP	Wildlife Hazard Management Plan
WNP	Western North Pacific
WXO	Weather Officer

Pacific Spaceport Complex – Alaska

Spaceport Master Plan

Executive Summary

Alaska Aerospace, a public corporation of the State of Alaska, was established by Alaska statute as the Alaska Aerospace Development Corporation (AADC) in 1991.

The purpose of Alaska Aerospace is to take a lead role in developing a high technology aerospace industry in the state through the exploration and development of space, to enhance human and economic development and to provide a unifying direction for accelerating space related economic growth.

Alaska Aerospace operates the Pacific Spaceport Complex – Alaska (PSCA), formerly known as the Kodiak Launch Complex. PSCA is a spaceport licensed by the Federal Aviation Administration Commercial Space Transportation (FAA/AST) under provisions of the Commercial Space Launch Act (CSLA) Title 51 U.S. Code Chapter 509) to provide an orbital launch capability. Located about 44 road miles south of the city of Kodiak at Narrow Cape on Kodiak Island, the spaceport was the nation's first commercial spaceport not collocated on a federal range. PSCA is situated on 3,717 acres of state-owned land under an Interagency Land Use Management Agreement (ILMA) with the Department of Natural Resources.

PSCA was designed specifically to provide optimal support for space launches to polar and high inclination orbits, including circular and highly elliptical Molniya and Tundra orbits. PSCA offers unrestricted down range launch azimuths ranging from 110° to 220° and is the only U.S. facility that can launch directly into the high inclination (63.4°) trajectory. Between 1998 and 2019, there have been a total of twenty-four (24) launches from PSCA. All have been in support of U.S. Government agencies, with the exception of two commercial launches in the summer of 2018.

The PSCA Spaceport Master Plan provides the Alaska Aerospace Board of Directors with a strategy for continued development of PSCA. This is the first Spaceport Master Plan developed for PSCA and is intended to provide a comprehensive roadmap for future development that supports increased spaceport activities while being balanced against community and environmental interests. The Master Plan will address infrastructure development of PSCA for the years between 2020 and 2030.

For the Spaceport Master Plan to be useful, identification of the goals and objectives of the project is an essential first step. These goals and objectives create the foundation from which a critical analysis can be conducted to determine an optimum infrastructure development plan that supports future growth of PSCA while being balanced against community and environmental interests. The goals and objectives of this plan focused on:

Safety	Maintain safe operations at PSCA
Operational Efficiency	Maintain and enhance the efficient operation of the spaceport throughout the development period
Financial Sustainability	Ensure long term financial sustainability

Land Use	Identify the essential land use requirements for future operations of PSCA and develop a Spaceport Layout Plan and Land Use Boundary Plan
Environmental Awareness	Protect the environment and minimize any impacts that may result from future infrastructure development
Community Interests	Balance community interests of land use and access to public lands and areas that surround PSCA, as well as to the fishing areas south of Narrow Cape and air corridors used to connect Kodiak with villages on the east side of the island.

Public Process: Development of this Master Plan involved an active public engagement process. A Spaceport Planning Advisory Group (SPAG) was formed to create two-way communication between the many diversified interests of Kodiak in development of the plan, with the expectation that following the adoption of the plan close coordination and communication may continue. The SPAG was structured to encourage participation and to facilitate public involvement. Additionally, the planning team conducted Public Informational Meetings at specific stages during the process to provide the public with opportunities to review the materials and provide comments. The following chart shows the timeline with SPAG and public meeting intervals.

Plan Components: This Executive Summary provides an overview of the various components covered in identifying the preferred development alternative for the 202-2030 planning period. These components were specifically addressed in the following categories:

- Inventory of Existing Conditions
- Demand Forecasts
- Facility Requirements
- Development Alternatives Evaluation
- Preferred Development Plan
- Environmental Evaluation
- Capital Investment Plan

Inventory of Existing Conditions: The Inventory of Existing Conditions chapter presents the spaceports existing conditions. This information establishes the baseline from which future development of the spaceport is considered. Much of the detailed information presented in this chapter is supplemented in subsequent chapters of the Master Plan, as appropriate, to support the various technical analyses required for the project.

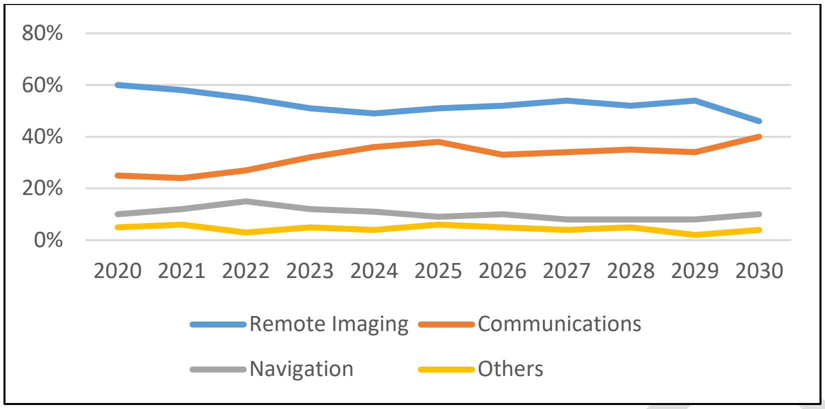
The chapter presents a relatively comprehensive overview of information related to the spaceports location; its role and historical activity; and its facilities, ancillary systems, and relationship with public lands, the cultural environment, and operations closure procedures. Information presented in the Inventory of Existing Conditions chapter was collected from existing data, spaceport operations and safety documents, past annual reports and strategic plans, relevant public plans and reports, on-site visual inspections, and interviews with staff.

To establish the facility requirements that may be necessary to support operations at PSCA over the next decade, in addition to the already established infrastructure, a projection of the future demand is necessary.

Demand Forecasts: Evaluating the expected future launch demand provides the baseline for determining the type, size, and location of facilities necessary to support potential demand. The demand forecast presented in this plan was developed using a variety of sources, which included an extrapolation of past activities, a market share assessment of PSCA's capabilities and advantages, evaluation of other payload and launch vehicle industry projections, and both government and commercial studies of the emerging small lift market.

Launch demand is driven by satellite requirements for access to space. The small satellite market pushes the need for low cost and reliable launch vehicles, as the satellite developers seek to achieve a market advantage through price and service benefits. Therefore, the industry is being driven away from high cost government and government-sponsored launch vehicles towards innovative, low cost, private sector launch vehicles. It is the small and ultra-small satellite demand that will drive the small and ultra-small launch vehicle market.

Historically, launches into polar orbits have accounted between 35%-40% of the total market. Because of the demands for near real-time imaging and the global communications requirements, demand for polar orbits are projected to increase at a faster pace than for equatorial orbits, primarily to serve the imaging sensor, telecommunications and broad band internet services, and navigation. This increased demand for polar orbit access drives the projections for increased polar orbit launch capabilities. The relationship between these different requirements is illustrated in the following chart.



Small and Ultra-Small Satellite Demand Projections by Market Percentage
(Market Average compiled from various sources by Alaska Aerospace)

According to SpaceTech, projected small satellite launch service demand for the next ten years shows that Low Earth Orbit (Polar) demand is expected to increase at 3% per year.

Without being permitted to quantify demand forecasts with operations projections for the Department of Defense publicly, the past twenty years of government launch operations validates that PSCA remains a location where the Department of Defense can successfully test and evaluate advanced systems in pursuit of the National Security Strategy (NSS). Therefore, projections reflect that Alaska Aerospace will continue to support government operations at PSCA in the coming years.

A series of demand forecast models were produced that recognizes the shift in market from government dominated launches at PSCA to growth in the commercial small launch vehicle market. The greatest growth for the future will be in the commercial market. The mid-range forecast was selected to determine the facility requirements that would be necessary to accommodate the projected demand for PSCA services in both the government and commercial markets using a conservative approach to the potential global market demand.

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Government	1	1	2	2	1	2	2	2	2	2	2
Commercial Solid	0	0	0	1	2	2	3	3	4	4	4
Commercial Liquid	3	6	10	14	18	20	24	26	28	30	30
Total	**4**	**7**	**12**	**17**	**21**	**24**	**29**	**31**	**34**	**36**	**36**

Selected Launch Demand Forecast

Forecasts are realistic projections of demand that may occur.
Justification for construction of facilities is still based on actual demand.

Facility Requirements: The Master Plan concluded that additional launch facilities are necessary to meet the projected demand, and most specifically, to meet the requirements to support the emerging small commercial liquid propellant launch vehicle market. To meet that demand, improvements are necessary at Launch Pad 1, with additional launch pads and launch pad enhancements needed in the vicinity of Area 3. The most significant improvements require installation of facilities to support liquid and hybrid propellant launch vehicles, such as building concrete launch pads with power and data connections, installation of water deluge and catchment systems, rocket propellant tank pads with adequate barriers or spacing, and appropriate lighting, camera and lightning protection systems; as well as establishing an area to support commercial stratospheric balloon launch systems.

Launch support facilities include establishing a rocket propellant storage area; an integration facility to support Launch Pad 3C; internal modifications to the Payload Processing Facility; and reserving space for expansion to the Rocket Motor Storage Facility.

The Launch Control Center does not require expansion at this time; however, an area should be identified for future facility expansion in later years. Internally, there are a number of improvements necessary to increase the efficiency of the facility. These include reconfiguring and expanding the security office; installation of upgraded meteorological weather instrumentation systems; improved HVAC controls; and expanding the restroom facilities.

With the increased operations, additional telemetry and instrumentation systems may be necessary. It is expected a demand for installing satellite downlink antennas may also occur within the planning period. Recommended additional antenna siting requirements include developing the land adjacent to the existing antenna area at PSCA; maximizing this area as the primary consolidated antenna site for future installations, so long as the location meets operational requirements; and identifying a second area for installation of additional antennas required by Alaska Aerospace launch customers. Furthermore, with the increased operations space should be identified for storage of up to two additional Range Safety and Command Destruct units at PSCA. Finally, an area should be identified in close proximity to PSCA for placement of “off-axis” optics and telemetry space.

With the substantial projected increase in launch operations, space within the Maintenance and Storage Facility (MSF) to accommodate vehicle maintenance, fabrication, Tech Control, Warehousing, storage and marshaling of both Alaska Aerospace and customer inventory, management offices, and other functions the MSF will exceed capacity under its current configuration. The MSF should be reconfigured for better space utilization and an additional soft-sided storage unit should be acquired.

With additional customers using PSCA, the need for additional land to accommodate commodity storage will increase. Areas should be identified for establishing customer commodity storage capability and an area should be identified for future aerospace related light manufacturing and warehouse operations by customers using PSCA on a long-term basis.

To meet an increase in motor vehicle fuel consumption, increasing the fuel delivery schedule and using the existing tanks should accommodate motor vehicle fuels storage requirements. However, based on the number of vehicles that may eventually operate at PSCA during the latter periods of the planning period, a need may develop to increase the size of the tanks. If that requirement develops, it is recommended larger tanks be installed in the same location that the current tanks use.

Alaska Aerospace has long served the government supporting test and evaluation missions at PSCA. Many of these support unique requirements that are dictated by the government customer at the time of each mission. The facility requirements evaluated various uses against projected demands and considered possibilities of repurposing areas that may no longer be necessary to support government operations.

For each of the areas where infrastructure improvements may be necessary, the plan identified the ancillary requirements that may also be required in order for the area to be effectively and safely utilized. These included the communication and data network; fiber optic and copper backbone; closed circuit television; intercom and warning systems; fire protection and alarming systems, security; water and waste water systems; and power distribution. All are dependent upon facility developments that may be constructed under the preferred alternative plan.

Based on increasing operational efficiencies at PSCA, and to address an issue that has been discussed since the spaceport was originally built, this plan evaluated the need for building a potential runway at the spaceport. A determination was made that construction of a runway at PSCA was not necessary and the option was eliminated from the final plan.

Preferred Development Plan: From the potential development alternatives, an analysis was conducted to create a preferred development alternative that best met the goals and objectives of the Master Plan. This section provides a brief description of the preferred development plan.

- To provide increased capability at Launch Pad 1, it is recommended the facility be modified to support launch vehicles which use liquid propellants. This option is selected in lieu of developing a new launch pad for larger-sized liquid propellant/hybrid powered launch vehicles. An area will be constructed near Launch Pad 1 to accommodate both rocket propellant (fuel and oxidizer) tanks, along with piping that connects the tanks to the launch pad and an access road that allows the transport of the tanks from existing paved roadway to the fueling pads. The rocket propellant pads will have berms to protect the launch structure from any unintended damage, built with environmental fuel spill containment systems. Additionally, a water deluge system will be installed at Launch Pad 1 for noise, vibration, and heat suppression during the initial stage of lift-off. A water catchment system may be installed to collect the used water for water quality testing post launch if the current flame trench is not deemed suitable to meet water catchment requirements.

- To limit expansion of small lift launch pads in undisturbed areas, Pad 3D will be converted to a multi-use government/commercial launch pad that can be used for liquid, solid, and hybrid propellant boosters. The pad would be developed to accommodate a concrete launch pad with separate bermed pads (if required) for the placement of LOX and rocket propellant; an environmental fuel spill containment system; a water deluge system with an environmentally approved water catchment system; enhanced communications and data systems; lighting; cameras; lightning rods; fencing; and an area for installation of a small vehicle integration facility.
- The USCG LORAN leased area may be developed as a small lift launch pad (Pad 3E) once the land lease is transferred to Alaska Aerospace and a customer is secured that requires that location. The pad would be developed to customer specifications, but would be similar to the development recommended for Pad 3D, above.
- A twenty thousand (20,000) square foot area directly across the access road from Pad 3C will be reserved for future construction of a Pad 3C launch vehicle integration facility.
- Pad 3A will be retained as a tactical and suborbital pad, which may also be used for staging and commodity storage of launch support equipment for Area 3 customers.
- Located six hundred (600) feet north of Launch Pad 1 and extending nine hundred (900) feet southwest and aligned with the prevailing winds at Narrow Cape, Area 5 will be repurposed to support future commercial stratospheric balloon launch systems.
- During the Master Plan development process members of the Spaceport Planning Advisory Group and the pubic affirmed that future needs for telemetry, downlink, and other antenna requirements should be accommodated to the maximum extent at the existing telemetry antenna site. Once this area reaches capacity, the abandoned USCG LORAN site would be the preferred antenna expansion area.

- There will be limited requirements, primarily by government customers, for use of Pasagshak Point as an off-axis site to track launches from PSCA. Recognizing the public concerns about development at this site this plan recommends no permanent structures be built at Pasagshak Point; however, the access road could be improved and an area no larger than one acre be maintained for off axis tracking on a temporary use basis.
- There are a few internal modifications necessary within the LCC to better accommodate large numbers of people supporting launches, which is usually required for government operations. Examples include:
    - Increasing the security office size to accommodate additional equipment, monitors, and personnel,
    - Installing upgraded meteorological systems, such as a new weather tracking computer display system; new anemometer system; a wind and temperature profiler; and an automated balloon launch facility with upgraded radiosonde equipment,
    - Improving the HVAC environment within the Tech Control Center to better control internal equipment temperature,
    - Increasing the number of toilets in both the women and men's restrooms,
    - Upgrade/Replace workstation cubicles with expanded office space.

  These will be addressed through a building reconfiguration study to be done after completion of this Master Plan.
- To preclude constraints to meet potential future LCC expansion needs, the area west of the LCC, which is currently used as the facility vehicle parking lot, should be reserved for future building expansion. This would result in the need to reserve the area where the current balloon launch building is located for new vehicle parking.
- The Area 1 instrumentation site should be retained for future government operations and restricted to temporary government uses only, no permanent structures should be built on the site, other than the utility and communications/data infrastructure needed to support operations.
- The Area 2 instrumentation site will be retained for future government operations, to include radar/telemetry operations, commodity storage, and/or staging. It is already developed, with supporting infrastructure, and is close to Pasagshak Road.

- Two LOX tanks and one Helium tank should be acquired. Up to eighteen (18) Helium bottles used mostly for weather balloon launches should also be procured.
- The area located on the west side of the Rocket Motor Storage Facility (RMSF) is reserved for development of a future launch vehicle propellant storage site.
- The area east of the existing RMSF is being reserved for future expansion of the RMSF launch vehicle storage building.
- An area directly adjacent to and west of the existing soft-sided storage facilities located behind the Maintenance Support Facility (MSF) is reserved for a third soft-sided storage facility to be installed when demand warrants the need.
- Increasing operations is expected to result in a demand for light manufacturing, fabrication of flight hardware, and warehousing/storage of inventory supporting launch operations to be available at the spaceport. This demand will be directly related to an individual company's business model for successful/profitable operations from PSCA. Therefore, the area directly adjacent to and west of the existing LCC is being reserved for these purposes when demand warrants the need.
- Four areas have been identified as future small commodities storage and equipment staging areas. One is located adjacent to the existing soft-sided storage units by the MSF. A second uses the Area 2 gravel pad when no longer required for government missions. The third uses Pad 3A, while the fourth site is adjacent, and to the east of the RMSF.
- Sufficient room is available at the existing vehicle fuel tank area to either replace the existing tanks with larger tanks or install additional tanks at the site to support vehicle fuel demands. Any future increased vehicle fuel demand will be accommodated using tanks installed above-ground and with an approved spill containment system installed that complies with state standards.
- A new Fire Response Facility will be built at PSCA to support both the fire fighting and emergency medical response requirements of the spaceport.

The preferred facility development plan is depicted in the following graphic.

PSCA Preferred Development Alternative

Other actions recommended in this plan include:

- Based on the projected government demand for PSCA operations, this plan identified a lodging requirement of approximately 300 beds per launch operation. A long-term lodging solution that provides up to 300 lodging rooms on or near PSCA for both government and commercial launch customers should be pursued. The current ILMA does not permit the establishment of a permanent lodging facility at PSCA. Should it be determined that a long-term lodging solution would best be located within the PSCA ILMA, although not recommended in this plan, a change to the ILMA with DNR must be initiated.
- With one of the major planning objectives being to reduce the footprint of PSCA at Narrow Cape, Alaska Aerospace should pursue transfer, acquisition, lease, or use of the existing USCG LORAN C lease area with the USCG, Civil Engineering Unit Oakland for use by Alaska Aerospace for future spaceport development. Ultimately, this area is being identified for potential instrumentation antenna placement or to accommodate an additional commercial launch pad (Pad 3E).

- To minimize public access impacts, this plan maximizes grouping new development areas close together to minimize the need to disturb areas of undeveloped lands that could remain in a natural habitat condition.
- To better inform the public of spaceport operations, the entranceway to PSCA will be improved to provide signage that welcomes people to the spaceport and explains launch operations, rocket operations, and a history of the spaceport. The parking area will be graded, existing fencing on the south side of the road will be removed, and the area made available for public viewing of launches when authorized by our customers.
- Alaska Aerospace recognizes the high value community residents place in access to Narrow Cape and the use of the public trail system. This plan recommends that the existing trails, as identified in the Kodiak Audubon Society Trails Map of Narrow Cape and the trails identified in the 2011 Kodiak Road Systems Trails Master Plan (KRSTMP) be marked with signage and excluded from consideration for future development.
- All future development alternatives must retain public access to the Burton Ranch.
- The road to Fossil Beach is a state-owned public road and of high interest to the public. As such Alaska Aerospace is committed to keeping the roadway open to the public, except during closure periods permitted under the existing ILMA.
- Narrow Cape has long been used by the public for a variety of recreational uses. While the area was used for coastal defense during World War II, it is not designated as a National Historic Landmark. Access to these public areas and historical sites will be maintained to the maximum extent permitted under the ILMA under this plan. To preclude any development at the far end of Narrow Cape, south of Twin Lakes, the area will be identified as a Non-Development Public Use Reserve.
- Alaska Aerospace must continue to engage with the commercial fishing industry to mitigate impacts of launch periods and de-conflict launches with season openings in the Narrow Cape are and downrange. Improved communication, more flexible launch scheduling to avoid openings/closures, and coordination between Alaska Aerospace and the fishing community must occur to allow for the shared use of the waterways.
- Increased launch operations from PSCA, can be expected to result in more airspace closures and international airline re-routes. Reducing the size of closed airspace and the amount of time airspace is closed is of a primary objective for

sustained spaceport operations. In order to reduce the airspace closure times and size as launch activities increase at PSCA, Alaska Aerospace will:

  - Work with the FAA on the SDI proof of concept project,
  - Evaluate alternative notification systems/procedures that could be implemented to allow for limited traversing closed airspace before a launch occurs,
  - Establish a hot-line between PSCA and the FAA Anchorage Air Route Traffic Control Center (ARTCC) to provide easier/quicker communications with the air traffic controlling agency throughout launch operations.
  - Work with the FAA on refining the closed area boundaries based on performance of the new entrant small launch vehicles operators from PSCA.

- While Alaska Aerospace is a state-owned entity that is exempt for local land regulations, this Spaceport Master Plan is intended to provide the Kodiak Island Borough Community Development Department with a projected land use and development plan for the years 2020 – 2030.

An objective of the plan was to reduce the size of the PSCA leased lands, if feasible. Based on the preferred development alternative layout, a reduction in the PSCA boundary property line is feasible. The preferred Land Use Boundary Plan is depicted below. This depiction is notional and not intended to be the absolute boundary determination. A boundary survey will be completed upon completion of the Master Plan and the new boundary coordinates will be submitted to DNR for inclusion in the ILMA as the defined PSCA boundary.

Preferred PSCA Boundary and Trail Map

Environmental Evaluation: The environmental evaluation identifies potential environmental issues that will need to be addressed as the spaceport moves forward with implementation of the recommended development plan. Any federal action would require completion of the National Environmental Policy Act (NEPA) process if not already covered by previous environmental approvals. The Master Plan provides an environmental overview of the following projects where construction and/or operational impacts may be created which includes:

- Development of liquid propellant capability at LP-1
- Development of Pad 3D and/or Pad 3E
- Installation of an Integration Facility on the north side of the access road from Pad 3C
- Installation of a Liquid Propellant Storage Facility
- Construction of additional Rocket Motor Storage Facilities
- Development at the abandoned USCG LORAN site

Capital Investment Requirements: Implementation of the projects identified in this Master Plan requires a significant financial investment. Potential project development costs need to be identified to provide spaceport management with the ability to understand the financial impacts project development costs may have on the long-term spaceport budget. To provide estimated costs for construction of each project, a Rough Order of Magnitude (ROM) cost estimate was included in the Master Plan to provide Alaska Aerospace with information from which to make reasonable financial decisions on future development and be able to establish quantifiable costs for customer proposals.

PND Engineers, Inc., and Alaskan engineering company, provided Alaska Aerospace with project construction estimates for the primary Capital Improvement Program (CIP) development projects recommended under this plan. Alaska Aerospace then conducted an internal review of past construction costs to determine the most reasonable cost estimates for future projects at PSCA.

Projects: The total CIP project costs are estimated to range between $22.4 and $31.2 Million over the next decade, with potential for additional costs should any of the reserves be developed.

- **Launch Pad 1** – This project increases Launch Pad 1 capabilities by adding infrastructure to support liquid propellant launch vehicles. Depending on the final design, specific location of newly installed systems, and type of equipment purchased, the cost of this project is estimated to range between $7.0 and $8.6 million.
- **Pad 3A** – Pad 3A will be expanded for development as a multi-Use Tactical Launch Pad with Commodity Storage and Equipment Staging Area capabilities. The project is estimated to cost between $1.0 and $1.5 million.
- **Pad 3C** – Pad 3C is already developed to support both liquid and solid propellant launch vehicles. Enhancements to Pad 3 C some upgraded systems, such as lighting and cameras, as well as construction of a launch Vehicle Integration Facility (VIF). The VIF will be located on the north side of the existing Area 3 access road and will include security fencing, utilities, lighting, and cameras would also be installed. The project is estimated to cost between $2.8 and $3.2 million.
- **Pad 3D** – Pad 3D was originally identified as the primary location for construction of Launch Pad 3. Based on market demands, the site was downgraded and developed to support government non-orbital test missions. The site is currently graded, with a gravel surface, fenced, and has utilities service available. To meet future projected demand for light and small lift orbital launch vehicles, this site will be converted to a multi-use government and commercial launch pad. The area will be expanded to include a concrete launch pad, launch support infrastructure, enhanced communications and data systems, lighting, cameras, lightning rods,

security fencing and an area for installation of a small VIF. The project is estimated to cost between $3.5 and $4.0 million.

- **Pad 3E** – Pad 3E is located within the USCG LORAN lease area. The site has the potential for development as either an alternative telemetry instrumentation site or an additional launch facility. Alaska Aerospace is pursuing the transfer of this area from the USCG to Alaska Aerospace to be include within the PSCA ILMA for use in aerospace operations at the spaceport. In the event this occurs and a customer selects this site for launch pad development, this site would be developed similar manner to the recommended changes for Pad 3D. Due to the size of the USCG leased area, this site could serve a dual purpose of supporting both a launch pad and as the alternate telemetry instrumentation antenna site. The site already has an access road and utilities, although it is expected some utilities, such as power and communications, may need to be upgraded. Costs estimates for development at this site is very dependent on whether it is used for construction of a launch pad, installation of telemetry instrumentation antennas, or both. Development as a telemetry instrumentation site alone is estimated between $1.2 and $1.7 million while launch pad development costs range between $1.9 and $4.0 million, depending on the facilities required to support the specific launch vehicle type to use the launch pad.
- **High-Altitude Balloon Launch Area** – To support future commercial stratospheric high-altitude balloon launch systems, Area 5 would be repurposed. The area was used for equipment staging and storage during the original construction of Launch Pad 1. The site would be graded level, a compacted gravel surface added, with a small storage and launch vehicle preparation facility purchased and installed. Lighting, lightning rods, cameras, and a paved pad for parking propellant tanks for inflating the balloon would also be installed. Depending on the type of use the future customer may desire, the area has sufficient space to also locate a customer reception and flight preparation facility. The project is estimated to cost between $900,000 and $1.5 million.
- **Off-Axis Telemetry and Optics Site** – This site is used on a temporary basis for telemetry and optics tracking when customers require a site that provides an angled view for tracking launches. The site is a popular public recreational site, not located within a state or federal designated recreational area. Bull Lake is also located in close proximity to the designated off-axis telemetry and optics site, for which ADF&G has expressed interest in maintaining access to the lake, as it is stocked by ADF&G for public fishing. Therefore, Alaska Aerospace recommends minimal investment in this area sufficient to support PSCA launch operations, such as grading and leveling the access road from Pasagshak Road. The project is estimated to cost between $500,000 and $1.0 million.

- **Launch Vehicle Propellant Storage Area** – An area west of the RMSF has been identified as a future Launch Vehicle Propellant Storage Area for storage of liquid oxygen, helium, nitrogen, and other oxidizers. Initially it is projected the existing two LOX tanks and one Helium tank will be installed in the new Launch Vehicle Propellant Storage Area. The area is also planned to meet the need for additional LOX and helium tanks as well as for the potential future storage of liquid fuels, such as RP-1. To support this the area will be graded and leveled, with a compacted gravel surface. The project is estimated to cost between $1.3 and $1.8 million.
- **Rocket Motor Storage Facility (RMSF) Modifications** – Previous chapters identified the need to modify the two RMSF bays to accommodate smaller, commercial rockets. In 2018/2019 one of the bays was modified using Federal Spaceport Infrastructure Enhancement funds. It is recommended that the second RMSF bay also be modified to maximize the use opportunities of the existing RMSF before expansion of the facility is considered. The modifications are estimated to cost between $500,000 and 750,000.
- **Fire Response Facility –** This project will construct a new Fire Response Facility in the vicinity of the LCC and MSF. The project includes construction of a metal framed facility to support a two-vehicle bay heated garage, with a small office area, storage area, restroom, and work area for competing minor maintenance on the vehicles. The site already has utilities, communications, and data connections in close proximity and has previously been disturbed during spaceport construction. No new road construction is necessary. Depending on the final location and structural design, support equipment, and layout of the interior of the facility, the project estimate ranges between $1.0 and $2.5 million.
- **Water and Wastewater Facilities –** To provide increased water capacity for the increased operations at PSCA, an additional water well will be drilled in the vicinity of Area 3. Estimated cost is $150,000.
- **Motor Vehicle Fuel Storage Tanks** – As PSCA operations increase, the need for additional/larger motor vehicle fuel storage will occur. Alaska Aerospace estimates that adding a 500-gallon gasoline tank and a 1,000-gallon diesel fuel tank to the existing location, to include an environmentally approved catchment system is estimated to cost between $40,000 and $55,000.
- **Launch Control Center (LCC) Internal Reconfiguration –** The primary reconfiguration priority within the LCC expands the security office to accommodate increased equipment and personnel activities. This will result in a reconfiguration of the LCC front reception area. It is estimated this reconfiguration will cost between $50,000 and $70,000. In addition, the restrooms require reconfiguration to increase the number of toilets. Estimated cost for the restroom reconfiguration

is between $60,000 and $75,000. Finally, improvements to the meteorological systems within the LCC are necessary. These include new weather tracing computer display systems, a new anemometer system, installation of a wind profiler, and an automated weather balloon launch facility. Meteorological system upgrades are estimated at between $500,000 and $600,000. The combined project is estimated to cost between $610,000 and $745,000.

- **Enhanced PSCA Entrance and Visitors Area –** Continuing Alaska Aerospace's public outreach, the entranceway to PSCA has seen a number of improvements. These include removing the old satellite receiving dish, installing a model display rocket, removing fencing, and working with ADOT to install a mileage sign for Fossil Breach and the Burton Ranch. Additional work will include grading the entire area to allow for vehicle parking and providing an area for launch viewing and other amenities. Future improvements may include informational display signs and a launch count-down viewing system to allow visitors a real-time launch viewing experience. Total estimated cost is between $1.7 and $3.0 million.

Throughout the planning period there will be other equipment acquisitions, facility modifications, upgrades and repairs that will be required to sustain a state-of-the-industry spaceport at PSCA. These additional items will increase the total capital expenditures to between $10.6 and $12.8 Million.

Capital Improvement Projects Funding Sources: To assist management in considering the financial aspects of capital improvements, potential funding sources were included in the Master Plan. These included:

1. Federal Spaceport Infrastructure Enhancement Program
2. Third Party Customer Financing
3. Alaska Aerospace Retained Earning and Discretionary Funds
4. Federal Aviation Administration (FAA/AST) Space Transportation Infrastructure Matching (STIM) Grant Program
5. Conventional Commercial Loans
6. Alaska Aerospace Bonds

Land Use Reserves: In addition to the development projects, the Master Plan identified areas at PSCA that should be reserved for future use. These areas would only be developed when customer demand creates the requirement for use of the area for spaceport operations. The following identifies the reserves:

- Launch Control Center and vehicle parking area extension reserve.
- Reserve an area directly adjacent to the existing soft-sided storage units north of the MSF for the addition of a third unit, when a requirement exists.

- USCG LORAN site transferred to AAC and reserved as a future Instrumentation/Telemetry Antenna expansion area and/or potential launch pad.
- Long Range Radar Site (Area 1) – Reserved for government use.
- Radar Telemetry Site (Area 2) – Reserved for government use, after which the site can be repurposed as a commodity storage and/or equipment staging area.
- Life Support Area – Reserved for future temporary lodging for government missions. This site will not be used for permanent lodging facilities by either the government or commercial customers. When no longer needed for temporary government lodging all above ground structures will be removed, leaving only the utilities and gravel pad for future government use.
- Reserve area for construction of up to three additional Rocket Motor Storage Facilities.
- Reserve four small areas around the spaceport for customer required commodity storage facilities.
- Light manufacturing, fabrication facilities, or commercial warehouse reserve area.

Economic Impact to Kodiak

The Master Plan identified a growth potential that will significantly improve the Corporations financial profile and provide the opportunity for the state to expand the aerospace market. It also will generate a significant positive economic impact for Kodiak.

An economic impact analysis was presented as part of the Master Plan to illustrate the additional direct and indirect economic benefit increased operations at the spaceport may have on the community. This was accomplished by combining the economic impacts for both government and commercial launches against the projected forecast demand for the ten year planning period. Induced impacts and potential revenues generated through taxes by the Kodiak Island Borough for private sector commercial development on leased lands at PSCA were not include in this calculation, but are expected to add additional positive economic benefit to the community.

The economic analysis shows a positive economic impact exceeding $120 Million direct and indirect economic benefit to Kodiak over the ten-year planning period, in addition to the contract value gained directly by Alaska Aerospace for services performed to support each launch from PSCA. It is also expected that increased launches will require an increased number of personnel being permanently employed by Alaska Aerospace or its subcontractors who will reside in Kodiak. Additionally, with a busy launch schedule for commercial customers, it is expected some launch companies will permanently assign a small number of employees in Kodiak to support their spaceport operations, resulting in additional permanent residents in Kodiak.

Chapter One – Pacific Spaceport Complex – Alaska Goals and Objectives

SECTION ONE - INTRODUCTION

The Pacific Spaceport Complex – Alaska (PSCA) Spaceport Master Plan provides the Alaska Aerospace Board of Directors with a strategy for continued development of PSCA. This is the first Spaceport Master Plan developed for PSCA and is intended to present a comprehensive roadmap for future development that supports increased spaceport activities while being balanced against community and environmental interests. The Master Plan will address infrastructure development of PSCA for the years between 2020 and 2030. The purpose of this chapter is to document key considerations and issues to be addressed through this planning process.

At the time of developing this Spaceport Master Plan, the Federal Aviation Administration Office of Commercial Space Transportation (FAA/AST) does not have a standard planning template for commercial spaceports. As additional spaceports seek federal licensing through the FAA/AST, it is expected a standardized Master Planning process will be established. In the meantime, Alaska Aerospace elected to closely follow the FAA Airport Master Plan process in development of this plan, as it provides a methodical approach to conduct a comprehensive review of existing facilities, identifying expected launch demand, developing alternatives that can be reviewed by the public, refined into a preferred development alternative, and reviewed against financial, environmental, and public interests.

SECTION TWO – SPACEPORT MASTER PLAN GOALS

Alaska Aerospace operates under a Vision and Values statement that defines our corporate culture and our work ethic. It reads: "Alaska Aerospace expertly operates spaceports and provides related services for customers in a manner that is safe, respectful of the environment, collaborative with surrounding communities, best value for customers, and is financially sustainable." This Vision and Values statement is the overarching principle for which this Spaceport Master Plan will follow.

For the Spaceport Master Plan to be useful to the Alaska Aerospace Board of Directors and the public, identification of the goals and objectives of the project is an essential first step. These goals and objectives create the foundation from which a critical analysis can be conducted to determine an optimum infrastructure development plan that supports future growth of PSCA while being balanced against community and environmental interests. This is an important aspect to the planning process which integrates various planning standards with market demands, community interests, and public inputs. To initiate the project, Alaska Aerospace identified the following goals to be addressed throughout the planning process.

Safety	Maintain safe operations at PSCA
Operational Efficiency	Maintain and enhance the efficient operation of the spaceport throughout the development period
Financial Sustainability	Ensure long term financial sustainability
Land Use	Identify the essential land use requirements for future operations of PSCA and develop a Spaceport Layout Plan and Land Use Boundary Plan
Environmental Awareness	Protect the environment and minimize any impacts that may result for future infrastructure development
Community Interests	Balance community interests of land use and access to public lands and areas that surround PSCA, as well as to the fishing areas south of Narrow Cape and air corridors used to connect Kodiak with villages on the east side of the island, such as Old Harbor and Akhiok.

It should be recognized these goals are not mutually exclusive and there may be conflicting interests as they are integrated into an optimum future development plan for PSCA. This Master Plan was designed so that projects could be initiated when demand dictates the need for development. The forecasts identify a projected timeline in which development could occur. However, the actual timeline for project implementation is based on actual activity reaching specific Planning Activity Levels identified in the study. Therefore, if activity does not materialize as quickly as forecast, specific development projects envisioned by this master plan could be delayed accordingly. The recent downturn in the economy is good example of why a project could potentially be delayed. Conversely, if growth were to accelerate, projects could be initiated prior to the timeline associated with the master plan forecasts.

The process is designed to address conflicting interests and provide a balanced and reasonable resolution process that results in a feasible development plan that creates minimal future negative impacts to any single interest while continuing to allow for the sustained operation and growth of PSCA. The following is a description of the primary goals for this plan.

Safety – Launching rockets has an inherent level of risk that spaceport operators strive to reduce to protect people, property, and the environment. The FAA has established safety criteria that must be adhered to in order to obtain and then maintain a spaceport operator's license. The Spaceport Master Plan provides an ideal document to address safety requirements and consideration for enhanced safety and reduced risk as facility development options are proposed to meet future operations demands.

Safety considerations include identifying areas around launch pads that may be damaged by any unintended explosion prior to, or immediately after launch. Another safety consideration is the impact that may result from any launch vehicle failure shortly after launch or during flight phase. Facility siting and establishing protected areas, such as Explosive Quantity Distance (EQD) areas around a launch pad, provide a determined level of safety to both people and property in the event of a launch failure.

Within the FAA/AST resides the Safety Inspection Division responsible for inspections of spaceports, mishap response, and safety enforcement. In addition to the safety requirements of an FAA licensed spaceport, every launch operator must also complete a safety analysis review that is approved by the FAA for flight operations. The Master Plan establishes the ability to evaluate safety standards against preferred facility development concepts to enhance safety of operations through wise infrastructure development.

Operational Efficiency – For the past fifty years, most space launch activities occurred on Federal sites, such as Cape Canaveral and Vandenberg Air Force Base. The emergence of commercial spaceports licensed by the FAA to provide vertical launch of rockets to both sub-orbit and orbital destinations has created the need for a methodical consideration of operational efficiency. In 2018 the FAA/AST had licensed only eleven (11) commercial spaceports in the United States. Of these only four are licensed for vertical launch activities. This makes vertical commercial spaceports a unique transportation facility.

PSCA was the first commercial spaceport licensed by FAA/AST to provide vertical launch capabilities to both sub-orbit and obit destinations. As a state-owned facility, PSCA was also a pioneer in offering commercial space launch operations from a non-federal range. PSCA has conducted twenty-four (24) launches since 1998 and is considered one of the nation's most successful non-federal commercial spaceport. To maintain operational efficiency as future launch operations increase requires a planned approach that balances the commercial and operational requirements of PSCA against the impacts created by the spaceport to surrounding public use areas. A concise plan for the efficient operation and growth of PSCA is a primary goal of this planning process.

Financial Sustainability – Alaska Aerospace faces tremendous pressure to operate profitably in a market where spaceports worldwide are generally subsidized by either state or federal governments and in some cases, both. As a state-owned corporation, Alaska Aerospace does not receive state general funds for operations or sustainment of PSCA. Likewise, as a non-federal spaceport, PSCA does not receive federal operations and sustainment funding. This creates a financial challenge for PSCA to streamline operations and customize services to the commercial launch vehicle customer's needs while making a sufficient return-on-investment to remain operational.

The Master Plan provides a comprehensive process to determine future customer demands and facility requirements and then compare against projected revenues and expenses, allowing Alaska Aerospace to tailor facilities and operations towards a customer base that ensures future financial sustainability. The change in focus from primarily government launches to supporting the emerging commercial small launch vehicle market has created the need to proceed with a planned development program best done through a structured Master Plan process to present a framework for sustained financial stability.

Land Use – Alaska Aerospace currently operates PSCA under an Interagency Land Management Agreement (ILMA) with the Department of Natural Resources (ADNR) on the 3,700 acres of state lands at Narrow Cape. The area surrounding PSCA is recreational land used for hiking, camping, picnicking, whale watching, and berry-picking. The area also includes the popular Twin Lakes and Fossil Beach. As such, Alaska Aerospace recognizes that any expansion of PSCA must be balanced against other public interests for Narrow Cape lands.

A key element of this Master Plan is to conduct an analysis of land requirements for space launch operations over the planning period against other competing land interests. It is the intent of Alaska Aerospace to carefully weigh future launch site requirements, followed by a review of the current land use boundaries, to maximize use of existing lands and determine whether the PSCA boundaries could be adjusted to increase public access areas and concurrently optimize PSCA operational areas. The expected result of this process is a new PSCA boundary map that will be used by Alaska Aerospace to enter into a new land agreement with ADNR to cover the projected future operational requirements.

Environmental Awareness – PSCA operates under an approved Environmental Assessment completed by the FAA/AST under the National Environmental Policy Act (NEPA) of 1969 requirements. The environmental impacts of constructing and operating the PSCA (formerly the Kodiak Launch Complex) were initially analyzed in the FAA May 1996 *Environmental Assessment of the Kodiak Launch Complex* (1996 EA), based on which the FAA issued a *Finding of No Significant Impact* (FONSI). The most current environmental assessment was completed by the FAA in 2016 to address potential expansion at PSCA and the addition of liquid fuel capabilities being used at PSCA. The *Finding of No Significant Impact/Record of Decision for the Kodiak Launch Complex* was approved on April 8, 2016.

Alaska Aerospace strives to be a good steward of lands and waters in which PSCA is located. Ensuring that development projects and operations are conducted with minimum environmental consequences, the Master Plan will provide an environmental overview that identifies potential issues pertaining to development that may need to be followed by a formal environmental study in compliance with federal laws. Alaska Aerospace's concern for the environment and diligence to mitigation and remediation is best illustrated by the removal process used of contaminated soils (refined kerosene) caused by a launch vehicle impacting the ground within the boundaries of PSCA in 2018. The Master Plan environmental overview will ensure potential environmental issues are identified and documented, but this section will not constitute an Environmental Assessment under the National Environmental Protection Act (NEPA). Should any environmental issues be identified in the Master Plan process, an updated Environmental Assessment may be necessary before any development occurred in the area where a potential environmental issue was identified.

Community Interests – Alaska Aerospace places a high value on maintaining a positive relationship with the local community and stakeholders. This effort covers a diverse population that includes the local commercial and sport fishing communities; local businesses; U.S. Coast Guard; commercial and general aviation groups; native tribes, organizations, and corporations; the local government and school district; community public interest groups and organizations; residents of the Pasagshak community; and the general public, especially those interested in outdoor recreation at and around Narrow Cape and Fossil Beach.

This planning process has been specifically designed to facilitate stakeholder's ability to be involved in the process; review documents as they are developed; provide comments, and recommendations to all elements of the plan; and offer suggestions for improvements and considerations to resolve issues.

A Spaceport Planning Advisory Group (SPAG) was established for this Master Plan process. The SPAG is comprised of thirty stakeholder groups, to include the general public. The planning process being used for this Master Plan includes four meetings of the

SPAG, in addition to three public meetings to be held in Kodiak. SPAG members will be asked to review draft materials developed for the Master Plan. After a first meeting to introduce the project and provide SPAG members the opportunity to meet each other and the planning team, a second meeting will be held following completion of draft work on the first two chapters of the Master Plan covering the Existing Conditions Inventory and Demand Forecasts. A third meeting will be held to review the draft Facility Requirements and Potential Development Alternatives Chapters. Following receipt of SPAG comments, a culmination meeting will be held to present the draft Preferred Development Alternative, Environmental Overview, and the Land Use Plan and to receive SPAG member comments and recommendations.

Community involvement is important beyond the SPAG member participation. Alaska Aerospace will hold an initial kick-off Public Meeting in Kodiak to present the process, introduce SPAG members, and solicit input on ideas and interest that the public would like addressed during the planning process. A second meeting will be held to present the first four chapters of the Master Plan and receive comments, recommendations, and suggestions for improvement. This meeting will be conducted after the SPAG has met and provided comments to Alaska Aerospace at previously discussed SPAG meetings. The final Public Meeting will be conducted after the SPAG has reviewed the Preferred Development Alternative and Land Use Plan. Public comment will be an important aspect of this final meeting to ensure that Alaska Aerospace can make any necessary adjustments prior to finalizing the development and land use plans.

SECTION THREE – SPACEPORT MASTER PLAN OBJECTIVES

Establishing objectives provides criteria from which Alaska Aerospace and the public can determine the success of attaining the identified goals. Throughout this planning process, the planning team will compare the work being accomplished in development of the Master Plan back to the objectives to ensure the final development plan is consistent with the intended objectives of the process. The Master Plan objectives are presented below, aligned by subject with the Master Plan goals.

Safety – The safety objective is to maintain or improve safe operations from PSCA. Safety is a corporate core value at Alaska Aerospace and ensuring that future development is pursued with the outcome to improve safe operations at PSCA transcends all other objectives of this plan. To accomplish this the location of future launch pads, fuel storage facilities, and hazardous operations areas will be compliant with both state and federal safety requirements. In designing facilities at PSCA, infrastructure and buildings will meet or exceed engineering design and operational industry standards.

While Alaska Aerospace respects public access to PSCA lands, public safety is of paramount concern. As future facility layouts are being proposed, specific focus will be made to protecting the public. Therefore, areas of development may also include fenced areas surrounding the facilities that need to be restricted from public access. This will be balanced against providing the maximum amount of PSCA public lands for public use during non-launch periods as is reasonably possible.

Operational Efficiency – Paramount to the Master Plan is the need to maintain or enhance the operational efficiencies of PSCA for both existing and projected future operations. In development of this Master Plan, the objective is to maximize the use of already developed lands before expanding into areas that are not already disturbed unless the expansion is operationally required. This will include evaluation of facilities necessary to accommodate the demand forecasts of operations expected during the planning period against an assessment of clustering similar activities in areas that may reduce land use sprawl. Joint use of facilities will be one consideration for increasing operational efficiency. Reducing the construction of duplicate facilities at PSCA and causing development of lands that need not be developed within the planning period are also important aspect of this Master Plan.

Financial Sustainability – Essential to the long-term operation of PSCA is the ability for the launch complex to be financially sustainable. One to the most significant outcomes of this plan is to address the question "What is the level of activity necessary to remain financially viable?" Using the demand forecasts to determine projected operations (revenues), measured against capital investment costs and the annual operations costs, this plan will prioritize spaceport projects and programs, phasing, and funding to establish an affordable development plan consistent with the objectives of this Master Plan. The purpose is to maximize the existing efficiencies of PSCA and balance future development requirements against financial capabilities. In conjunction with Operational Efficiencies, this portion of the plan will look at maximizing the use of existing facilities to meet demands, followed by an analysis of repurposing facilities to meet demands in lieu of building new structures.

Another important aspect of the Master Plan is consideration of the economic value to the community. Therefore, once the operations demand forecasts and facility requirements are affirmed, an analysis will be prepared addressing the potential economic benefits that may occur in Kodiak should the development plan be implemented. Since Alaska Aerospace is a state-owned corporation, it is also important to all Alaskans (stakeholders) that PSCA generate sufficient revenues to provide a positive return-on-investment for the development of the spaceport. This plan will provide a projection of dividends the State of Alaska may experience if the proposed development is accomplished.

Land Use – Alaska Aerospace currently holds an Interagency Land Use Management Agreement (ILMA) with the Department of Natural Resources for 3,700 acres of land at Narrow Cape for the operation of PSCA. Strategic land use management is an essential part of a planning process and Alaska Aerospace intends to concentrate on maximizing land use options for future development to minimize the need for additional lands. Under this objective the plan will present a Land Use Plan for PSCA which presents the maximum land use expectations to meet future demands, with an emphasis on the reuse of existing facilities and clustering common activities together to reduce land use requirements.

It is a primary objective of this planning effort to ensure that PSCA has the facilities and space necessary to meet operational demands and that Alaska Aerospace remain a viable economic corporation. Consideration of land use compatibility and development requirements are important elements of this section, which will include a focused review of PSCA boundaries to ascertain whether any adjustments could be achieved that reduces the amount of acreage required to operate PSCA and to consider ways of increasing access to popular areas like Twin Lakes and Fossil Beach.

Environmental Awareness – An overarching principle of this planning effort is to minimize the impact PSCA development may create by presenting environmental issues that may need to be addressed in a future Environmental Assessment process, should development under this plan be pursued. Successful development at PSCA demands that construction projects and operational activities are compliant with state and federal environmental requirements. This planning process is intended to identify potential development so that a comprehensive review of potential environmental issues can be identified and resolved through the NEPA process, if necessary.

As PSCA engages in the vertical launch of both liquid and solid fueled rockets to both orbital and sub-orbital destinations, special focus will be concentrated on noise sensitivity, wetlands, water and air quality, hazardous materials handling, and possible soil contamination remediation requirements. Other important aspects of the environmental review will cover possible impacts to historical, archeological, and cultural resources, as well as fish and wildlife impacts.

Community Interests – Alaska Aerospace recognizes that PSCA is not the sole source of economic value to Kodiak and that Narrow Cape has a multitude of community interests that should co-exist with PSCA operations. PSCA is a federal, state, and local community asset that must strive to accommodate non-space launch interest to the maximum extent possible. In fact, it is not without understanding that the commercial fishing industry provides a strong economic impact on Kodiak and requires access to the waters south of Narrow Cape, especially during scheduled "Openings." A main objective of this planning process is to identify procedures and communication relationships to foster a closer working relationship with the fishing industry for mutual use of the waterways south of Narrow Cape.

It is recognized that fishing is not the only community interest with the operations of PSCA. For that reason, the Master Plan will include an active public participation process. With future development, it is an objective of this Master Plan that concerns with road closures, access to Fossil Beach, and disruption of air travel on the east side of Kodiak Island also be addressed. There must be a balance between commercial users of public lands and waterways and the general public's desire for access to these same areas. Through this Master Plan, it is intended that community concerns can be identified and addressed in the future development plans for PSCA. It is also intended that this planning effort will provide a transparent educational opportunity to better understand what services are provided at PSCA and to dispel inaccurate perceptions about the spaceport.

Within this Master Plan a Spaceport Planning Advisory Group (SPAG) was formed to create two-way communication between the many diversified interests of Kodiak in development of the plan, with the expectation that following the adoption of the plan close coordination and communication may continue. The SPAG was structured to encourage participation and to facilitate public involvement.

SECTION FOUR – SPACEPORT PLANNING ADVISORY GROUP KICK-OFF MEETING BRAINSTORMING ISSUES

Spaceport Planning Advisory Group brainstorming issues and recommendations for addressing in the PSCA Spaceport Master Plan. Following is a compilation of the specific issues presented at the January 30, 2019 meeting in Kodiak.

- How to communicate to road travelers' closures, using radio frequencies?
- Coordinating airspace closures with air carriers, air taxis, private aviation, tourism and sport fishing?
- How can we improve air space access through Temporary Flight Restricted (TFR) airspace?
- Ensure capability to accommodate medivacs in launch windows?
- How do we plan launch windows? – be mindful of how long we extend launch windows, time of day, conflict with other users.
- Adjust windows to accommodate fishing openings and high priority fishing events.
- Maintaining access to hiking areas at Narrow Cape for the public and special attention to specific periods of bird watching, bird survey's, bird count periods, and whale watching.
- How do we work better with our fishing community on closures?
- Varying level of closures – communications on how we do closures – possibly different level.
- Mindful of how we handle airway and maritime day of closure accommodations.
- We need to be mindful of the livestock that occupy the property.
- We don't address neighbors, berry pickers, hikers.
- Land access for the neighbors during closures.
- How will AAC ensure the safety of the water, soil, berries where people recreate – will people be alerted the results of testing?
- What are the maximum number of launches anticipated at PSCA?
- How do we handle a launch failure that results in rocket falling back into ocean, does it impact the bottom of the ocean, does it close the area for a period of time, are there toxic elements in the water?
- What happens if a trawler hauls up rocket parts, what is the possible risk to boat and crew?

- Maximize local hire, employment, logistics, and purchase materials.
- Consider environmental impact of rockets that reach the water.
- Can launch windows be reduced in length and scheduled at periods like between midnight and 3 a.m.?
- Trawlers use grids that are not aligned with our closure coordinates making it difficult for trawlers to know when and when not they are in a restricted area.
- Evaluate using LORAN site.
- Will we continue to use Pasagshak Point for off axis and is that compliant with our ADNR land use agreement?
- Consider closure notifications using an App for public notice and public updates.
- Continue to work with FAA and USCG on refining restricted areas during closure periods.
- Include comparison of fishing value vs launch value.
- Tax property for contribution back to borough not paid as government, consider PILOT or business model taxation model.
- Consideration of state roads from Kodiak to Narrow Cape both maintenance and cost of future rehabilitation. AAC used to do road maintenance to P bay, can that be restarted.
- Work with ADOT on road rebuild and traffic flow of PSCA.
- Is there a way for AAC to notify local community before we sign contracts so the community can be aware of what is happening at PSCA?
- Tsunami evacuation facilities accommodations.
- Consideration of subdivision of Burton Ranch and impacts to residents' access.
- Consideration of cumulative environmental impact of fuels, contaminated soils over long term.
- Maintain public access to East Twin Lakes to stock fish and allow the public access to fish.
- Enhance public access to public uplands, consider parking in proximity to LOCC for public parking.

Review of the Spaceport Planning Advisory Group comments lend themselves to four primary areas of interest:

1. Access to Public and Private Lands at and around Narrow Cape
    a. Maintain access to Twin Lakes
    b. Impacts on Burton Ranch and possible future development plans

    c. Maximize access to Fossil Beach and Narrow Cape for birders, berry-pickers, hunters, hikers, picnickers, and other non-aerospace activities

2. Closures of the waterways, airways and roadways during launch operations
    a. Duration and time-of-day of launch windows
    b. Adjust launch windows to accommodate fishing openings and high priority fishing periods
    c. Communications with the fishing fleet to improve information sharing, launch window scheduling, and notifications
    d. Access to airspace for medevac flights, air taxi and private aviation during launch closure periods
    e. Provide access through Temporary Flight Restricted (TFR) areas during launch windows

3. Possible Environmental Impacts of increased operations
    a. Potential soil and water contamination
    b. Air quality
    c. Noise
    d. Impact of launch mishaps on ground and waterways surrounding PSCA

4. Land Use and Local Government Relations
    a. Maintenance, repair, and eventual replacement of the paved state roadway from Kalsin Bay to PSCA
    b. Local tax and zoning
    c. Tsunami evacuation concerns

Relating back to the Goals and Objectives, the four areas of interest are concentrated primarily on the Land Use, Environmental Awareness, and Community Interests. Throughout the development of the Master Plan, these specific concerns and issues will be addressed as part of the plan.

Chapter Two – Pacific Spaceport Complex – Alaska Inventory of Existing Conditions

2018 Aerial Photo of Pacific Spaceport Complex - Alaska

SECTION ONE - Background and General Description

PSCA is a spaceport licensed by the Federal Aviation Administration Commercial Space Transportation (FAA/AST) under provisions of the Commercial Space Launch Act (CSLA) Title 51 U.S. Code Chapter 509) to provide an orbital launch capability. The principle law governing operations at PSCA is Title 14 CFR 420 – License to Operate a Launch Site.

This CFR, PSCA's site operator's license (reference LSO-03-008), and Alaska Aerospace's enabling legislation (Alaska Statute 14.40.846, Article 7), all designate Alaska Aerospace as the final authority for ensuring flight, ground, and operational safety at PSCA. Therefore, it is Alaska Aerospace's responsibility to ensure that customers comply with the policies and procedures developed as a condition of the operators' license.

Company History

Alaska Aerospace, a public corporation of the State of Alaska, was established by Alaska statute as the Alaska Aerospace Development Corporation (AADC) in 1991. Enabling legislation envisioned economic development and educational advancement through an affiliation with the University of Alaska and the Poker Flat Research Range. AADC was located, for administrative purposes, within the Alaska Department of Commerce, Community, and Economic Development (DCCED).

Plans started for development of a spaceport, originally known as the Alaska Orbital Launch Complex. The site selection process began with investigation of the Poker Flat Research Range, Alaska in October 1993, cumulating with visits to Cape Grevelle and Narrow Cape on Kodiak Island in 1994. The unsurpassed and unobstructed downrange across the Gulf of Alaska and the North Pacific Ocean made Narrow Cape the ideal location.

Construction on the site began in January 1998. On November 5, 1998, the United States Air Force conducted the launch of a suborbital rocket (AIT-1), marking the first launch from the Kodiak Launch Complex (KLC). During the 16-minute flight, the vehicle flew a trajectory that reached an altitude of about 450 miles and traveled approximately 1,000 miles downrange, landing in the Pacific Ocean west of Seattle, WA. This was the first launch from an FAA-licensed launch site not located within the boundaries of a federal facility.

AADC transitioned to Alaska Aerospace Corporation (AAC) in 2009 as a reflection of market changes and recognition of the fully operational aspect of KLC. The purpose of Alaska Aerospace is to take a lead role in developing a high technology aerospace industry in the state through the exploration and development of space, to enhance human and economic development and to provide a unifying direction for accelerating space related economic growth.

Alaska Aerospace has a history of providing reliable launch services into conventional polar and unique orbits. The Pacific Spaceport Complex – Alaska (PSCA), formerly known as the Kodiak Launch Complex, was the nation's first commercial spaceport not collocated on a federal range. Located about 44 road miles south of the city of Kodiak at Narrow Cape on Kodiak Island, the spaceport is state-of-the-industry. PSCA is situated on 3,717 acres of state-owned land under an Interagency Land Use Management Agreement (ILMA) with the Department of Natural Resources. AAC can restrict access to another 7,048 acres surrounding the launch complex for the purpose of protecting the general public from potential operational hazardous associated with launch operations at KLC.

AAC's ILMA grants the right to construct, maintain, or improve and remove buildings, roads, airports, and works of other description, and to use or remove sand, gravel, timber or other materials on or near the surface for purposes directly related to the project is limited to those expressly state in the approved development plan, and is subject to the stipulations as follows:

- AAC has the right to grant or permit the creation of third party interests for utilities or other public works (such as roads, pipelines, etc.) that are extensions of improvement from adjoining lands and do not interfere with the approved use of the tract is subject to the written approval of the Alaska Division of Land.

AAC's ILMA requires compliance with the following federal and state regulations:

- "National Historical Preservation Act" (Title 36 CFR 800)
    - AAC is required to be compliant with the National Historic Preservation Act when federal funding is received for construction.
- "Alaska Historic Preservation Act" (Alaska Statue (AS) 41.35.000)
    - AAC is prohibited to appropriate, excavate, remove, injure, or destroy any state-owned historic, prehistoric, or archaeological site without a permit from the Commissioner of ADNR.
- Guidelines defined in "Policy For Use and Classification of State Land Surface" (AS 38.04.060)
    - AAC's ILMA is subject to review by the Division of Mining, Land, and Water for possible utilization other than for the purposes assigned when considered in the best interest of the state.
- Guidelines defined in "Timber or Material Requested by other State Agencies" (Title 11 Alaska Administrative Code 71.015)
    - AAC shall not sell, transfer, or donate material including gravel, sand, rock, or peat to a third party except as necessary to construct and maintain the facility when the material is used within the confines of this ILMA.

- Guidelines defined in "Improvements On State Land" (AS 38.95.160)
    - AAC must retain a professional architect, engineer, or surveyor to supervise the location and design of any improvements on the tract and shall be

    responsible for preparing a plat for recording in the appropriate recording district if the costs of such improvements are more than $100,000.

- Guidelines defined in “Geophysical Hazard Areas” (Title 6 Alaska Administrative Code 80.050)
    - AAC shall ensure that siting, design, and construction measures for facilities minimize risk from geophysical hazards identified in the vicinity of the project.
- AAC shall recognize other co-located ILMAs
    - Grazing leases for portions of Narrow Cape held by local ranchers.

Effective 1 July 2011, AAC moved departments from DCCED to the Department of Military and Veteran’s Affairs (DMVA). This move proved advantageous to the State, DMVA, and AAC, as until that time all AAC’s launch customers had been Federal, and most of those sponsored by the Department of Defense (DoD) organizations such as the USAF or the Missile Defense Agency (MDA). As AAC gains more commercial customers, consideration may be given to realigning the Corporation back to DCCED, but other considerations may include the Department of Revenue or others.

Between 1998 and 2019, there have been a total of twenty-four (24) launches from PSCA. All have been in support of U.S. Government agencies, with the exception of two commercial launches in the summer of 2018. The chart on the following page lists completed launches at PSCA through 2020.

YEAR	MONTH	SPONSOR
1998	NOV	USAF
1999	SEP	USAF
2001	MAR	USAF
	SEP	NASA/USAF
	NOV	SMDC
2002	APR	USAF
2004	DEC	MDA
2005	FEB	MDA
2006	FEB	MDA
	SEP	MDA
2007	MAY	MDA
	SEP	MDA

YEAR	MONTH	SPONSOR
2008	JUL	MDA
	DEC	MDA
2010	NOV	USAF
2011	SEP	ORS/USAF
2014	AUG	SMDC
2017	JUN	MDA
	JUL	MDA
2018	JUL	Astra
	NOV	Astra
2019	JUL	MDA
2020	FEB	DARPA*
	SEP	Astra

*Campaign did not result in liftoff

All government launches have been successful; however, in 2014 a government launch vehicle experienced an anomaly shortly after lift-off that resulted in extensive damage to a number of PSCA facilities. The facilities were repaired and are currently in full service. The two commercial launches also were successful, again however, the launch vehicles experienced anomalies, impacting the ground within the boundaries of PSCA. The first launch caused minor damage to the outside of the IPF and created a small impact area. The second launch did not damage any facilities but did create a small impact area. Both impact areas were remediated of any hazardous materials and returned to a natural state, with the mitigation plan confirmed by the Alaska Department of Environmental Conservation (ADEC). On March 2, 2020, Astra attempted to launch from PSCA. The launch experienced an anomaly that destroyed the launch vehicle on the launch pad forcing cancellation of a planned launch attempt by the company.

The corporation has a conventional top down business organization including a Board of Directors, a Chief Executive Officer, a President, and Directors who oversee focus areas. AAC's corporate offices are in Anchorage, Alaska, with presence in Huntsville, Alabama.

Pacific Spaceport Complex–Alaska General Description & Capabilities

PSCA is a launch site owned and operated by Alaska Aerospace, an agency of the State of Alaska. PSCA is located at Narrow Cape on Kodiak Island, Alaska and occupies 3,717 acres. The complex provides integration, checkout, and launch facilities to government and commercial customers desiring to launch suitably sized vehicles. The launch site is focused on providing responsive and efficient launch capability for polar, sun synchronous, and high inclination orbits.

The coordinates (Datum WGS 84) for the center point of Launch Pad - 1 (LP-1) launch mount are:

Latitude: N 57° 26' 06.748"

Longitude: W 152° 20' 22.224"

Launch Pad 2 (LP-2) is a sub-orbital launch pad located approximately 439' west of LP-1. The coordinates for the center point of Launch Pad 2 (LP-2) are:

Latitude: N 57° 26' 06.752"

Longitude: W 152° 20' 22.237"

PSCA primarily supports launches of small-lift to medium range space launch vehicles, ranging in size from the small-lift Castor 120 and Peacekeeper motors (used in the Athena, Minotaur IV, and Minotaur V systems). PSCA has expanded commercial launch services to support the emerging small launch vehicle market, such as the Rocket Lab Electron, Vector-R, and other similar sized vehicles.

PSCA was designed specifically to provide optimal support for space launches to polar and high inclination orbits, including circular and highly elliptical Molniya and Tundra orbits. PSCA offers unrestricted down range launch azimuths ranging from 110° to 220°. PSCA is the only U.S. facility that can launch directly into the high inclination (63.4°) missions without land over-flight and the requirement to resort to energy consuming dog leg flight segments, which can result in a 15% - 19% payload weight advantage out of PSCA. Figure 2-1 depicts the launch latitudes and azimuths for PSCA.

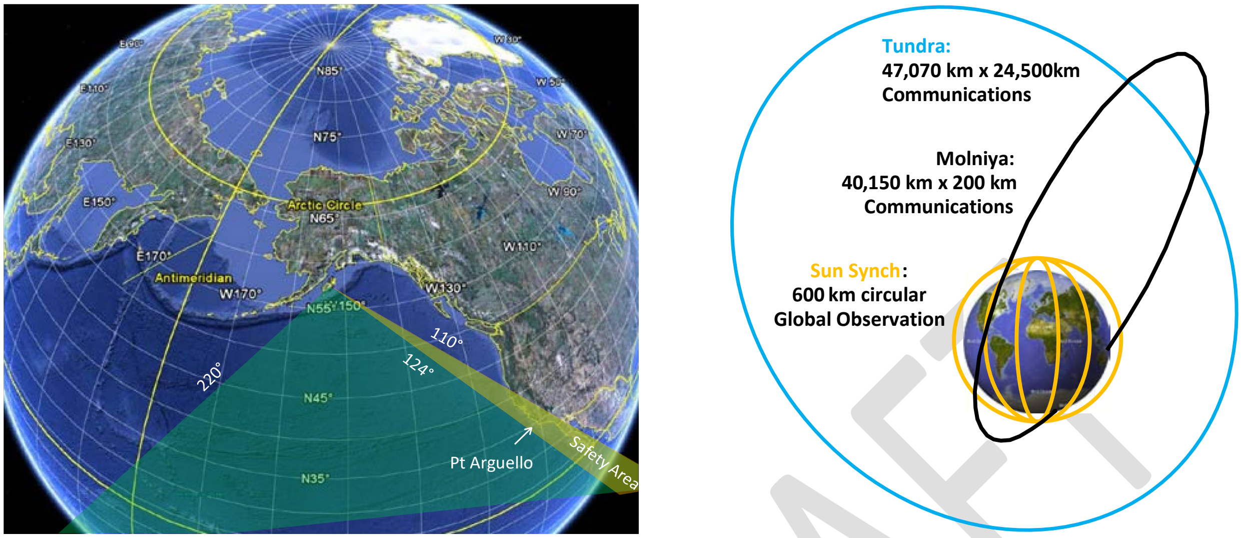


Figure 2-1: PSCA's Launch Azimuths and Inclinations and Orbit Capabilities

PSCA Road System:

Road access to PSCA is via the paved state owned, public Pasagshak Road. Once entering PSCA managed property, just past the Range Control Center building, the paved road veers to the right and continues 2.5 miles through the center of the spaceport, terminating at Fossil Beach. This paved road is open to the public at all times, except during launch activities, when the road is closed either at the spaceport boundary east of Surfing Beach for government launches, or at the entranceway to PSCA for commercial launches.

PSCA also has an internal road system that connects each of the developed areas to the paved Pasagshak Road. Comprised of both paved and unpaved roads, these roads provide access to the developed areas of the spaceport and are used by PSCA, contractor, and customers. Three thousand five hundred feet southeast of the Range Control Center starts Burton Road, an unpaved gravel access road that extends from the Pasagshak Road to the Narrow Cape Lodge and Burton Ranch. The road system is depicted in Figure 2-2.

Figure 2-2. PSCA Layout and Road System

SECTION TWO – Facilities Descriptions

PSCA is the nation's highest latitude full-service spaceport. It features indoor, all weather, processing and a modern GPS metric mobile Range Safety and Telemetry System. The complex consists of nine primary facilities and a number of support facilities. This section provides a detailed description of PSCA facilities and capabilities.

Range Control Center (RCC)

The RCC is the administrative, engineering and operations support facility for PSCA. It is the primary communications and data center for Launch Site functions and is connected throughout the facilities by the communications backbone. Located approximately two miles away from the LP-1 & 2, the RCC is outside the safety hazard zone, thus ensuring the safety of mission personnel.

The RCC is a 14,000 square foot' building that houses the Launch Operations Control Center (LOCC) and customer offices, Tech Control/Communications Room for inter and intra communications, weather office, security, emergency medical services, conference rooms for unclassified and classified support, administrative and engineering support personnel offices, restrooms, and break room. The RCC provides both private office and open space areas primarily for Launch Site Users.

The RCC has a paved and security fenced area that supports parking for up to seventy-seven (77) vehicles. The facility is also supported by an independent diesel fueled power backup generator and Uninterrupted Power Supply (UPS) system. A stand-by 350kW 480/277 Volt generator supplies power to the entire building during outages. The generator fuel tank is sized to run the generator for a minimum of 72 hours at full load. Each generator at the PSCA is contained in heated enclosures. A total of 32 kVA UPS are located in the Tech Control. The UPS supplies uninterruptible power to critical communications systems and Launch Site User equipment. Figure 2-3 shows the exterior of the RCC.

Figure 2-3: Exterior of Range Control Center

Launch Operations Control Center (LOCC): The LOCC is approximately 1,610 square feet and has raised flooring that allows for console reconfiguration. The LOCC is connected with an under-floor cableway to the Tech Control to accommodate connectivity changes. The LOCC has both fiber optic and satellite communications connectively for worldwide communications and data distribution, both secure and non-secure. This includes built-in pass-through connections to support connectivity to customer supplied launch vans.

The LOCC seats up to forty-nine (49) people with operations consoles for Alaska Aerospace and Launch Site User personnel. Workstations consist of computer monitors, keyboards, and CPUs. The mission voice network or Operational Intercom System (OIS) is also distributed to each workstation. 120/208 VAC, 3-phase, 60 Hz, 30-amp power is available in the LOCC. The LCC/LOCC has auto-transfer generator backup power and an UPS system capable of supplying non interrupted power to mission critical KLC and customer equipment.

In 2018 Alaska Aerospace upgraded the launch processing systems by modernizing the Launch Operations Control Center (LOCC), including built-in upgradeability by using COTS systems and links for possible remote LOCC capabilities or mirroring data/displays at off-site locations. New LOCC Console and Rack Replacements were installed, along with an upgraded Mission Communication and Network System. Meteorological Processing, Integration, & Test Capability upgrades were accomplished to provide improved weather forecasting capabilities during launch operations. These changes are shown in the Figure 2-4 picture below of the modernized LOCC.

Figure 2-4: Launch Operations Control Center

The LOCC was renovated in 2018 with state-of-the-industry technology. The configuration below in Figure 2-5 is an example of how the LOCC can be configured.

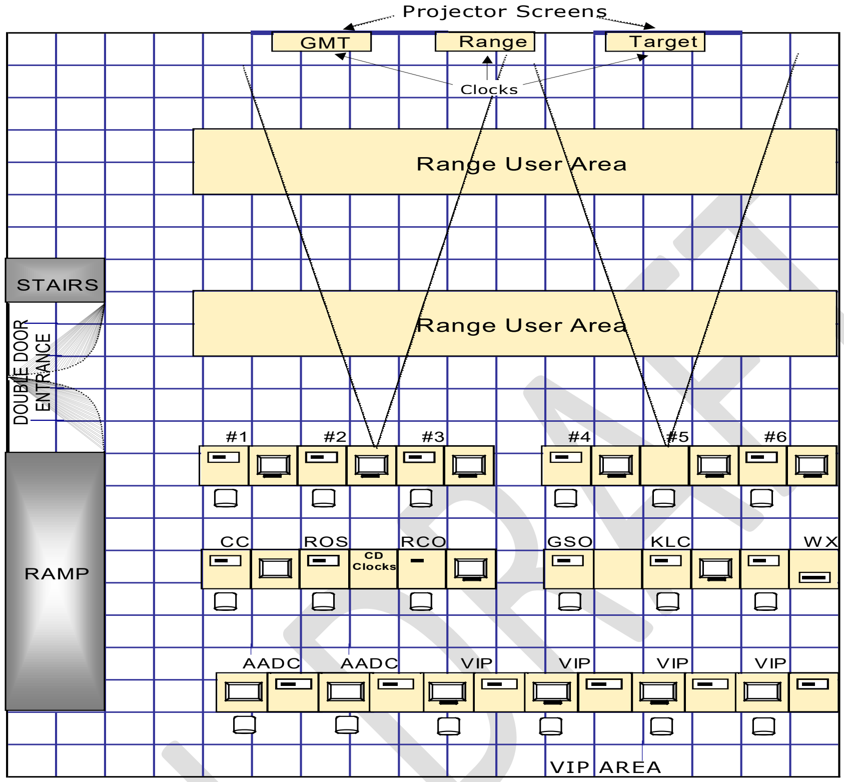


Figure 2-5: LOCC Interior Configuration Example

Engineering Office Area: The engineering office area (4,059 square feet) seen below in Figure 2-6, offers partitioned offices and cubicles. This area is generally configured to support 64 cubicles and offices. Electrical power, telephone and data connections are provided to each workstation. A dedicated customer Local Area Network (LAN) is provided for printing and internet access.

Figure 2-6: Enginering Office Area

Tech Control/Communications Room: The Tech Control/Communications includes the communications and network equipment shown in Figure 2-7. This area houses the core of the communications system, timing and countdown, Public Address, Closed Circuit Television, telephone, and the interface for the Hazardous Vapor Detection System (HVDS). Tech Control is also the interface point for external copper and fiber distribution cabling from other PSCA facilities and Launch Site User equipment.

Figure 2-7: Typical Tech Control Equipment

Meteorological Systems and Support

Alaska Aerospace provides comprehensive meteorological services at PSCA, including weather forecasting, ground observation, and upper-air observations for launch, as seen in Figure 2-8. A Launch Weather Officer (LWO) and Upper Air Observer (UAO) manage and relay weather forecasting, measurements, and data processing during operations.

PSCA's meteorological equipment include: W-9000 Dual Track GPS ground station, balloon inflation and sonde preparation, Weather Radar, Lightning Strike Detection System, Field Mill Lightning Potential Systems, Ground Weather Stations (RCC and launch pads); and Internet resources for accessing NOAA Weather Maps, solar activity monitoring, and other meteorological advisories. A new RDR200/GX weather radar is being installed at PSCA, with completion expected in 2019.

Figure 2-8: PSCA Meteorological Services

Ground and upper-air measurements include temperature, pressure, relative humidity, wind speed/direction, visibility, cloud cover, density, lightning, and potential gradient. Lightning strike, reflective index, and speed of sound are also available. Upper air measurements are available up to 100,000' with low-resolution balloon sondes, and up to 50,000' with high-resolution balloon sondes. Multiple balloons can be tracked at the same time. Launch weather constraints, advisories, and warnings shall be provided in accordance with program operational requirements.

Payload Processing Facility (PPF)

Space vehicles and payloads are processed in the PPF, which includes a 40’ x 60’ x 66’ receiving bay and a 40’ x 60’ x 66’ processing bay, as depicted in Figure 2-9. Each bay has 2,400 square feet of floor space for a total of 4,800 square feet. The PPF can be operated anywhere from a class 100,000 up to a class 10,000 clean room for the checkout and fueling of spacecraft, depending on customer needs. An air shower with air lock provides personnel access to the clean room. A washroom and area for changing clothes is also included.

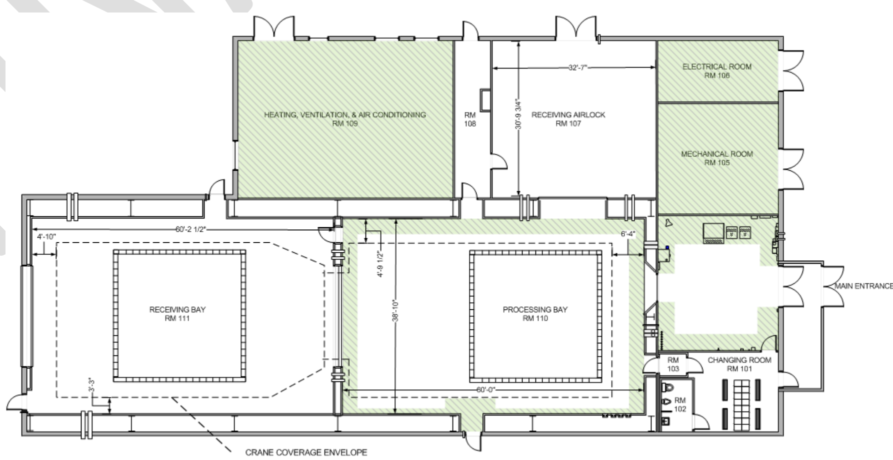


Figure 2-9: PPF Interior Layout

A 15-ton bridge crane with 50' of hook height serves both the receiving and processing bays. A 30’ x 32’ equipment airlock facilitates controlled entry of support equipment and fueling carts to the processing bay without having to open the primary airlock. Pass-through conduits are available to bring cabling from outside support equipment into the structure without compromising environmental quality. The PPF also includes a 700 square foot control room with blast shutter. The facility is equipped to support fueling operations of up to 10,000 lbs. of hydrazine/hypergolic fuel to space vehicles and payloads and includes a HVDS and appropriate engineering controls to provide a safe fueling environment. Each bay also has hazardous fuel containment trenches installed.

Figure 2-10: Payload Processing Facility

The PPF is also equipped with ordnance certified (Class 1, Div 2) electrical equipment. The breathing air system in the clean room is capable of supporting four SCAPEs from a wall mounted panel. Hypergolic fuels are stored proximal to the PPF in an approved vault. One of the two high bays is pictured in Figure 2-11.

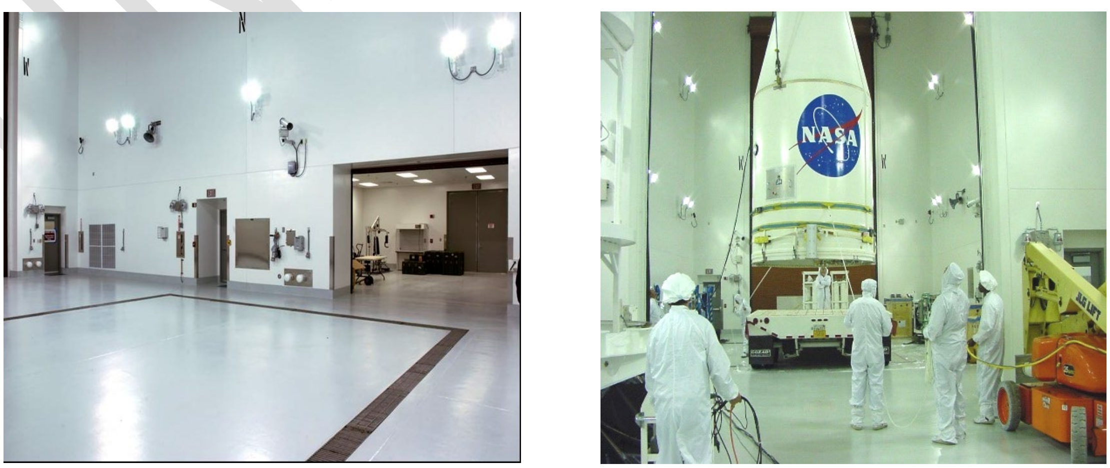


Figure 2-11: Payload Processing Facility (PPF) Interior

Propellant and Gases Support

AAC can provide inert gases (e.g., helium) and liquid oxygen (LOX) of required quantity, purity, and pressure in either standard sized cylinders or AAC's bulk storage, see Figure 2-12.

Figure 2-12. Bulk LOX and Helium Storage

The PPF receiving bay and processing bay are both equipped with containment trenches to support hypergolic fueling. A breathing air system capable of supporting four personnel in Self Contained Atmospheric Protective Ensemble (SCAPE) is internal to the PPF. A Hazardous Vapor Detection System (HVDS) monitoring system supports payload operations and can be equipped with multiple types of sensors as required.

A barricaded Hydrazine Storage Facility is located outside the PPF and sited for 10,000 pounds hazardous division (HD) 1.3 stored in Alaska Department of Transportation (ADOT) approved 4BW containers. The Hydrazine Storage Facility is constructed in the side of a hill which provides protection from fragments in the event of an explosive's mishap.

Figure 2-13: Hydrazine Storage Facility

Integration and Processing Facility (IPF)

The IPF is designed to support indoor horizontal processing of vehicles and other covered, horizontal operations. The IPF is a 50' x 100' environmentally controlled structure capable of maintaining vehicle specific temperature and humidity with four 40' high by 18' wide roll-up doors. The IPF is also equipped with ordnance certified (Class 1, Div 2) electrical power receptacles and a 25-ton bridge crane having 40' of hook height. A Test Assemblies Inspection Records Room, washroom/lavatory, and mechanical room complete the structure. Stepdown transformers and switch panels supply 208-480V, 3 phase and 120V single phase throughout the IPF.

Figure 2-14: Integration and Processing Facility

The IPF is located two miles away from the RCC. The IPF is equipped with a stand-by 600kW 480/277 Volt generator to power the entire building during outages. The generator fuel tank is sized to run the generator for a minimum of 72 hours at full load. Inside the IPF is pictured in Figure 2-15.

Figure 2-15: Integration and Processing Facility (IPF) Interior

Spacecraft Assemblies & Transfer Building/Launch Pad-2

The Spacecraft Assemblies and Transfer (SCAT) building is a self-contained, environmentally controlled rail-mounted mobile structure that is capable of enclosing Launch Pad 2 (LP-2) and used for vehicle transfers at the IPF and LSS to maintain all inside operations during loading and unloading. The SCAT is 45’ wide and 70’ long, with a 60’ high ceiling, with four roll-up doors. Three doors are 40’ high by 18’ wide, and one door is 43’ high to allow SCAT removal from the stool-mounted launch vehicles while on the LP-2 launcher. This structure is roller mounted on tracks between the IPF and the LSS.

The SCAT is also available as a launch vehicle processing building when positioned over LP-2. Ordnance certified (Class 1, Div 2) electrical power receptacles and 25-ton bridge crane with 45’ hook height service the SCAT. Both primary (750 KW) and standby backup generator (600 KW) power, with auto switchover, are available to the IPF-SCAT and launcher area. Electrical heaters and humidifiers provide environmental control.

Used to launch sub-orbital missions, and vehicle processing can be performed inside the SCAT by positioning it over the launch pad/stool at LP-2. LP-2 is supported by the Launch Equipment Building (LEB), a small blockhouse that provides pass-throughs to LP-2. It can also accommodate customer supplied launch stools. The reinforced concrete LEB, located adjacent to the LP-2, is environmentally controlled, and offers 108 square feet of floor space to house User electrical ground support equipment (GSE). Conduit pass-throughs are available between the LEB and the LP-2 to accommodate User umbilical connectivity. The SCAT/LP-2 is pictured in Figure 2-16.

Figure 2-16. SCAT/Launch Pad-2

To support the emerging small launch vehicle commercial market, Alaska Aerospace constructed two fueling earthen barriers in 2018, one for LOX and inert gas ISOs/bottles; the other for rocket fuel ISOs. Commercial supplied piping systems were connected from each of the two barriers to Launch Pad 2 for customers use during rocket fueling operations. By providing economical and sustainable liquid fueling capabilities, “New Space” customers will be able to benefit from the capability to launch small, liquid propelled vehicles with payloads that need polar and other high inclination orbits from the Pacific Spaceport Complex - Alaska.

Figure 2-17: LOX & Inert Gas Earthen Barrier at LP-2

Launch Service Structure (LSS)/Launch Pad-1 (LP-1)

LP-1 consists of a 174' tall LSS, which will accommodate Minotaur, Athena, Vega, Shavit, and Epsilon class vehicles and is mainly used for orbital launches. The LSS is an environmentally controlled, all weather facility, with adjustable height and adjustable diameter work platforms, flame trench, transporter erector accommodation, side entry with booster break-over accommodations, and fiber and copper connectivity to the RCC/LOCC.

The LSS is also equipped with ordnance certified (Class 1, Div 2) electrical power receptacles and has a 75-ton bridge crane to hoist rocket segments and payloads for vertical build up on the launch stool. Prior to launch, two rotating building sections are rotated clear of the launch vehicle. The LSS is also equipped with OIS, telephone, data, CCTV, and Paging/Area Warning systems. Stepdown transformers and switch panels supply 208-480V, 3 phase and 120V single phase.

The LSS is constructed with a 20' diameter throat by 40' deep flame trench rated for up to 1.3 Million pounds of thrust. Outside of the LSS is the Launch Equipment Vault (LEV), a reinforced concrete structure with pass-throughs to the pad and umbilical tower for communications, power, and conditioned air. The LEV is environmentally controlled and offers 331 square feet of floor space to house User launch vehicle electrical ground support equipment (GSE). Conduit pass-throughs are available between the LEV and LP-1 to accommodate umbilical connectivity. The LSS/LP-1 is pictured in Figure 2-18.

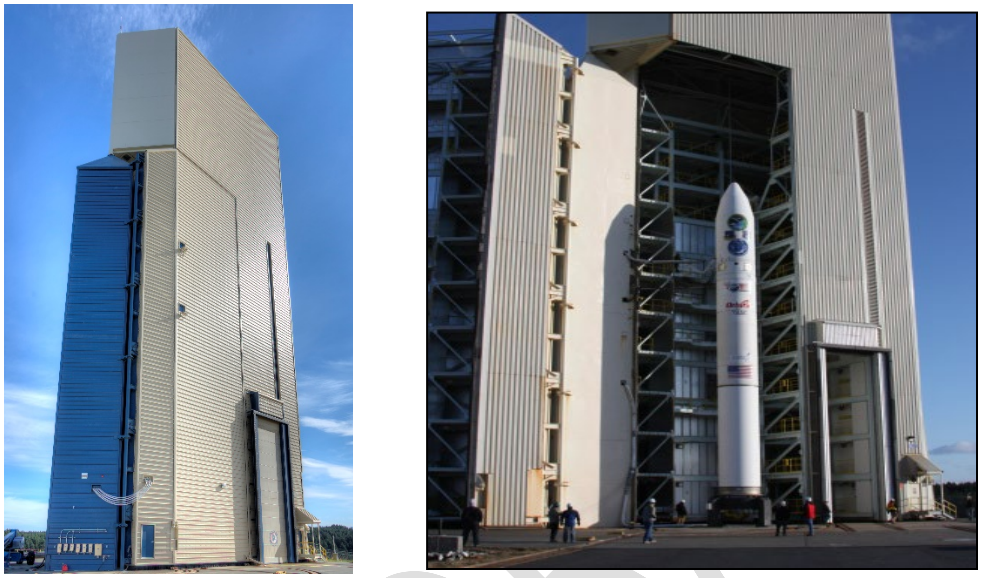


Figure 2-18: Launch Service Structure (LSS)/Launch Pad-1 (LP-1)

Range Safety and Telemetry System (RSTS)

AAC operates three RSTS systems: one fixed (T-1) and two mobile (T-2 and T-3). Each RSTS systems consists of two mobile, GPS based, S-band telemetry receiving and UHF command destruct systems, each with two 5.4-meter auto-tracking antennas, and two omnidirectional command destruct antennas.

Two RSTS systems often operate from PSCA with a transportable system operating at mission-specific off-axis locations depending on the mission geometry and requirements. The systems are highly-interoperable and integrate with each other or operate as stand-alone units. See Figure 2-19 for a picture of T-3.

Figure 2-19. Transportable Range Safety & Telemetry System

In 2018, telemetry and command destruct systems were relocated from a mobile facility into a fixed location within the Maintenance Support Facility. Testing and certification were completed by the summer of 2018 and used for both government and commercial launches the remainder of the year. Figure 2-20 shows a PSCA telemetry monitoring workstation.

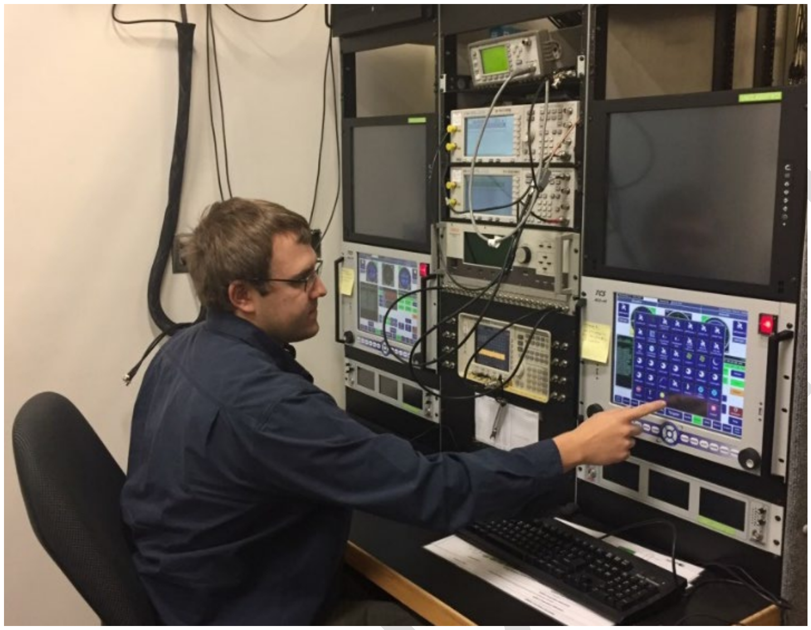


Figure 2-20: Telemetry Antenna Control Workstation

Instrumentation Field

A 260’ x 390’ gravel area that accommodates a wide array of spaceport instrumentation equipment and antennas seen in Figure 2-21. It provides line of sight to all launch pads. This area also houses a weather radar, surveillance radar, security cameras, customer equipment, and a communications, power and fiber optics hub.

In 2018, modifications were completed on Telemetry System 2 (T-2) and two new telemetry antennas, Telemetry and Communications Inc (TCS) Model 5000 antenna system, were procured, installed, and are designated as Telemetry System 1 (T-1). The T-1 antennas are permanently mounted with radome covers. The radomes improve system availability as it protects the antennas from the environment and can improve antenna performance since high winds and temperature variations can distort the shape and pointing direction of the reflector. The radomes also provide a benign environment for personnel when working on the antenna system. This system is state-of-the-industry and provides full-sky auto-tracking feed that receives in both the L and S Bands, with the capability for C-Band tracking.

The instrumentation field is secured by an 8' barbwire topped fence with controlled access and includes the Antenna Field Utility Building (AFUB), Range Radio Equipment Building (RREB) and antenna pads. The AFUB supplies power and communication, via copper, fiber, and coax, to meet customer requirements. A single, 500 KVA transformer supplies 480V power to provide lugged 1-phase or 3-phase 120/208 VAC volts. The RREB facilitates radio communication throughout the entire complex.

Within the instrumentation filed, SpaceX has installed a single, radome covered small tracking antenna used to support SpaceX missions.

Figure 2-21: Instrumentation & Antenna Field

Telemetry Subsystem

The RSTS telemetry subsystem is capable of receiving multiple telemetry downlinks in a redundant configuration via dual auto-tracking antennas. The RSTS receives and records the downlink S-band data and computes and performs engineering unit conversion, while sending Launch Site Safety-pertinent data to the two Mission Flight Control Officer (MFCO) positions. Each RSTS is capable of processing 16 telemetry streams with a maximum data rate of 20 Mbps, with complete redundancy: formats include PCM/FM, PCM/FM/FM, BPSK and A-QPSK. Each stream is processed through redundant antenna paths and redundant receiver channels. Pre-D analog and combined Post-D Recording is available. Timing, telemetry modulation, formats, and rates are compatible with IRIG standards.

Launch Site Safety Subsystem – Command Destruct System (CDS)

The CDS Subsystem provides for a Range Safety Operator /Mission Flight Control Operator to verify a safe flight trajectory or terminate the flight if flight safety criteria are violated. This command destruct is accomplished by transmitting a UHF 1 KW signal modulated by secure or standard IRIG tone frequencies. Two antennas operate for each Command Subsystem: a low-gain omni-directional antenna for the early boost phase and the high-gain auto-track antenna for downrange boost phase.

The omni-directional antenna and a command RF signal monitoring probe antenna are mounted separate from the steerable auto track antennas. The center frequency for the command transmitter is tunable from 400 MHz to 450 MHz and is able to receive and decode 20 IRIG tones and 7 secure tones.

Re-Radiation Telemetry Coverage Support

An S-band to L-band Re-Radiation (Re-Rad) system can be deployed to Pasagshak Point in support of missions if required. The purpose of the Re-Rad system is to augment telemetry coverage during a potential S-band plume attenuation at PSCA before Acquisition of Signal (AoS) to the off-axis site. The off-axis site is also useful for optical tracking of launches.

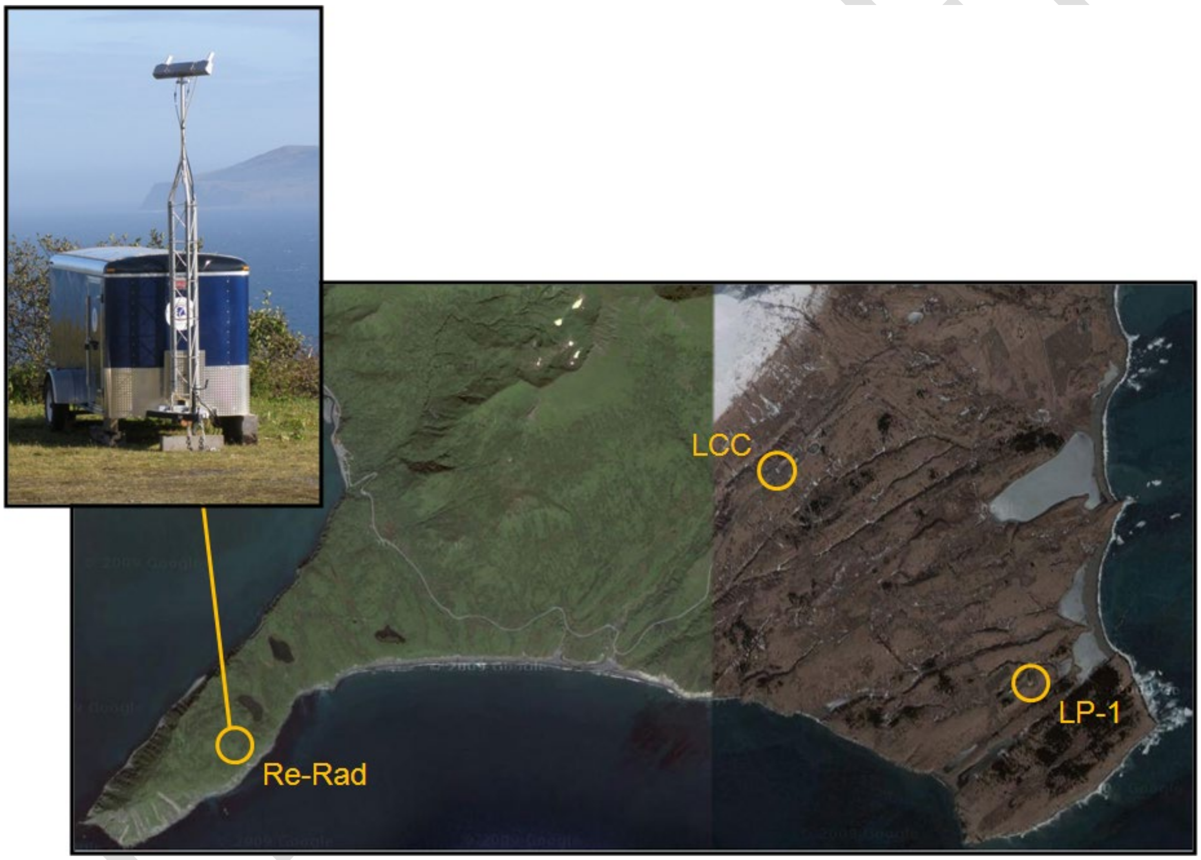


Figure 2-22: Pasagshak Point Re-Rad Site

Rocket Motor Storage Facility (RMSF)

The Rocket Motor Storage Facility (RMSF) shown in Figure 2-23, is comprised of two Earth Covered Magazines (ECM's) for short- or long-term storage of rocket motors. The RMSF is designed using the DDESB Technical Paper 15 approved 7-bar Oval Arch Steel Magazine design number 421-80-03. Each ECM is suited for 225,000 lbs. HD 1.1 and 225,000 lbs. HD 1.3. The RMSF allows multiple customers to have motors at PSCA at the same time. The 7-bar DDESB approved design of each ECM will protect the contents of the magazine even if there is detonation in an adjacent magazine. The RMSF is separated from the lower range by Intra-Line Distance (ILD) in order to provide direct support to the launch pad area, regardless of the mission. A modification to the RMSF is being completed in 219 that will provide additional processing capability in ECM-2.

Figure 2-23: RMSF Storage Bunkers

Maintenance and Support Facility (MSF)

The MSF is a 19,000 square foot building housing three large maintenance and support bays that provide all-weather in-door equipment maintenance and support areas for PSCA: as well as storage bays for RSTS and customer equipment. Within the MSF there are three separate bays. One bay is dedicated as a maintenance shop for PSCA. In this bay PSCA personnel conduct vehicle maintenance. In addition, the site is equipped to do light fabrication work for both PSCA facilities and customer requirements. This section of the MSF also has a small kitchen for use by both PSCA personnel and customers, as well as the washroom facilities for the MSF. A small bunkroom provides capability of supporting up to six personnel overnight when weather conditions preclude road travel back to Kodiak, or for short durations for individuals required to work extended hours at PSCA. On the second floor of the MSF, above the first bay area, are offices for use by PSCA staff.

A second bay is used for storage and maintenance of equipment of RSTS equipment. Within this bay a fixed telemetry station has been installed. Offices are located above the fixed telemetry station for personnel that support RSTS operations. The third bay is used for storage of inventory and can be dedicated for Launch Site User support.

The MSF has a stand-by 100kW generator that supplies power to the entire building during outages. The MSF is surrounded by paved parking that can accommodate up to twenty (20) vehicles. The MSF is secured by an 8’ barbwire topped fence with controlled access. The MSF is pictured in Figure 2-24.

Figure 2-24: Maintenance and Support Facility (MSF)

Soft-Side Storage Units

Located directly behind the MSF are two soft-sided unheated storage units. Each unit measures 100 ft by 30 feet. These units are used by PSCA for long term storage of a variety of equipment.

Vehicle Fueling Tanks

PSCA maintains two tanks for storage of diesel fuel and motor gas. These tanks are constructed of reinforced metal, surrounded by a concrete barrier and environmentally approved containment catchment area. Tank one has a 1000-gallon motor vehicle fuel capacity, while the second tank holds up to 2000 gallons of diesel fuel.

Extended Mission Control Center (EMCC)

The EMCC was developed as an expanded area to accommodate larger-staffed government launch campaigns. Within the secure fence line there is 68,500 square feet (250’x 274’) of compacted gravel. Power infrastructure includes a 750 kva 3-phase transformer that supplies 480/277 volts at both 50hz and 60hz to a central command complex and several outlying shelters. The low voltage infrastructure includes fiber optic and ethernet cable for communication, security, data requirements and launch support. LED area lighting is attached to four 40’ poles that also support security cameras. Facilities in the EMCC mimic the RCC and includes a launch control center, conference room, security building, three office buildings, break room/kitchen building, and restroom facilities for men and women. The EMCC is pictured in Figure 2-25.

Figure 2-25: Extended Mission Control Center (EMCC)

Long Range Radar Area (Area 1)

Area 1 was developed as a long-range radar site for government launch campaigns. The compacted gravel pad within the secured fence line is 50,000 square feet and 3 feet thick (200'x 250'). To the north and west of the Area 1 Pad, there is an additional 90,000 square feet of compacted gravel for parking and storage. The Entry Control Point (ECP) is a 20-foot shipping container that serves host to a security office and the electrical & communication distribution center. Power infrastructure includes a 750 kva 3-phase transformer that supplies 208/120 volts at 60hz. The low voltage infrastructure includes fiber optic and ethernet cable for communication, security, data requirements and launch support. LED area lighting is attached to five 40' poles that also support security cameras. Power, fiber optic and ethernet cable is distributed to eight asset pedestals within the secure fence line. These pedestals provide the customer complete plug and play capability when assets are deployed to the Pad. The Area 1 Pad is pictured in Figure 2-26.

Figure 2-26: Area 1 Long Range Radar Site

Radar Gravel Pad (Area 2)

Area 2 was developed as a radar tracking site for government launch campaigns. The compacted gravel pad within the secure fence line is 112,450 square feet and 3 feet thick (325'x 346'). To the west of the Area 2 Pad, there is an additional 12,000 square feet of compacted gravel area for parking. The ECP is a 20-foot shipping container that serves host to a security office and the electrical & communication distribution center. The power infrastructure includes a 500 kva 3 phase transformer that supplies 208/120 volts at 60hz. The low voltage infrastructure includes fiber optic and ethernet cable for communication, security, data requirements and launch support. LED area lighting is attached to four 40' poles that also support security cameras. Power, fiber optic and ethernet cable are distributed to ten asset pedestals within the secure fence line. These pedestals provide the customer complete plug and play capability when assets are deployed to the Pad. The PSCA main water tank supplies water to a yard hydrant near the ECP. The Area 2 Pad is pictured in Figure 2-27.

Figure 2-27. Area 2 Radar Site

Government and Commercial Launch Pads (Area 3)

Government Launch Pad (Pad 3A)

Pad 3A is a 10,000 square foot (100'x 100') compacted gravel launch pad intended for use during government launch campaigns. Pad 3A currently has no electrical or communication infrastructure installed. Also included on Pad 3A is a 75'x 25' fenced area used as secured storage. Future government programs will provide actual requirements for any needed infrastructure and additional development. Pad 3A is pictured in Figure 2-28.

Figure 2-28. Pad 3A Government Launch Pad

Reserved Commercial Launch Pad (Pad 3B)

Pad 3B, located in the south-central quadrant of Area 3, is a commercial orbital-class launch pad. Pad 3B design includes 50,000 square feet of compacted gravel, concrete pads for a launch stool, liquid oxygen fuel tank (LOX), rocket propellant tank, and a 50' x 80' fabric building for launch vehicle processing and storage. The pad is secured with chain-link fencing and access control entry points. As with all PSCA launch pads, the infrastructure includes fiber optic and ethernet cabling for communications, security, and launch support. Pad 3B is pictured in Figure 2-29.

Figure 2-29: Commercial Launch Pad 3B

Combined Use Government and Commercial Pad (Pad 3C)

Pad 3C was originally developed as a 10,000 square foot (100'x100') compacted gravel pad for government launch campaigns. Pad 3C has been modified to provide capabilities for commercial liquid propellant light lift vehicle launches. Modification include concrete pads for a launch stool, vehicle transport erector, liquid oxygen (LOX) pad and fuel pad. The addition of liquid propellant capabilities has introduced the need to construct protective berms at the fuel pads per requirements in the AAC Launch Operators' license. To the west of the LOX pad, there is an additional 5,525 square feet of compacted gravel for rocket propellant tank access and storage. To the east of the propylene pad there is also an additional 3,750 of compacted gravel for propellant tank access and storage. The ECP shipping container hosts the power and low voltage distribution equipment. Pad 3C power infrastructure includes 3-phase transformer that supplies 240/120 volts at 60hz. The low voltage infrastructure is a network of fiber optic and ethernet cable for communication, security, data requirements and launch support. LED area lighting is attached to four 40' poles that also support security cameras. Pad 3C is pictured in Figure 2-30.

Figure 2-30: Pad 3C Joint Use Government Commercial Launch Pad

Government Gravel Pad (Pad 3D)

Pad 3D is a 10,000 square foot (100'x 100') compacted gravel launch pad intended for use during government launch campaigns. Pad 3D is ideally suited for use with a mobile launcher or a transport erector for light lift launch capabilities. The ECP shipping container hosts the power and low voltage distribution equipment. Pad D power infrastructure includes single phase transformer that supplies 240/120 volts at 60hz. The low voltage infrastructure includes fiber optic and ethernet cable for communication, security, data requirements and launch support. LED area lighting is attached to four 40' poles that also support security cameras. Pad 3D is pictured in Figure 2-31.

Figure 2-31: Pad 3D Government Launch Pad

Life Support Area Gravel Pad (Area 4)

Area 4 Life Support Area (LSA) was originally constructed as a 50,000 square foot (200'x 250') compacted gravel pad for temporary soft wall accommodations that would house 100 government personnel. Power infrastructure includes a 300 kva 3-phase transformer that supplies 208/120 volts at 60hz. The low voltage infrastructure is a network of fiber optic and ethernet cable for communication, security, and data requirements. LED area lighting is attached to four 40' poles that also support security cameras. Also installed was a 2500-gallon gray water septic tank with a 5,000 square foot absorption bed. Potable water is supplied to LSA from the PSCA main water tank. At the end of the 2017 government program, the temporary LSA facilities were disassembled and shipped back to Anchorage. Area 4 is pictured in Figure 2-32.

Figure 2-32: Area 4 Life Support Area (LSA) with Temporary Facilities

Vacant Gravel Pad (Area 5)

Area 5 is a 50,000 square foot (200'x 250') compacted gravel launch pad intended for use during government launch campaigns. The ECP shipping container hosts the power and low voltage distribution equipment. Power infrastructure includes a 225 kva 3-phase transformer that supplies 208/120 volts at 60hz. The low voltage infrastructure is a network of fiber optic and ethernet cable for communication, security, data requirements and launch support. The plug and play capabilities at Area 5 are well suited for rapid deployment mobile launch programs. When not in use as a launch pad, Area 5 is commonly used by government programs as secured storage.

Figure 2-33: Area 5 Government Launch Pad

SECTION THREE – Ancillary System Descriptions

This section highlights the many multifacility capabilities provided at PSCA common to some, or all of the spaceport facilities. Each site within PSCA is connected by Operational Intercom System (OIS), telephone, data, Closed Circuit Television (CCTV) and Paging and Area Warning (P/AW) systems. Communication is by dual submarine fiber optic telecommunications systems connecting Kodiak Island with the Kenai Peninsula and Anchorage, as well as a second connection to Seward. Both cables onshore connection is at Narrow Cape adjacent to PSCA. Both secure and unsecure communications can be transmitted through this system. Technical systems supporting the facilities and operations at PSCA are addressed in this section.

Fiber Optic and Copper Backbone Systems

Fiber optics and copper communications lines run underground throughout the PSCA. The Tech Control is the central hub between the Instrumentation Field, PPF, IPF, LEB, LEV, RMSF, and other launch pads. Connectivity is available for customer use at each facility.

Communications Systems

PSCA's modern communication infrastructure includes fiber optic marine cable to mainland Alaska and the lower 48 states. Offsite communication is provided through fiber optic marine cable via Tech Control downlinking to locations required by the Launch Site User. The locations include, but are not limited to, Anchorage, Cordova, and Seattle. This system provides T-1 and IP based services for voice, data, and Internet connections. If fiber optics is unavailable at an off-axis site, communications would be routed through satellite communication (SATCOM) ground station with its antenna located at PSCA. Communication from the Launch Pads to the other facilities at PSCA is via telephone, operational intercom, paging, and the data network. All communications, security, fire alarm, and area warning are controlled at the resident facilities and report back to Tech Control.

Closed Circuit Television (CCTV)

CCTV is available in each of the PSCA facilities. A video switch located in Tech Control determines what displays have access to individual camera outputs and allows slave control for Launch Site User predetermined cameras so that monitoring and control of cameras can be accomplished from the LOCC.

In the PPF, local control of cameras is available in the PPF Control Room. At LP-1, local control for tower and pad perimeter cameras is available from the LEV.

Paging and Area Warning (P/AW)

The P/AW system provides paging and initiation of area warnings such as hazardous operations, lightning alerts, or security concerns throughout the PSCA. Each facility is equipped with direct access to the paging system through a dedicated station with speakers located to allow dissemination of pages or area warnings throughout interior and exterior areas. At the direction of the Launch Director or PSCA Launch Site personnel, a pre-programmed alert signal can be sounded throughout the Complex.

Telephone

A PBX telephone system provides phone communications throughout PSCA. This system is configurable to allow controlled access to long distance service. The phone system interfaces with the OIS allowing remote users to monitor various intercom networks. Phone location and quantity may be specified for each campaign.

Operational Intercommunication System (OIS)

A mission critical networked OIS is installed throughout PSCA. The OIS is a Quintron DICES IV intercom system and can be connected depending on Launch Site User requirements.

The OIS interfaces with the telephone and P/AW systems to allow monitoring of the OIS by remote users via telephone and paging initiation on the P/AW system. The OIS provides direct communication from station to station. Stations are either 24 or 6 channel with handsets and headsets, depending on location and need.

Timing Systems: Real-Time, Mission Clock, Countdown Clock

Timing information is available throughout the Complex with Time of Day (TOD), countdown, and mission elapsed time displays in various locations. The system consists of a master controller in the RCC. Display units are located in the RCC, LOCC, PPF, and IPF. The display unit consists of three items: GMT or Zulu time, Launch Site time, and LV/missile countdown time. These units are wall mounted in strategic places in each facility.

Timing is based on either an IRIG-B or IRIG-G signal format. TOD is based on GPS time from a receiver at the RCC. The IRIG-B signal is available at BNC (Bayonet Neill- Concellman) connector outlets in the PPF and IPF for connection to Launch Site User equipment.

Hazardous Vapor Detection System (HVDS)

HVDSs are installed in the PPF and LSS. Each facility reports to its own controller, which then reports to the control unit in the RCC.

The PPF and LSS HVDS systems are connected to the RCC for monitoring purposes and interfaces with the fire alarm, C/AW, and P/AW systems. Detection in the PPF is from ceiling-mounted detectors and from portable detectors positioned by the Launch Site User for optimum detection. Each HVDS will be fitted with chemical sensors specific to the chemicals to be detected (i.e., hydrazine, ammonia).

Hazardous vapor detection in the LSS is provided through portable detectors positioned by the Launch Site User. Connection points are available on work levels where detectors are expected to be placed. The detection of a hazardous vapor condition will initiate audio and visual alarms at the affected facility and at the fire alarm control panel in the RCC.

Security

AAC must ensure that PSCA is compliant with guidelines and requirements defined in the NISPOM for the protection of national security information. AAC must also comply with mission specific security requirements associated with the flight hardware and defined in security classification guides.

The PSCA Facility Security Officer (FSO) is located in the RCC and available to the customer to assist with security matters related to PSCA. Physical security for the various facilities throughout the site includes both external and internal security features to control access and detect intrusion. Balanced magnetic switches and infrared detectors are used to monitor access. Electrical and Mechanical Spin Dial and keyed locks are used to control access. The security systems function through contact-type door switches and passive infrared detectors to transmit entry and exit status, integrity, and alarm signals to the local control unit and the master control unit in the RCC. Alarms are both visible and audible in the RCC security office.

Each facility has a security system consisting of intrusion detection devices that are connected to a control panel. The PSCA site security systems are UL-certified. Entry and passive sensors are used to monitor access and detect intrusion. Secure locking systems are used to controls access. The security systems function by transmitting status, integrity, and alarms signals to local and remote units. Alarms are both visible and audible.

Caution and Area Warning (C/AW)

C/AW lights are installed at a variety of PSCA locations to alert people when operations are being conducted at the spaceport. The C/AW consists of pole-mounted warning lights that use a three-color approach to visually indicate dangerous operations. A green light represents non-hazardous operations. An amber light indicates that hazardous operations are active and that access to the facility is limited. A red strobe light means that an emergency condition exists or launch operations are underway and access to the facility is restricted. Manual control stations are located inside each facility.

Water Storage Facility

PSCA maintains a well water storage tank on site. The water storage tank is located near the PPF and has a capacity of 169,000 gallons of water. Water distribution lines extend from the water storage tank to all facilities at PSCA where the water flows through individual facility Water Treatment Plants.

Power Distribution

Public electrical power provided by the Kodiak Electric Association, along with on-site standby generators configured with Uninterruptible Power Supplies (UPS), provide power throughout the Complex. High voltage main facility power conduits are buried.

Commercial Power Interface

Primary commercial electrical power is supplied at 24,000 Volts via an underground grid to step down transformers at each of the three main launch and processing facilities. Each facility has switch panels, with 480/277V, 3 phases, 120/208V, 3 phase and 120/240V single phase for distribution to the equipment. Single phase 220 V power is available upon request. Additional power capacity is available with site modifications.

Electrical receptacles in hazardous materials processing areas are Class 1/Div 2 ordnance certified. Receptacles in administrative and non-hazardous processing areas are standard.

Backup Power

Each generator starts automatically upon loss of power and provides backup power for essential equipment within the PSCA. The minimum operating time of each generator is 72 hours for normal operations.

Uninterrupted power supply (UPS) backup is provided for critical equipment in areas where required. Launch Site Users may bring their own UPS system for Launch Site User-supplied equipment.

Area	KW	Voltage	Hz	Phase	Type	Fuel	Connected Facility
RCC	350	480/277	60	3	Standby	Diesel	RCC, Balloon Building
MSF	100	208/120	60	3	Standby	Diesel	MSF, RREB, AFUB, and MSF Water Treatment Plants
RSTS	65	208/120	60	3	Portable	Diesel	Mobile Antenna, CDS System
PPF	500	480/277	60	3	Standby	Diesel	PPF, PPF Water Treatment Plant and Facility Fire Pump
IPF	600	408/277	60	3	Standby	Diesel	IPF, SCAT, LSS, LEB, LEV, Water Treatment Plant and Facility Fire Pump

Table 2-1: Back-Up Generator Specifications and Locations

Electrical Grounding and Lightning Protection

Non-ordnance related electrical grounding and bonding systems at PSCA are installed according to articles 250 and 500 of the National Electrical Code (NEC).

Ordnance grounds, where ordnance is stored and tested on vehicles (PPF, IPF, LP-1 and LP-2), are provided via dedicated ground buss bars connected directly to the ground grid. Ordnance grounds are tested biannually and at the request of customers and are in accordance with AFMAN 91-201 section 2.52 and 2.53, and Air Force Instruction (AFI) 32-1065, Grounding Systems.

PSCA’s high voltage transformers are equipped with counterpoises that are connected to the ground grid at each facility having a transformer. Each occupied building has a buried copper ground grid surrounding its perimeter. Building steel is bonded to the grid at several locations. The mobile SCAT is connected to the grid by hot line clamps.

Lightning protection is provided on PSCA facilities in accordance with National Fire Protection (NFPA) Standard 780 Lightning Protection Code. A 10' air terminal on top of a 42' 5" in tower provides lightning protection when the SCAT is located away from LP-2. Grounding grids are tested biannually and upon customer request. Chain link fences are also grounded. Grid continuity is provided by copper cable bonded to the building grids.

Fire Protection, Alarm and Reporting

An automated pre-action system provides fire protection for the PPF and IPF facilities. Hydrant service is available at the RCC. A 4-inch Class II standpipe is provided for the LSS with fire hoses provided at each work level. Additional site fire protection is provided for by fire hydrants located in parking lots and along the main road and access drives and a 750-gallon pumper fire truck.

Each facility has its own fire alarm, detection system, and fire alarm control panel. Each fire alarm control panel reports back to the Master Display Unit in the RCC. The Master Display Unit has a modem connection for off-site reporting to Alaska Aerospace personnel. Additionally, sensors automatically activate zoned sprinkler systems in the PPF and IPF.

Cranes

Bridge cranes are located in the PPF, IPF, LP-2/SCAT, MSF, and LP-1/LSS. Alaska Aerospace personnel maintain and safety-certify each crane. Crane operation during payload processing is performed by the Launch Site User's personnel or Alaska Aerospace personnel, if desired. Operators must be certified as operators of the specific cranes. Launch Site Users are required to submit a list of critical and flight hardware certified crane operators to Alaska Aerospace prior to operating any crane. Alaska Aerospace personnel shall provide familiarization for crane operation to Launch Site Users as required.

Detailed descriptions of the facility bridge cranes are listed in Table 2-2.

Facility	Capability (Tons)	Hook Height (Ft)
PPF	15	50
IPF	25	40
LP-2/SCAT	25	45
LP-1/LSS	75	157

Table 2-2. Facility Cranes and Capabilities

SECTION FOUR - Public Lands, Cultural Environment, and Operations Closure Procedures

Dept of Natural Resources, Interagency Land Use Management Agreement (ILMA)

The core of PSCA consists of 3,717 acres of state public land for spaceport operations under an ILMA (ADL 226285). The ILMA was granted in 1994. In 2008, the ILMA was amended to provide an additional 7,048 acres of outlaying area surrounding PSCA which may be closed to public access, to "include state lands, tidelands, and waterways," for limited periods during hazardous operations, such as launch vehicle fueling and launch activities for safety reasons. This area includes Pasagshak Point and Surfers Beach, as well as Ugak Island.

Planning and Zoning

PSCA is located on the east side of Kodiak Island in area known as Narrow Cape and is situated on lands zoned under the Kodiak Island Borough as a "Conservation District."

Alaska Aerospace is a state-owned corporation operating under Alaska Statute 26.27.120, which gives Alaska Aerospace the authority to "exercise its corporate powers within a municipality specifically in all portions of a space-related facility or territory to the same extent and in the same manner as in areas of the space-related facility or territory not within the boundaries of a municipality." This has been determined to mean that Alaska Aerospace is granted immunity from complying with local land use regulations and not required to seek local government zoning approvals for space-related activities at PSCA.

However, Alaska Aerospace recognizes the value of engaging with the local government. As such, Alaska Aerospace did request and receive two Conditional Use Permits (CUP) for gravel extraction in support of constructing PSCA and two CUP's for temporary housing of construction workers during the initial stages of the spaceport development phase from the Kodiak Island Borough Planning and Zoning Commission. This Spaceport Master Plan is intended to provide the Kodiak Island Borough Community Development Department with a projected land use and development plan for the years 2020 – 2030.

Public Lands Use and Trails

As identified in the 2016 Kodiak Launch Complex Launch Pad 3 Environmental Assessment Finding of No Significant Impacts document, dated April 2016, "There are no formally designated parks/recreational areas, wildlife, or waterfowl refuges, or historic sites" located on PSCA lands. The lands are part of the State public lands which are generally open to recreational uses, such as fishing, hunting, surfing, hiking, camping, boating, beachcombing, picnicking, and wildlife and scenic viewing, except during periods of hazardous operations where PSCA has the authority to restrict access for short periods of times.

Lands assigned to PSCA are co-occupied by the Burton Ranch, a commercial ranching operation, under a separate state-issued livestock grazing lease. Under the Burton Ranch grazing lease agreement, the lands within the PSCA ILMA may be used for grazing.

In 2011 the Kodiak Island Borough incorporated into the 2008 Comprehensive Plan the November 2011 Kodiak Road Systems Trails Master Plan (KRSTMP). This document categorized the numerous trails systems on the island and specifically identifies two trails that are located within the 3,717 acres of land under Alaska Aerospace management control for PSCA.

The first is the Narrow Cape Loop trail that starts above the bluff north of Twin Lakes and proceeds down to Fossil Beach. From Fossil Beach the trail circumnavigates the shoreline of Narrow Cape back to Twin Lakes. It is 4.6 miles in length. In the 2004 *Kodiak Trails Survey of Residents and Enthusiasts*, this trail was ranked as the second most important wildlife viewing trail and third most important bird viewing trail within the Kodiak Island Borough.

The second trail is The Burton Ranch Trail which starts at the intersection of Pasagshak Road and Kodiak Cattle Company Ranch Road, also known as the Burton Ranch Road, and follows the Kodiak Cattle Company Ranch Road along the gravel road eastbound to north of Barry Lagoon and then veers to the left and down the hill to the Burton Ranch and beyond. The trail leaves PSCA as it veers down the hill towards the Burton Ranch and extends 7.62 miles northeast. From this trail there is also a spur trail known as the Barry/Sacramento Trail that extends along the north shore of Barry Lagoon to its south shore.

The Kodiak Audubon's have also categorized public trails on Kodiak Island, specifically focused on trails best suited for birding along the Kodiak road system. In the vicinity of Narrow Cape, the Audubon's Trail Plan trails mirror the KRSTMP trails, but includes additional trails for bird viewing. The Audubon's Trail Plan includes a trail that connects Fossil Beach with Surfing Beach. This trail is on a rise above the shoreline and is a tremendous vantage point for birding, as well as for whale watching. From this trail, on the ridge line north of Fossil Beach, the Audubon's Trail Plan as identifies a trail that extends from the shoreline to Pasagshak Road. While the trail is not described on the Kodiak Audubon Society map, the area is known for both flora and fauna viewing.

On the east side of PSCA, the Audubon Trail Plan includes a trail that extends from Pasagshak Road to the south shore of Barry Lagoon and then veers to the right and extends down the shoreline, with two branches on each side of Triple Lakes, to join with the KRSTMP Narrow Cape Trail.

All trails on PSCA are for non-motorized use, except when on an existing paved or un-paved road.

United States Coast Guard (USCG) LORAN-C Navigation Site

The USCG operated a LORAN navigation transmitter station within the boundaries of PSCA until 2012 when the site was decommissioned, and the 625-foot-tall antenna was dismantled.

Cultural and Historical Environment

PSCA is situated on State of Alaska lands under the management of the Department of Natural Resources. However, the lands have historically been occupied by Native Alaskans and the launch complex is near lands with Native Alaskan interests. Previous environmental studies of PSCA have concluded there is “No Historic Properties Affected” with development of spaceport facilities within the area designated under the ADNR ILMA. Furthermore, the previous documents concluded there is very low probability of any prehistoric archeological or cultural resources that would be impacted by the development at PSCA. However, it was recommended, the State of Alaska concurred, that because there may be a potential to encounter archeological resources within development areas it is prudent and feasible to conduct identification efforts in advance of construction. Should archeological resources be encountered, they would be protected, and a testing plan established to determine the value/importance prior to proceeding with development/construction in the area where the resources were found.

PSCA lands and those surrounding the complex are owned by the State of Alaska, ADNR, shown in lime green on Figure 2-30. Alaska Aerospace has an Interagency Land-Use Management Agreement with ADNR for use of the 3,700 acres located at Narrow Cape. There are no population centers located at Narrow Cape. Four miles west of PSCA is the community of Pasagshak, while twelve miles north is the community of Chiniak.

Twenty-six miles southwest of PSCA, at the south shore of Kiliuda Bay, the U.S. Fish and Wildlife Services controls the majority of lands on the southern end of Kodiak Island, shown in dark green on Figure 2-34.

There are a number of Native Alaskan tribes, villages, and corporations located on Kodiak Island. Some have sub-surface and/or surface ownership rights, while others are service organizations, and/or corporations established by the 1971 Alaska Native Claims Settlement Act (ANCSA). Those with the most direct connection to PSCA operations are addressed in this section to ensure that future development plans include the perspectives, concerns and interest of these neighbors.

Leisnoi is a native corporation established by ANSCA which owns approximately 50,000 acres of land on Kodiak Island, most lying from northeast to northwest of the State of Alaska lands north of PSCA. The two closest holdings to PSCA are the Cape Chiniak holding which is an 18,325 acre parcel of heavily wooded lands. Leisnoi also is the landowner of a 15,000 acre holding at Kalsin Bay.

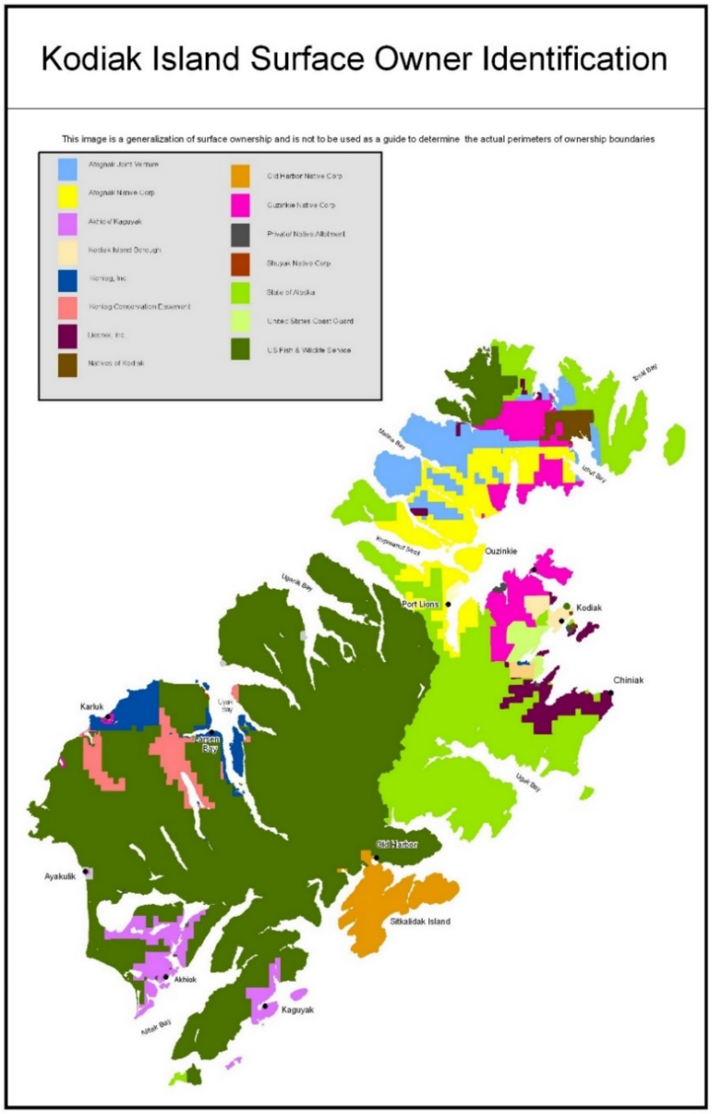


Figure 2-34: Kodiak Island Surface Owner Identification Map

The Native Village of Old Harbor is located forty miles southwest of PSCA and is the closest community directly affected by launches from PSCA, as the village sits just west of the restricted airspace during launch operations. As will be discussed later in this section, during launch operations the FAA establishes a Temporary

Flight Restricted area the results in closing the mountain passes between Old Harbor and Kodiak used by the air service companies to transit between the two communities. The village is known for practicing its traditional Alutiiq culture and subsistence lifestyle. The community relies on the natural resources of the surrounding sea and land environment for livelihood. Today, the community of Old Harbor has a modern airstrip, a harbor for its fishing fleet and the modern amenities of water, sewer, electricity, internet and satellite services, and is continuing to grow each year. The Old Harbor Tribal Council is a federally recognized Tribe, and was established in 1968, to serve the native community of Old Harbor. In addition, the Old Harbor Native Corporation is a Native village corporation established by ANCSA to provide economic opportunities to shareholders. According the Old Harbor Native Corporation, the corporation “maintains a balanced portfolio of investments in the securities market and owns commercial properties in Anchorage and Kodiak.”

Kodiak Area Native Association (KANA) is a nonprofit corporation providing health care and social services for the Alaska Natives and provides resources for improved health and wellbeing, including Medical, Dental, Behavioral Health, and Community Service Programs to serve the communities of the City of Kodiak, Akhiok, Karluk, Old Harbor, Ouzinkie, Port Lions, and Larsen Bay.

The Sun’aq Tribe of Kodiak is a federally recognized Alaska Native Tribe located within the City of Kodiak on Kodiak Island in the north-western edge of the Gulf of Alaska. The Sun’aq Tribe of Kodiak’s traditional homelands, as identified in Tribal Resolution No. 2010-35 which encompasses an area of nearly 75,000 square miles of land and sea and includes the area surrounding PSCA, as depicted in Figure 2-35. Over two-thirds of the Alaska Native population living in the Kodiak archipelago are members of the Sun’aq Tribe of Kodiak, which is the largest of the 10 federally recognized Tribes in the area and the largest Alaska Native community in the Gulf of Alaska.

Figure 2-35: Sun’aq Tribe of Kodiak

Road, Waterway and Airway Closures

Road, Waterway, and Airway closures are controlled by three primary agencies. Road closures are controlled by the Alaska Department of Transportation (ADOT); waterway closures are under authority of the United States Coast Guard (USCG); while airspace closures are controlled by the Federal Aviation Administration (FAA).

Road Closures

ADOT requires a “Lane Closure Permit” (LCP) when closing portions of the highway for launch operations and during transport if traffic flow will be restricted in a single or both lanes. This permit applies to any full closure of roadways during launch operations. The LCP requires a “Traffic Control Plan” detailing operation and signage. A condition of the LCP is that Alaska Aerospace must notify ADOT prior to starting operations. ADOT requests a two-week advance notice.

Alaska Aerospace has established a section on the company’s web site that shows roadways closures. This information is updated “real-time” during launch operations. In addition, Alaska Aerospace has installed temporary illuminated road signage at Women’s Bay on the way towards PSCA which identifies road closure times and dates.

Since the ADOT also operates the commercial portion of the Kodiak Airport, Alaska Aerospace personnel coordinate with the local ADOT staff to notify them of specific road closure dates, times, and requested special runway operations that require either runway closures or unloading operations on live runways or taxiways.

Waterway Closures

Waterway closures to the south and southeast of Narrow Cape are conducted whenever launches occur from PSCA. Depending on the launch vehicle type and trajectory of flight, waterway closures may impact the sport and commercial fishing areas south and southeast of PSCA. In accordance with PSCA Launch Site Operator License, Alaska Aerospace has a signed Memorandum of Agreement (MOA) with the United States Coast Guard (USCG) District 17 Office which outlines the procedures used to issue Notice to Mariners (NOTMAR's) during launch operations. Under the MOA, thirty days prior to a launch, Alaska Aerospace provides the USCG with launch information. USCG issues a NOTMAR to advise of the closure area and times of activation. During this period, surface vessel operations are restricted from operating in the NOTMAR'd area. Under the federal authority, the USCG may cite any vessel that violates a published NOTMAR area.

The waterway south and southeast of Narrow Cape lies within the Eastside Kodiak District and includes many active fishing areas. According to the Alaska Department of Fish and Game, "*The Kodiak Management Area (KMA) is located in the western Gulf of Alaska south of the latitude of Cape Douglas (58°52' North latitude) and east of Imuya Bay (156°20'13" West longitude) near Wide Bay on the Alaska Peninsula. The marine waters around Kodiak are among the most productive in the North Pacific. Offshore upwelling combines with abundant freshwater runoff to make near shore waters rich in nutrients. There are over one hundred species of marine fish native to the KMA, Commercial fishing and processing account for 55% of the private sector work force."*

Because of the large variety of fish within the Eastside Kodiak District, openings occur numerous times throughout the year. Alaska Aerospace is acutely aware that launch operations may temporarily disrupt fishing within restricted areas at the same time as a fish opening may occur. For that reason, Alaska Aerospace initiated a waterway closure notification section on the company's web site. Information provided through this forum depicts the actual closed areas on a map during launch operations and lists the specific dates and times that the closure is in effect. Additionally, boundary boats are often used to patrol the outside edges of restricted areas. The boundary boat operators are authorized to approach and communicate with other boats in the area if it appears, they may enter the restricted waterway during the restricted times.

In 2018, due to increased launch operations at PSCA, Alaska Aerospace increased communications with the local fishing community. Alaska Aerospace engaged the Department of Alaska Fish and Game to develop a communication exchange that allows Alaska Aerospace to inform customers of specific commercial fishing opening dates and times so as to schedule launches that create the least interference with commercial fishing. Additionally, Alaska Aerospace has participated with the Kodiak

Fisheries Work Group to maintain open communication between fishing interests and PSCA launch requirements.

Airway Closures

Airway closures for hazardous and launch operations at PSCA are in accordance with the MOA between Alaska Aerospace and the Federal Aviation Administration (FAA) Anchorage Air Route Traffic Control Center (ARTCC). Under this agreement Alaska Aerospace must provide the ARTCC with the launch date(s) and launch trajectories, as defined by the launch vehicle operator. The ARTCC coordinates this information with the FAA Air Traffic Management Center to establish a Temporary Flight Restricted (TFR) area for periods of launch operations. These TFR's are published in a Notice to Airmen (NOTAM) that is available to general commercial, and government aviators. It is a pilot's responsibility to be aware of all NOTAM's in areas where they will operate and to comply with all TFR's.

The area to the south of PSCA is mostly over water; however, the region west of PSCA includes mountainous terrain that often experiences low cloud cover. In this area pilots rely on low altitude passes and the shoreline to traverse between Kodiak and Old Harbor. One of the primary passes used by general aviation and air taxis services extends from Middle Bay along the American River and down the Salty Cove Road to Salty Cove. An alternative pass extends south from Kalsin Bay down the Olds River to Summit Lake and then to Portage Cove. Both of these routes end at Ugak Bay, where a pilot crosses to reach the opposite shore where a wide pass provides passage to Kiluda Bay. From this point a pilot can fly along the shoreline to reach the Old Harbor Airport.

When TFR's are issued pilots are unable to use these low altitude passes. While the Old Harbor Airport lies outside of the TFR, including the low altitude passes essentially shuts down air traffic between Kodiak and Old Harbor unless a pilot decides to fly around the west side of Kodiak Island, which more than triples the distance and increases both the costs and time of air service between Old Harbor and Kodiak. Work has been initiated with the FAA to seek relief from this restriction.

Chapter Three – Pacific Spaceport Complex – Alaska Demand Forecasts

SECTION ONE - Overview

In development of a spaceport Master Plan, evaluating the expected future launch demand provides the baseline for determining the type, size, and location of facilities necessary to support potential demand. This chapter presents both the historical activities at the Pacific Spaceport Complex – Alaska (PSCA) and projections for both government and commercial launches through the planning period. Based on the types and frequencies of these projected launches, a determination can be made to identify facility requirements, which will be addressed in the next chapter to this report.

Because the small commercial market is an emerging business model that has little historical information, projections will evaluate both the new small satellite market, as well as the developing commercial launch vehicle market to ascertain a probable demand for launches from PSCA. Since orbital launches from PSCA only provide access to polar orbits, an extrapolation of future demands between polar and equatorial orbit needs will also be addressed.

The forecasts were prepared in 2019 and updated in 2020 following the unexpected global coronavirus pandemic that created a global economic slowdown. The product for this chapter is a forecast of expected annual launches from PSCA for the planning period, with a delineation between government and commercial operators. This data is used as the basis to determine future facility requirement.

SECTION TWO – Market Review

To frame the issue, it is important to define the potential market. In the United States launches must be conducted over water to prevent debris or launch vehicle first stages from impacting land and causing injury, death, or property damage. As such there are currently four primary spaceports serving the government and commercial industry with launches to orbit in the United States. On the east coast Cape Canaveral and the Mid Atlantic Regional Spaceport (MARS) at Wallops provide launches into equatorial orbit. On the west coast Vandenberg Air Force Base and PSCA provide launch capabilities for polar orbits (Figure 3-1)

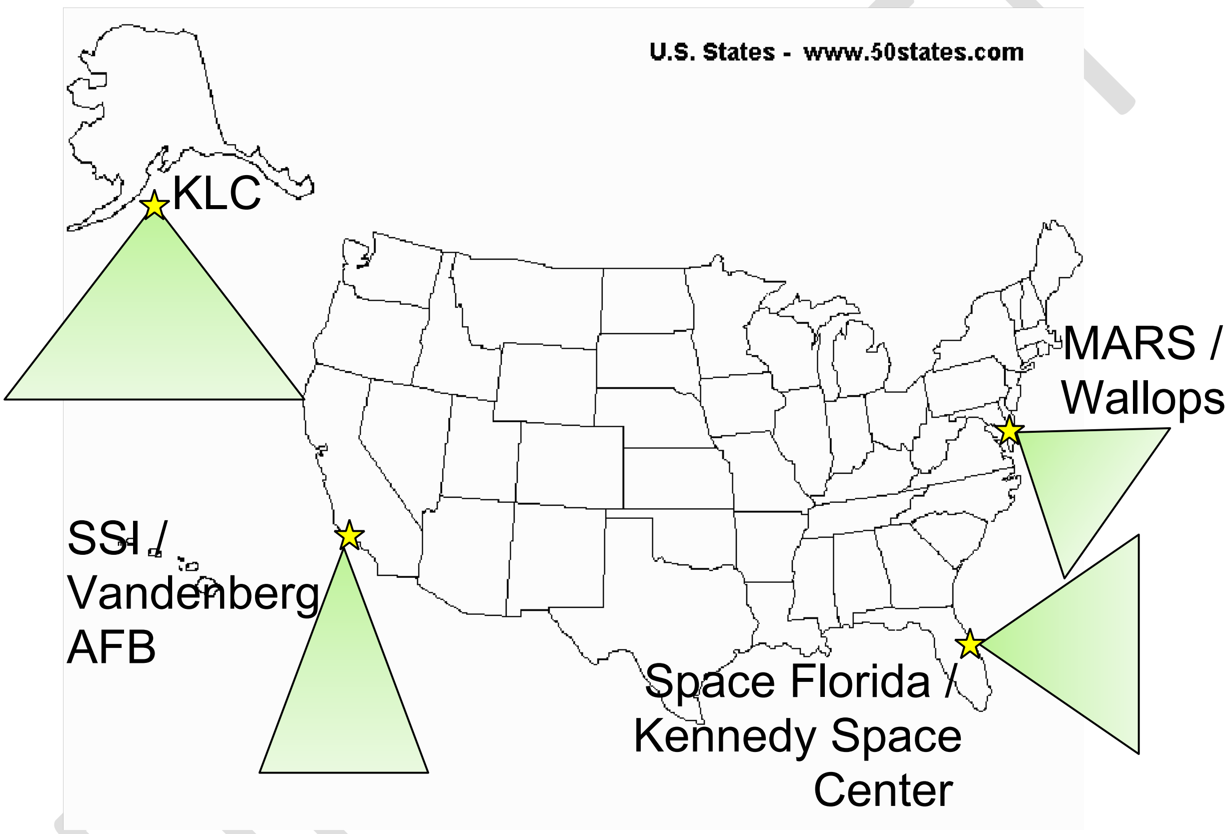


Figure 3-1: The four operational spaceports in the U.S. that can launch satellites into orbit.

Vandenberg Air Force Base and PSCA are not direct competitors. Vandenberg Air Force Base's primary mission is to launch large/heavy rockets that support the National Space Security Program. In 2018, Vandenberg conducted eight launches, six by SpaceX and two by United Launch Alliance (ULA). Both ULA launches supported NASA missions, while three of the SpaceX launches supported satellites for the Iridium constellation and the other launches supported variety of multi-national governments and commercial companies. Of note, none of the Vandenberg launches were for commercial small launch vehicle operators.

PSCA was developed to support the small launch vehicle market, which includes up to the Minotaur, Athena, and STARS sized launch vehicles. The following chart (Figure 3-2) depicts the traditional sized launch vehicles for which PSCA, formally known as the Kodiak Launch Complex (KLC), was originally built to serve.

Vehicle	LV2	STARS	Minotaur II	C4 Hybrid	Minotaur I	Athena I	Minotaur IV	Athena II	Taurus XL
Company	LM	Sandia	Orbital	Sandia	Orbital	LM	Orbital	LM	Orbital
Liq / Solid	S	S	S	S	S	S	S	S	S
Payload (lbs)	Sub-Orbital			750	1,250	1,500	3,800	4,000	3,000
Thrust (lbs)	202 k	202 k	210 k	202 k	210 k	427 k	495 k	427 k	427 k

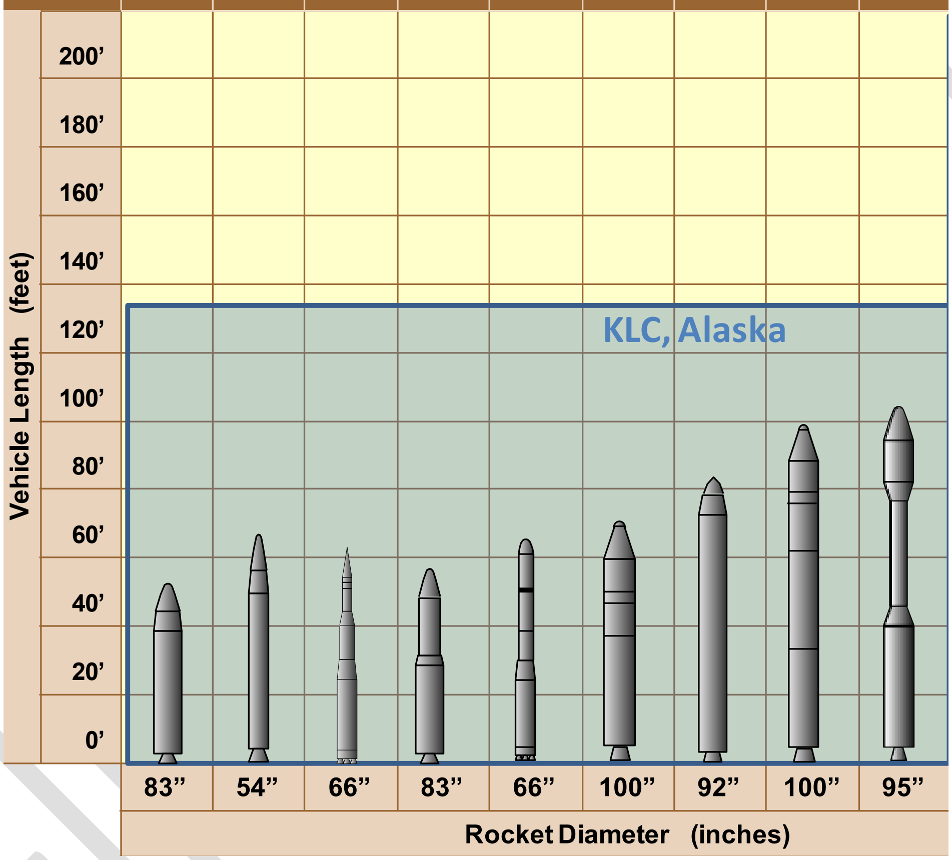


Figure 3-2: Historic PSCA Launch Vehicle sizes

Over the past few years a dynamic change has been occurring in the launch vehicle market, whereby much smaller launch vehicles are being developed to serve the small and ultra-small sized satellite market. According to Frost & Sullivan’s report: *“Global Space Launch Market to Increasingly Rely on Commercial Companies for its Vehicles and Services*, “As government spending decreases worldwide, space launch expenditures within established national programs will steadily decrease with the implementation of cost-cutting measures. Instead, governments will become more reliant on commercial companies to execute space launches.”

Frost & Sullivan's Aerospace & Defense found that global spending for space launch activities totaled $6.70 billion in 2011. Of importance to this report is the upwards tend in commercial launch activity, especially starting in 2016. Between 2011 and 2018 space launch activities worldwide account for a four-fold increase, with the greatest increases occurring in China and the United States in 2017.

The Space Report 2017: The Authoritative Guide to Global Space Activity, published by The Space Foundation, provides a much more comprehensive economic projection of the space industry and found that the global space economy in 2016 totaled $329 billion. This report provided a breakdown of space activities in the four following segments: Commercial Infrastructure and Supporting Industries ($126.26 billion), Commercial Space Products and Services ($126.62 billion), U.S. Government Space Budgets ($44.44 billion), and Non-U.S. Government Space Budgets ($31.98 billion). Figure 3-3, provided by the Space Foundation *Space Report 2017,* depicts the Global Space Activity 2016 Investments.

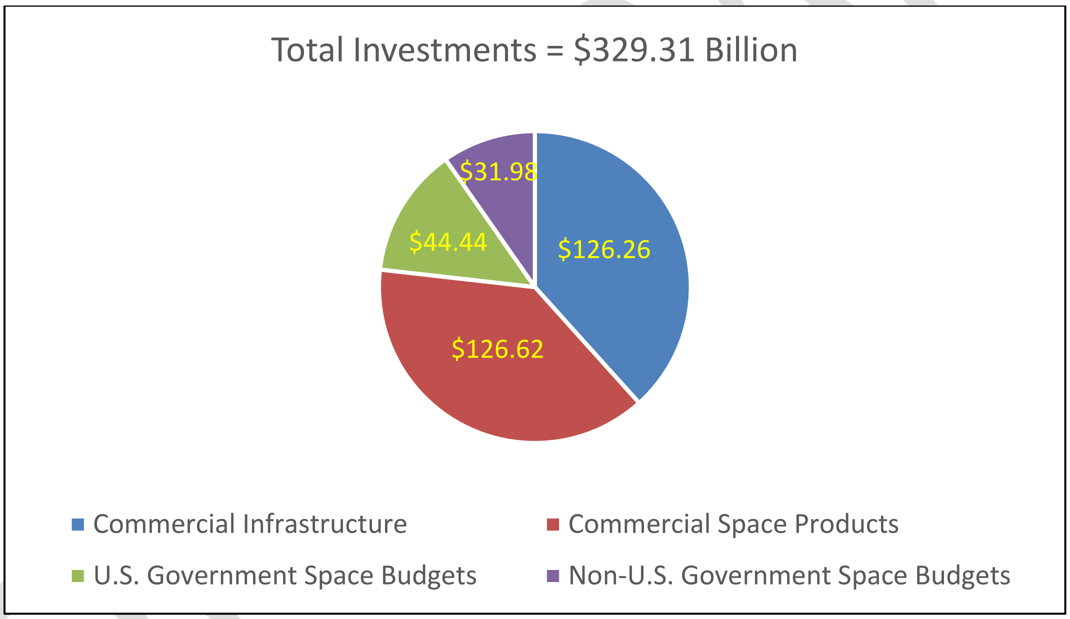


Figure 3-3: Global Space Activity 2016 (*The Space Report 2017*)

The investment community has become bullish on space. Investments from venture capitalists and equity firms in start-up space companies has grown exponentially. For example, the investment company, Space Angels, focuses on space industry investments and, as a leader in the industry, Space Angels invests in only the top 5% of space investment opportunities. Examples of recent investments include SpaceX, Vector Space Systems, and Planet, all of which are successfully operating and expanding in 2019. It can be seen by these investments that the financial industry is confident in space economy growth. Morgan Stanley projects the global space economy will be $1.1 trillion by 2040. Bank of America's forecast is even more bullish, projecting the industry could reach $3 trillion by 2035. It is projected that most of this growth will be in the private sector, commercial launch vehicle and satellite market.

The United States accounted for 26% of the global orbital launch market, second only to China in 2016. Specifically, the United States conducted 20 launches in 2015 and 22 launches in 2016. By 2018, the global launch industry conducted 114 launches, with 67 to Low Earth Orbit (LEO), according to the *2018 Space Launch Report.* The United States accounted for 27% of the global orbital launch market with 31 Federal Aviation Administration Office of Commercial Space Transportation (AST) 31 licensed launches, of which 14 went to LEO. This included six SpaceX launches from Vandenberg and two commercial launches from PSCA.

Also, during 2018 new entrant small launch vehicle providers successfully launched commercial satellites, including successful launches of the Rocket Lab USA Electron launch vehicle from Launch Complex One in Mahia, New Zealand and test launches by another new entrant commercial company at PSCA. These activities prelude the expansion of commercial small launch activities by a plethora of companies currently developing small low-cost launchers designed to specifically support the less than 500 kilogram satellite market. It is clear that the commercial launch pace has increased at an expediential rate in just the past couple of years. With an estimated 6,000 small satellites currently waiting for launch opportunities, it is reasonable to project that the rate of launches will continue increasing over the next decade.

Towards the end of 2019, after the initial forecasts had been developed, the global market took a drastic downturn as the result of the novel coronavirus pandemic. World reaction to control the virus was to significantly reduce business operations and in many locations institute community quarantines. This caused an unprecedented market decline in all sectors, resulting in an international recession.

In the United States, the aerospace industry was declared an essential industry and was permitted to continue operations, albeit in many locations local restrictions did impact company's abilities to operate at pre-pandemic levels. As of early 2020, financial analysts predict that investment in private sector space companies may slow. Coming off a record year of venture capital investment in the space industry, nearly $6.0 Billion in private sector investments, early indications are that the private sector space industry will become leaner, with some pull-back in investment funds and creating a more competitive environment for developing company's.

According to a CNBC article on April 22, 2020, Quility Analytics predicts that the "COVID-19 induced recession" will result in an industry shake-up that will last about two years. Specifically, they predict "companies that are building small rockets to launch spacecraft" are relatively high risk investment opportunities that are capital intensive and highly dependent on venture capital funding. This is expected to result in investors being more judicious about investing in the more speculative start-ups, thereby reducing the number of companies that are expected to be successful.

As a result of this sudden change in small launch vehicle market expectations, the demand forecasts for this Master Plan were reviewed and updated accordingly.

To accurately project launch vehicle demands, a presentation of the projected small satellite demand must first be conducted. The annual demand for small satellites will drive the demand for small launch vehicles. Therefore, once a reasonable future satellite demand is established, a determination can be made as to the number of launches that will probably be required to support these satellites can be deduced.

Figure 3-4: Orbit Illustration

SECTION THREE – Small Satellite Development

This section provides an overview of small satellite development that creates the basis for driving the development of the new entrant small and ultra-small launch vehicle market. It is the small satellite market that pushes the need for low cost and reliable launch vehicles, as the satellite developers seek to achieve a market advantage through price and service benefits. Therefore, the industry is being driven away from high cost government and government-sponsored launch vehicles towards innovative, low cost, private sector launch vehicles. It is the small and ultra-small satellite demand that will drive the small and ultra-small launch vehicle market.

To understand the dramatic increase in small satellite launch requirements for the future, it is important to review the demand of the recent past. According to the Mordor Intelligence Forecast Report 2018, the combined commercial and government satellites launched globally expanded exponentially. This can be seen in the following chart, produced by UCS Satellite Database, which shows commercial demand far exceeding military demand between 2012 and 2017.

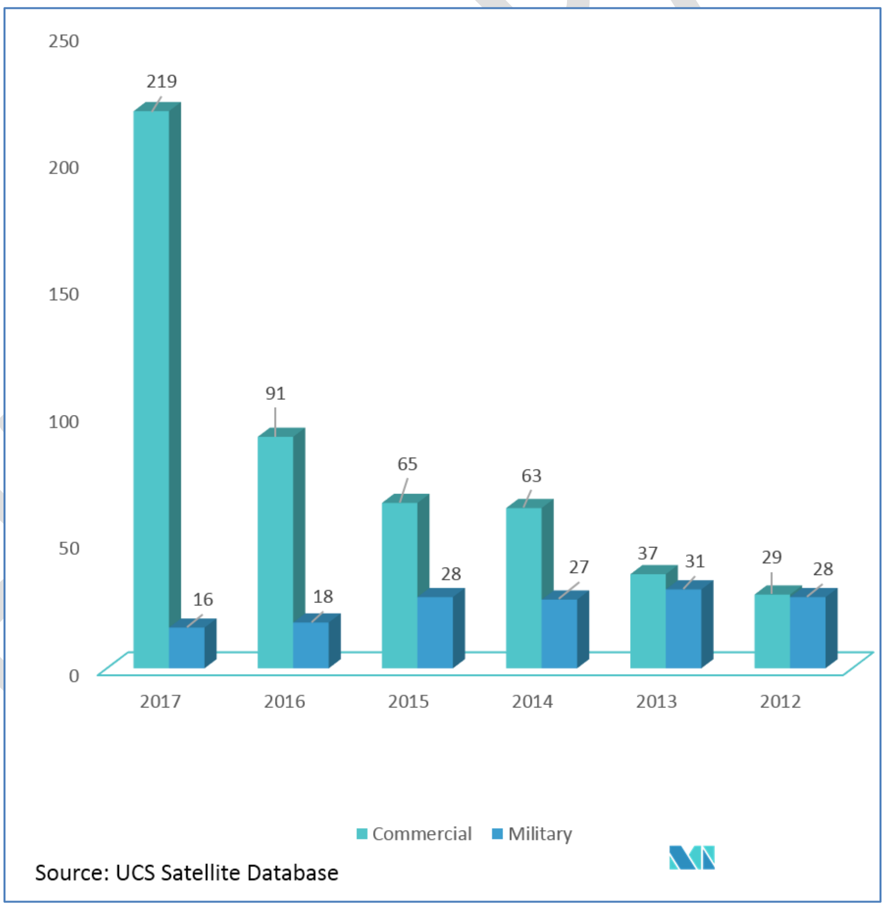


Figure 3-5: Commercial and Military Satellites Launched, 2012-2017
(*UCS Satellite Database*)

Space-based capabilities are delivered today through large, expensive systems. That limits markets and consumer choices. Future technologies will be much smaller and cheaper. Fixed services are losing market share to mobile services. It is projected that space-based hardware will continue to shrink, with advances in C-Band, Ka Band, and Ku Band technologies. Also pushing the increase in satellite capabilities is the increasing demand for live, streaming, video-quality services not available to all by limited terrestrial infrastructures and technologies. Large parts of the global community do not have access to the global network because of an inability to afford the terrestrial investments. These challenges fuel a powerful change towards space-based networks with the capacity to serve the entire globe.

According to a 2017 research report by Global Market Insights, Inc, increasing usage of communication data-based services and GPS systems is driving the commercial satellite launch service market size over the forecast period, resulting in the commercial satellite launch industry reaching $7.0 Billion by 2024. “Usage of smart devices and services for personal use such as Smart TVs, online streaming services, etc. accelerates the financial investments. High demand for weather forecasting software is witnessed such as AccuWeather, The Weather Channel, Yahoo Weather, Google Weather, etc. Schools and colleges across the globe are introducing new smart class initiatives. Rising penetration of mobile phones internet usage across the globe owing to next generation 4G/LTE networks with attractive data plans is driving the wireless technology. Due to proliferating usage of these applications across the globe additional number of satellites will be required. This in turn will escalate the revenue generation of the commercial satellite launch service market,” stated Global Market Insights, Inc.

SpaceWorks completed a comprehensive survey of nano/microsatellite demand in 2017. Based on the commercial market demand identified with existing and developing satellite technology, there is a demand for 2,400 nano/microsatellites through 2023. These satellites are divided between communications, scientific, technology, and earth observation remote sensing (which accounts for nearly one half of the demand through the forecast period). While not specifically addressed in the SpaceWorks forecasts, the majority of the communications and earth observation remote sensing satellites will require polar orbits to provide low cost coverage for the entire globe.

Historically, launches into polar orbits have accounted between 35%-40% of the total market. Because of the demands for near real-time imaging and the global communications requirements, demand for polar orbits are projected to increase at a faster pace than for equatorial orbits. The Space Foundation, *Space Report 2017*, provides a graphic illustration of the market demands for spacecraft launches, based on the types of payloads/missions. This clearly shows how the remote earth observation sensing satellite market currently dominates the spacecraft launch numbers. Figure 3-6 shows the breakdown, by user groups for 2016.

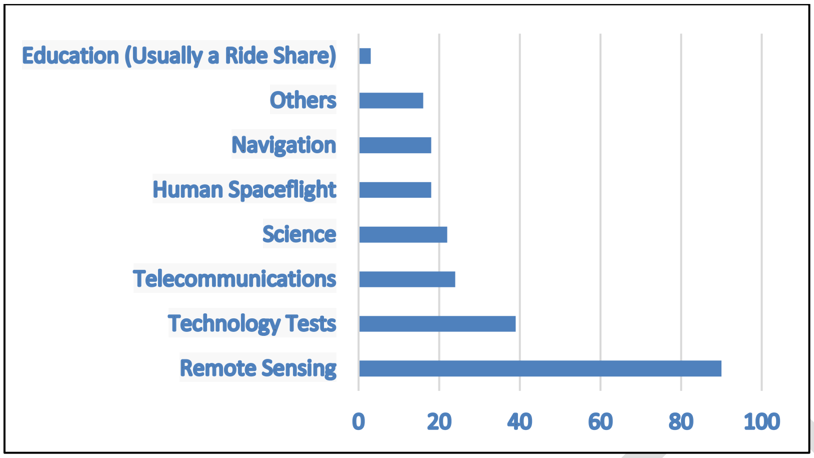


Figure 3-6: Spacecraft Launched by Mission, 2016 (***The Space Report 2017***)

Overcoming the limitation of geographical reaches, satellite imaging has surpassed the use of terrestrial and aerial imagery, owing to its comprehensive coverage of the world and quick delivery of image data. According to Planet, an earth observation remote sensing company, "With 150+ satellites in orbit, Planet is able to image anywhere on Earth daily at three meter and seventy-two centimeter resolution; monitoring areas of interest, discovering patterns, and delivering timely insights. Planet's stream of daily, three to five-meter resolution imagery enables precision agriculture management at scale, such as monitoring crop health with continuous field coverage over broad and distributed areas; improving productivity benchmarking with access up to 10 years of historical archive; creating dynamic management zones." Part of Planet's business model is to replace on average 50 satellites every year to ensure that on-orbit satellite technology is never more than 36 months old, which creates a continuous demand for launching small clusters of these satellites annually.

Planets' satellites, dubbed Dove, are 10 by 10 by 30 centimeters long with a weight of 4kg. The complete constellation of Doves is called a Flock. The majority of Doves have been launched into equatorial orbit, collecting images from latitudes that are within 52 degrees of Earth's equator. However, a strong requirement exists for polar orbits to collect images of a large portion of the world's agricultural regions and population centers.

Planet also operates both the RapidEye and SkySat imaging satellites. Both are larger than the Dove satellite and are currently in polar orbit. Once the full constellation of Planet satellites are deployed, remote earth imaging satellites will be operating in both equatorial and polar orbits. It is estimated that at a weight of only 4kg, multiple Dove satellites can be launched on a single rocket. The largest single collection of Doves was launched on February 15, 2017 aboard an Indian Space Research Organization sponsored launch from Satish Dhawan Space Center in India. This single launch placed 88 Doves into equatorial orbit.

The Space Foundation reports that 2016 commercial earth observation remote sensing revenues were estimated at $2.9 billion. The market increased nearly 40 percent from 2011 to 2016 and is expected to reach $7.6 billion by 2024.

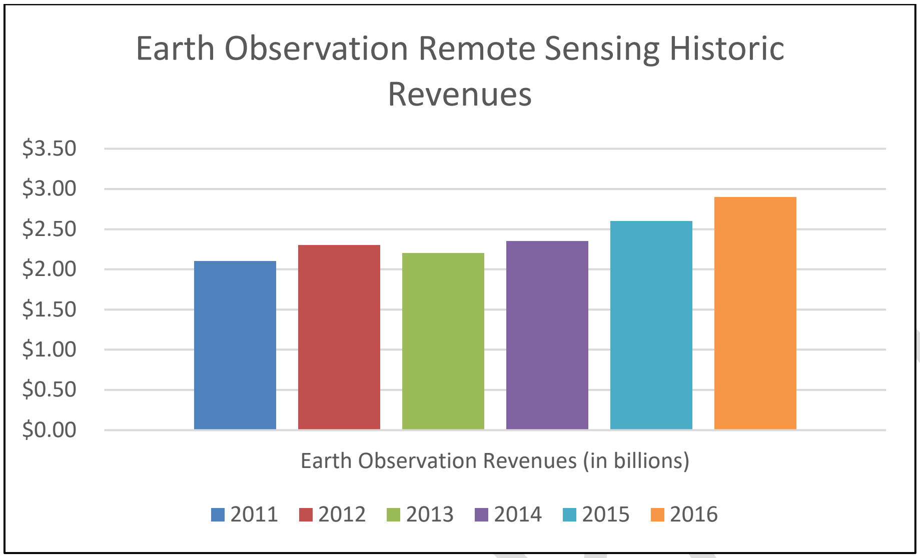


Figure 3-7: Earth Observation Remote Sensing Historic Revenues
(*The Space Report 2017*)

Communications satellites are another primary market for both equatorial and polar orbits. While the geostationary (equatorial) orbit has traditionally been the preferred orbit, where a satellite remains stationary over a populated area, the trend towards satellites that use Low Earth Orbit (LEO) polar orbits is increasing. In LEO orbit, the satellites are continuously rotating around the earth and relaying communication messages from point of origin to destination. This market has seen a steady increase since 2015 and is projected to expand with new technology solutions that also provide lower cost services.

Communications satellites include a wide variety of users. From Satellite phones, to cell phone constellations, to broadband services, the communications satellite industry has seen a significant increase in the past twenty years and is on the cusp of significant advancements during this planning period. Originally, communications satellites consisted of large satellites, primarily in equatorial orbit to service the majority of the earth's population. However, as advancements in technology occurred, the satellites reduced in size and weight and the customer base increased with a demand for worldwide coverage. This has stimulated growth in the communications industry.

An early entrant into satellite communication was Iridium Communications. Originally launched in 1998, Iridium faced financial pressures and entered bankruptcy in 1999. By 2001, Iridium had reorganized and resumed business as Iridium Satellite LLC, owned by private investors and merged with another company to become Iridium Communications, a privately-owned company. Presently, Iridium operates 66 active satellites in six polar low earth orbits used for worldwide voice and data communication.

Iridium, while an early entrant into the communications satellite market, has recently seen a variety of competition for both voice and broadband satellite operations. Companies like OneWeb, Global Eagle, Direct TV, Intelsat, Orbcomm, EchoStar, and others are United States companies pursuing satellite operations. Worldwide, over 90 companies and governments are actively using space for communications operations. As the satellites get smaller, with less weight, the demand for smaller launch vehicles that provide lower cost launch will continue to grow.

According to Research and Markets report *“Global Satellite Communications (SATCOM) Equipment Market Analysis and Trends – Industry Forecasts to 2017,”* the global satellite communication equipment market is poised to grow strong during the forecast period 2017 to 2027. Some of the prominent trends that the market is witnessing include increasing need for high throughput satellite services and increasing use of cloud-based services for ground mobility platform.

Satellite broadband plays an important role in meeting public safety needs. Satellite communication in the public safety domain involves the adoption of next-generation satellite communication technology in mission-critical field applications, equipping people with real-time data, video, voice, or other forms of tactical communication, and rich media services.

In the broadband market, three U.S. companies are aggressively pursuing deployment of small satellites in low Earth orbit that provide space-based terminals to offer broadband internet connectivity. Space X is pursuing a project named *Starlink*, which will consist of approximately 12,000 satellites, supported by customer ground transceivers, to provide low cost internet communications worldwide. In late 2018, SpaceX received approval to launch and operate the initial 7,500 satellites. The launch date for these initial satellites has not yet been confirmed. However, it is expected that the majority of these satellites will be launched on SpaceX owned and operated Falcon 9 and Falcon Heavy launch vehicles and will be launched primarily from SpaceX operated spaceports in Florida, Texas, and California.

In February 2019 OneWeb launched the first six satellites of a low Earth orbit satellite constellation using the Russian Soyuz – 2 SB-B rocket from the Guinea Space Center in French Guinea to also provide low cost broadband internet services. The initial plans are to position 648 satellites into orbit to provide global services beginning in 2021. Ultimately, OneWeb intends to expand the constellation to approximately 2,500 small satellites. While OneWeb had success in launching 74 satellites by the end of 2019, the Company reported in March 2020 that the COVID-19 pandemic had created significant set-backs in their ability to generate crucial financing from its largest investor, resulting in the company filing for Chapter 11 bankruptcy to allow for reorganization and possible sale of the company.

In April 2019, Amazon announced they also intended to develop a large broadband internet constellation, named “Project Kuiper.” This initiative will include a constellation of 3,236 satellites in low Earth orbit, which will operate through 12 ground satellite station facilities owned and operated by Amazon, “providing low-latency, high-speed broadband connectivity to unserved and underserved communities around the world,” stated an Amazon spokesperson to CNBC on April 4, 2019. Of interest to this study is the fact that Jeff Bezos, owner of Amazon, also is the founder of Blue Origin LLC, a privately funded company and developer of the *New Shepard* launch vehicle. Like SpaceX, it is highly probable that the Project Kuiper satellites will be launched aboard the *New Shepard* from Cape Canaveral, once both are fully operational.

Alaska has been actively pursuing broadband internet services to cover the entire state. To accomplish this, communications satellites in polar orbits that provide affordable services will be necessary. In 2014, the Alaska Broadband Task Force published a report, *A Blueprint for Alaska’s Broadband Future,* in which it concluded that satellite broadband services are necessary for statewide service. While the report ultimately determined that terrestrial and fiber connectivity provided enhanced services, the reality of cost versus benefits concluded that satellite connectivity was necessary for the state to gain the economic and educational benefits that broadband internet would provide to all state residents.

Global Maritime Satellite Communications and Tracking demand is increasing, especially in the North Pacific, Bering Sea and Arctic Ocean regions. On December 9, 2018, the United States Coast Guard launched two demonstration satellites from Vandenberg Air Force Base as part of their Polar Scout program to support Arctic Region Search and Rescue (National Defense Business and Technology Magazine, December 2018). According to the USCG, “Potential uses for satellites include improving communication in the Arctic environment, monitoring large areas for illegal activity and helping to locate persons lost at sea.” If successful, the USCG plans to use satellite technology to enhance continuous coverage across the region in future years.

In addition, satellite tracking of vessels using both terrestrial and satellite technology is rapidly increasing. The Marine Exchange of Alaska is a non-profit organization which has developed “a comprehensive system throughout Alaska providing Maritime Domain Awareness for ports, regulatory agencies, vessel operators and maritime communities to enhance safe, efficient and environmentally sound maritime operations.” The Marine Exchange operates one of the largest marine vessel tracking systems in the world, providing information to the Coast Guard on vessels locations, incorporating data transmitted by various satellite transponders to track fishing vessels, barges and other vessels.

Tracking marine vessels in the Arctic region requires satellites in polar orbits. As the demand increases for shipping activities in the Bering Sea and Arctic Ocean, additional vessel tracking capabilities will be necessary, thereby driving the need for more, and more accurate satellite tracking capabilities.

Navigational requirements for satellite-based technology is also increasing. With the introduction of the Global Positioning Satellite (GPS) navigation technology for aviation, a significant shift has occurred towards space-based navigation, especially in regions were ground based systems are impractical, such as over the Arctic Ocean. This change has opened up vast airspace for routine government and commercial use. For example, flights between North America and Asia are now able to fly the most fuel efficient route with accurate positioning, which often times takes commercial aircraft well north of Alaska.

According to an article by Gizmodo, airplanes use many of the same towers and satellites that deliver data to our smartphones, connecting to towers on the ground, or to satellites, or to both to provide connectivity to passengers. “Because an airplane is moving through the stratosphere at such high speeds, a WiFi antenna must constantly maintain a connection to any given tower or satellite. It doesn’t help that the satellites themselves are orbiting the Earth at 18,000 miles per hour. However, ground-to-orbit connectivity is the way of the future. Although the signal must travel thousands of miles more to connect to satellites, the satellite connections allow for much greater bandwidth.” As technology improves the demand for greater, faster, cheaper connectivity will drive for more satellite availability. For instance, in 2017, the Indian Space Research Organization announced projected launches of 3,000 satellites in the next 10 years for navigation-based applications.

In March 2019, the United Kingdom and Canada initiated improved trans-oceanic air navigation services using space based Automatic Dependent Surveillance-Broadcast (ADS-B) receivers carried aboard the Irdium satellites. “Using space-based ADS-B, air traffic controllers will receive vastly more frequent position updates from aircraft plying the oceanic sector, allowing them to substantially reduce separations between aircraft on the current route tracking system,” stated a representative of the United Kingdom National Air Traffic Services (UKNATS) in an article published by Air Transport World on March 15, 2019. In the United States, ADS-B technology will become mandatory for commercial flights in 2020.

The above information is provided to frame the understanding that the demand for satellite technology is rapidly increasing worldwide and the need for smaller, less expensive satellites with greater capabilities that operate in polar orbits will continue to increase throughout the planning period of this report.

The following chart is a compilation of various small and ultra-small satellite projections developed by Alaska Aerospace to illustrate the projected demand from 2020 to 2030. It shows that remote earth observation imaging satellites will dominate the market throughout the planning period, but also shows that communication satellite demand will increase.

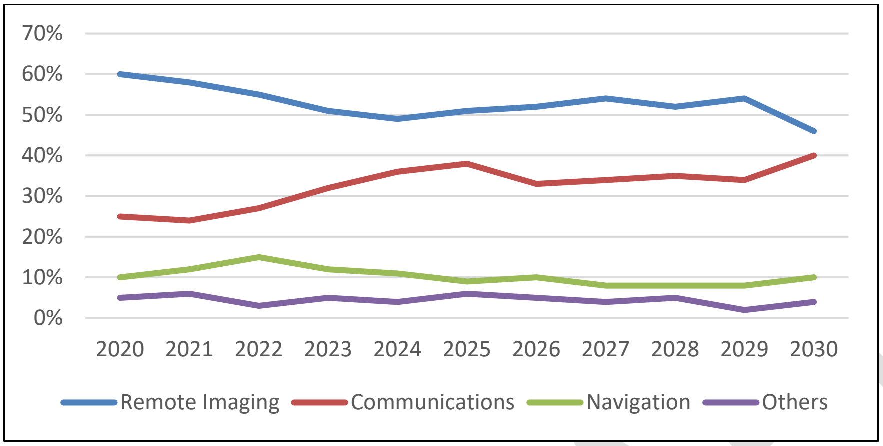


Figure 3-8: Small/Ultra-Small Satellite Demand Projections by Market Percentage
(Market Average compiled from various sources by Alaska Aerospace)

SECTION FOUR – Small and Ultra-small Launch Vehicle Development

The commercial launch vehicle market has seen a rapid expansion in capability as a number of new entrant companies have pursued small launch vehicle development to support the rapidly expanding small satellite market. The pioneer in small launch vehicle development for the commercial market was Space Explorations Technology Company, commonly referred to as SpaceX. Founded in 2002, SpaceX achieved a milestone in the launch industry when in 2008 it launched the Falcon 1, the first privately developed liquid fuel rocket to reach Earth orbit. Two years later, SpaceX launched the much larger Falcon 9 and has not launched the Falcon 1 since. Presently, SpaceX is a premier commercial space launch vehicle company that concentrates on large rocket operations, to include the most recent Falcon 9 Heavy version. Due to the size and mission profiles conducted by Space X, they operate from Cape Canaveral and Vandenberg AFB. However, SpaceX is currently constructing a private SpaceX owned and operated spaceport on the eastern shore of south Texas at Boca Chica Village for their exclusive use.

Recognizing the potential demand for small and ultra-small launch vehicles in the commercial market, Rocket Lab USA was founded in 2006. In 2009, Rocket Lab was the first private company in the Southern Hemisphere to reach space with the Atei-1 sounding rocket. With the end of the Falcon 1 program by SpaceX, Rocket Lab USA expanded into larger rocket development and in 2017 launched the first Electron rocket from Rocket Lab's Launch Complex One on the Mahia Peninsula, New Zealand. The Electron is a commercial launch vehicle designed, built, and launched exclusively by Rocket Lab. On November 11, 2018 Rocket Lab USA achieved its first commercial launch, carrying satellites for a number of commercial satellite companies and a CubeSat built by students. Rocket Lab USA has an extensive manifest of commercial customers for future launches, expected to reach a cadence of monthly launches in 2019.

In pursuit of low cost, reliable commercial launch services, a number of start-up companies are currently developing small and ultra-small launch vehicles to support orbital launches for satellites in the one to five hundred kilogram weight class. According to published information covering vehicle companies currently developing small and ultra-small launch vehicles, no less than a dozen (12) U.S. companies are actively developing small and ultra-small launch vehicles for commercial use. In addition, companies in Japan, Australia, Spain, Italy, China, Russia, the United Kingdom, and others are actively pursuing development of small and ultra-small launch vehicles. Most companies are currently in the fund raising/early development phase. As of this report, only Rocket Lab is a fully FAA licensed and operational commercial small launch vehicle provider.

In the United States, commercial satellite and spaceport activities are under the jurisdiction of the Federal Aviation Administration Office of Commercial Space

Transportation (FAA/AST). Every few years this office provides a forecast report in conjunction with the Commercial Space Transportation Advisory Committee (COMSTAC) designed to preview potential demand of commercial space launch services. The most recent report provided forecasts for the 2015-2024 timeframe, which was prior to the first launch of the Rocket Lab Electron in 2017 and prior to many of the new start-up launch vehicle company's establishment.

The FAA/COMSTAC "*2015 Commercial Space Transportation Forecasts*" took a conservative projection which concluded that the demand for non-geosynchronous (polar) orbit launches would peak in 2016 with 19 launches, caused by the requirements for deployment of the Iridium constellation, Skybox imaging satellites, and other launches that require medium to large launch vehicles. They forecasted a decline thereafter to an average of 13.1 per year. However, in 2018 FAA/AST licensed 31 commercial launches. This is a dramatic increase with the difference primarily explained by the rapid increase in small satellite and launch vehicle development that occurred post 2015 which is rapidly changing the commercial launch market in the United States.

The twenty-year launch history of primarily all government sponsored launches from PSCA, coupled with the forecast that government sponsored launches will continue to focus on medium and large size launch vehicles, highlights the need to expand operations into growth areas for Alaska Aerospace to have a greater economic impact on the Kodiak community and the state. Therefore, this section focused on the relationship between government launches and the future potential to develop the small and ultra-small commercial launch vehicle market at PSCA.

The following chart provides an illustrative depiction of the comparative launch vehicle sizes being considered for launches from PSCA, should the forecast demonstrate market strength and long-term growth potential.

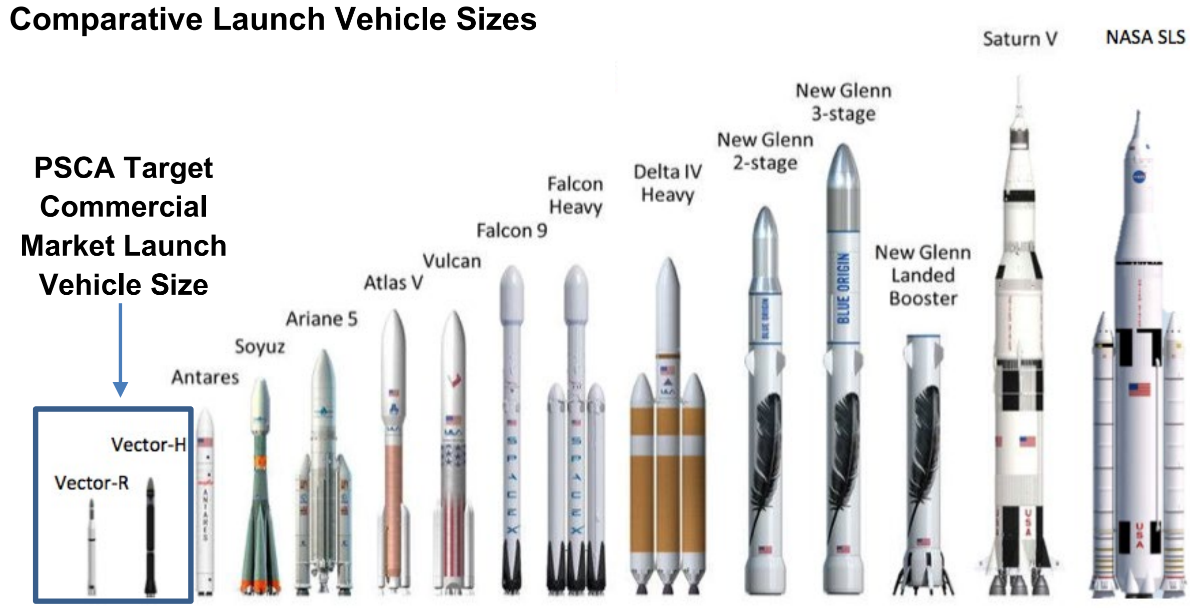


Figure 3-9: Sample Launch Vehicle Size Comparison

Presently, there are more than a dozen U.S. companies developing small and/or ultra-small launch vehicles for the private sector, all at different stages of development. Most of the new development is designed as vertical launch, liquid fueled systems, but there are at least two companies developing a solid fuel launch vehicle and two companies that are developing horizontal launch platforms. The early entry of Rocket Lab in 2017 stimulated other companies to aggressively pursue this market niche, with the potential for additional companies to enter development in the future.

In 2018, Alaska Aerospace hosted the first two commercial launches at PSCA, heralding in a new era of space launch activities for the spaceport. Currently, Alaska Aerospace is under contract with two new entrant commercial companies planning on conducting small launch vehicle activities from PSCA in 2019 and 2020.

Alaska Aerospace has also had inquiries from no less than eight other new entrant launch vehicle companies. While it is recognized that in a developing industry not all initial start-ups will be successful in sustaining a profitable business, the commercial market has significant unmet demand which may be met by the new class of small and ultra-small launch vehicles. As presented in the previous section, the commercial satellite market is rapidly expanding, which requires additional launch capability. Therefore, it is reasonable to expect that some of the new entrant small commercial launch vehicle operators will establish profitable businesses and remain in the market for a number of years and that the satellite demand will be met regardless of the number of small launch vehicle developers that are successful.

Based on the fact that PSCA is the only polar orbit launch alternative to Vandenberg Air Force Base; that the small satellite industry has a strong demand for launches over the next decade; that the financial sector has identified space as a high growth industry and is investing in new entrant satellite and launch vehicle company's; and that Alaska Aerospace is already working with a number of new entrant small and ultra-small launch vehicle providers it is projected that the potential exists for a significant increase in commercial small launch operations over the next decade from Alaska.

According to SpaceTech, projected small satellite launch service demand for the next ten years shows that Low Earth Orbit demand is expected to increase at 3% per year. This is consistent with the Space Report 2017 projections for the next decade.

The following chart depicts the projected demand for commercial polar orbit launches in the planning period.

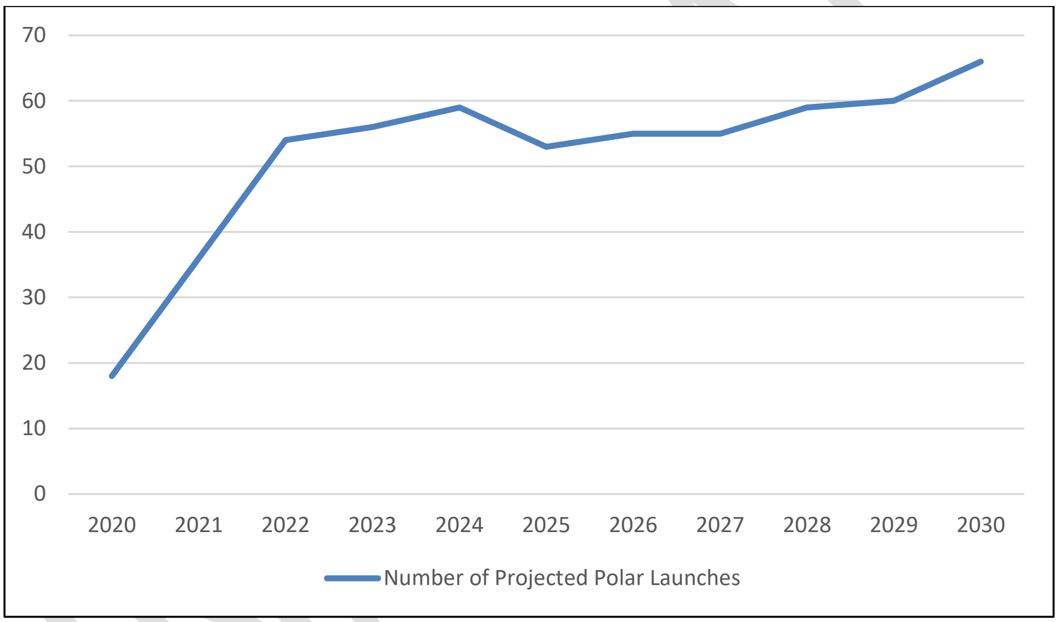


Figure 3-10: Projected Polar Satellite Launch Requirements
(*Alaska Aerospace Averaging from Numerous Sources*)

SECTION FIVE – Government Launch Potential

In the Winter 1999 Naval War College Review, Lieutenant Commander J. Todd Black wrote an intriguing article titled *“Commercial Satellites…Future Threats or Allies?”* The article presented a discussion about the emerging commercial satellite industry and how it may be used by governments to provide cost effective services in communications, imaging, and navigation. As the article was written from a military perspective, Lt Cmdr Black presented the risks of possible hostile use of space. “Commercial satellite imagery, communications, and navigation services will have an impact on the ability of the United Sates to conduct military operations over the next twenty years,” he wrote. Twenty years later, in 2019, his prediction has been validated, with the commercial small and ultra-small satellite industry eclipsing his expectations. The future of launch operations at PSCA must consider both commercial and government launches serving a broad spectrum of government and commercial satellites.

Of the twenty-two launches conducted at PSCA since 1998, all but two have been government sponsored launches. Figure 3-11 depicts the launch history of PSCA.

YEAR	MONTH	SPONSOR
1998	NOV	USAF
1999	SEP	USAF
2001	MAR	USAF
	SEP	NASA/USAF
	NOV	SMDC
2002	APR	USAF
2004	DEC	MDA
2005	FEB	MDA
2006	FEB	MDA
	SEP	MDA
2007	MAY	MDA
	SEP	MDA
2008	JUL	MDA
	DEC	MDA
2010	NOV	USAF
2011	SEP	ORS/USAF
2014	AUG	SMDC
2017	JUN	MDA
	JUL	MDA
2018	JUL	Astra
	NOV	Astra
2019	JUL	MDA
2020	FEB	DARPA*
	SEP	Astra

*Campaign did not result in liftoff

Figure 3-11: PSCA Historical Launch Information

The National Security Space Strategy (NSSS) released in 2011 highlighted partnering with commercial firms as one of the strategic approaches to promote security and stability in space. This was reinforced with a tenant that the United States needs to be able to deliver capability cost-effectively and provide leadership with flexibility. “Strategic partnerships with commercial firms will continue to enable access to a more diverse, robust, and distributed set of space systems and provide easily releasable data. Strategic partnerships with commercial firms will be pursued in areas that both stabilize costs and improve the resilience of space architectures upon which we rely,” stated the NSSS. The NSSS also identifies an expansion in missile defense testing, advanced hypersonic testing, asymmetrical operations testing, and strategic initiatives, many of which are tailored for being able to be conducted at PSCA.

This vision was reinforced in the Department of Defense Directive 3100.10, issued October 12, 2012 which confirmed that “Enhanced cooperation with the intelligence, civil, and commercial space sectors will be pursued to maximize access to mission capabilities, infrastructure protection, and interoperability, and to ensure all U.S. space sectors benefit from space technologies, facilities, and support services.

In 2016, Alaska Aerospace signed a five-year Indefinite Delivery Indefinite Quantity (IDIQ) contract with the Missile Defense Agency (MDA). MDA has historically performed a number of operations at PSCA. It is projected that the MDA will continue to use PSCA for a variety of operations over the coming years. In addition, other government agencies have either signed contracts or are in negotiations with Alaska Aerospace for operations from or around PSCA in the coming years. Since most of the military operations are classified, this report will not detail the missions, other than to confirm that projections of between one and two missions annually are expected during the forecast period.

In March 2018, the White House released a new National Space Strategy. The document is devoted to developing “conducive” environments for working with commercial and international partners. “We will streamline regulatory frameworks, policies, and processes to better leverage and support U.S. commercial industry, and we will pursue bilateral and multilateral engagements to enable human exploration, promote burden sharing and marshal cooperative threat responses,” stated the White House press release. This highlights the focus on US commercial industry development of space related services, which provides Alaska Aerospace the opportunity to capture a large percentage of those polar orbit requirements.

Without being permitted to quantify demand forecasts with operations projections for the Department of Defense, the past three years validated that PSCA remains a location where the Department of Defense can successfully test and evaluate advanced systems in pursuit of the NSSS. Therefore, all indications are that Alaska Aerospace will continue to support government operations at PSCA in the coming years. However, it is also expected that government use of PSCA will not significantly increase in future years, therefore this report provides a steady state projection of one to two missions per year for the duration of the planning period.

SECTION SIX - PSCA Demand Forecast Analysis

Forecasting future operations in an industry that is emerging and rapidly changing is challenging. As has occurred at PSCA, past forecasts of operations did not materialize as expected. Originally, the demand for commercial satellite launches was expected to start in the mid to late 2000's; however, the commercial small and ultra-small satellites and launch vehicles did not develop as quickly as was predicted. With the initial contract for launches at PSCA by MDA, it was forecast that government launches would remain steady into the future. In reality, MDA conducted modest program at PSCA between 2004 and 2008, then relocated the program to other launch sites. Besides MDA, there have been seven U.S. Air Force sponsored launches (1998, 1999, 2001, 2001, 2002, 2010, and 2011), two by Space and Missile Defense Command (2001 and 2014), and two additional MDA launches in 2017.

This series of demand forecasts recognizes the shift in market from government dominated launches at PSCA to growth in the commercial small launch vehicle market and projects the greatest growth in all scenarios for the future will be in the commercial market.

Using 2018 as the base year for actual operations and extrapolating the potential future commercial demand for polar launches coupled with projected government missions, the following tables provide three potential growth in operations, by year, and by type from 2020 – 2030. In March 2020, the forecasts were adjusted based on market fluctuations created by a contraction in launch companies pursuing small lift launch vehicles and the result of market movement associated with the coronavirus pandemic.

***Low-Range Launch Demand Forecast**:* The first chart is based on a low-market projection of commercial launch vehicle activity at PSCA. Under this scenario, the U.S. Government operations remain stable at a single launch per year through the duration of the current Missile Defense Agency IDIQ contract; thereafter PSCA would have limited future government launches. It is projected the commercial solid fuel X-Bow rocket will be developed and enter service by 2023, but with only a single launch per year from PSCA until 2026, when two launches are projected, increasing to three launches per year by 2029.

Based on the back-log of small commercial satellites and the projected increase in small satellite demand, the growth of the commercial liquid propellant launch vehicles from PSCA is expected to dominate the future market. However, this scenario projects that Rocket Lab, which owns and operates Launch Complex One in Mahia New Zealand, will conduct most of its launches from New Zealand and will not have any requirements to launch from PSCA during the planning period. This scenario projects a conservative growth in the small commercial launch market for PSCA, based on competition from other spaceports and means to launch small satellites into orbit. Development of the Virgin

Orbital 747 launch platform and other means for launching, such as through the use of high-altitude balloons, provides other non-traditional means to access polar orbit which may reduce the demand for using PSCA for polar orbit.

Finally, this scenario projects that international competition for launch services will cause additional new spaceports to be developed which will become competitors for PSCA and have the potential to capture most of the international launch demand. Japan, China, Russia, Australia, the United Kingdom, Germany, and others are currently evaluating or progressing with commercial spaceport development that could dampen the demands for using PSCA. Table 3-1 shows the Low-Range Launch Demand Forecast.

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Government	1	1	1	0	0	1	0	0	1	0	1
Commercial Solid	0	0	0	1	1	1	1	2	2	2	2
Commercial Liquid	2	3	5	6	9	10	12	12	12	12	12
Total	**3**	**4**	**6**	**7**	**10**	**12**	**13**	**14**	**15**	**14**	**15**

Table 3-1: Low-Range Launch Demand Forecast

Mid-Range Launch Demand Forecast: The mid-range forecast increases the expected demand for PSCA services in both the government and commercial markets. Under this scenario, it is anticipated that the Missile Defense Agency will continue to use PSCA for test and development launches beyond the current IDIQ. In addition, this scenario projects that at least one additional U.S. Government agency will use PSCA and/or PSCA services for test and development programs throughout the planning period.

This projection continues to project the X-Bow solid fuel launch vehicle to become operational by 2023 but provides a higher launch rate than under the low-range forecast. The X-Bow demand remains much lower than the liquid propellant demand forecast, primarily due to the fact that only one company is currently pursuing the X-Bow launch vehicle, while there are a number of companies pursuing liquid propellant launches. With the X-Bow projected launch costs higher than many of the smaller liquid propellant vehicle companies, it is expected the X-Bow market share of the small commercial satellite business will be significantly less than being projected for liquid propellant launch vehicles.

The biggest increase in launch operations under this scenario will occur with the small and ultra-small liquid propellant launch operators. Most of the new entrant small liquid propellant launch vehicle operators are projecting launches every week or two, being divided between both polar and equatorial orbits, with a large demand for the polar orbit. Because the industry is maturing and it is hard to project how many new entrant companies will be successful, this mid-range forecast remains conservative. The primary difference between the mid-range and low-range forecasts lies with the assumption that the successful launch vehicle companies will be very price competitive and seek to maximize the use of existing facilities that have a demonstrated capability to provide low-cost launch services. That places PSCA in an ideal position to serve the market by already having the launch infrastructure in place that can be used by a number of commercial operators, thereby reducing development, overhead, and sustainment costs to individual launch customers. Table 3-2 depicts the Mid-Range Launch Demand Forecast.

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Government	1	1	2	2	1	2	2	2	2	2	2
Commercial Solid	0	0	0	1	1	2	2	3	3	3	4
Commercial Liquid	3	6	9	12	15	18	20	21	24	28	30
Total	**4**	**7**	**11**	**15**	**17**	**22**	**24**	**26**	**29**	**33**	**36**

Table 3-2: Mid-Range Launch Demand Forecast

High-Range Launch Demand Forecast: The High-Range Demand Forecast assumes aggressive development and a highly successful commercial small launch vehicle market. This scenario assumes that a higher percentage of the commercial small launch vehicle market will select PSCA over other polar capable spaceports worldwide. With over sixteen commercial small launch vehicle companies pursuing the market the demand for this larger number of launches is realistic. However, the financial implications of the COVID-19 pandemic is expected to reduce the amount of venture capital available to launch vehicle developers, thereby creating a negative impact on the number of future launch companies that may ultimately be successful. The unknown is how many of these companies will actually achieve launch capability with their vehicle and whether they will become profitable companies. As in most entrepreneurial business ventures into new market areas, not all companies succeed. Additionally, with some of these companies not being domestic companies, it is unknown how many, if any will eventually select PSCA for Polar launches. Regardless, the demand forecasts show that the small satellite demand in this planning period will require a large number of launches. Therefore, the High-Range Demand Forecast could be achievable if a significant percentage of the small launch vehicle market selects PSCA for launch services. Table 3-3 illustrates the High-Range Launch Demand Forecast.

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Government	2	1	2	2	1	2	2	2	2	2	2
Commercial Solid	0	0	0	1	2	2	3	4	4	5	5
Commercial Liquid	6	12	18	24	24	28	30	32	32	36	36
Total	**8**	**13**	**20**	**27**	**27**	**32**	**35**	**38**	**38**	**43**	**43**

Table 3-3: High-Range Launch Demand Forecast

SECTION SEVEN – Demand Forecast

The Space Foundation *2018 Space Report* projects launch activities to continue growing over the next decade. Launch activity increased at 36% from 2016 to 2017, with commercial activity accounting for 21% of this increase. At PSCA the pace of commercial launch activity will continue to increase, as well. However, with a potential of new spaceport development worldwide and development of other launch options (air launch, balloon launch, and sea launch) competition for launches services will also increase in the next decade. Recognizing that market demand for commercial small satellites requiring polar orbits will also continue growing at a pace of between three and four percent per year, but tempered by increased competition for launch services worldwide, this report has selected the Mid-Range Launch Demand Forecast as the most probable operations growth rate within the planning period. This is shown in Figure 3-12.

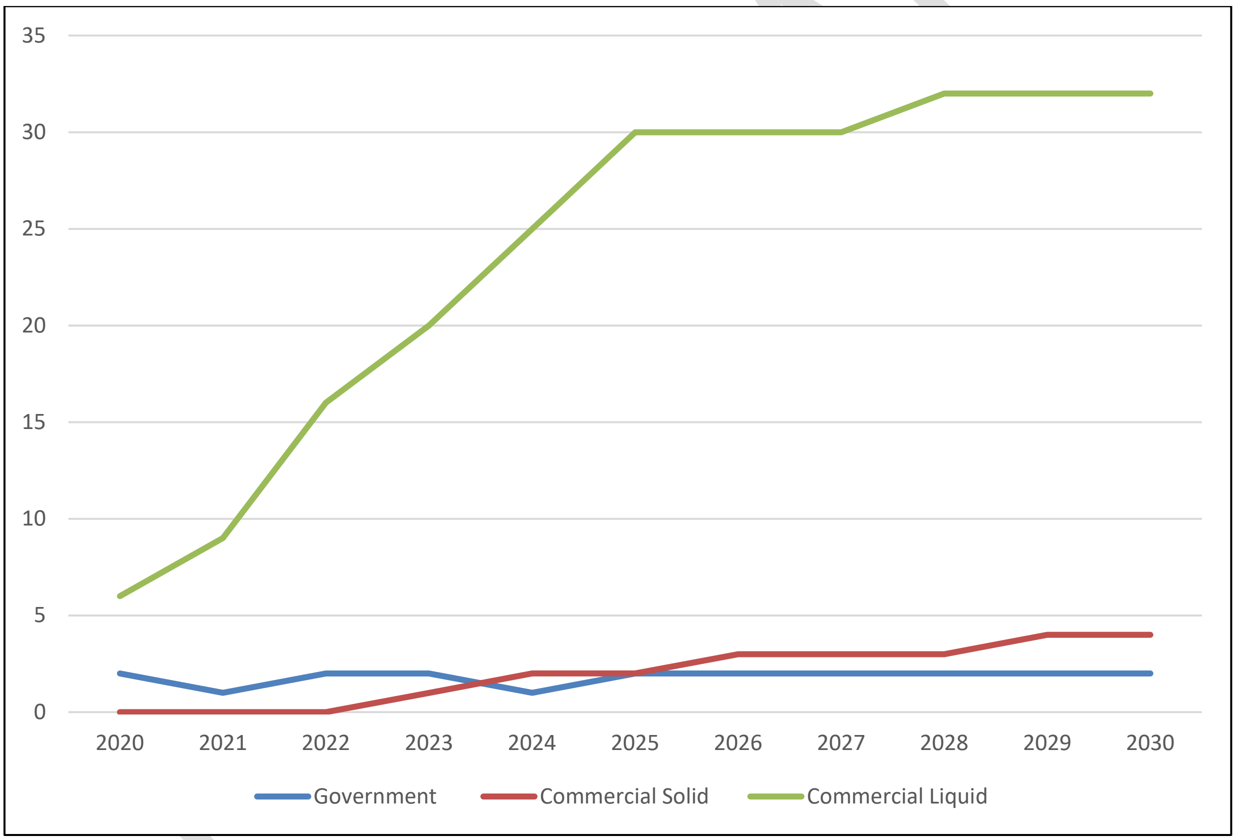


Figure 3-12: Selected PSCA Launch Demand Forecast

Projections for launches from PSCA show a steady increase in commercial launches with a steady state of on-going government launches throughout the planning period, peaking at thirty-six (36) launches per year. This is based on the variable that PSCA will be attractive to the new entrant small and ultra-small launch vehicle operators that will be launching small remote sensing, communications, and navigation satellites for the commercial market due to low cost, schedule assurance, and geographical location for placing satellite into polar orbits. It is also projected that the commercial liquid small launch vehicle market will be the dominate launch vehicle used during the forecast period. Commercial solid fuel small launch vehicles will not grow beyond a few launches per year. It is projected that U.S. Government launches will also be relatively flat the entire planning period, with one to two launches per year, averaged. This forecast growth opportunity will be used to establish the facility requirements for the Spaceport Master Plan recognizing that plan seeks to present a balanced approach between community and economic interests. The following chapter will present an analysis of facility requirements to meet the projected increased operations, followed by an alternative evaluation that addresses how PSCA can best be prepared to meet the forecast growth at the spaceport.

Chapter Four – Pacific Spaceport Complex – Alaska Facility Requirements

2019 Aerial Photo of Pacific Spaceport Complex – Alaska

SECTION ONE - Introduction

Facility requirements involve an assessment of the ability of existing facilities to meet the current and future operations demand, followed by identification of projected infrastructure improvements that would be necessary to meet both. The purpose of this chapter is to explore the relationships between demand and capacity in the context of various spaceport systems (facilities), and to provide general assessments of the ability of existing facilities to meet future demand. The facility requirements for the Pacific Spaceport Complex – Alaska (PSCA) were initially intended to be developed using the medium forecast projection that was presented in Chapter Three – Demand Forecasts, Table 4-1.

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Government	1	1	2	2	1	2	2	2	2	2	2
Commercial Solid	0	0	0	1	1	2	2	3	3	3	4
Commercial Liquid	3	6	9	12	15	18	20	21	24	28	30
Total	**4**	**7**	**11**	**15**	**17**	**22**	**24**	**26**	**29**	**33**	**36**

Table 4-1: Mid-Range Launch Demand Forecast

During the development of this plan, changes in the marketplace occurred which required a review of the preferred medium forecast projection. For example, in 2019, Vector filed for bankruptcy. Vector had conducted two separate pathfinder operations at PSCA and made a significant investment at PSCA in development of Pad C.

In April 2020 the demand forecasts were revised, as a result of the significant shift in investment funds available to space launch vehicle start-ups due to the global coronavirus pandemic. These are the reflected numbers in Figure 4-1.

Firefly Aerospace is another launch vehicle company that had previously filed for bankruptcy protection, but in 2017 received new investment funding and has aggressively developed their Alpha launch vehicle, as well as development of a launch pad at Vandenberg AFB. The Alpha launch vehicle is similar to the Minotaur II, which has successfully launched from PSCA in the past, and can place 1,000 kg into LEO or 630 kg's into Sun-Synchronous Orbit. While Firefly has initially selected Vandenberg AFB as their west coast launch site, the potential for Firefly to also use PSCA in future years is realistic based on the projected launch tempo that may be required to support small payloads and congestion at Vandenberg AFB caused by multiple government and commercial operators. These changes were addressed in the previous chapter and resulted in the revised launch forecasts presented here. The following figure shows the worldwide demand for small launch vehicles intended to place payloads into Low Earth Orbit at the beginning of 2019.

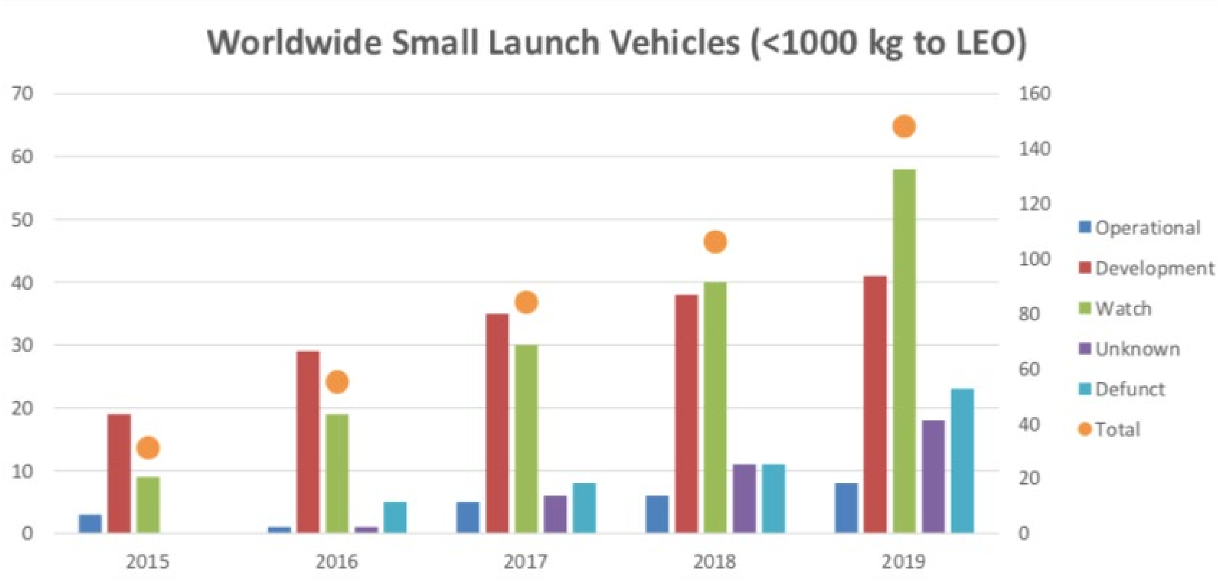


Figure 4-1 Extracted from a paper published at the International Astronautical Congress 2019 which shows the small launch vehicle development market

Identifying these requirements is the basis for creating potential development alternatives that meet the projected demand, which will be used later in this report to develop a refined preferred alternative. The facility requirements for the following functional areas at PSCA are covered in this chapter:

- Launch Facility Requirements
    - Government and Commercial Launch Pads for both solid and liquid fueled launch vehicles
    - Introduction of both manned and unmanned balloon launch capabilities
    - Liquid propellant storage facilities
- Launch Support Facilities
    - Propellant Storage Facility
    - Launch vehicle integration facilities
    - Payload processing facilities
    - Launch vehicle and payload storage facilities
- Launch Control Center
    - Launch Operations Control Center
    - Security system requirements
    - Meteorological Systems
    - Tech control/communications requirements

- Administrative and Engineering office space requirements.
- Telemetry antennas and locations
- Range Safety and Command Destruct systems
- Spaceport Support
  - Maintenance support facility requirements
  - Government support areas
- Ancillary Requirements
- Lodging requirements
- Public Lands, Cultural Environment, and Operations Closure Procedures

Figure 4-2 depicts existing development areas at PSCA that will be used as the baseline for discussing future facility requirements in this chapter.

Figure 4-2: Pacific Spaceport Complex – Alaska (PSCA)

SECTION TWO – Launch Facility Requirements

Launch Pads

Chapter Two presented a description of the existing launch pads at PSCA. Using the demand forecasts presented in Chapter Three, this section will identify facilities necessary to meet the future demand for both government and commercial launches. Where possible, additional facility requirements will be recommended to be built in proximity to existing facilities to minimize development sprawl.

Launch Pad-1, Launch Pad-2, the Space Craft Assembly and Transfer Facility and the Integration and Processing Facility are depicted on Figure 4-3.

Figure 4-3 Launch Pad – 1 (LP-1)

Launch Pad 1 (LP-1)

LP-1 was originally built to accommodate solid propellant launch vehicles up to the height of one hundred and ten (110) feet. It is equipped with a 75-ton overhead crane to handle vertical integration of launch vehicles. To handle liquid propellant launch vehicles, the Launch Service Structure (LSS) at LP-1 would require modifications.

Solid propellant launch vehicles arrive at PSCA pre-loaded with fuel, while liquid propellant launch vehicles arrive empty and are fueled after being placed on the launch stool a few hours prior to launch. The primary modification for LP-1 would be to install infrastructure for the fueling of liquid propellant rockets. Specifically, two areas would need to be developed adjacent to the launch pad. One area would support Liquid Oxygen (LOX) while the other area would support rocket propellant. Included with this installation would be the necessary LOX/fuel transmission lines connecting the propellant tanks to the launch vehicle.

Depending on the height of the commercial launch vehicle, a modification to the height of LP1 may be necessary. While the Rocket Lab Electron rocket stands at fifty-six (56) feet in height and could be accommodated in the existing LSS configuration, the Vega-C is one hundred and seventeen (117) feet in height and would require some facility modifications. Rockets launched from LP-1 must be placed on a stool prior to launch. Traditional stools are built to support the weight of the rocket and are designed to keep the launch vehicle above ground level. The height of the stool for each individual launch vehicle must be accounted for in determining the maximum launch vehicle height for operations at LP-1. Therefore, in order to support launches of the Vega-C, the height of the LSS would need to be increased. For planning purposes, it is estimated that LSS height would need to be increased by up to twenty feet, to also include increasing the size of the drive-in opening.

The majority of the heat and pressure of the launch vehicle exhaust plume can be redirected away from the actual launchpad by building exhaust plume tunnels or trenches beneath the launch pad. The LSS is constructed with a 20' diameter throat by 40' deep flame trench rated for up to 1.3 million pounds of thrust. This would meet the requirements for both liquid and solid propellant projected operations from LP-1. However, to accommodate liquid propellant launch vehicles, installation of two small fueling areas/pads would need to be constructed. The first would be a pad measuring approximately twenty feet by forty feet with an earthen barrier between the pad and LP-1 to accommodate LOX tanks. The other would be a twenty foot by twenty foot (20) pad, also including an earthen barrier between the pad and the LSS for the vehicle propellant (RP-1, Propylene, etc.).

Launch pads supporting liquid propellant launch vehicles require a water deluge system that sprays large amounts of water onto the pad. This process starts a few seconds before ignition and continues through the launch. This system serves many purposes primarily protect the pad from damage and reduce noise impacts. During the launch phase, excessive heat from the vehicles exhaust mixes with the water from the water deluge system which converts to steam and dissipates/rises quickly. The water absorbs some of the energy, reducing noise impacts.

➢ Recommended additional LP-1 requirements:
    - Increase Capability by Installing Liquid Launch Vehicle Systems
    - Install a Liquid Oxygen Tank pad and earthen berm.

- Install a launch vehicle propellant pad and earthen berm.
- Install a water deluge system.
- Increase the size of the LSS to accommodate taller launch vehicles.

Launch Pad Two and Spacecraft Assemblies & Transfer Building (SCAT)

Launch Pad Two (LP-2) was the original launch pad at PSCA. It consists of a single reinforced concrete pad capable of supporting the launch vehicle's weight on a launch stool as well as the pressure generated by the launch vehicle motor at lift-off. LP-2 has been used for smaller solid propellant launch vehicles and was used in 2018 for the first commercial liquid propellant launch vehicle operations at PSCA. In 2017 LP-2 was modified by adding two small concrete pads with earthen berms on each side of the launch pad to support both LOX and launch vehicle propellant tanks. Commercial customer supplied removable piping systems were connected from each of the two barriers to LP-2 during operations. There are no improvements necessary at LP-2 to support the future demands at PSCA.

The SCAT was fully rebuilt following the 2014 launch vehicle failure at PSCA. The SCAT is designed primarily to be a transport facility for horizontal launch vehicle stages between the Integration and Processing Facility (IPF) and the LSS at LP-1. There are no recommended changes in the configuration of the SCAT to meet this operational requirement.

The SCAT also functions as an enclosure facility for processing launch vehicles using LP-2. It was this functionality that provided weather protection for the first two commercial launches at LP-2. For both launches the SCAT was placed over LP-2 allowing the launch vehicle to be processed inside the facility and was rolled away from LP-2 during the launch operations. The SCAT has an interior height of 58 feet, with door opening heights of 40 feet, which is the limiting factor in the size of launch vehicles when raised in a vertical position that will use the SCAT.

Presently, Alaska Aerospace is developing an area west of LP-2 and the IPF for commercial launch activities. This includes the development of new launch pads. It is the management policy that the new commercial pads being developed will be sized to accommodate the new small and ultra-small liquid and solid propellant commercial launch vehicles. Therefore, there is no recommendation to increase the SCAT size in this plan.

- ➢ Recommended additional LP-2 requirements: None
- ➢ Recommended additional SCAT requirements: None

Area 3 Launch Pad Sites

Figure 4-4 depicts the locations for Launch Pad 3A, Launch Pad 3B, Launch Pad 3C, and Launch Pad 3D.

Figure 4-4: Area 3 Launch Pad Sites

Launch Pad 3A

Launch Pad 3A is a 6,400 square foot (80'x 80') compacted gravel area. There is no electrical or communications service to the pad. There has not been a launch pad constructed at Pad 3A. Pad 3A is situated on the north side of the access road relative to the commercial launch pad area. As such, it is not in an ideal location for launching vehicles, as they would overfly the launch pads on the opposite side of the access road.

Pad 3A has a 75'x 25' fenced area previously used as secured storage. Under the medium forecast projection, there is a demand for an area to support storage of materials and for staging segments of launch vehicles. Pad 3A is perfectly situated at the entranceway to the commercial launch pad area to support this requirement. Based on the configuration of the site and the projected operations forecasts it is expected Pad 3A will provide non-launch support throughout the planning period but may also be used for limited government launch operations on a non-interference basis with other launch pads.

- Recommended additional Pad 3A requirements:
  - None for use as a storage area.

- Limited modifications may be necessary if used for government launches with the specifications of modifications determined by the government customer, such as possibly extending the fenced area.

Launch Pad 3B

Launch Pad 3B was initially planned to be located on the north side of the access road, midway down the access road towards Pad 3D, reserved for development as a commercial launch pad. There was commercial interest in relocating this area to the south side of the access road, between Pads 3C and 3D. Relocating this site eliminates over-flight issues created by vehicles launched from the original location over-flying Pad 3C and/or Pad 3D. Relocating to the south side of the road improves the potential for increased use and reduces pressure for additional launch pads. Relocating the pad also provides efficiencies in keeping underground utilities all co-located on the south side of the access road.

Based on a contractual agreement with a commercial launch company, Alaska Aerospace relocated Pad B in 2019 and is developing commercial launch infrastructure similar to Launch Pad 3C. The relocated Pad 3B measures 248 feet by 286 feet and includes:

- A concrete launch pad measuring 225 sq ft. (15' by 15').
- A deluge catchment system and tank.
- A cryogenics (branch of physics that deals with the production and effects of very low temperatures, such as liquefied oxygen, nitrogen, hydrogen, etc.) pad measuring 50' by 50'.
- A rocket propellant pad measuring 50' by 50'.
- Pole mounted camera for safety and security.
- Area lighting.
- Lightning protection terminals.
- Weather instrumentation.
- Boundary fencing.
- A semi-portable soft-sided vehicle integration tent facility on a concrete slab.

Once finished in 2019, Pad 3B will be complete with no additional changes required during the duration of this planning period.

- ➢ Recommended additional Pad 3B requirements: None

Launch Pad 3C

Launch Pad 3C is located midway down the access road on the south side of the road, just prior to Pad 3B. This site was used by the government for the 2017 test launches. Pad 3C was originally developed as a 10,000 square foot (100'x100') compacted gravel pad for government launch campaigns. It has since been modified to provide capabilities for commercial liquid fueled light lift vehicle launches. This was accomplished by installing concrete pads for a launch stool, vehicle transport erector, a liquid oxygen (LOX) pad and a propellant pad. To the west of the LOX pad, there is an additional 2,000 square feet of compacted gravel for propellant tank access and storage along with an earthen berm between the LOX and the launch pads. To the east of the propellant pad is also an additional 2,000 square feet of compacted gravel for propellant tank access and storage, also separated from the launch pad by an earthen berm.

Pad 3C is fenced with lighting and security camera poles installed at the four corners of the launch pad. As such Pad 3C is capable to serve both government and commercial customers; however, additional improvements are necessary for full utilization of the site.

- Recommended additional Pad 3C requirements:
  - Provide ability for use of a portable water deluge system.
  - Install a water deluge catchment system.
  - Install lighting protection rods at the perimeter of the launch pad.
  - Modify current light/security camera poles to allow being lowered during commercial liquid propellant launches.

Launch Pad 3D

Launch Pad 3D is located at the far end of the access road, west of Pads 3B and 3C. This site was originally built to support government test operations. Like Pad 3C before modifications, it measures 10,000 square foot (100'x 100') of compacted gravel launch pad intended for use during government launch campaigns. The area is fenced and includes both lighting and security camera poles, with lightning rods attached. The site does not have a concrete launch pad installed. With increased commercial operations at PSCA, Pad 3D provides an ideal location to repurpose for both government and commercial operators, similar to what was done to maximize the use of Pad 3C. To accomplish this, additional infrastructure investments are required, as follows:

- Recommended additional Pad 3D requirements:
  - Reorient the site to accommodate additional facility upgrades and modifications.

- Install a fifteen foot by fifteen foot (15’ x 15’) concrete launch pad in the center of the site.
- Construct a concrete pad for cryogenics, with an earthen berm between the tank and launch pads.
- Construct a concrete pad for Rocket Propellant tanks, with an earthen berm between the tank and launch pads.
- Install a deluge catchment system and tank.
- Provide ability for use of a portable water deluge system.
- Install lighting protection rods at the perimeter of the launch pad.
- Modify current light/security camera poles to allow being lowered during commercial liquid propellant launches.

Launch Pad 3E:

Based on the demand forecasts, the need for an additional launch pad to support small commercial launch vehicles may be necessary within the planning period. Should additional launch pad capability be required to support this market, it is recommended it be located in an area complimentary to the other commercial launch pads to avoid overflight of existing facilities. This site should be able to support small and ultra-small, liquid and hybrid propellant launch vehicles. Technology is developing where some launch vehicles may use a hybrid fuel mixture between liquid and solid propellants on different stages of the vehicle, to include the probability of developing a launch vehicle that uses a mixture of liquid and solid propellants together.

- ➢ Recommended Pad 3E requirements:
  - An additional launch site should be identified for development of Launch Pad E once all other launch pads are being used to capacity. In order to provide the broadest range of capabilities for developing commercial launch vehicles, this site must be able to handle both liquid and hybrid designs.

High Altitude Balloon Launch Vehicles

A number of companies are developing capabilities to launch small and ultra-small payloads using high-altitude balloon technology in lieu of powered launch vehicles. Launch area configuration is similar to a traditional launch pad, with the need for fuels, processing, loading and handling, the difference is in the launch pad configuration. A high-altitude balloon launch would not require a launch stool, flame trench, water deluge system and bermed areas for fuels; a high-altitude balloon launch area would need to have sufficient area to layout the high-altitude balloon and fill the balloon with a lighter than air gas (helium, hydrogen, or similar gas) to lift the balloon to altitude before deploying the payload. Since this Master Plan is designed to identify areas for operations of potential future needs, a site should be identified to support potential commercial high-altitude balloon launch operations.

- Recommended high-altitude balloon launch vehicle requirements:
  - Because high-altitude balloons launch vertically and are influenced by wind direction, a balloon launch pad must be aligned to permit the balloon to be filled and launched with the prevailing winds. Therefore, this plan should identify a location for high-altitude balloon launch vehicle operations. Support facilities would use existing facilities or be established on the outer edge of the launch pad area.

Launch Support Facilities

Propellant Storage Facility

PSCA currently does not have any launch vehicle propellant storage capability. All propellants (LOX, RP-1, etc.) is purchased by individual launch vehicle customers for use by that customer. The small launch vehicles projected to operate from PSCA will average between 1,000 and 2,000 gallons of LOX per launch, totaling up to 72,000 gallons annually. In addition, these vehicles will need a liquid propellant, such as Rocket Propellant (RP-1) or Propylene. Based on the medium forecasts, it is projected that up to 92,000 pounds (10,000 gallons) of cryogenics and 35,000 pounds (5,000 gallons) of rocket propellant will be required annually at PSCA. As the launch cadence increases, it is projected that a cryogenic fuel production facility may be more cost effective than continuously shipping cryogenics into PSCA over the Kodiak road system. As such, sufficient area needs to be identified where propellant production and storage could occur without impacting other operations at PSCA.

- Recommended additional propellant storage facility requirements:
  - To reduce the number of vehicles transiting LOX and rocket propellant between Kodiak and PSCA, it is recommended a fuel storage area be established with cryogenic and rocket propellant holding tanks capable of large scale storage of these consumables on site. The area should have sufficient space to allow for future installation of a small propellant production facility. This increases safety be reducing transport activities of LOX and rocket fuel on the public roadways and contains quantity storage. Similar to the Rocket Motor Storage Facility, the Propellant Storage Facility would be developed in a separate area from the launch pads. Potential propellant production and Storage Facility locations will be proposed in the next chapter, *Potential Development Alternatives.*

Launch Vehicle Integration Facilities

The current Integration and Processing Facility (IPF) was substantially rebuilt following the 2014 launch vehicle failure. State-of-the-Industry lighting, HVAC, and electrical systems were installed. The current facility is capable of handling solid and liquid propellant rocket stages up to a length of ninety (90) feet in the horizontal position and slightly less than forty (40) feet in the vertical position. Under the medium demand forecast, the IPF is capable of meeting future demands for launch vehicles and no changes are begin recommended under this plan.

At Launch Pad 3B a new soft-sided vehicle integration facility was constructed to support commercial operations from that launch pad, specifically designed to meet a particular customer's integration requirement. As the commercial launch market expands and PSCA reaches the launch demands forecast in the later years of the Master Plan, it is expected that additional integration facilities will be required to support each of the commercial launch pads, since at maximum operations it is projected that commercial companies will be concurrently processing launch vehicles and a single shared facility will not be practical to meet the customers launch requirements. Therefore, it is recommended that individual integration facilities be constructed at each commercial launch pad.

- Recommended additional requirements:
  - Reserve sufficient space at each newly developed commercial launch pad for small and ultra-small launch vehicle storage and integration. Individual integration facilities would be constructed as demand increases by commercial customers at Pad's 3A, 3C, 3D, and 3E for simultaneous operations.

Payload Processing Facilities

The existing Payload Processing Facility (PPF) includes a 40' x 60' x 66' receiving bay and a 40' x 60' x 58' processing bay with each bay having 2,400 square feet of floor space for a total of 4,800 square feet. There is a 15-ton crane in the PPF. This facility is sized for medium to large payloads (satellites). Based on the demand forecast, Alaska Aerospace is not planning for commercial or government missions that will require larger, or additional payload processing capabilities for these larger payloads. Rather, due to fact that satellite sizes are getting smaller with technology changes that provide increased capabilities within smaller components, it is projected that the current PPF meets future square footage demands for payload processing.

A reconfiguration of the PPF could provide additional capacity without the need to develop a new PPF to meet the demand created by increased launch activities. Under the demand forecast, it is highly probable that more than one customer will require payload processing at any given moment, as stated above. Recognizing that the size of satellites is decreasing and that many satellite customers will bring fully processed satellites to PSCA, there is no recommendation to develop an additional PPF.

Should the demand for payload processing increase beyond the capabilities of the current PPF configuration can effective accommodate, it is recommended the PPF be reconfigured with the 40' x 60' x 66' receiving bay be subdivided into two processing bays sized exclusively to meet the small and ultra-small satellite market. Under this option, the receiving bay would be established with temporary clean-room capabilities which could be removed to accommodate the transport of larger satellites from the original processing bay to the launch pad. Installing temporary clean room capability within the existing PPF is a cost and time effective method to increase processing capabilities without the need for constructing a new and separate PPF for smaller satellite processing.

- Recommended additional PPF requirements:
    - As satellite processing demands increase, subdivide the PPF receiving bay into two separate payload processing clean-room capable bays with temporary construction that retains the ability to transport larger satellites from the original processing bay to the launch pad.

Launch Vehicle and Payload Storage Facilities

The current two Rocket Motor Storage Facilities (RMSF) were designed and built specifically for Minotaur/Polaris (medium) sized launch vehicles. Both facilities have been underutilized since being built. Using the demand forecast for government launches, the RMSF is capable of handling any future requirements.

In 2019, federal capital investment funds were received to modify one of the two storage facilities to accommodate smaller launch vehicles. This reconfiguration resulted in gaining the capability of storing multiple launch vehicles within a single storage facility. This reconfiguration increased the marketability of PSCA, as commercial customers are now able to ship multiple launch vehicles to PSCA resulting in a more rapid ability to launch missions at closer intervals. As the commercial market increases at PSCA, it is recommended that the second storage facility be reconfigured to accommodate multiple commercial launch vehicles. This would increase the ability to store up to four unfueled liquid propellant launch vehicles at PSCA at one time.

Under the original RMSF development plan, space was reserved for three new storage facilities directly adjacent to the existing RMSF. Without a demand for these facilities, no capital investment should be expended for development until such time as the demand presents itself as viable. However, the land should be retained for future expansion as both the government and commercial launches increase.

- Recommended additional RMSF requirements:
  - Reconfigure both RMSF bays to accommodate multiple commercial liquid propellant launch vehicles with a capacity of storing up to four unfueled vehicles. Retain the reserved adjacent land for future expansion of the RMSF.

Launch Control Center (previously the Range Control Center)

The Launch Control Center (LCC) provides a variety of administrative and operational functions at PSCA. This section will provide a facilities requirements assessment for the major components of the LCC.

Launch Operations Control Center (LOCC)

The primary operations area within the LCC is the LOCC, which measures 1,600 square feet to accommodate forty-nine (49) individual launch team positions during launch operations. This space has sufficiently accommodated all past government launch team requirements for government launches. Commercial customers have a significantly smaller space requirement.

For both government and commercial launches, Alaska Aerospace will require a minimal level of PSCA personnel to operate from LOCC to function as the Range Control Officer (RCO), the Range Operations Supervisor/Operations Director (ROS/OD), Ground Safety Officer (GSO), and Weather Officer (WXO). Commercial launch team requirements are projected to range from only a few operators in the LOCC (between 1 and 6), to government launch team requirements which are projected to often use the full capacity of the LOCC for launches.

With the increased number of operations projected in this plan, the challenge for the LOCC will be meeting different configurations for individual customers during periods when multiple customers are scheduling launches within close timeframes of each other. To meet that challenge, in 2018 Alaska Aerospace converted the semi-transportable launch consoles to a table-top PC style system which can be quickly reconfigured to meet specific customer requirements. Should additional positions be required to support launch activities, the individual launch team positions can be reconfigured to increase the number of personnel supporting launches within the LOCC up to forty-nine (49) and in the next chapter consideration will be given to providing additional facilities for potential commercial launch operations use.

The mission voice network or Operational Intercom System (OIS) is also distributed to each workstation and has adequate capacity to handle increased positions and activity. It is projected that the current LOCC configuration and size is sufficient to meet future demands.

With the increased launches projected through the planning period, it expected that both government and commercial customers may be operating at PSCA simultaneously. These concurrent operations may not be able to be accommodated in a single LOCC; therefore, it is recommended that an additional area be identified for establishing an alternate launch control center, thus permitting the simultaneous operations for customer sat PSCA.

- Recommended additional LOCC requirements: No modifications are necessary at the existing LOCC. Recommend and Alternate Mission Control Center be identified to permit simultaneous operations of both government and commercial customers at PSCA.

Security system requirements

The central security office is located within the LCC. It ties all security camera systems across PSCA into a central monitoring system that is staffed by a security guard. The PSCA camera systems provide enhanced security at facilities and feature focus control, zoom capability, and panning motion capability. A series of sixty (60) cameras are located at strategic locations, both internal and external to facilities.

As new facilities and launch pads are established at PSCA, additional security cameras will be required. For example, with the construction of Pad B additional cameras will be integrated into the security system. Installation of security cameras at facilities operated by commercial launch providers are not required to have security cameras installed, therefore, the number of future security cameras at PSCA will be customer dependent.

The current security office measures 400 square feet (20 feet by 20 feet). In addition to the four central monitoring systems displays, the room also has a desk for the security officer and all supporting electronics. With the increased operations and expanded facilities at PSCA, the need for additional space for security will become necessary. The specific number of new security cameras required will be dependent on customer requirements. However, with the increased number of cameras and increased operations, security will require up to a fifty percent expansion in space, as well as additional displays and data storage capabilities.

- Recommended additional security office requirements:
  - Reconfigure LCC front area and increase the security office by 50%.
  - Add two additional display monitors, as camera demand increases.
  - Increase data storage capability to support the additional cameras and data requirements.

Meteorological Systems

The meteorological systems provide comprehensive weather forecasting capabilities using a variety of instrumentation addressed in *Chapter Two – Inventory of Existing Conditions*. These capabilities are sufficient to meet the current and future weather forecasting requirements for launch operations. However, much of the equipment is over a decade old and some pieces of equipment are reaching obsolescence.

In 2019, a new X-band weather radar was purchased to provide enhanced forecast information. The RDR200/GX is an X-Band Radar with a dual polarization Doppler radar. It provides advanced hydro-meteorological applications and can be used to monitor convective phenomena associated with severe atmospheric events. The dual polarization technology, coupled with sophisticated analysis software permit an accurate classification of the hydrometeors allowing the forecaster to determine whether it is rain, hail, or snow.

A new balloon launch building was constructed in 2017. This facility, while new construction, still requires manual balloon inflation and equipment activation. New technology being used by the National Weather Service (NWS) across Alaska which utilizes autonomous balloon launches. NWS is installing the Finnish "Autosonde" stations to release weather balloons and collect data. Each cost roughly $1.2 million to install. The NWS tested the first prototype in Kodiak and concluded the system was "effective, efficient and resilient," according to National Weather Service Acting Director of Public Affairs Susan Buchanan.

- Recommended additional meteorological system requirements:
  - Install new weather tracking computer display systems.
  - Install new anemometer system.
  - Install an automated balloon launch facility, with upgraded radiosonde equipment, at PSCA.
  - Install a wind profiler and temperature profiler

Tech Control/Communications Requirements

The tech control/communications room is located next to the large conference room and is the main switching center for all communications and data lines at PSCA supporting the LCC. Over the years the increased communications and data requirements have added a number of new systems and subsystems to the PSCA network. This has resulted in a significant increase in capability at the spaceport while simultaneously reaching the physical capacity of the tech control/communications room. As more systems were added to the room, the heat generated by these systems exceeded the original HVAC systems cooling capability. In 2019, the HVAC systems at PSCA were upgraded to accommodate the new cooling requirements, however, additional cooling capability is necessary in Tech Control if additional systems are to be installed at a future date.

- Recommended additional Tech Control requirements:
  - Increase the internal HVAC cooling capability.
  - As additional telecommunications and data systems are required for operations at PSCA, Tech Control should be expanded to provide adequate space for system operations.

Emergency Medical Technician (EMT) Office

Alaska Aerospace employs a part-time EMT during all launch operations. The LCC has a small medical office to handle minor medical issues. It is equipped with a locked medicine cabinet, an administrative desk and chair, and examination gurney, a recliner chair and counter space and cabinets for storing supplies. The LCC also has ambulatory services available for use in responding to emergencies and transporting patients in need of greater medical care to Kodiak. The EMT space is adequate to handle expected future operational needs.

- Recommended additional EMT office requirements: None

Administrative Space Requirements

The main entranceway front desk area has sufficient capacity to be expanded, with an additional administrative reception desk, if necessary.

- Recommended additional administrative space requirements - No changes are required for this area throughout the planning period, although a reconfiguration plan will be completed to accommodate the security requirements previously identified.

Management Offices

Along the west side of the LCC are four private offices. These offices measure 10 feet by 10 feet and are used by PSCA management personnel during operations to support the RCO, ROS, OD, and GSO. There are an additional four offices located next to the small conference room. These offices are reserved for customer use.

- Recommended additional management office requirements: None

Engineering Office Space Requirements

In the center of the LCC resides an open area (3,350 square feet) that is divided into partitioned offices and cubicles. This area is identified as the Engineering Office and is generally configured to support 64 cubicles and offices. Each cubicle is wired to support both phone and data connections and can be configured to support more than a single person within each cubicle.

This area is used exclusively by customers to support all engineering and technical requirements supporting a launch operation. The area is primarily used by government customers but can be tailored to meet the reduced requirements of commercial customers. With the modular configuration of partitioned offices, this area can be specifically designed to serve individual customer's needs. In the past, government missions have utilized this area twenty-four hours per day. In doing so, cubicles have the flexibility to have more than one person assigned per cubicle, increasing the daily capability to over one hundred and twenty (120) people. This is projected to be sufficient for the planning period.

- Recommended additional engineering office requirements: None

Large Conference Room

The large conference room is located adjacent to the LOCC and is used for a variety of purposes. It measures 750 square feet and can accommodate up to sixty-five (65) people in theater type seating. It also is capable of being configured with a large conference room table that seats up to twenty (20) people, with additional seating available around the sides of the room. The room as full video and teleconferencing capabilities, along with a video projector for PowerPoint presentations. This conference room has not been modified for classified presentations.

The greatest demand for the use of the large conference room is from government customers. The room has been used to provide orientation presentations of the PSCA, as a VIP reception area, media center, mission briefing room, daily planning meeting room, and a variety of other functions usually requested by customers. It is often used by both government and commercial customers as the briefing room for Launch Readiness Reviews, and other operational presentations. Based on the demand forecasts, the large conference room should remain adequate to accommodate future needs.

- Recommended additional large conference room requirements: None

Small Conference Room

The LCC has a small conference room measuring 20 feet by 25 feet. It is equipped with a small conference table and chairs for approximately ten (10) people. There is additional seating around the room for up to twenty (20) people. The small conference room has cabinets for storage and telecommunications capability for videoconferencing, teleconferencing, and PowerPoint presentations. This room has been modified to allow for up to SECRET presentations and is secured for classified presentations.

- Recommended additional small conference room requirements:
    - There may be future government requirements to increase security capability to the Top-Secret level. If so, the space within the Small Conference Room is sufficient to support Top Secret operations.

Bathroom Requirements

There are two gender specific restrooms in the LCC. The women's restroom consists of four stalls and two sinks, while the men's restroom consists of two stalls, one urinal, and two sinks. Both restrooms have a shower facility, with lockers for storage of personal items. When the LCC is supporting government launch operations, both restrooms have often not met the usage demand.

Occupational Safety and Health Administration (OSHA) requirements for toilets is based on the number of full-time personnel using a specific building. Employees must have access to a bathroom facility in a timely manner. According to OSHA standards, a workplace must have a minimum of one toilet for one to fifteen (15) employees, two for sixteen (16) to thirty-five (35) employees, three for thirty-six (36) to fifty-five (55) employees, four for fifty-six (56) to eighty (80) employees. All employee restrooms must have hot and cold running water, or at least tepid (lukewarm) running water and each restroom must have soap for employee use.

OSHA has exceptions to the minimum number of toilets required when the facility is used by mobile workers. While the number of restroom facilities with LCC are compliant with OSHA standards, actual usage of the facilities during large government operations has shown that the restroom demand has exceeded capacity at certain times. Therefore, increasing the number of urinals to meet these peak demand periods is warranted.

- Recommended additional bathroom requirements:
    - Install additional toilets in the restrooms.

Kitchen Requirements

The LCC has a fully functional kitchen which includes two refrigerators, two microwave ovens, a standard oven, and sink with a garbage disposal. A drink vending machine is also located in the kitchen. There is plentiful cabinet space, with dishes for both preparing and serving food. Two table and twelve (12) chairs are also in the kitchen. The facility has adequately handled the food service demands for past launches.

- Recommended additional kitchen requirements: None

Telemetry Antennas and Location

Alaska Aerospace operates four tracking antennas at PSCA, with an additional two mobile antennas available for use at PSCA or other off-axis sites. Two new permanent tracking antennas, with radome covers, were installed in 2018, supported by two new Command Destruct antennas installed in 2019. Based on the projected demand for launches at PSCA, these four antennas, supplemented by the two mobile antennas that have both tracking and command destruct capability, no additional Alaska Aerospace owned antennas are projected for the planning period.

The current telemetry antenna location sits on high ground east of the Maintenance Support Facility and provides ideal line-of-sight to launch pads for telemetry tracking. During the May 15, 2019 Spaceport Planning Advisory Group meeting, a presentation of near-term antenna demands was presented, along with six options for locating the new weather antenna (see figure), as well as requests from the commercial sector for launch vehicle tracking antennas. Consensus of the group was to expand the existing antenna site to accommodate the immediate demand for the new Alaska Aerospace weather antenna and maximize use of the area for other new telemetry antennas.

Figure 4-5: Potential Telemetry / Downlink Antenna Locations

During the summer of 2019, the new Alaska Aerospace weather antenna was installed to the east of the Alaska Aerospace telemetry tracking antennas. During the installation phase, the terrain was surveyed to ascertain the viability of additional telemetry tracking antenna installations at that site. The terrain drops off steeply to the northeast side of the site and gradually slopes downward on the southeast and southerly side of the site, making for difficulties in installing large numbers of telemetry antennas at this location.

The market for antennas capable of both transmitting and receiving signals for launch vehicle and satellites is increasing parallel to the demand for small commercial launches. Alaska Aerospace has received numerous requests to provide land availability for installation of antennas at PSCA. One such request is from a current commercial small launch vehicle customer who intends to install two small tracking antennas to directly support their PSCA launch activities.

While the demand for antennas located at PSCA appears high, Alaska Aerospace is focused on serving commercial and government customers who also conduct launches from PSCA as the highest priority for new antenna installations. Because the actual demand forecast for antennas at PSCA has not been quantified by customers, this plan presents alternative locations to the existing antenna site as a possible location for future antenna installation by commercial customers that are launching from PSCA.

- Recommended additional antenna siting requirements:
    - Develop the land adjacent to the existing antenna area at PSCA and install the new weather antenna in that area.
    - Maximize this area as the primary consolidated antenna site for future installations, so long as the location meets operational requirements.
    - Identify a second area for installation of additional antennas required by Alaska Aerospace launch customers

Range Safety and Command Destruct Systems

Alaska Aerospace currently has two systems configured for flight termination of launch vehicles. These Range Safety and Command Destruct Systems operate separately. One is located in the Tech Control Center (TCC) in a permanent configuration. The second system is in the Mobile Operations Center used since 2016 supporting Rocket Lab's Launch Complex One in New Zealand.

The TCC unit was upgraded in 2018, while the mobile system will be upgraded in 2020. Because only one customer may launch at any given time, PSCA only requires a single Range Safety and Command Destruct system at the spaceport. The second set of equipment is available for "off-axis" (not located at PSCA) operations. With the 2018 upgrade to the TCC and the acquisition of two new command destruct antennas for PSCA, no additional systems are projected for the planning period.

Future projections include government missions which may require additional off-axis range safety and command destruct capabilities. Should the government require an increased number of off-axis capabilities, additional Range Safety and Command Destruct Systems would need to be acquired. In previous launches, Alaska Aerospace has installed off-axis telemetry systems at King Salmon, Cordova, and Sand Point. Since any additional units would be purchased to provide off-axis support and the systems would not be installed at PSCA, no location requirements exist for placement of the systems at PSCA for operational purposes; however, space would be needed to store the units when not deployed to off-axis sites.

- ➢ Recommended additional range safety and command destruct requirements:
  - Identify space for storage of up to two additional Range Safety and Command Destruct units

Off-Axis Launch Trajectory Tracking and Optics

One requirement several launch vehicle operators typically need is collecting data from a side-view, "off-axis." from the planned flight trajectory of the launch vehicle. Rocket trajectories fly away from the launch site which generally results in spaceport-positioned instrumentation viewing down the trajectory path (e.g., looking end-on to the flight). Once a rocket pitches to start the arc of their flight, the rocket's engines and exhaust plume largely obscures the rocket body and upper stages from being viewed at the launch site. This can cause complications for optical tracking systems as well as telemetry and range safety systems. For example, using side view optical and/or telemetry tracking and command destruct systems allows observation the launch vehicle body unobscured from the rocket's plume and also allows for independent measurement or observation of the rocket's downrange trajectory. This can support both real time and post-analysis across a wide range of the electromagnetic spectrum (e.g., ultraviolet, visible, to infrared).

In-axis telemetry systems can be susceptible to loss of the radio frequency (RF) link from the rocket's transmitters due to RF signal attenuation from the rocket's exhaust plume. Loss of RF signal will result in a loss of important rocket technical performance data and extended loss may result in an unnecessary commanded destruct of the rocket since ground operators will not have sufficient rocket positional data. If plume attenuation is predicted to impact rocket RF transmission to the launch site antennas, an off-axis RF system (e.g., range safety and telemetry system (RSTS)) can provide the side-view geometry to the rocket to avoid such issues.

Historically, Alaska Aerospace has positioned “off-axis” telemetry and range safety systems at locations other than on Kodiak Island. Sites at Cordova, King Salmon, and Sand Point have been used for these purposes. In addition, Pasagshak Point has been used for optics instrumentation to allow data collection close-in to the launch site. The land used at Pasagshak Point is State of Alaska public lands managed by the Department of Natural Resources.

- Recommended additional range safety and command destruct “off-axis” requirements:
  - Identify a location on Kodiak Island in close proximity to PSCA for placement of “off-axis” optics and telemetry space, as well as storage space at PSCA for up to two additional Range Safety and Command Destruct units.

SECTION THREE – Spaceport Support Facilities Requirements

Maintenance and Support Facility (MSF)

With the substantial projected increase in launch operations, space within the MSF to accommodate vehicle maintenance, fabrication, Tech Control, Warehousing, storage and marshaling of both Alaska Aerospace and customer inventory, management offices, and other functions the MSF will exceed capacity under its current configuration. A review of square footage use concluded current use of the facility is not maximized, based on an inefficient layout and divide between the three bays. Specifically, the warehouse/inventory bay uses a lot of open floor space for storage of Alaska Aerospace and customer inventory. More efficient use would be to install additional property storage cages to a higher vertical level with adequate space between the property storage cages for access using a forklift to reach high cages.

In the middle bay offices have been built over a quarter of the bay, above the Tech Control Center. The Communications Manager office is located on the ground floor in a corner near the main bay door entrance. Space is available above this office to build offices, freeing up floor space for storage and use in maintenance/fabrication/final assembly.

As the vehicle fleet increases, additional space may also be necessary for maintenance. While it is recommended that new vehicles be maintained under purchase agreement warranties, once the vehicles are no longer covered by warranty, demand for space increases to accommodate required vehicle maintenance. Currently, the vehicle maintenance area is also used for other maintenance and fabrication purposes, as well as for parking vehicles, such as the fire truck and/or ambulance. As the vehicle fleet increases in size, the vehicle maintenance area will require expansion.

There has been interest expressed by customers to use the MSF for their requirements. One example is to establish a semi-permanent Launch Control Center at PSCA for the customer's exclusive use. An indoor facility is preferred. Using space in the MSF for this purpose would permit the middle bay to be repurposed from storage, fabrication and final assembly into a functional operational area, being co-located with the Tech Control Center. However, displacing office, warehouse, and maintenance space would mean additional space would be required in another facility or through expanding the MSF.

- Recommended MSF requirements:
  - Maximize existing internal space in the MSF to meet future demands.
  - Relocate the Communications Manage office from the MSF storage area and increase storage capability.

- Following completion of this Master Plan, a separate building functional study should be accomplished to maximize the square footage and increase efficiencies. Options for increased MSF space will be considered in the next chapter to provide sufficient area to meet projected demands and accommodate customer requirements.

Soft-Side Storage Units

The two soft-sided unheated storage units located behind the MSF are used primarily by Alaska Aerospace for storage of equipment that requires protection for weather or need to be secured in a locked facility. Each unit measures sixty (60) feet by eighty (80) feet. Currently these two units average 70 percent space usage. There remains additional storage space available in each facility. With the projected increase in activities and the number of different customers projected to use PSCA during the planning period, it is projected both facilities will reach capacity. Based on the forecast demand, it is expected a fifty percent increase in storage space will be required. Vacant land is available adjacent to the existing units.

- ➢ Recommended additional soft-side storage unit requirements:
  - One additional unit is projected during the planning period. Reserve a space for the potential installation of a third semi-soft sided storage unit.

Customer Commodity Storage Area

As commercial activities increase at PSCA, it is projected that customers will require space that is not available today for commodity storage, such as supplies, parts, materials, and fuels. With additional customer using PSCA, the need for additional land for commodity storage will increase.

- ➢ Recommended customer commodity storage area requirements:
  - To preclude a proliferation of storage areas around PSCA, Alaska Aerospace should identify an area for establishing a centralized customer commodity storage area.
  - An area should also be identified for future light manufacturing and warehouse operations by customers using PSCA on a long-term basis.

Ground Support Vehicle Fueling Tanks

The two existing fueling tanks located across the parking lot from the Maintenance Support Facility has additional capacity to support increased motor vehicle activity at PSCA. Tank one has a 1000-gallon motor vehicle fuel capacity, while the second tank holds up to 2000 gallons of diesel fuel. Increased vehicular activity at the spaceport and increasing number of vehicles operating at the spaceport will increase the rate of fuel consumption.

➢ Recommended additional vehicle fueling tank requirements:
  - To meet the initial increase in fuel consumption using the existing tanks, increasing the fuel delivery schedule should be able to accommodate demand. However, based on the number of vehicles that may operate at PSCA during the latter periods of the planning period, a need may develop to increase the size of the tanks. If that requirements develops, it is recommended the larger tanks be installed in the same location the current tanks use.

Government Specific Support Areas

The following section discusses the areas specifically developed in support of government customer requirements.

Government Tactical Support Center (Alpha Site)

The 68,500 square feet (250'x 274') Government Tactical Support Center was developed specifically to support government operations at PSCA. The site is located immediately east of the LCC and is built of compacted gravel, with temporary facilities located at the site during missions. The site has power and communications links. The site is occupied by a number of facilities that provide launch control, tech control, conference room, office, bathroom, and support offices.

Since the area is located adjacent to the LCC and is already improved with compact gravel, power, and communications fiber, the site is a prime area for repurposing to other government and/or commercial needs. Specifically, the Alpha Site will be considered developable property by either commercial or government customers for mission and/or operations control facilities, storage/warehouse facilities, administration offices, expanded security operations facilities, temporary living units, additional vehicle parking, or optics instrumentation. Based on the increasing demand for both government and commercial operations at PSCA, these facilities have the potential to off-set other facility development that would be required to support increased operations over the planning period.

➢ Recommended Alpha Site use requirements:
  - Retain the facilities of the Alpha site and use the existing facilities to meet future customer demands in lieu of developing additional areas to accomplish new customer requirements.

Long Range Radar Area (Area 1)

Built to support a specific government mission, this area covers 140,000 square feet of compacted gravel with both power and communications data availability. The location is ideal for operating long range radar systems and telemetry, tracking, and downlink antennas. This area will remain available to the government for use throughout the term of the current contract with Alaska Aerospace, and will be considered available for government use under future government contracts. However, should the government no longer require the use of Area 1, this planning process should consider other potential uses.

During the May 15, 2019 Spaceport Planning Advisory Group meeting, a discussion was conducted concerning future antenna locations that would be both technically feasible and publicly acceptable. The group was unanimous that establishing Area 1 as a permanent antenna site would not be viewed favorably, due to its visual impact on the area. Therefore, Area 1 has been eliminated from further consideration as a permanent antenna location.

- ➢ Recommended Area 1 use requirements:
  - Remove all above surface facilities, except for utility connections and fencing. Retain the gravel pad and communications, power, and support infrastructure for future government use. Reserve area for future launch support system use, which could include future temporary Long Range Radar equipment for government missions.

Radar Gravel Pad (Area 2)

Area 2 has been used to support various government operations as a radar tracking site. Future government operations may require radar tracking in addition to the capabilities provided by Alaska Aerospace at PSCA. With 112,450 square feet of compacted gravel, this pad remains a viable site to meet future government requirements. This pad, along with the 12,000 square feet of compacted gravel area for parking, is ideally situated to support launch operations at PSCA, as well as potentially serving other uses.

- ➢ Recommended Area 2 use requirements:
  - Retain the gravel pad and communications, power, and support infrastructure for possible future government use, which will be addressed in the next chapter as on option to reduce the need to develop additional pads at PSCA.

Life Support Area Gravel Pad (Area 4)

The Life Support Area is designed for installation of temporary modular and transportable housing units specifically to support customer requirements. The pad is specifically located to support unique government operations at PSCA. In accordance with the Alaska Aerospace Interagency Land Use Management Agreement with the Department of Natural Resources, long term/permanent housing/lodging units are not permitted at PSCA. There remains a demand for temporary lodging at or near PSCA for future government missions, as there are no facilities in close proximity to PSCA that can accommodate 100+ personnel.

- Recommended Area 4 use requirements:
  - Remove all above surface facilities.
  - Retain the gravel pad and communications, power, and support infrastructure for possible future government use. This site will be part of the future lodging requirements consideration in the next chapter, Preferred Alternatives.

Gravel Pad (Area 5)

Area 5 is a 50,000 square foot (200'x 250') compacted gravel launch pad and was constructed during the original development of PSCA and used as a lay-down area for construction equipment, materials, and supplies. The site does not have power or communications data capability but is built adjacent to the main roadway between the Launch Control Center and Launch Pad 1 and Launch Pad 2. Therefore, both capabilities are readily available as spurs from the main trunks, if needed.

With the increase in commercial operations projected during the planning period, PSCA may experience constraints in processing, storage, and test facilities for commercial companies. Area 5 is located close to all launch pads at PSCA and is situated along the main road with easy access to all launch pads. Since the site was originally built to support specific government operations and has not been actively used, this area is a prime candidate for repurposing to support commercial operations.

- Recommended Area 5 requirements:
  - Retain Area 5 and when no longer required by the government, repurpose the site for commercial use. Projected use would be based on customer requirements but would be directly related to launch support requirements at PSCA. Options could include storage units, small integration facilities, engine test stand, or other launch vehicle associated requirements.

SECTION FOUR – Ancillary Requirements

Communications Systems

The communication infrastructure at PSCA is a complex array of interconnected systems. PSCA's modern communication infrastructure includes fiber optic marine cable to mainland Alaska and the lower 48 states. Offsite communication is provided through fiber optic marine cable via Tech Control downlinking to locations required by the Launch Site User. The locations include, but are not limited to, Anchorage, Cordova, and Seattle. This system provides T-1 and IP based services for voice, data, and Internet connections. If fiber optics is unavailable at an off-axis site, communications would be routed from the satellite communication (SATCOM) ground station at the off-axis site through a ground link in Anchorage to PSCA. Communication from the Launch Pads to the other facilities at PSCA is via telephone, operational intercom, paging, and the data network. All communications, security, fire alarm, and area warning are controlled at the resident facilities and report back to Tech Control.

- Recommended communications requirements: Expanded, as needed, in future facilities.

Telephone

A PBX telephone system provides phone communications throughout PSCA. This system can be expanded as customer demand dictates. No specific requirements are presented in this plan, as phone requirements are usually configured based on each individual customer requirements.

- Recommended telephone requirements: Installed, as needed, in future facilities.

Fiber Optic and Copper Backbone Systems

Fiber optics and copper communications lines run underground throughout the PSCA. The existing fiber is not being used to its full capacity; however, with the increased activities projected for PSCA, additional fiber capability will occur during the planning period. Currently Alaska Aerospace has an agreement with GCI for operation of the fiber cable system at PSCA and is in negotiations for long term service to meet both current and future demand.

- Recommended fiber and copper backbone requirements:
  - Due to a significant projected increase in launch operations, Alaska Aerospace should expand discussions with GCI pertaining to meeting future fiber needs either with existing fiber and/or activation of the dark fiber.

Closed Circuit Television (CCTV)

CCTV is available in each of the PSCA facilities. As new facilities are developed at PSCA specific CCTV requirements to meet the facility purpose will need to be determined.

- Recommended CCTV requirements: New facilities constructed at PSCA will determine any future CCTV requirements.

Paging and Area Warning (P/AW)

- Recommended P/AW requirements: New facilities constructed at PSCA will require installation of a P/AW system for paging and initiation of area warnings such as hazardous operations, lightning alerts, or security concerns throughout the PSCA.

Operational Intercommunication System (OIS)

The OIS provides site-wide and off-axis communications links and can interface with the phone system, site wide radios, and VHF radio channels.

- Recommended OIS requirements:
  - New facilities constructed at PSCA will require OIS capability.

Timing Systems: Real-Time, Mission Clock, Countdown Clock

Timing systems are only required in facilities that are utilized for vehicle and payload preparation and launch operations.

- Recommended timing systems requirements: There does not exist the demand to establish any additional LCC, LOCC, IPF, or PPF capability at PSCA during the planning period; therefore, no additional timing systems are identified.

Hazardous Vapor Detection System (HVDS)

HVDSs are installed in the PPF and LSS.

- Recommended HVDS requirements: This plan does not recommend development of any additional IPF, PPF, or LSS facilities. Therefore, no additional HVDS requirements are identified for the planning period.

Caution and Area Warning (C/AW)

C/AW lights are installed at a variety of PSCA locations to alert people when operations are being conducted at the spaceport.

- Recommended C/AW requirements:
  - Install C/AW at all operational launch pads.

Fire Protection, Alarm and Reporting

PSCA has both an ambulance and fire response vehicle on site. However, the vehicles are stored either outdoors or in bays of the MSF. Fire protection, alarm, and reporting capability meets state Fire Marshall requirements for existing facilities at PSCA.

- Recommended fire protection, alarm, and reporting requirements:
  - Identify a location and construct a Fire Response Facility to house both the fire response vehicle and the ambulance.
  - For any new buildings constructed at PSCA, compliance with the state Fire Marshall regulations for fire protection, alarms, and reporting would be required.

Power Distribution

PSCA operates using commercial power from Kodiak Electric Association. Based on the recommendation for facility development during the planning period, KEA has sufficient capacity to meet future power projections. KEA generates over ninety-eight (98) percent of its electricity from hydro and wind-turbine generators, making it one of the most cost-effective renewable power generation companies in the United States. Alaska Aerospace intends to continue purchasing power from KEA in the future, ensuring an environmentally friendly energy source for operation at PSCA.

Most recommended facility additions within this plan will not require dedicated back-up power; however, there may be a requirement for dedicated power at specific locations where power interruption during operations is not permissible. It is expected that when a new telemetry antenna site is developed, dedicated back-up power with an Uninterrupted Power Supply (UPS) backup will be required to support critical equipment.

- Recommended power distribution requirements:
  - Provide dedicated back-up power with a UPS at all new facilities that require uninterrupted power during operation. Examples include the new telemetry antenna site and operations support facilities in the Alpha Area, when developed.
  - Install UPS capability to all existing facilities

Cranes

Bridge cranes are located in the PPF, IPF, LP-2/SCAT, MSF, and LP-1/LSS are sufficient to handle projected demands.

- Recommended crane requirements: None.

Water Storage Facility

The dry summer of 2019 identified a limitation in the water storage capability at PSCA not previously experienced. During the summer mission, the existing water system was not able to produce sufficient water volume to support operations. A supplemental water supply was needed, so water was trucked in from Kodiak to fill the water storage tanks at PSCA. As operations increase at PSCA, up to an additional 30,000 gallons of water storage will be necessary at the launch complex.

- Recommended water storage requirements:
  - Increase water storage capability by fifty percent. This may include development of a new well that provides higher capacity over an extended period of time.

Wastewater Requirements

Collecting, properly handling, and disposing of wastewater at PSCA is done in a variety of ways, all in compliance with ADEC and ADNR requirements. For the RCC, MSF, PPF, IPF, and temporary lodging area, Alaska Aerospace has installed septic systems with drainage fields. The collected wastewater is removed from the site by a contractor and disposed in the Kodiak public wastewater treatment plant. During the time the temporary lodging area was used in 2019, the government collected wastewater in tanks, and had it removed and disposed of at the Kodiak wastewater treatment plant daily by a contractor. This area also had a gray water station that was used during the LSA removal period. Solid waste was incinerated.

- Recommended wastewater disposal requirements:
  - Wastewater collection and disposal may have different requirements for specific areas and facilities at PSCA. In the development alternatives evaluation, wastewater solutions will be addressed to ensure compliance with proper wastewater containment and disposal at any new areas developed at PSCA under this plan.

Security

Over the past few years, security infrastructure has been increased and upgraded. Additional camera systems, visitor registration system, fencing around new facilities, and signage has been installed to provide physical security to PSCA property. Recognizing that PSCA in on public lands and that the primary road through the site to Fossil Beach is a state roadway, Alaska Aerospace is sensitive to the visible impact fencing, signage, etc. has on the public's perception of accessibility to public lands. As new development is completed at PSCA over the planning period, Alaska Aerospace will minimize security requirements to the extent necessary to provide physical security of PSCA and customer property and to protect the public from hazardous and launch operations. As Area 3 is developed, more inclusive perimeter security fencing may be necessary to protect both customer infrastructure investments and the public from potential hazardous events. It is not the intention of Alaska Aerospace to close off the Narrow Cape area, other than during hazardous and launch operations in accordance with the existing Department of Natural Resource Interagency Land Use Management Agreement for the protection of the public.

- Recommended security requirements:
  - Install security systems for new infrastructure development which protects the assets but maintains maximum public accessibility to public lands for public uses when the area is not closed for hazardous or launch operations at PSCA.

Vehicles

Alaska Aerospace has a large inventory of vehicles at PSCA to support both daily facility and launch operations. Many of the heavy maintenance vehicles are old and in need of repair or replacement. The spaceport also has an old fire response vehicle and an old ambulance. Both in need of replacement. Additionally, as launch operations increase, the general vehicle fleet will need to be expanded to meet customer support requirements.

- Recommended vehicle requirements:
  - Develop a comprehensive vehicle maintenance/replacement plan to address repair, upgrade, and replacement requirements for all owned vehicles.

Fire Response Facility

PSCA currently has a fire response vehicle and an emergency response ambulance. Both vehicles are stored either outdoors or within the MSF, using space that is identified for other purposes. Due to the age of the vehicles, and the harsh weather conditions experienced at PSCA, the vehicles need to be stored inside year-round.

- Recommended fire response facility requirements:
  - Construct a new Fire Response Facility that can accommodate both the fire response vehicle and the ambulance.

Aviation Support

PSCA has a designated helipad located on the south edge of the Maintenance Support Facility roadway connecting to the antenna field.   The helipad is ideally situated for current and future operations.   Previously, an area parallel with and south of the Burton Ranch Road was identified for future development of a gravel runway capable of supporting C-130/C-17 operations. By building a runway at PSCA, most government payloads and launch vehicles could be flown directly to PSCA, alleviating traffic on the road system between Kodiak and the launch site. Construction of a runway has not been financially feasible in the past; however, the combination of government and commercial launches at PSCA may ultimately justify the cost of constructing a runway.

If developed, an area approximately one mile long and one-quarter mile wide would be required. Initial development would entail a single gravel runway with a length of no less than 4,000 feet and a width of 100 feet. A short gravel taxiway connecting the runway to a single gravel aircraft parking pad would also be needed. While the runway would not require instrumentation, due to the weather conditions at Narrow Cape, and the opportunity to create an alternate landing location for U.S. Coast Guard C-130's stationed at Kodiak Air Station, providing runway, taxiway, and parking pad lighting and non-precision approach capability (as a minimum) would be desirable.

- Recommended aviation support requirements:
  - An area should be identified for the potential development of requirements for a future runway. In the next chapter, this site and others should be evaluated for potential development if the volume of government launches increase to the level that development of a runway is economically beneficial.

SECTION FIVE – Lodging Requirements

As launch activity increases, the demand for lodging facilities in close proximity to the launch facilities will also increase. Historical use at PSCA has ranged from a couple dozen people supporting commercial operations to over two hundred and fifty (250) government personnel supporting government launches. Time frames have ranged from a few weeks to up to four months of lodging needs, again based on the customers' requirements.

With only one or two government launches per year over the past twenty years, lodging needs have been satisfied by using the Kodiak Narrow Cape Lodge (KNCL), a privately owned 56 room lodge located northeast of PSCA on Burton Ranch lands, to renting individual rooms in homes in the Pasagshak community, to using commercial lodging facilities in Kodiak.

As commercial operations increase, the expectation is that commercial customers will continue reducing the number of people and duration of the stay at PSCA to conduct launch activities. It is projected that future commercial launches may only require four to six people coming to PSCA for a five to seven-day period per launch. The number of people and duration of stay will vary between commercial customers, depending on each company's requirements and operations plans.

With government projections steady between one or two launches per year, the projected need for lodging is in excess of the fifty-six (56) room capacity at KNCL and the modest number of rental rooms in the Pasagshak community. As was experienced in both 2017 and 2019, government programs can drive large lodging requirements. Based on the government demand for operations at PSCA, this plan identifies a capacity requirement of approximately 300 beds per launch operation. Taking into account the Kodiak Narrow Cape Lodge and room rentals available in the Pasagshak community, a need for approximately 250 additional rooms exists.

- Recommended lodging requirements:
  - Alaska Aerospace should pursue a long-term lodging solution that provides up to 300 lodging rooms on or near PSCA for both government and commercial launch customers. The current ILMA between AAC and ADNR does not permit the establishment of a permanent lodging facility at PSCA. Should it be determined that a long-term lodging solution would best be located within the PSCA ILMA, a change to the ILMA with ADNR must be initiated. The next chapter will present alternatives to meet the anticipated lodging deficiency at PSCA.

SECTION SIX - Public Lands, Cultural Environment, and Operations Closure Procedures

Department of Natural Resources, Interagency Land Use Management Agreement (ILMA)

As identified in Chapter Two, the core of PSCA consists of 3,717 acres of state public land for spaceport operations under an ILMA (ADL 226285). The ILMA also provides an additional 7,048 acres of outlaying area surrounding PSCA which may be closed to public access for limited periods during hazardous operations, such as launch vehicle fueling and launch activities for safety reasons.

A major objective of this master planning effort is to accurately define the boundaries of PSCA land under the ILMA. To confirm boundaries, Alaska Aerospace conducted a new survey of property boundaries. This survey map identified the locations of both existing and will be used to identify the locations of planned facilities at PSCA at the conclusion of this planning process. The finalized survey will be submitted to ADNR to annotate the current boundaries consistent with the current ILMA and future land negotiations.

A second, and equally important objective of the Master Plan is to identify future land requirements. An evaluation of the area that comprises PSCA concluded that all future facility requirements can be accommodated within the existing boundaries, with the possible exception of the lodging requirement described in Section Five of this Chapter. While the existing PSCA lands may be sufficient to accommodate the lodging requirements, as has been previously demonstrated by the temporary Life Support Area used by the Government for the 2019 mission, the establishment of long term lodging facilities within the boundaries of PSCA is not permitted under the existing ILMA terms with ADNR. In addition, lodging has not been approved as a permitted use by the Kodiak Island Borough under the existing Conditional Use Permit.

This Master Plan will consider long term lodging requirements and provide alternatives for both on PSCA and off PSCA lands. In doing so, the Master Plan will also identify the requirements necessary to obtain approvals to permit long term lodging, if it is determined that the preferred lodging alternative is to develop the capability within the ILMA boundaries of PSCA.

In consideration of the public access interests to Narrow Cape; Alaska Aerospace's interest of minimizing the impact of operations on public lands; and the Master Plan objective identified above; Alaska Aerospace concluded development alternatives included in the following chapter must present alternatives that provide the potential of reducing the acreage needed for use by PSCA under the ILMA.

- Recommended ILMA requirements:
    - If it is concluded that long-term lodging requirements are best met by developing a lodging facility on PSCA lands, identify the process for changing the ILMA to allow this development.
    - Use the survey completed as part of this Master Plan to verify the boundaries of PSCA and in creating alternatives for future development, cluster development areas to the maximum extent possible to preclude any boundary expansion with an objective of reducing the current acreage under the ILMA, if feasible to meet future demands.

United States Coast Guard (USCG) LORAN-C Navigation Site

The USCG LORAN-C navigation transmitter station within the boundaries of PSCA provides an excellent opportunity for Alaska Aerospace to gain space for future development without expanding beyond the current land area boundaries. As identified in this chapter, there is a forecast need for additional land for telemetry and tracking antenna installation. During the May 15th, Spaceport Planning Advisory Group meeting, an analysis was conducted to make a preliminary selection of an alternative antenna cluster site, as discussed in Section Two of this chapter. Initial review indicates that the USCG LORAN-C site could be a good location for a second antenna cluster.

Alaska Aerospace has requested the USCG Civil Engineering Unit Oakland enter into formal discussions concerning potential transfer of the lease area and/or facilities to Alaska Aerospace for future spaceport development. Should the USCG agree to formal discussions, ADNR will be advised and requested to participate, as the underlying land use ownership is the State of Alaska. In Chapter Five, development alternatives will be presented based on the assumption that the land/facilities can be transferred to Alaska Aerospace, as well as if the land and/or facilities are not transferred to Alaska Aerospace.

- Recommended USCG LORAN C site requirements:
    - Initiate discussion with the USCG, Civil Engineering Unit Oakland for possible transfer, acquisition, lease, or use of the existing USCG LORAN lease area and facilities to Alaska Aerospace to be use by PSCA for future spaceport development.

Planning and Zoning

Alaska Aerospace received two Conditional Use Permits (CUP) for gravel extraction in support of constructing PSCA and two CUP's for temporary housing of construction workers during the initial stages of the spaceport development phase from the Kodiak Island Borough Planning and Zoning Commission. While Alaska Aerospace is a state-owned entity that is exempt for local land regulations, this Spaceport Master Plan is intended to provide the Kodiak Island Borough Community Development Department with a projected land use and development plan for the years 2020 – 2030.

Public Lands Use and Trails

Alaska Aerospace recognizes the high value community residents place in access to Narrow Cape and the use of the public trail system. As future infrastructure alternatives are developed for the planning period, the locations and use of the trail system will be considered. Balancing development requirements for spaceport expansion against public access to lands and trails is a shared value whereby development alternatives must be assessed against maintaining maximum public access to Narrow Cape. Future development alternatives will be reviewed against the 2008 Comprehensive Plan, November 2011 Kodiak Road Systems Trails Master Plan (KRSTMP) and any potential conflicts will include a mitigation recommendation.

Likewise, maintaining public access along the Burton Ranch road is necessary. This is the primary road used by the private landowner to access property at the northeast side of PSCA, as well as to access the Kodiak Narrow Cape Lodge. All future development alternatives must retain the existing conditions for public access to the Burton Ranch. Additionally, lands assigned to PSCA are co-occupied by the Burton Ranch for livestock grazing. Future development may disturb lands used for livestock grazing at PSCA to accommodate infrastructure requirements. The alternatives analysis will include a review of any grazing impacts that may be created by future development.

The road to Fossil Beach is a state-owned public road. As such Alaska Aerospace is obligated to keep the roadway open to the public, except during closure periods permitted under the existing ILMA. Alaska Aerospace recognizes the strong public interest to provide maximum access to Fossil Beach, as that area is a popular public recreation area. The alternatives presentation in the following chapter will specifically address any modifications, expansions, or re-routing of the Fossil Beach road to maintain public access in accordance with the ILMA.

The Narrow Cape has long been used by the public for a variety of recreational uses. At the southern end of the Cape, historic World War II bunkers remain in place, although unused. While the area was used for coastal defense during World War II, this area is not designated as a National Historic Landmark. Access to these public areas and historical sites must be maintained to the maximum extent permitted under the ILMA.

The area south of Twin Lakes and the PSCA LP-1/2 developed area remains a relatively undeveloped area that is often used by hikers, campers, and others for recreational and educational purposes. The area is heavily treed along the southeast slope and has hiking trails identified along the shoreline.

To the east of the LP-1/2 and Rocket Motor Storage Area lies another undeveloped area used by the public. The shoreline has hiking trails with two lagoons abutting the shoreline of TV Beach. Along the shoreline from Narrow Cape up to Barry Lagoon there is a large variety of birds in most seasons. Barry Lagoon has public hiking trails on the north, south and east side of the lake.

The public also has access to the lands within the ILMA designated lands for PSCA, except during hazardous and launch operations of the spaceport. This area is used by a wide variety of people from hikers, campers, berry-pickers, birders, and hunters.

- Recommended public land use and trails requirements:
  - In alternatives development, maintain public access to Fossil Beach Road and avoid encroachment onto established trails in the vicinity of Narrow Cape.
  - Maximize grouping new development areas close together to minimize the need to disturb areas of undeveloped lands that could remain in a natural habitat condition.
  - Evaluate the total acreage requirements of PSCA and consider reducing the boundaries of the spaceport in areas that are not necessary to meet future development requirements.
  - Evaluate the potential of transferring the abandoned USCG LORAN site to Alaska Aerospace as a potential area for development of required facilities.

Cultural Environment

In developing alternatives for future infrastructure investments, preserving cultural, historical, and prehistoric archeological resources is a priority. Previous environmental studies of PSCA have concluded there is "No Historic Properties Affected" with development of spaceport facilities within the area designated under the ADNR ILMA. Furthermore, the previous documents concluded there is very low probability of any prehistoric archeological or cultural resources that would be impacted by the development at PSCA. However, it was recommended, and the State of Alaska concurred, that because there may be a potential to encounter archeological resources within development areas it is prudent and feasible to conduct identification efforts in advance of construction.

These requirements remain valid for any future development at PSCA. The Spaceport Master Plan will identify potential development sites for the facilities outlined in this chapter. It is acknowledged that all previous environmental work has determined there is no impact or a very low probability of any impact on the cultural environment. However, any development of previously undisturbed terrain would be subject to the provisions of the approved environmental documents. Should archeological resources be encountered, they would be protected, and a testing plan established to determine the value/importance prior to proceeding with development or construction in the area where the resources were found.

Chapter Two provided a comprehensive assessment of the Native Alaskan land surface interests in the vicinity of PSCA. As depicted on the Kodiak Island Surface Owner Interest map, the lands surrounding PSCA are state owned and managed by the Department of Natural Resources. Should development alternatives consider expansion beyond the existing PSCA boundaries, a review of possible impact on Native Alaska lands must be completed. Alaska Aerospace recognizes that containment of the spaceport within the current boundaries is preferred, as such every reasonable effort will be made in the alternatives chapter to develop a land use plan that allows Alaska Aerospace to reduce the current ILMA boundaries.

Road Closures

Roadway closures are required for launch operations and certain hazardous operations at PSCA. Alaska Aerospace has made multiple changes to better inform the public of the times when roadways closures at PSCA will occur. As the number of launches increase over the planning period, it is projected the number of roadway closures will proportionally increase. The alternatives chapter will focus on improving information sharing to ensure the public is aware of when roadway closures will occur, as well as to evaluate ways to reduce the number of days/hours per launch operation that traffic on public roadway that transects PSCA down to Fossil Beach must be restricted. Part of this evaluation will also include alternative methods to permit select transit of PSCA within launch and hazardous operations closures for those who require access to the Burton Ranch Road and the private lands at the Burton Ranch.

- Recommended roadway closure requirements:
    - Minimize roadway closures and access to the Burton Ranch area during roadway closure periods.

Waterway Closures

Waterway closures to the south and southeast of Narrow Cape can have a negative economic impact on the commercial fishing fleet. With increased launch activities during the planning period, it is expected waterway closures will increase. Consideration must be given to scheduling launch operations during periods with the least amount of activity in the affected areas, as well as limiting the number and hours of launch closure periods. Improved communication with the commercial fishing industry to better coordinate closure periods that impact the commercial fishing fleet are necessary. Alaska Aerospace has made a concerted effort the past year to engage the commercial fishing community to learn more about the impacts, times, and means for coordinating closures. Regardless of the alternatives recommended for development, Alaska Aerospace must continue to engage with the commercial fishing industry to mitigate impacts of launch periods and de-conflict launches with season openings in the Narrow Cape are and downrange.

- Recommended waterway closure requirements:
  - Improved communication, more flexible launch scheduling, and coordination between Alaska Aerospace and the fishing community must occur to allow for the shared use of the waterways. The development alternative chapter will present options for improving communication, coordination, and scheduling waterway closures with the local fishing community.

Airway Closures

The communities on Kodiak Island are not connected by a road network; therefore, people rely heavily on airborne transportation. Airway closures for PSCA operations can cause significant disruption in the air transportation connections between Kodiak and the surrounding island communities when closures cut off access routes. In addition to the local air traffic, Kodiak Island is a major waypoint for high altitude trans-pacific commercial air routes. On any given day, dozens of international passenger and cargo aircraft operate over and south of Kodiak transiting between North America and Asia. During launch operations, some trans-pacific flights must be rerouted outside of the projected launch area, which increases flight times and propellant usage.

Increased launch operations from PSCA, can be expected to result in more airspace closures and international airline re-routes. Reducing the size of closed airspace and the amount of time airspace is closed is of interest to both Alaska Aerospace and the Federal Aviation Administration (FAA). As such, Alaska Aerospace has been invited by the FAA to participate in a development program to automate the way space launch vehicles transit through the National Airspace System (NAS). The Space Data Integrator (SDI) proof of concept project will integrate space vehicle missions in real time with traditional air traffic management systems to provide air traffic controllers with "situational awareness" of launch activities, allowing dynamic management of the airspace. The objective is to reduce the airspace closure times in advance of a launch and being able to more rapidly release airspace back to air traffic control after a launch is completed. The FAA selected PSCA as the first spaceport to participate in sharing data, with the objective of reducing airspace closure for future launches.

- Recommended airspace closure requirements – In order to reduce the airspace closure times and size as launch activities increase at PSCA, Alaska Aerospace will:
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- Work with the FAA on the SDI proof of concept project,
- Evaluate alternative notification systems/procedures that could be implemented to allow for limited traversing closed airspace before a launch occurs,
- Evaluate establishing a hot-line between PSCA and the FAA Anchorage Air Route Traffic Control Center (ARTCC) to provide easier/quicker communications with the air traffic controlling agency throughout launch operations.
- Working with the FAA on refining the closed area boundaries based on performance of the new entrant small launch vehicles operators from PSCA.

SECTION SEVEN – Identified Facility Requirements

The Facility Requirements for PSCA during the planning period were determined using the medium launch projections from Chapter Three -Demand Forecasts, based on a conservative assessment of customer requirements and with the intention of maximizing land use efficiencies to avoid infrastructure sprawl. In consideration of the unique capabilities offered by PSCA to both the government and commercial markets, a focus of this chapter is to concentrate on areas where facilities could be jointly used, reducing the need for facility redundancy and expansive new development areas. Repurposing existing facilities, concentrating on minimizing duplicity, and developing operational efficiencies through infrastructure development will allow the alternatives chapter to meet future demands within the existing footprint (possibly excluding lodging requirements), with the potential of reducing the acreage allowed for spaceport operations.

The following provides a list of the primary facility requirements that will be addressed in the alternatives chapter of this report.

1. Maximize Existing development areas.
2. Modify Launch Pad 1 to support liquid propellant launch vehicle operations.
3. Modify Launch Pad C to provide ability for use of a portable water deluge system, install lighting protection rods at the perimeter of the launch pad, and modify current light/security camera poles to allow being lowered during commercial liquid propellant launches.
4. Repurpose Launch Pad D to serve both government and commercial launch operators, using both solid and liquid propellant launch vehicles.
5. Identify an area for future development of a commercial launch Pad E.
6. Identify location for potential, payload carrying, commercial high-altitude balloon launch operations.
7. Identify area for installation of LOX and rocket propellant holding/storage tanks.
8. Identify locations for up to three additional small and ultra-small launch vehicle integration facilities at PSCA.
9. Subdivide the current PPF receiving bay into two separate payload processing clean-room capable bays with temporary construction that retains the ability to transport larger satellites from the original processing bay to the launch pad.
10. Reconfigure both RMSF bays to accommodate multiple commercial liquid propellant launch vehicles with a capacity of storing up to four vehicles.
11. Retain the reserved adjacent land for future expansion of the RMSF.
12. Increase security office space, support equipment, and external cameras.
13. Expand meteorological capabilities with additional systems.

14. Launch Control Center Improvements, to include bathroom facilities expansion, weather equipment upgrades, and Tech Control room expansion.
15. Expand existing antenna area for new weather antenna.
16. Identify new area for future antenna installations.
17. Identify location in close proximity to PSCA for “off-axis” optics and tracking systems.
18. Reconfigure MSF internal bays to maximize space efficiency.
19. Reserve space for future MSF expansion.
20. Reserve space for a third semi-soft sided storage unit.
21. Identify area for customer commodity storage, as well as an area for potential future light manufacturing and warehousing of aerospace related materials at PSCA
22. Expand Water Storage System.
23. Develop a Fleet Repair, Upgrade, and Replacement Plan for all state-owned vehicles at PSCA.
24. Increase both motor and diesel fuel storage capacity.
25. Identify location and construct a Fire Response Facility at PSCA.
26. Retain the current LSA gravel pad (Area 4) and under-ground infrastructure for potential reuse to support government operations at PSCA.
27. Repurpose Area 5 to meet commercial customer launch support requirements.
28. Potential use of USCG LORAN-C land and/or facilities by Alaska Aerospace for PSCA operations.
29. Identify future aircraft runway alignment and aircraft parking apron location.
30. Identify lodging capability to serve both government and commercial PSCA customers.
31. Electric power lines will need to be extended to new development areas, such as a new telemetry antenna site.
32. Conduct PSCA boundary survey and consider reducing acreage under the existing ILMA, provided all facility requirements for the planning period can be met.
33. Reduce roadway, waterway, and airspace closure times for hazardous and launch operations at PSCA.
34. Participate in the FAA SDI proof-of-concept project for Kodiak to reduce airspace closure times.

Chapter Five – Pacific Spaceport Complex – Alaska Development Alternatives Evaluation

2019 Pacific Spaceport Complex – Alaska Launch

SECTION ONE – Introduction

The first two chapters of this Master Plan presented an inventory of existing facilities and projected future demand forecasts. This information was shared with the Spaceport Planning Advisory Group at meetings in Kodiak and to the public in a Public Informational Meeting. Using the information from the first two chapters, the facilities that will be required to meet the projected future demand were developed in the previous chapter. To ensure a comprehensive presentation of potential future facility requirements, this information was developed from discussions with spaceport staff and other stakeholders using the spaceport.

Using the facility requirements to meet projected demand, a series of development alternatives were created for presentation to, and discussion by, the Spaceport Planning Advisory Group (SPAG). Following SPAG review the facility requirements and development alternatives will be presented to the public at a Public Informational Meeting. This chapter presents these development concepts, from which a preferred development alternative will be created following the SPAG and public review process.

SECTION TWO – Developing Facility Alternatives

This section considers potential development alternatives to meet the requirements identified in Chapter Four. In developing these potential alternatives, Alaska Aerospace staff conducted a series of evaluation reviews and considered a number of factors, such as operational requirements; proximity and access to other infrastructure; repurposing existing facilities for other uses; minimizing the need for developing new/undeveloped areas of Pacific Spaceport Complex – Alaska (PSCA); potentially consolidating activities to allow for a reduction in the total acreage under the existing Interagency Land Use Management Agreement (ILMA) with the Alaska Department of Natural Resources (ADNR); environmental concerns; public access; and impacts on operations costs in creating a series of development alternatives.

There are several constraints on future development at PSCA. First and foremost are constraints that may limit optimal operations by customers. This includes:

- Having line-of sight between the telemetry antennas, the launch pads, and down-range trajectory of the vehicle;
- Quantity-Distance (QD) – QD is the foundation of Department of Defense explosives safety standards that defines levels of protection from blasts based on relationships between the quantity of explosive material and distance between a launch pad and other infrastructure;
- Uneven terrain across the site;
- Launch limitations as defined by the Federal Aviation Administration Environmental Assessment for PSCA;
- Retaining maximum public access of the Pasagshak/Fossil Beach Road;
- Access to the Burton Ranch area;
- Minimizing encroachments or creating limitations to the many trails in the Narrow Cape area and use of the public lands except during periods of launch and hazardous operations; and
- Impacts to waterways and airways during launch operations; and authorized use of the public lands under the current ILMA.

In addition, for the spaceport to operate as a profitable entity of the State of Alaska there are constraints related to:

- Infrastructure funding;
- Public acceptance of PSCA development alternatives; and
- Long term commercial and government customer commitments.

There are also opportunities that support development of PSCA and the continued profitable operation of the spaceport. Being a state-owned asset provides Alaska Aerospace with a tremendous opportunity for sustained operations, especially with government customers who desire a government to government type relationship in space operations. Being located at Narrow Cape also provides a strong opportunity to attract new customers and grow the launch business because PSCA provides an optimum location to launch directly into sun-synchronous/highly elliptical orbits. Additionally, not being co-located on a Federal Range with other government operations provides maximum flexibility for launch. This also creates an incentive for critical missions to be able to launch on schedule without any delay caused by other government missions having higher priority.

In developing PSCA for the future, the spaceport also has sufficient lands to accommodate all envisioned future needs. In fact, there may be the opportunity to reduce the current 3,717 acres of land under the ILMA and still meet all projected future demand. The expectation of this chapter is to develop alternatives that maximize the use of existing land and facilities to reduce the need for additional land/acreage. One of the opportunities is to re-purpose some existing facilities and consider the potential for obtaining the land and facilities from the USCG of the now decommissioned LORAN site at Narrow Cape. This area and facilities could allow PSCA to accommodate future growth in an area that has already been previously used by the government and is now vacant.

In this chapter these challenges and opportunities will be compared to the facility requirements to create a series of potential development alternatives. The SPAG and public will be provided the opportunity to review and consider the most reasonable development alternative to sustain PSCA operations and accommodate future demands.

Figure 5-1: Developed Areas at PSCA

Figure 5-1 identifies the developed areas of PSCA that will be discussed in this chapter and can be used for referencing areas as they are presented in the document.

SECTION THREE – Alternatives Development Methodology

Developing alternatives to accommodate the projected future demand for launch operations at PSCA requires a process that is both analytical and practical. The analytical portion includes the specific technical requirements for each element being presented. Therefore, this chapter will first provide a brief presentation of the concept used to develop the alternatives, followed by a series of potential development alternatives that meet the projected 2020 - 2030 demand. Each potential development alternative will include an assessment of minimal/no development of the specific concept along with potential development concepts. The alternative will be reviewed by the Alaska Aerospace and PSCA staff and then presented to the SPAG for a screening review. Upon completion of the SPAG review, the development alternative will be presented to the public in a Public Informational Meeting to gain public comments, suggestions, and recommendations prior to advancing to development of a preferred alternative.

Presentation of Concepts – The alternative development methodology identifies, refines, and evaluates a range of alternatives for accommodating facility requirements. If the existing site cannot accommodate the anticipated growth, a selection process to find a new site may be necessary. This chapter uses the information from the previous chapter to create a series of potential development concepts that would meet the projected future demands at PSCA. For each requirement a “No Build” alternative is also presented to identify the impacts of not providing facilities to meet the projected demand.

Each concept will provide a discussion of the requirements and specify a suggested solution. In the discussion section, both positive and negative attributes of the scenario will be presented. This chapter is not intended to lead the reader to a pre-determined outcome, but rather offers information by which people can make objective and accurate decisions on future growth activities.

The approach was to identify, evaluate, and refine alternative concepts for satisfying the 2020-2030 requirements in each of major functional areas of the spaceport – launch pads; launch support facilities; spaceport support facilities; ancillary facilities and systems; lodging; and public lands, cultural, and closure procedures. The alternatives for these functional areas are described in the following sections.

SECTION FOUR – Launch Facility Development Alternatives

Figure 5-2: Overhead View of Launch Pad 1

Launch Pad 1 and Launch Service Structure – Launch Pad 1 (LP-1) meets future requirements for launching solid fuel vehicles and is supported by the Launch Service Structure (LSS) which is 174 feet tall and can support launch vehicles up to 128 feet in height. This allows for launches of Minotaur, Athena, Polaris and Vega sized solid fueled vehicles, as well as the new entrant commercial liquid fuel rockets, such as the Rocket Lab Electron, Firefly Alpha and Beta, and other developmental rocket companies, such as Rocket Crafters, Relativity Space, Odyne Space, and others who are pursuing the commercial launch market.

In Chapter Four a requirement to increase the height of the LSS was recommended to meet the demand for launch vehicles such as the Northrup Grumman Antares II and the Lockheed Martin Athena III. In 2016 Alaska Aerospace completed an Environmental Assessment for the potential construction of a new launch pad (Launch Pad 3) to support launching the Antares from PSCA. In 2012 Lockheed Martin selected PSCA for launching the Athena III into low-earth orbit, but no contract was ever signed and the LP-3 project at PSCA was cancelled. Meanwhile, Northrup Grumman was concentrating launch activities of the Antares II from the Mid Atlantic Regional Spaceport in Wallops, Virginia. This weak market interest for medium sized launch vehicles appears to have been eclipsed by the advancing technology in the large, small, and ultra-small launch vehicle market. Therefore, with no identifiable demand for larger launch vehicles operations from PSCA, it is not being recommended that the LSS height be increased.

With the LSS already built and the market for larger launch vehicles not sufficient to support capital expenditures for increasing the height of the LSS, the development alternatives for the LSS and LP-1 are limited to modifications to the existing structure and supporting infrastructure to accommodate liquid fuel launch vehicles.

***Development Alternative 1*:** This alternative provides maximum capability to meet the full spectrum of projected customers requiring the LSS and LP-1 for launch operations. To meet this requirement, installation of a permanent fuel pad with an earthen berm and tanks to accommodate LOX would be constructed, along with another pad, earthen berm and tanks installed to support launch fuel propellant. Fuel line piping would also be installed from the LOX/fuel tanks to the LP-1 launch pad.

Due to the majority of launches from LP-1 going southeasterly to southwesterly to take advantage of optimum insertion into highly elliptical orbit, both the LOX and fuel pad would be located on the north side of the launch pad. The terrain declines at the northern edge of the proposed development area for the fuel tank pad. Therefore, either fill would be required to bring the area up to grade before the pad and earthen berm could be built, or the area would have to be excavated, allowing the hillside to be a natural berm. An access road would also be constructed from the main, paved area adjacent to Launch Pad 2 connecting to the fuel and LOX pad areas for use by refueling trucks and operations/maintenance personnel.

Installation of a water deluge system would be required to support liquid fuel launch vehicle operations. This system would consist of a water tower and tank constructed in close proximity to the launch pad which would hold the deluge water until released during the initial engine ignition of the launch vehicle. From the water tower, a series of water nozzles would be installed around the launch pad from which the water, under pressure, would be sprayed at the base of the launch vehicle and directly on the launch stool.

***Development Alternative 2**:* This alternative also meets the requirements for supporting liquid fuel launches from LP-1 but does not require the installation of permanent fuel tanks or piping. Rather under this alternative, fueling berms would be constructed to provide adequate facility protection, but no permanent LOX/fuel tanks would be installed. Fuel tanks would be temporarily placed behind earthen berms and removable fuel-line piping would be installed to support liquid fuel launches. Once the launch is complete, the LOX/fuel tanks and piping would be removed.

Under this alternative the LOX and fuel pads, as well as the earthen berms, would be constructed in the same location as with the previous development scenario. This alternative also requires installation of a water deluge system for liquid fuel launch vehicle operations. An access road would also be required for trucks to deliver the temporary fuel and LOX tanks prior to launch and again to remove the tanks once the launch is complete.

Earth work required to meet the requirements as presented in the previous scenario would also be necessary under this scenario.

***No Build Alternative**:* LSS and LP-1 would remain operational and would meet some of the projected demand, limited to only solid fuel launch vehicle operations.

Figure 5-3: Launch Pad 1 Development Alternative

Launch Pad 2 – Launch Pad 2 (LP-2) adequately meets future projected demands. LP-2 was the location of the first launch from PSCA in 1998 and was again used in 2018 for the first commercial launch. The site is designed to be flexible for either solid or liquid fuel launch vehicles, as was demonstrated in 2018 when Alaska Aerospace conducted the first liquid fuel launch from the existing facility. Chapter Four offered no recommendations for modifications to LP-2, therefore, no development scenarios are being presented.

Commercial Launch Area (Area 3) – Area 3 has experienced the most active development at PSCA over the past couple of years, as both government and commercial customer launch requirements could not be met from either LP-1 or LP-2. Area 3 was developed to accommodate these new operational requirements. The first customer that established a launch pads in Area 3 was the Missile Defense Agency (MDA). Under an Indefinite Delivery Indefinite Quantity (IDIQ) contract with MDA, Alaska Aerospace constructed pads A, C, and D (depicted in Figure 5-4).

Figure 5-4: Commercial Development Area

In the Demand Forecast chapter, the commercial small and ultra-small launch vehicle market was identified as potentially having the highest growth rate at PSCA. This demand was first demonstrated when Vector Space committed to using PSCA for their initial polar launch operations and conducted two pathfinder operations at the spaceport. To maximize efficiencies of existing facilities and to minimize disturbance to surrounding area, Pad C was repurposed to support the initial commercial customer requirements, as well as to meet the existing government launch needs. In that way, no additional land was disturbed, and Alaska Aerospace was able to meet the operational requirements of both MDA and Vector Space.

In regard to the Vector Space current situation, they have experienced a financial challenge which has required them to delay further development until new investment funds are secured. They still intend to launch from PSCA. This is not a unique experience in the space business. For example, Firefly Aerospace lost financial backing in 2016 and had to shutter their launch plans at that time. However, within a year they secured new financing and are back in business, building a launch pad at Vandenberg AFB. Should Vector not be able to secure financing, Pad C is still a joint-use commercial/government pad that the government does plan to use again, so the pad remains an operational pad to meet customer demand.

Improvements to Pad C were completed in early 2019, which included building a concrete launch pad in the area that had previously been a gravel surface. In addition, a fueling pad for rocket propellant with an earthen berm was constructed on one side of the launch pad and another pad for LOX, behind an earthen berm, was constructed on the opposite side of the launch pad. These facilities are depicted in the picture of Area 3 above.

Concurrently, another commercial small launch vehicle company negotiated with Alaska Aerospace to conduct launch operations from PSCA. Their initial launches were conducted from LP-2, with the liquid fuel modifications discussed earlier in this chapter. This company's market projections precludes long-term use of LP-2, as the proximity of LP-2 to LP-1 has the potential of impacting launch schedules for LP-2 when LP-1 is being used. To provide launch schedule assurance, the company signed a contract with Alaska Aerospace to develop a new launch pad which would minimize conflicts with the operations of other launch activities happening at PSCA.

An area adjacent to and southwest of Pad 3C was selected. Because both Pad 3C and Pad 3B are designed for small liquid fuel commercial operations, simultaneous use of the two pads is permitted, except during periods of hazardous operations and launch periods. Figure 5-5 depicts the improvements being made at Pad 3B. This development is built to the specifications of the private company that invested in the development of the pad.

Figure 5-5: Pads 3C and 3B

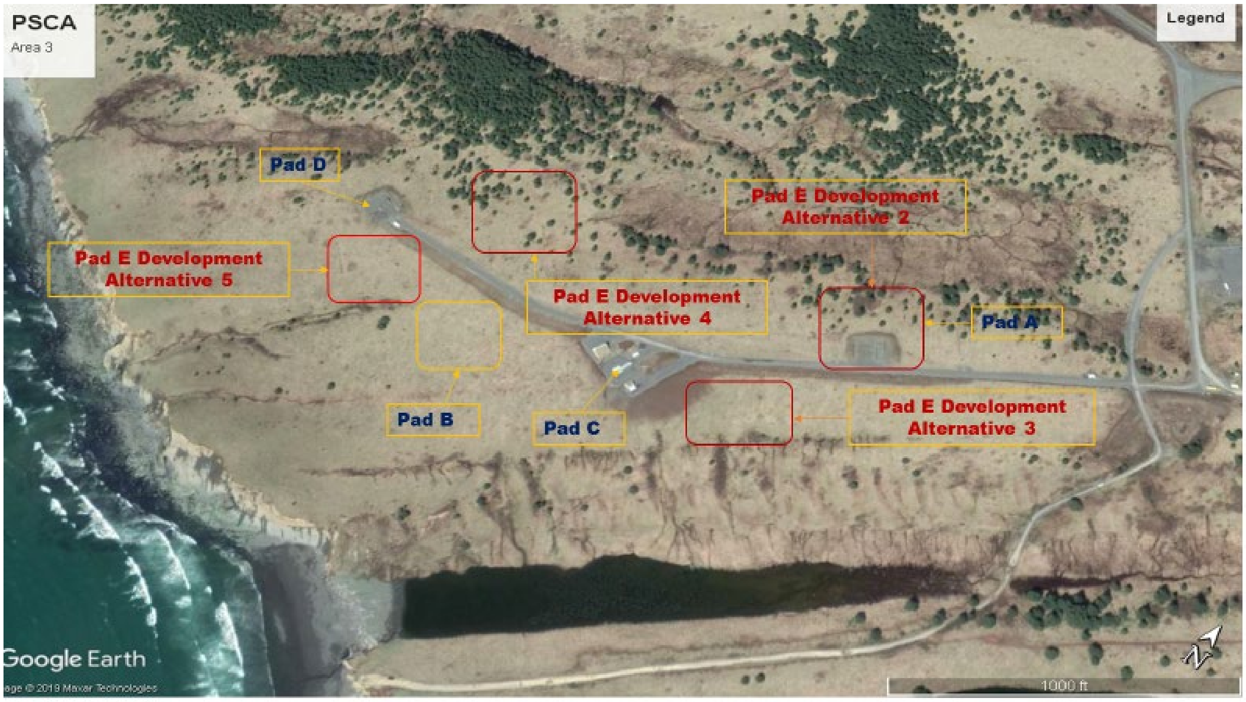


Figure 5-6: Launch Pad 3E Development Alternative Locations

Development Alternative 1: The first development alternative in Area 3 includes building Pad 3D to support both government and commercial launch operations of solid and liquid fuel vehicles. To accomplish this, improvements to the site would be required, similar to what is available at Pads 3B and 3C. A concrete launch pad would be installed in the center of Pad 3D, with an access lane out towards the road.

Two fueling pads would need to be constructed, one for LOX, the other for rocket propellant. Due to the tight footprint of the site, with terrain dropping off on the north and west side of the pad, the separation between the fuel pads and the launch pad would require earthen berms be built at each of the fuel pads, similar to what is installed at Pad 3C. A water deluge system would also need to be installed, along with an associated water catchment system to contain the water used during launch operations.

This alternative would repurpose Pad 3A as a support area, with no increase in size. Fencing would be expanded around the full site, power added and the availability for a small support facility built on the existing pad should it be required by a customer.

***Development Alternative 2*:** This alternative includes the full build out of Pad 3D for government, commercial, or joint use. To accommodate the projected demand for additional commercial launch operations during the planning period, this alternative identifies a location for a new launch pad: Pad 3E. Pad 3E would only be built if Pads 3A, 3B, 3C, and 3D reach capacity. However, in the event demand for launches exceeds the capacity of the four other pads in Area 3, Pad 3E would provide the increase capability to meet customers' demands.

In the Pad 3E, Development Alternative 2 location, sufficient area exists to develop a launch site, similar to the Pad B development. The area measures approximately 60,000 square feet (200 feet by 300 feet). The land drops off steeply on the north side of the pad area, which would restrict development at this site. While enough land is available to space the fuel pads a sufficient distance from the launch pads so that no earthen berm/barriers need to be constructed, there would be limited land for efficiently building a launch vehicle integration facility at this site. To develop this site, power, data, communication, and water service would need to be available. Power, data, and communication links are already available along the road alignment and would simply require a drop be established at the pad site. Perimeter fencing, lightening protection terminals, area lighting and cameras would also need to be installed to make the site fully functional. This site provides line-of-site with the existing telemetry instrumentation site at PSCA.

Water service is not available along the roadway. The most efficient short-term method for providing water to the site would be to truck water into the site. However, with all liquid fuel launch vehicles requiring a water deluge system, water drainage ditch and catchment area to collect water; developing Pad 3E may make it cost-effective to drill a water well in the vicinity of Area 3 that could provide sufficient water for all launch uses associated for these pads in Area 3.

There are three major constraints with developing Pad 3E in the Alternative 2 location. The first is the close proximity to LP-1. Pad 3E is 2,335 feet from LP-1 and for certain launches would place Pad 3E within the Quantity Distance (QD) restricted area. Being located within the LP-1 QD would cause periods of times when operations at Pad 3E would be prohibited while operations were occurring at LP-1. This restriction, while not in effect all the time, would create a less than optimum launch operation condition on Pad 3E.

Locating a new launch pad at the Alternative 2 location creates another problem caused by the requirement of launches from Pad 3E to overfly Pads 3B and/or 3C, depending on the launch trajectory of the Pad 3E launch vehicle. Overflying structures increases the risk factor resulting in higher insurance cost and causing the overflown area to be vacated during hazardous and launch operations. Building Pad 3E at the Alternative 2 location would place the operators of Pad 3B, 3C, and 3D at a disadvantage of: 1) Having to schedule around launches from Pad 3E to avoid having Pad 3E launches overflight issues, 2) restricting launch operations at Pad 3E dependent on operations of Pads 3B and 3C, 3) create increased risk to equipment and property at Pads 3B, 3C, and 3D whenever a Pad 3E launch overflew any/all of these pads.

The narrow shape of the size, caused by the limited distance between the road and the slope of land on the north side, would not be conducive to efficient layout of the launch pad, fuel pads, and a small integration facility.

Another issue with developing Pad 3E at this site is that it eliminates the current Pad 3A capabilities to serve as a storage and staging area for the other launch pads in Area 3. If Pad 3A is not available for support use, that use must move to another location at PSCA. Should this happen, the optimum location to relocate Pad 3A would be further west along the same roadway, resulting in the need to disturb undeveloped land to build the support area.

Development Alternative 3: Development Alternative 3 retains the option to build out Pad 3D as the first option to meet future liquid fuel launch vehicle demand as outlined in the previous alternative discussion. Under this alternative, Pad 3A would be retained and repurposed as a support area for Area 3 customers, similar to as outlined in Development Alternative 1.

To avoid the issues pertaining to overflight as presented in Development Alternative 2, this alternative moves the location of a future Pad 3E across the access road, just east of Pad 3C, shown as Pad 3E Development Alternative 3. This provides further separation from LP-1 and avoids overflight of other launch pads.

This site provides line-of-sight with the existing telemetry instrumentation site at PSCA. To develop this field, power, data, communication, and water service would be required. As identified in the previous alternative, power, data, and communication links are already available along the road alignment and would simply require an extension be established at the pad site. A water deluge system, water drainage ditch and catchment area to collect water would need to be constructed. As with the previous alternative, the most cost-effective method for providing water to the site would be to truck water into the area, with consideration given to installing a water well in Area 3 to serve all launch pad requirements. Perimeter fencing, lightening protection terminals, area lighting and cameras would also need to be installed to make the site fully functional.

The most significant issue at this site is the narrowness between the roadway and the steep terrain drop off to the south towards Twin Lakes. In this area, the distance between the roadway centerline and the terrain drop-off is approximately 260 feet, depending on exactly where the launch pad is centered. It would result in allowing only around 45,000 square feet (150 feet by 300 feet) of area for development. That is the minimum space required to develop a launch site in this area if the launch pad is constructed with the same separation and distance as was built with Pad 3C. Pad 3C measures 190 feet from the road to the outer edge of the launch pad and has a width of 300 feet. The limited space between the road and the terrain drop-off would result in narrow pad development, which would not permit an optimum configuration. With this tight development and the proximity between the LOX tanks, rocket propellant tanks, and the launch pad, fuel pad earthen berms would be required for safety. The berms would be similar to those at Pad 3C, which may make them visible from Fossil Beach. Additionally, the site would require lighting and lightning poles, which also would be visible from Fossil Beach. Building a small launch vehicle integration facility on this site is problematic due to the narrowness of the site.

Development Alternative 4: This alternative retains the concept of building Pad 3D, as described in the previous alternatives. It also includes repurposing Pad 3A as a support area for Area 3, as previously described in this section. Under this alternative an area northeast of Pad 3D and on the north side of the access road, shown on the map as Pad 3E, Development Alternative 4 would be reserved for future launch pad development.

The area has sufficient space to accommodate the infrastructure improvements required to support small and ultra-small launch vehicle operations, as previously identified to include power, communication and data, lighting, a concrete launch pad, water deluge containment ditch and catchment area, and is sufficiently separated from other infrastructure to preclude any QD complications. The area also has sufficient space to also permit building a small launch vehicle integration facility. This site provides line-of-sight with the existing telemetry instrumentation field at PSCA.

Power, data, and communication links are available along the road alignment and would simply require an extension be established to the pad site. A water deluge system, water drainage ditch and catchment area to collect water would need to be constructed. As with the previous alternatives, the most cost-effective method for providing water to the site would be to truck water into the location, with consideration given to installing a water well in Area 3 to serve all launch pad requirements. As with the previous alternative, consideration should be given to install a water well in Area 3 to serve all launch pad requirements. Perimeter fencing, lightening protection terminals, area lighting and cameras would also need to be installed to make the site fully functional.

Development Alternative 5**:** Development Alternative 5 allows for a third launch pad to be built on the southeast side of the Area 3 access road between Launch Pad 3B and Launch Pad 3D. Under this alternative Pad 3D would be retained, but the construction of Alternative 5 would create a restriction on Pad 3D for flights to the south, as southerly flights would might overfly Alternative 4 infrastructure. This could be mitigated by limiting the physical infrastructure developed at the Alternative 5 location and/or waiving immunity for any damages that may be caused to Alternative 5 by launches from Pad 3D.

The area has sufficient space to accommodate the improvements required to support small and ultra-small launch vehicle operations, as previously identified to include power, communication and data, lighting, a concrete launch pad, water deluge containment ditch and catchment area. The area also has adequate space to permit building a small launch vehicle integration facility. This site provides line-of-sight with the existing telemetry instrumentation site at PSCA.

As with the previous alternatives, the most cost-effective method for providing water to the site would be to truck water into the site, with consideration given to installing a water well in Area 3 to serve all launch pad requirements. As with the previous alternative, consideration should be given to install a water well in Area 3 to serve all launch pad requirements. Perimeter fencing, lightening protection terminals, area lighting and cameras would also need to be installed to make the site fully functional.

Figure 5-7: Launch Pad 3E USCG LORAN Site Development 6 Option

Development Alternative 6: This development alternative recommends Pad 3D be built and Pad 3A be repurposed as a support area for Area 3. Under this scenario the Pad 3E location would not be co-located with the other commercial pads in Area

3, but rather would be located southwest of the existing USCG LORAN site as depicted in Figure 5-7. Power and communication/data lines already exist to the abandoned LORAN buildings but would need to be extended to the launch pad area. Perimeter fencing, lightening protection terminals, area lighting and cameras would also need to be installed to make the site fully functional.

The site is relatively level and void of trees. The area provides excellent alignment for launching south to southwesterly without overflying other facilities or occupied areas. The site is located over one mile from the Launch Control Center and over 3,500 feet from Area 3. Line-of-sight to the telemetry instrumentation field is satisfactory, although some trees may have to be removed in the direct line between the telemetry instrumentation site and Launch Pad 3E. The area has sufficient space to also permit building a small launch vehicle integration facility.

This site is also a location being considered for future telemetry antenna installations. During the May 14, 2019 Spaceport Planning Advisory Group (SPAG) meeting, discussion was held with members to determine acceptable areas for future antenna installations. The SPAG concluded expanding the existing antenna field was ideal; however, it was recognized the terrain in that area may not provide sufficient space for all future needs within the planning period. The SPAG recommended the existing antenna area be expanded first to its maximum capacity, and then the area south/southwest of the LORAN site be reserved to accommodate additional antenna demand. This area cannot be used for both a launch pad and antenna site. Therefore, if this site is selected as the Pad 3E reserved area, another site at PSCA will need to be identified for future telemetry antenna installations. Telemetry alternatives will be addressed later in this chapter.

Developing this site for launch operations creates additional conflicts with other uses of the public lands in that area. It would require closing additional lands to public use when hazardous and launch operations are on-going and would further increase land areas potentially susceptible to damage from launch failures, such as was experienced in 2018 from LP-2.

Separating this Pad 3E alternative from Area 3 creates other disadvantages to efficiently utilize development. Reserving this area for Pad 3E development would result in disaggregating commercial launch operations over a wider area of PSCA land and would duplicate infrastructure investments already made in Area 3 once Pads 3B, 3C, and 3D are fully built out. This alternative increases installation and maintenance costs, while simultaneously decreasing operational efficiencies.

No Build Alternative: Under the No Build Alternative, no further development of commercial/government small or ultra-small launch pads will be constructed in Area

3. This would result in limiting future growth opportunities to the facilities existing at the start of the master planning period. This does not mean there may not be additional business attracted to PSCA, as Pads 3B and 3C would be complete and usable. In addition, Pad 3D, while not developed to the extent of Pads 3B and 3C, does have a gravel launch area, power, lighting, data, phone, fencing, and road access to the operational areas of PSCA and therefore could be used for additional government or commercial launches. Being that Pad 3D is not developed for liquid fueled launch vehicles, the ability to use Pad 3D would be restricted.

Likewise, Pad 3A, while initially developed for use by MDA, does not have adequate infrastructure, nor is it adequately sized to support most potential commercial small liquid fuel launch vehicle operations. Under the No Build Scenario, Pad 3A would remain unusable for launch operations, but available for support services.

High-Altitude Balloon launch vehicles: While the primary payload launch vehicle is projected to be a vertical launch rocket, a high-altitude balloon launch concept is being pursued by the industry. Under this concept a balloon would vertically lift a payload to high altitude for release. There is also a concept being advanced for tourism that would use a vertical rising balloon to lift people to an ultra-high altitude before descending back to earth. In anticipation of potential interest form balloon launch customers, this plan identified development alternatives that could be used for vertical balloon launches.

Alternatives for this requirement would include an area configuration for balloon launches that accommodates fueling, processing, loading, and handling. A high-altitude balloon launch area would need to have sufficient area to layout the balloon and fill the balloon with a lighter than air gas (helium, hydrogen, or similar gas), to lift the balloon to altitude before deploying the payload. Since a high-altitude balloon launch is very dependent on the wind speed and direction, a balloon launch pad would be configured to take maximum advantage of the prevailing winds at PSCA.

Three development alternatives are presented as follows:

Figure 5-8: High-Altitude Balloon Launch Pad Alternative 1

Development Alternative 1 – This alternative takes advantage of previously disturbed lands that were originally used as the equipment lay-down area for construction of LP-1, LP-2, SCAT, and the IPF. Since then that area was improved by the federal government for potential use as a launch pad and/or operations site. Thus far the site has not been used operationally and remains available for repurposing.

Developing this alternative provides a distinct advantage by reducing costs of development and providing close proximity to the IPF and utilities installed in the general area. The alignment of the site is to the southwest to take advantage of the predominate periods of low velocity to calm wind conditions, which is conducive to balloon launches. Development in this area keeps launch activities at PSCA geographically located at the southern end of the spaceport and reduces development sprawl.

The site would measure 800 feet long by 250 feet wide with a level concrete surface. Located within heh development area would be a small payload integration facility, connected to PSCA power, water, and communications fiber.

Figure 5-9: High-Altitude Balloon Launch Pad Alternative 2

Development Alternative 2 – Under this development alternative the high-altitude balloon launch pad would be constructed southwest of the USCG LORAN site. Also measuring 800 feet long by 250 wide, this site would require development on an area that has not previously been disturbed, but it would be located close to the existing USCG LORAN buildings. Being close to the LORAN support building provides the site with close proximity to utilities and road access from Pasagshak Road. Minimal access road development would be required. The orientation of the site is ideal for the weather conditions required to support high-altitude balloon launches. Selecting Commercial Launch Pad Development Alternative E for future vertical launch liquid fuel rockets would also result in a concentration of both a vertical launch pad and balloon pad in close proximity to each other. Operationally this could cause conflicts between users that would have to be resolved to meet desired launch windows for each customer.

Figure 5-10: High-Altitude Balloon Launch Pad Alternative 3

Development Alternative 3: Development Alternative 3 again measure 800 feet long by 250 feet wide with a concrete surface. While this site is situated in a good location for access, the site has a number of issues that would challenge the site being able to provide optimum launch support.

Directly at the western end of the site, across the Pasagshak Road, GCI has a cell tower installed, along with support equipment. While the tower is outside of the launch area for a balloon, the close proximity of the two site increases the potential that a balloon could interfere with, or even impact the tower during ascent. While the probability is low, due to balloon launches requiring extremely low to calm wind velocity, the increased risk would be a negative factor for customers and may result in causing potential customers to select alternative spaceports for operations.

Another constraint is the narrowness of the land between the Burton Ranch Road and the bluff to the south. To provide the full size, the concrete pad would require moving the entranceway of the Burton Ranch Road to the north by about 200 feet until passing the eastern edge of the balloon launch pad. This is added cost that would also require negotiations with the Burton family over the exact location of the realigned road, as the area is currently used for grazing. While this area does reside within the PSCA ILMA area, the joint use of the area between the spaceport and farm grazing must be balanced and equitable to both parties.

Further compounding this location is the terrain to the south, which drops off rather steeply at the southern edge of the launch pad. In addition to the operational constraints referenced above, grading this site to a level condition for pad construction would be more expensive that other alternative sites.

Figure 5-11: High-Altitude Balloon Launch Pad Alternative 4

Development Alternative 4 – From a development and operations perspective, Development Alternative 4 provides a good location to establish a high-altitude balloon launch pad. Also measuring 800 feet long by 250 feet wide, this area is relatively flat, is located close to utility infrastructure and our existing weather balloon storage and launch facility. It aligns properly for wind conditions and has no flight restrictions for launches to the southwest.

If this site were selected, it would preclude the site being available for possible permanent lodging development, as will be discussed later in this chapter. It also would require closing the Pasagshak Road prior to entering the PSCA operational area during launch operations. The visual image of the long concrete pad at the entranceway to PSCA may also not be considered desirable.

No Build Alternative – High-Altitude Balloon launch pads are unique in size, orientation, and use. There exist no facilities currently at PSCA that can accommodate this type of launch activity. In order to attract the market, a launch pad must be available. A No Build Alternative would preclude Alaska Aerospace from bringing this business to PSCA. This would result in less revenues and less indirect revenues for Kodiak.

SECTION FIVE – Launch Support Facility Development Alternatives

Figure 5-12: Launch Support Structure at Sunrise

Launch Control Center – The Launch Control Center (LCC) is a 14,000 square foot facility that houses the administrative and mission operations center for PSCA. This section will provide development alternatives for the facility to accommodate projected demand. Based on the 2020 – 2030 operations projections, no recommendation will be presented to increase the size of the LCC. This section will present alternatives for internal facility realignments and reorganization.

Launch Operations Control Center – The Ed Allen Launch Operations Control Center (LOCC): The LOCC meets future demand in the present configuration. No development alternatives are recommended.

Security Requirements – The existing security office at the entrance to the LCC requires additional space to meet both current and future requirements. The previous chapter projected a 50% increase in size. The following options are presented for future expansion of the security office.

***Alternative 1*:** Reconfigure the existing office and expand the back wall office out to provide a total area of 500 square feet office space. The space would be reconfigured to allow for installation of additional video screens, used to monitor the numerous facilities around PSCA. This additional space would also allow for increased storage capacity to support recording and communication/data equipment. The additional space would al\so allow for increased storage capability for security items.

Alternative 2: Relocated the security office to the existing Facility Security Officer (FSO) office and expand the side wall out to provide a total area of 500 square feet office space. This provides the same square footage and capability advantages as outlined in Alternative 1.

By extending the security office under this scenario, one of the management offices would be eliminated. There are four management offices on the west side of the LCC, each measuring 100 square feet. These offices are to support the launch team RCO, ROS, OD, and GSO. The loss of one of these offices would result in disaggregation of the launch team leadership and would create a negative impact on efficient communicate between launch team leadership during launch operations.

Under this scenario, the FSO would be relocated into the existing security office with no expansion to that office required.

No Build Alternative: This alternative would result in an inability to expand both the office space and security systems necessary to support the projected increase launch demand at PSCA.

Meteorological Systems*:* The meteorological office is of sufficient size to meet future demands. However, the equipment within the meteorological office requires upgrades. It is recommended that a new weather tracking computer system be installed, along with a new anemometer system. While not required at this time due to the recent upgrade to the weather balloon launch facility, Alaska Aerospace should consider a further upgrade to the system by installing an automated balloon launch facility. These systems are relatively new on the market; however, the National Weather Service has been moving towards automated weather balloon launching across Alaska, installing the first “Autosonde” station at Annette, Alaska in May 2018.

The system was tested for two years in Kodiak by the National Weather Services and has demonstrated improved launch success rates. The system works in all weather and climate conditions and is considered easier to launch in advance of extreme weather conditions. Each system currently costs $1.2 Million to purchase and install.

Tech Control/Communications Requirements*:* The Tech Control/Communications room within the LCC is reaching capacity and will need to be expanded in the planning period. The only viable alternative is to extend the side wall adjacent to the HVAC mechanical room ten feet into the HVAC mechanical room. To accomplish this, some equipment in the HVAC mechanical room will need to be relocated; however, space is available within the HVAC mechanical room to accommodate the relocation of panels and equipment.

The Tech Control room also needs to have the cooling upgraded to handle the heat generated by the communications and data systems operating in the room.

Emergency Medical Technician (EMT) Office*:* The EMT office meets future demand in the present configuration. No development alternatives are recommended.

Administrative Office Space*:* The entranceway administrative office space within the LCC is of adequate size to accommodate future demand.

Management Offices*:* The existing management offices in the LCC meet future demand in the present configuration. No development alternatives are recommended. However, if the Security Office Alternative 2 is selected, this area would be reduced to three management offices, which would create a negative impact on launch team leadership during operations.

Engineering Office*:* The engineering office meets future demand in the present configuration. No development alternatives are recommended.

Large Conference Room*:* The large conference room meets future demand in the present configuration. No development alternatives are recommended.

Small Conference Room*:* The small conference room size meets the requirements for both government and commercial operations through the planning period. The one issue identified in the previous chapter was the potential need for a higher level of security to support government missions. Should the government require a Sensitive Compartmented Information Facility (SCIF) at PSCA, the small conference room could be modified to meet the physical construction standards as specified by the various federal agencies that established construction standards. The small conference room security level was upgraded in 2016 to allow for classified briefing. The facility is capable to be increased to SCIF standards without requiring additional space.

Bathrooms: As identified in the previous chapter, the bathrooms within the LCC currently meet OSHA standards based on the number of full-time employees that occupy the building. However, the LCC is designed to be able to accommodate over 75 people during missions. Additionally, the LCC bathrooms have a shower stall installed, intended for use by personnel working extended hours. Since there are no requirements for shower stalls in the LCC, to better meet the demands of the customers using the building it is recommended that the shower stalls be removed and the women's bathroom have an additional toilet stall installed and the men's bathroom have an additional urinal installed.

Kitchen: The LCC kitchen is sufficient for the demand usage during peak operations. Space is available should there become a need for additional cooking or refrigeration features to be added over time. No expansion to the kitchen is being recommended.

Launch Vehicle Integration Facilities – Launch vehicle integration facilities at PSCA consist of the Integration and Processing Facility (IPF), Space Craft Assembly and Transfer (SCAT) facility. During the course of this master planning process, a commercial customer installed a small, soft-sided vehicle integration facility at Pad B.

Integration and Processing Facility (IPF): The IPF received significant damage from the August 2014 launch vehicle failure at PSCA. Repairs were required to the building structure, plus all internal components, such as lighting, electrical circuits, communication and data fiber/cable, fire suppression, back-up power, and HVAC system had to be replaced. The building size and configuration is sufficient to meet projected demand; therefore, no facility modifications, upgrades, or expansions necessary for the IPF during the planning period.

Space Craft Assembly and Transfer (SCAT) Facility: The SCAT was heavily damaged by the launch failure in August 2014 and was completely rebuilt in 2016. There are no facility modifications, upgrades, or expansions necessary for the SCAT during the planning period.

Area 3 Commercial Pad Integration Facilities: As mentioned above, a commercial customer installed a small, soft-sided integration facility at Pad B to support their operations. While commercial launch pads at PSCA are not built for exclusive use, customers that contract for long term launch activities at PSCA are permitted to install support facilities that may be necessary to operate at PSCA. This may result in additional small integration facilities at any or all of the commercial launch pads already built or built following completion of this Master Plan. Commercial pad launch vehicle integration facilities are addressed as part of the launch pad development alternative section in this chapter.

Payload Processing Facility – As previously identified in the master plan, the Payload Processing Facility (PPF) meets projected requirements for future satellite support operations. At 10,694 square feet, no increase in the size of the building is necessary to meet projected demand. With that said, the facility requirements chapter did identify an increasing demand for satellite processing capability to support the new entrant small and ultra-small satellite industry. To meet the expected increase satellite processing at PSCA, an internal reconfiguration development alternative is presented for consideration.

Development Alternative: Subdivide the Receiving bay into two separate processing bays. The exact layout of the interior should retain the ability to support large payload processing, as has been previously required for government mission, in the bay closest to the technical support room. The second bay should be reconfigured to allow for two clean-room operations of smaller payloads. It is recommended this be accomplished using a temporary clean-room concept that can be adjusted to the size requirements of each customer based on their dimension and space needs.

***No Build Alternative**:* Not reconfiguring the PPF would have minimal impact on future operations. The PPF is of sufficient space to accommodate any satellite size capable of being launched on launch vehicles projected to operate from PSCA during the planning period. Eliminating the ability to have a third processing bay may cause some scheduling challenges if three or more customers are preparing to launch in close intervals. However, this limitation could be offset by providing temporary processing capabilities within other facilities at PSCA.

Launch Vehicle and Payload Storage Facilities – The Facility Requirements chapter identified a need to increase the storage capabilities of small and ultra-small launch vehicles within the planning period. That chapter also determined that the existing facility configuration allowed for potential reconfiguration to increase storage capacity. As such, Alaska Aerospace programmed federal infrastructure enhancement funding to reconfigure Rocket Motor Storage Facility One to increase the capacity from a single solid fuel launch vehicle to accommodate multiple liquid fuel vehicles. It is anticipated that this reconfiguration will meet the short-term requirements for launch vehicle storage at PSCA.

***Development Alternative**:* To maximize utilization of existing facilities, it is further recommended that Rocket Motor Storage Facility Two also be reconfigured to accommodate multiple launch vehicles as demand increases within the planning period. Once both facilities reach capacity, it is recommended future expansion occur on the land directly adjacent and east of the existing site. An area measuring approximately 16,000 square feet (400 feet by 400 feet) should be reserved to allow for no less than three additional launch vehicle storage facilities to be installed, giving PSCA an ultimate storage capacity of up to ten launch vehicles, as depicted in the following picture.

While there are other locations at PSCA that could be considered for future launch vehicle storage, there is only one development alternative being presented for this requirement to minimize development in other locations at PSCA that have not previously been disturbed. Concentrating like activities reduces development sprawl at the spaceport and increases operational efficiencies at PSCA.

Figure 5-13: Launch Vehicle Storage Facility Expansion Area

No Build Alternative: Under the No Build Alternative the ability for PSCA to meet the storage needs for customers may impact the ability of some customers to meet launch operations requirements. This alternative is not expected to have a negative impact in the short-term, as reconfiguration of the two existing facilities will meet projected demand; however, as the commercial launch business increases the lack of additional capacity may restrict business growth opportunities.

Telemetry Instrumentation Antenna Location – The current Telemetry Instrumentation Antenna site is located on high ground east of the Maintenance Support Facility that provides direct line-of-site viewing of LP-1, LP-2, and Area 3. It contains a wide array of Alaska Aerospace and customer instrumentation equipment and antennas. Due to the unique operational characteristics and frequencies in which the antennas operate, specific siting requirements dictate the location where antennas can be placed in relation to other antennas. Currently there are two mobile telemetry antennas, two permanent telemetry antennas, and two mobile command destruct antennas, along with support vans, owned and operated by Alaska Aerospace at the site. In addition, a commercial customer downlink antenna and an Alaska Aerospace surveillance radar antenna are located within the existing site. Additional space is reserved for mobile customer antennas to be placed at the site during operations.

Figure 5-14: Telemetry Instrumentation Field

In 2019 Alaska Aerospace purchased a new X-band weather antenna. During the May 15, 2019 Spaceport Planning Advisory Group meeting Alaska Aerospace solicited recommendations for placement of the new weather radar, as the systems operational requirements precluded installing within the existing boundaries of the telemetry instrumentation antenna site. The consensus of the SPAG was to expand the existing site further to the east to the maximum extent possible to avoid the need to create a second telemetry antenna site at PSCA.

During the fall of 2019, Alaska Aerospace cleared just under an acre of land east of the existing telemetry instrumentation antenna site and installed the new weather antenna. The area cleared was sufficient to also allow for installation of an additional customer owned telemetry antenna.

Figure 5-15: Expanded Telemetry Antenna Site

Depending on the frequency spectrum requirements and antenna size, this area may have the ability to support antenna installations in the future; however, it is probable that an additional site for antenna installations will be necessary during the planning period.

Future Expansion Area(s) – While the previous chapter determined the existing PSCA antenna system is sufficient to meet future launch operations demands, the need to identify additional land for antenna placement is necessary for two primary reasons. The first is customer demand. There are at least two companies interested in installing customer owned antennas at PSCA to support both satellite tracking and downlink capabilities. Additionally, the expanding commercial downlink industry has created an opportunity to increase revenues at PSCA by providing a dedicated area for antenna operations. With the existing antenna area reaching capacity after the expansion completed in 2019, the need for an additional site remains valid. The following picture depicts the potential future antenna expansion areas presented to the SPAG at the May 15, 2019 meeting.

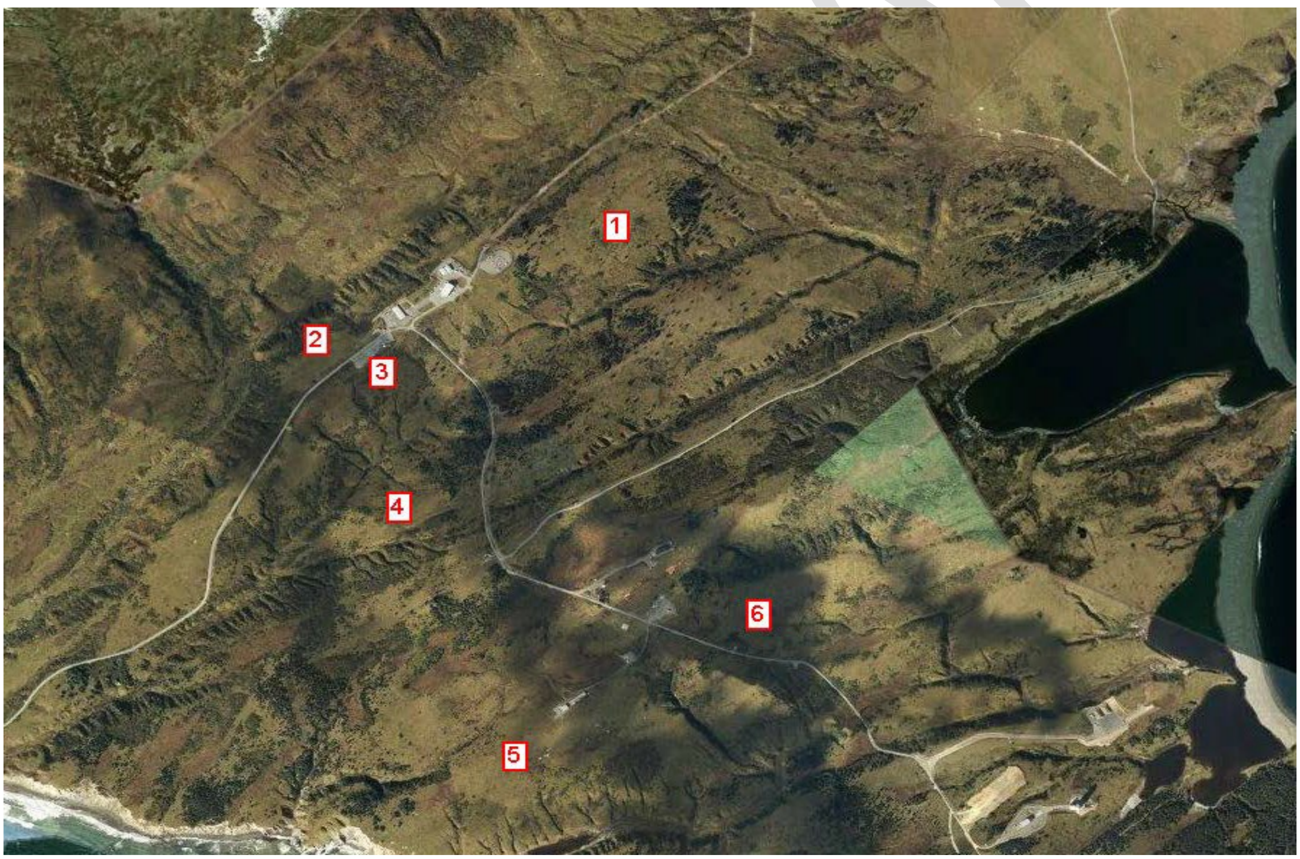


Figure 5-16: Telemetry Tracking/Downlink Antenna Potential Sites

Figure 5-17: Telemetry Antenna Alternative 1 Site

Development Alternative 1: This alternative provides for the expansion of the existing telemetry antenna site to accommodate future requirements. As previously discussed, the SPAG recommended this as the first course of action for antenna development requirements. The site is currently being developed to support the immediate antenna needs at PSCA.

Figure 5-18: Telemetry Antenna Alternative 2 Site

***Development Alternative 2*:** This site is located on the north side of Pasagshak Road on undeveloped land at the entrance to PSCA. The site is in close proximity to power and communications/data connections. The site is elevated and provides line-of-site to the launch pads.

The site is narrow, with limited level land between the roadway and a steep drop off that occurs approximately 200 feet north of the road right-of-way. This space limitation would have minimal negative impact on development, since a single antenna usually would only require an area less than 100 feet wide. However, in this location antennas would radiate across Pasagshak Road and depending on the transmitting frequency, may interfere with road use and/or antenna operations. Due to the limited depth of the site, future antenna installations would have to be built parallel to the roadway, which may also be considered by some as creating a negative visual.

Developing this site would require removing the top cover, grading and placing a gravel base, concrete pads for the antennas, lighting, fencing with an access gate, and power and communications/data extensions. Antennas would also have radomes installed, similar to the two white radomes currently in use in the existing telemetry antenna site.

Figure 5-19: Telemetry Antenna Alternative 3 Site

Development Alternative 3: Located in close proximity to Development Alternative 2, Development Alternative is also at the entranceway to PSCA but located on the south side of Pasagshak Road on developed land that was previously used by GCI for operations of a satellite communications antenna and supporting equipment. The site has power and communications/data connections. The site is elevated and provides line-of-site to the launch pads. The site is level but has a significant terrain drop off at the southern edge. Establishing a second antenna site in this location does meet the objective of clustering development and reduces sprawl, as the area was previously used for antenna operations.

Reactivating this site as an antenna site meets one of the Master Plan objectives of minimizing unnecessary additional disturbance to public lands at Narrow Cape. Developing this site would require installing concrete pads for the antennas, lighting, fencing with an access gate, and power and communications/data extensions. Antennas would also have radomes installed. This location eliminates the problem of transmitting across Pasagshak Road, as the antennas would be facing south.

The area is currently identified as a public reception and viewing area for PSCA. Recently a new welcome sign was installed, along with a rocket and rocket engine static display. Current plans are to expand the reception area to provide parking, seating and other amenities for public viewing of launches from PSCA. If this area is developed as an antenna site, the public amenities improvements would be relocated, at additional cost, to southwest of the PSCA welcome sign and rocket display. This site also has the same negative aspect as Development Alternative 2 of being directly next to the Pasagshak Road and highly visible to the public.

Figure 5-20: Telemetry Antenna Alternative 4 Site

Development Alternative 4: The Development Alternative 4 site was selected because it is an area that has also previously been developed, having been used by the government. Using areas previously developed is one of the objectives of this Master Plan to avoid unnecessary additional disturbance to public lands at Narrow Cape. Repurposing this site for antenna use meets that objective. The site is graded and has a gavel surface, with an unpaved road access to the Fossil Beach

Burton Road intersection. It is fenced with power, communications and data availability. The site provides adequate line-of-site to the launch pads.

While this location is 1,000 feet to the south/southeast of the Pasagshak Road, it is located on elevated land which would make the antennas and radomes highly visible to the public from the roadway. When used by the government as a radar site, equipment is visible for only a short period of time, as the radar equipment is removed at the end of each mission. Placing permanent antennas and radomes in this location would result in always being visible to the public.

While the site is a good location for antenna development, the site remains the best location for future government tracking radar equipment. The site was specifically selected by the government because of the direct line-of-site to the south and southwest. Repurposing this site for permanent installation of government and commercial antennas would most probably result in the need to establish another area for government radar operations to support future missions. Since the government paid for the development of this site, it can be expected that the cost of establishing another radar site would be borne by Alaska Aerospace, without reimbursement from the government.

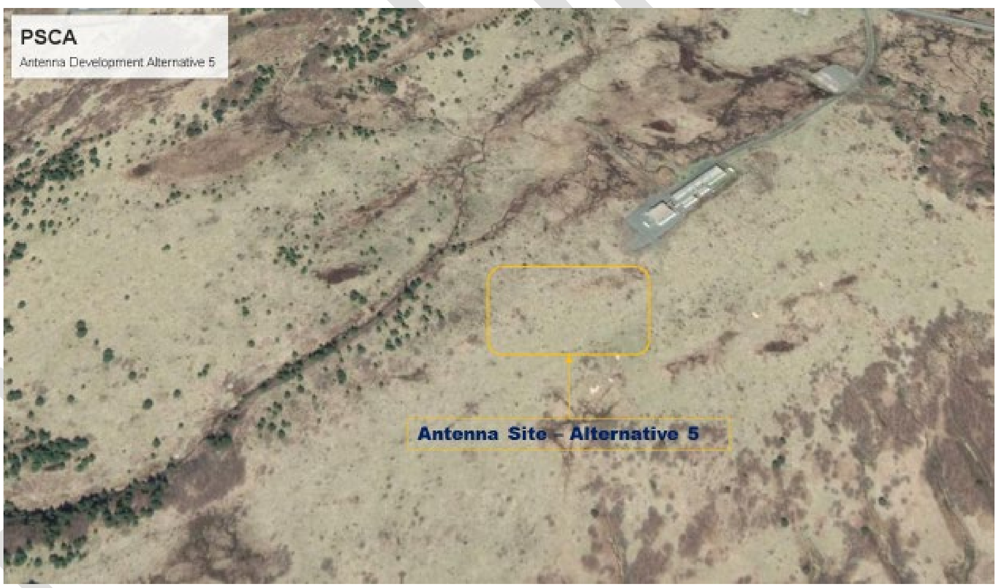


Figure 5-21: Telemetry Antenna Alternative 5 Site

Development Alternative 5: Development Alternative 5 provides an ideal location for establishing a second antenna site. It is situated south/southwest of the abandoned USCG LORAN site, on relatively level land with power and communications/data connectivity. Currently the location for installing new antennas is unimproved and would require grading; placing a gravel base; installing fencing, lighting, and security cameras; extending power and communications/data, as well as building a short access road connection to the LORAN site roadway.

This site is currently under lease by the USCG from ADNR. In order for this site to be used by Alaska Aerospace, a lease agreement, trade agreement, or purchase agreement between the USCG and Alaska Aerospace would be necessary. Additionally, a transfer of the land lease from the USCG to Alaska Aerospace would be required with ADNR.

This development alternative directly conflicts with Launch Pad Development Alternative 5, discussed previously in this chapter. Co-locating launch pads and antenna sites is not operationally feasible; therefore, the site could only be used by one of the two potential purposes. A significant decision from this chapter will be a determination as to whether this site should be selected as a location for a future launch pad (Launch Pad 3E), reserved as the second antenna site, or left under the existing land use agreement and not utilized by Alaska Aerospace.

Figure 5-22: Telemetry Antenna Alternative 6 Site

Development Alternative 6: In considering potential areas for future antenna placement, Development Alternative 6 was identified due to its mid-range location and proximity to power. Located across the Pasagshak Road from Area 2, this site has been previously developed with a small gravel pad for storage of materials and use as a parking area during government missions. There is no long term identified development purpose for this location; therefore, it is a good spot for establishing a second antenna site. As with the previous alternatives, developing this site would require expanding the gravel pad, extending power and communications/data connectivity, installing fencing, lighting, and camera security systems.

A major drawback for this site is its close proximity to Pasagshak Road. Located adjacent to the roadway, the antennas and radomes would be highly visible to the public using the road. It also is close to Area 2. Depending on the transmitting frequencies for the antennas at this site and the frequency transmissions of Area 2, a conflict could be created that could impact the operations of one or other operators. This site is also the closest to the launch pads, being less than one mile for the government and commercial launch pads.

***No Build Alternative**:* The existing antenna site is being expanded to its maximum dimensions to support the short-term demands for antenna systems at PSCA. Once this site is built out, any additional antenna installations will require a new site. Under the No Build Alternative, no additional sites would be identified at PSCA to support future antenna demand. This has the potential of limiting Alaska Aerospace's ability to provide space for future antenna customers, which could impact launch capabilities and limit diversifying aerospace business opportunities at PSCA

Off-Axis Telemetry and Optics – The previous chapter outlined the requirement to have off-axis, side view, telemetry, range safety, and/or optics capability for launches of some rockets. Off-axis sites are very dependent on specific customer requirements. Therefore, for any launch that requires an off-axis site that is not situated in close proximity of PSCA, the location will be determined by the launch vehicle operator and Alaska Aerospace will work with the local jurisdiction for placement of equipment and personnel at the desired site.

From a local geometry perspective, there are very few options to view the side of a launch from the pad through flight at Narrow Cape. This section will provide options for establishing a temporary off-axis location for telemetry, range safety, and optics systems in the Narrow Cape/Pasagshak area.

***Development Alternative 1**:* Pasagshak Point – Currently Pasagshak Point is used for obtaining data from a side angle and for optics collection. Not all launches require the use of Pasagshak Point, however, it has proven to be an ideal location to collect data. This option proposes acquiring the land needed to conduct the data collection and make it part of the current ILMA for PSCA operations. No facility improvements would be required at the site, as all equipment would be temporarily installed to support specific missions and removed following mission completion. A road already exists to the site. Power would be provided by generators that would be removed when the site is not active. At times that the site is not being used to support data collection for PSCA operations, the land would be open for public use. The area required to meet mission requirements is 15 acres.

This site is popular as a recreational area and is often used for viewing launches from PSCA by the general public. Under this scenario, the public would only be restricted from being in close proximity to the equipment, leaving the remaining area open for public use.

Development Alternative 2: Ugak Island - Ugak Island could be an alternative, but its close proximity to the launch pads puts it close to the launch hazard area. There are also logistics concerns with locating equipment and personnel on Ugak Island for launches. The island has no amenities and has a large population of marine mammals. Due to the close location of Ugak Island to the primary launch pads, operationally the site does not have and would require fast slewing of the instruments (which is tough to do for heavy equipment like 5.4m antenna dishes, expensive, and induces mechanical jitter). Furthermore, based on the selected launch trajectory, equipment at Ugak Island may not actually provide a sufficient side view to collect the necessary data.

Development Alternative 3: Marine based platform - A boat-based solution is another alternative but requires additional (costly) stabilization systems and increased costs for the boat itself. Marine based telemetry tracking and range safety is feasible and is used for some government programs that extend over great lengths of ocean. Establishing this system at PSCA would be cost prohibitive compared to other land-based options are available.

No Build Alternative: Without the capability to provide off-axis support, some customers may not be able to launch from PSCA, resulting in lost business, lower revenues, and creating a negative impact on the business.

Launch Vehicle Fuel Storage Facility – Developing launch vehicle fuel storage facility(s) was identified in the previous chapter as a requirement to meet the planning period launch demand. It was previously identified in the Launch Facilities Development Concepts that launch vehicle fueling capabilities would be built at each of the commercial launch pads to handle the fueling requirements prior to launch. This section identifies a consolidated fuel storage area for storing larger commodities of fuel that would

Rocket Propellant One (RP-1) is a combustible liquid, similar to traditional aircraft jet propellant primarily kerosene based. Propylene is also a flammable liquid. Liquid Oxygen (LOX) is a non-flammable commodity; however, as a concentrated oxidizer increases flammability of other organic compounds. The FAA/AST has developed specific separation requirements for storing of launch vehicle fuels in regard to siting within launch pad areas. Commodity storage is a normal industrial process that is covered by use of Occupational Safety and Health Administration (OSHA) requirements, local codes and NFPA codes.

According to OSHA 1910.104 flammable liquid storage above-ground tanks storing up to 1,000 gallons must be separated from other facilities at a distance of no less than 50 feet. Storage of over 1,000 gallons of liquid fuels requires a separation of at least 90 feet between facilities. Berms are not required. Likewise, OSHA requires flammable gas storage (such as compresses flammable gases, liquefied flammable gases and flammable gases in low pressure gas holders) with a cubic foot capacity up to 5,000 to be separated by 50 feet. Tanks with more than 5,000 capacity require a 90 foot separation.

Under OSHA 1926.152 Flammable Liquids, the distance between two tanks shall not be less than three feet or not less than one-sixth of their combined diameters. If multiple tanks are installed additional separation must be considered for access by firefighting equipment, which is no less than 12 feet. Finally, there must be diversions, curbs, diking, or grading for containment in case of a spill. For propylene, it must be at least 10 (ten) feet from the edge of the containment area and outside of any diked area.

In addition, OSHA requirements for siting and installation include a number of restrictions and requirements for handling or transfer of propylene. To minimize risks and impacts to operations, this plan recommends establishing fuel storage areas that does not require handling or transfer of fuels at the site.

The previous chapter determined that PSCA should identify a fuel storage area that can accommodate 10,000 gallons of LOX and 5,000 gallons of rocket fuel (RP-1 and/or Propylene). This section provides a series of development alternatives to meet this demand. All five potential development areas are presented in the following depiction and are proposed as above-ground installations. It is proposed that fuels from the storage area to the launch pads would be transported via truck. No underground or above ground pipeline is proposed.

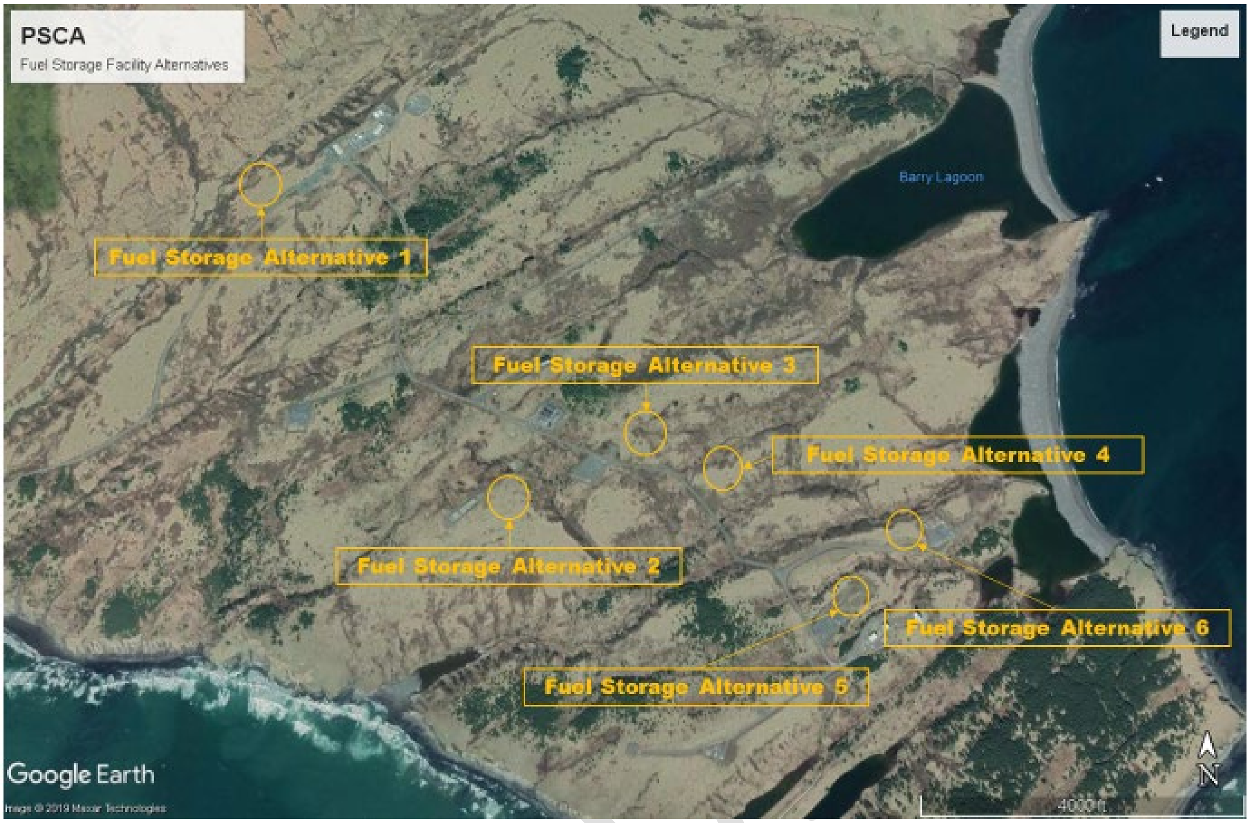


Figure 5-23: Launch Vehicle Fuel Storage Alternatives

Figure 5-24: Launch Vehicle Fuel Storage Alternative 1

Development Alternative 1: The first potential fuel storage area considered in this plan is Fuel Storage Alternative 1, shown in greater detail below. This area is a narrow 60,000 square feet (400 feet by 150 feet) along the north side of the Pasagshak Road at the entranceway to PSCA. The site meets the OSHA separation standards and is outside the QD area for all launch pads. However, placing fuel storage tanks in this area places the stored fuels in close proximity to the Launch Control Center.

Figure 5-25: Launch Vehicle Fuel Storage Alternative 2

Development Alternative 2: This area provides more space for installation of tankage, as the terrain is relatively level. This area would measure approximately 150,000 (500 feet by 300 feet) and provides over twice the area offered in Development Alternative 1. Furthermore, it moves the storage facilities away from the entranceway to PSCA and being directly adjacent to the public Pasagshak Road and the Launch Control Center. The site already has an access road built to the abandoned LORAN site which would be used to support fuel transfers from the site to the launch pads.

Figure 5-26: Launch Vehicle Fuel Storage Alternative 3

Development Alternative 3*:* Slightly smaller in area than Development Alternative 2, this site measures 120,000 square Feet (300 feet by 400 feet) and provides sufficient area to install fuel storage tanks to meet future demand. The site is adjacent to Pasagshak Road but is further away from the roadway than Development Alternative 1. Utilities are available near the site and the entranceway to the site has already been improved with a gravel parking area. This location is very close to the temporary lodging are that has been used in the past for government missions, which could create a conflict. The site is level close to the road, but drops off to the east, resulting in the possible need for some fill on the eastern edge of the site, depending on the specific locations of the fuel tanks.

Figure 5-27: Launch Vehicle Fuel Storage Alternative 4

Development Alternative 4: Alternative 4 provides the smallest area for development of a fuel storage area, measuring only 40,000 square feet (200 feet by 200 feet). This area is further restricted by the terrain, which is uneven and slopes downward along the north side, with gradual downward sloping on the south side. The site is conveniently located adjacent to the Pasagshak Road and is close to the launch pads. Closest other facilities are the LP-1/LP-2 area and the temporary lodging area, each being just over 2000 feet from Development Alternative 4.

While the space is adequate to support installation of the required fuel storage tanks, the limited space makes access to and between tanks very restrictive, most probably hindering the maneuverability of the vehicles that would need to use the site to load fuel for transport to the launch pads. The small size of the area that could be developed for fuel storage at this site makes this alternative less desirable than all other alternatives presented in this section.

Figure 5-28: Launch Vehicle Fuel Storage Alternative 5

Development Alternative 5*:* There are many benefits for establishing a fuel storage area at this site. Development Alternative 5 would be located on previously disturbed lands, near both LP-1/LP-2 and the Area 3 launch pads. The site measures 150,000 square feet (150 feet by 300 feet). It has utilities located close by and the site is set back 350 feet from the Pasagshak Road. Based on the large area available, access to Pasagshak Road, extended distance from the LCC, MSF, and PPF, and proximity to LP-1/LP-2 and Area 3 launch pads, this site is considered a good location for constructing a fuel storage area at PSCA.

Figure 5-29: Launch Vehicle Fuel Storage Alternative 6

Development Alternative 6: A final development alternative was suggested at the December 4, 2019 Spaceport Planning Advisory Group meeting to consider establishing a fuel storage area next to the existing Rocket Motor Storage Area. There is sufficient undeveloped land in this area to accommodate the fuel storage requirements. Power and communications infrastructure is available with road access to the site also already developed. This site is in close proximity to the launch pads at PSCA and sufficiently away from the Launch Pad 1 and Launch Pad 2 areas to provide sufficient distance separation for safe operations. Based on the area available near the RMSF, access to Pasgashak Road, extended distance from the LCC, MSF, and PPF, and proximity to LP-1/LP-2 and Area 3 launch pads, this site is also considered a good location for constructing a fuel storage area at PSCA.

No Build Alternative: The No Build Alternative for a fuel storage facility area would create a negative factor in future liquid launch vehicle operations. One of the cost drivers in launching liquid fuel vehicles from PSCA is the high cost of fuel when purchased in small quantities.

Logistically, requiring each customer to secure fuel requirements reduces the opportunity to provide lower fuel costs. When purchased in bulk, costs of fuel can be lower than purchasing small quantities separately by individual customers. The cost of shipping and transport of small qualities of fuel also makes the ultimate cost much higher than bulk shipments that can be stored at PSCA and sold to launch operators, on an as needed basis. With a large number of commercial liquid fuel launch vehicle operations per year, as is projected in the later parts of the planning period, substantial cost savings can be gained by bulk storing liquid fuels on -site and selling to customers from PSCA. The No Build Alternative would not allow for decreased costs and therefore would not offer an advantage in the competitiveness for launching from PSCA.

SECTION SIX – Spaceport Support Facilities Development Alternatives

Maintenance Support Facility (MSF): The MSF evolved over time with a mixture of uses, ranging from vehicle maintenance; fabrication; warehouse storage; shipping and receiving; equipment storage; equipment assembly; equipment and vehicle painting; to offices for the engineering, communications, telemetry and instrumentation personnel. Most recently the mobile Telemetry Control Center (TCC) was relocated into the MSF and installed as a permanent TCC.

Soft-Sided Storage Facilities: As demand for storage increases at PSCA additional soft-sided storage facilities should be purchased and installed. Once the Maintenance Support Facility has been reconfigured to maximize utilization of space within the MSF, and the two existing soft-sided storage facilities are fully utilized, a third unit should be installed next to the two existing units.

Vehicle Fueling Tanks: The existing vehicle fuel storage and fueling area meets projected demand for vehicle operations at PSCA through 2030. However, the storage capacity of the tanks should be increased as the number of ground support equipment and roadway vehicles increases to meet the projected launch demand. Under this section it is not necessary to consider relocating the vehicle fuel storage tanks. Instead, higher capacity tanks should be installed as operations increase throughout the planning period.

Government Specific Support Areas:

EMCC Site: The EMCC was used in 2019 by the government as the Government Tactical Support Center. The site measures 68,500 square feet and has full utility connections to the main PSCA systems.

Following completion of the government operation, the assets were purchased by Alaska Aerospace to provide a secondary mission control capability that can be used by either government of commercial launch customers. The Pacific Spaceport Complex – Alaska (PSCA)'s Expanded Mission Control Center (EMCC) provides climate-controlled flexible operational space for a la carte use to support small or large mission needs across short and long-term time frames. The EMCC is depicted in Figure 5-30.

Figure 5-30: Expanded Mission Control Center (EMCC)

Located between the RCC and MSF, the EMC² provides convenient workspace within short walking distance to other spaceport mission operations centers. The EMCC is a separately fenced, badge-accessed, security-surveilled area which includes five workspace trailers suitable for small launch vehicle command and control activities or office space, a conference room for kickoffs and team meetings, and a large command and control center for complex operations. In addition, the area includes a restroom, breakroom, and cell-phone storage area. A gravel raised area provides an excellent

observation area for temporary sensors, small short-term antenna placement, or for a VIP visitor tent.

Five on-site trailers provide space for small to support a launch operations Small Command and Control (C2) Center and/or dedicated office space. Each trailer is approximately 650 sq ft (56' x 11.67') and configured with three rooms—large center rooms and two side rooms. The Large Command and Control (C2) Center is approximately 2,600 sqft (4-trailers wide) and accommodates over 40 launch support staff. Equipped with a dedicated IT/Comms room, black-out curtains, countdown clocks, and four additional side rooms for support staff or dedicated functional teams, this center can handle complex mission operations.

The on-site conference room of 1,300 sqft (two trailers wide) can support large team gatherings and can also be partitioned with a curtain to support two simultaneous functions. This room is wired for video conferencing to accommodate off-island meetings. The room is also equipped with countdown clocks to serve as launch watch overflow or for additional support staff.

With the addition of these facilities, PSCA has the capability to serve projected demand without building additional mission control facilities. This area also provides expanded office and conference room availability for use by PSCA staff as operations increase. No additional facilities for mission control and administrative functions are proposed.

Figure 5-31: Long Range Radar Site (Area 1)

Long Range Radar Site (Area 1): The Long Range Radar Site was constructed to support government operations. Following the 2019 mission, all facilities were removed from the site, with the exception of security fencing and utility connections. While this site could be used for a variety of functions i.e. temporary and/or permanent lodging facility(s); storage facilities; customer specific uses, such as fabrication facilities, integration and/or processing facilities; telemetry antenna placement; or recreational parking, the government has indicated that the site may be required for future temporary radar placement in the future. The cost of developing the site was paid by the federal government. With the potential future government need for use of the site, no recommended development alternatives are being developed. While the site has locational advantages to be repurposed into a permanent commercial antenna site, instead the site is being reserved for future government use. Should the government vacate the site and indicate there is no longer a future government need to use the site, the site may be made available for use by commercial launch customers.

Figure 5-32: Radar Gravel Pad (Area 2)

Radar Gravel Pad (Area 2): Area 2 was also built to support government operations and was used in both 2017 and 2019 by the government to support operations at PSCA. The location is ideal for installing antennas that track launches from PSCA. Alternatives sites for placement of the government tracking antennas was conducted in 2016 and the Area 2 site selected due to its line of sight to the launch pad and unobstructed views to the south and southwest to track launch vehicles. The site is next to Pasagshak Road, making for convenient access. The site also has utilities installed to support the previous government operations.

The site proved ideal for the 2017 government operations and was used again for the 2019 government launches. While other locations on PSCA are capable of supporting tracking antenna's, the fact that this sight has been used satisfactorily for two different purposes for separate government missions confirms this site is a desirable location for antennas.

However, this plan is intended to address future needs and to provide options to meet these needs. Therefore, alternative sites are identified in this section.

***Development Alternative 1*:** Close or repurpose Area 2 and relocate all future antenna requirements to the existing telemetry antenna field site east of the MSF. As was discussed in the previous section of this chapter, this expanded telemetry antenna location has limited further expansion capability due to the sloping terrain. The expanded site maximized the level terrain for development, making further expansion of this area challenging and expensive. To expand this site would require bringing in fill to raise the level of the terrain on the south and southwest side of the site, as well as clearing more trees and vegetation. In addition, due to potential transmission frequency interference, it was recognized that an alternative site for future development was preferred for future growth art PSCA.

An important aspect for selectin Area 2 for antenna placement during the 2017 mission was the proximity of the antenna site to the temporary lodging area, as the mission profile required quick responses by government personnel to the site during launch operations. Closing or repurposing Area 2 and relocating the antenna location from Area 2 would cause operations issues for some government operations. An unintended consequence may also be that relocating the antenna site would also require relocating the temporary lodging site, causing further development in areas that are not developed today. This is inconsistent with one of the primary objectives of the Master Plan which his to minimize developing undeveloped areas if other viable options exist at PSCA.

***Development Alternative 2*:** Keep Area 2 available for future government use but limit the site to temporary antenna placement. No above ground level permanent development of any kind would be permitted at the site, except for the utility connections and current fencing. Selecting this alternative provides flexibility for future government operations, as past missions have demonstrated a requirement for using the site. However, there has been no commercial interest in using the site.

No Build Alternative: This alternative would result in the area being abandoned, with no further use permitted. Whether used for lodging, operations, or support this area provides a large already developed surface area that allows customers options. If this site is no longer used for operations, the potential that another area would have to be disturbed and developed to support potential lodging, operations, or support requirements is inconsistent with the objective of this Master Plan – to maximize use of already developed areas.

Figure 5-33: Life Support Area (Area 4)

Life Support Area Gravel Pad (Area 4): The Life Support Area was used in both 2017 and 2019 to provide temporary lodging facilities for the government. Following the 2019 mission, the temporary facilities were removed, leaving the security fencing and utility connections in place. The area includes 121.60 square feet of compacted gravel base with fencing, power, communications, and data connections, as well as water and wastewater lines installed. The site is strategically located to support government missions in close proximity to the Area 2 pad that has been used to operations support to government launches.

> ***Development Alternative 1***: Alternative 1 retains the developed area as a location for future temporary lodging, as was done in 2017 and 2019. Retaining this area for future use reduces the need for developing new areas for temporary lodging to support future missions.
>
> This site is within the QD for some of the larger sized launch vehicles that have historically used PSCA. By using this site for lodging, there may be times that the facility has to be completed evacuated for hazardous operations and launches.
>
> ***Development Alternative 2***: Converting this site to a permanent lodging area further complicated the issue of QD proximity to the launch pads. In addition, the current ILMA does not permit permanent lodging to be built at PSCA, therefore, to implement this alternative a change to the ILMA with ADNR would be required. Furthermore, if the ILMA is changed and permanent lodging is built at this site, a zoning variance would have to be obtained from the Kodiak Island Borough to permit the long-term establishment of a permanent lodging facility at PSCA and the facility would be subject to Borough taxation.

Development Alternative 3: With the site already developed and having supporting infrastructure in place, converting the site to a customer designated use area to support launch operations is a viable option. As has been identified in other sections of this chapter, there is a need for additional customer support facilities, such as soft sided storage areas, commercial integration facilities, and warehousing and maintenance services. Repurposing this area for launch support facilities is consistent with the projected demand for commercial and government support requirements.

No Build Alternative: As with Area 2, this alternative would result in the area being abandoned, with no further use permitted. If this site is no longer used for operations, the potential that another area would have to be disturbed and developed to support potential lodging, operations, or support requirements is inconsistent with the objective of this Master Plan – to maximize use of already developed areas.

Gravel Pad (Area 5): Area 5 was originally built as a lay down pad for temporarily storing of equipment and supplies. It was expanded for potential use as a launch pad for government programs with power, fiber optic lines, and Ethernet cable for communications. The area is in close proximity to the IPF, SCAT, LP-2, and LP-1, making it a good location for equipment storage when not needed for launch operations. When configured for launch operations, the site has a restricted launch trajectory to avoid overflight of the IPF, SCAT, and LP-1; as well as a restriction on launching over infrastructure located in Area 3. Therefore, this plan recommends the site be reserved for other launch operations support, such as possible fuel storage area, high-altitude balloon launch area, soft-sided storage unit placement, or other storage area and launch activities.

SECTION SEVEN – Ancillary Development Requirements

This section addresses the various ancillary requirements that would be necessary to support the alternatives addressed in the previous section. Regardless of the preferred development alternative selected, there are a number of infrastructure needs that would be necessary for the development alternative to be operational. These improvements are presented in this section.

Communications Systems – The internal communications systems at PSCA are state-of-the-industry. Communication configurations for launch operations is designated by the customer with Alaska Aerospace staff tailoring the communications links and connections as outlined in the operations communications plan. The external communications provider at PSCA is GCI. With any new facility development at PSCA, internal communications requirements on Alaska Aerospace owned infrastructure will be completed by PSCA staff. External communications requirements are the responsibility of the customer. It is expected that new communication and data lines will need to be installed to new areas, such as if another commercial launch pad is developed, a new antenna site is activated, or increased capacity is necessary. For this section, no specific recommended improvements are being recommended, as any improvements will be facility specific.

Fiber Optic and Copper Backbone Systems – Fiber optic and copper communications/data lines are installed underground at PSCA. The existing capacity of the system meets current demand. The fiber optic cable system is primarily owned by GCI, who acquired the fiber from Kodiak Kenai Cable Company. Currently the fiber cable is not fully utilized and has capacity for increased service as PSCA increases operations. Alaska Aerospace has initiated discussion with GCI about fully utilizing the existing fiber and options for future expansion, should the demand occur.

The PSCA copper backbone system serves the facilities within the spaceport. Both fiber and copper lines would need to be extended to any newly developed areas at PSCA. These extensions could be accommodated within major disruption to existing systems, with the majority of work specifically configured to meet the requirements of the customer to which area the line would be extended. The PSCA Tech Control Center will require expansion as the fiber and copper demand increases. Expansion of the Tech Control Center was previously addressed in the Facilities Requirements Chapter Four which identified a need to expand the Tech Control Center in space to meet the additional requirements, as well as to increase the internal Heating, Ventilation, and Air Conditioning capability for cooling the room and equipment. This expansion should be tailored to the specific requirements of customer sand the increased capacity at PSCA.

Closed Circuit Television (CCTV) - New facilities constructed at PSCA will determine any future CCTV requirements.

Page and Warning (P/AW) - New facilities constructed at PSCA will require installation of a P/AW system for paging and initiation of area warnings such as hazardous operations, lightning alerts, or security concerns throughout the PSCA. Each system will be designed to the specific facility being built and installed ideal location for P/AW

Operational Intercommunications System (OIS) - The OIS provides site wide and off-axis communications links and can interface with the phone system, site wide radios, and VHF radio channels. New facilities constructed at PSCA and operational areas will require OIS capability.

Timing Systems, Real-Time, Mission Clock, Countdown Clock - There does not exist the demand to establish any additional timing systems capability at PSCA. However, should a customer develop an IPF or PPF facility, installation a timing system may be necessary. If so, the customer will be responsible for installation and operations.

Hazardous Vapor Detection Systems – Hazardous Vapor Detection Systems (HVDS) are installed to alert personnel whenever a hazardous vapor is present in an area where personnel are working. While the current HVDS meets all requirements for existing facilities, should a facility, such as a launch vehicle fuel storage and/or production area be established at PSCA, HVDS installation would be required.

Caution and Area Warning (C/AW) - C/AW lights are installed at a variety of PSCA locations to alert people when operations are being conducted at the spaceport. The existing C/AW lighting system meets operational requirements. As new commercial launch pads are constructed in Area 3, additional C/AW lights should be installed to protect the public from unauthorized access to the area during hazardous and launch operations.

Fire Protection, Alarm, and Reporting – Any new facility built at PSCA must meet the State Fire Marshall regulations for fire protection, alarms, and reporting. In addition to alarm and reporting systems, PSCA has a fire response vehicle that is currently maintained in the MSF vehicle maintenance bay. The fire response vehicle is relatively old and will be replaced in the next few years. It is recommended that, when the vehicle is replaced, a stand-alone fire response facility be built at PSCA. This facility could also support the site ambulance.

Power Distribution - Most recommended facility additions within this plan will not require dedicated back-up power; however, there may be a requirement for dedicated power at specific locations where power interruption during operation sis not permissible. Uninterrupted Power Supply (UPS) backup is required to support critical equipment, therefore this plan recommends installing dedicated back-up power with a UPS at all new facilities that require uninterrupted power during operation.

Cranes - No additional bridge cranes are projected during the planning period.

Water Storage Facility - As operations increase at PSCA, up to an additional 30,000 gallons of water storage will be necessary at the launch complex. With the development of Area 3 for liquid fuel launch vehicles, an increased demand for water will present itself during launch operations, as the liquid fuel launch pads will be using a water deluge system to suppress noise and col the launch stool/concrete. To meet this requirement, it is also recommended that a new water well be drilled in the vicinity of Area 3 to provide an additional water source for the water storage facility.

Security – Security systems at PSCA have been significantly enhanced over the past few years. However, with development of new facilities at the spaceport under this plan, additional security systems will be necessary. In general, new areas developed for launch pads, antenna sites, fuel storage and distribution will require fencing and lighting. In some cases, security cameras will need to be installed, while some locations may also require electronic access systems. The security system requirements for any new development will be established by the level of security required by customers or for general security protection of assets, as determined by Alaska Aerospace.

It is important to state that any security systems installed at newly developed areas will be designed to have minimal impact on the surrounding area. Consistent with the objectives of this planning process, security fencing, as an example, will be kept to the minim area needed to be fenced to protect the assets. It is not an intention of this section to suggest, imply, or recommend that PSCA, as an entire spaceport be fenced. Consistent with past practices and the objective of this plan, secured areas will be installed only at specific sites that require the enhanced security, leaving as much of the public lands at PSCA open to the public when not being restricted for hazardous or launch operations.

Vehicles - Alaska Aerospace needs to develop a comprehensive vehicle maintenance and replacement plan to address repair, upgrade, and replacement requirements for all owned vehicles. As PSCA operations increase and the customer base diversifies, the need to have a vehicle fleet maintain and ready for use becomes increasingly important. Additional vehicles are also expected to be needed as the operations increase. This plan recommends that Alaska Aerospace management develop a fleet management system to improve the maintenance and replacement process for all vehicles at PSCA, as well as to project future requirements so that purchases can be obtained through a competitive process.

Since Alaska Aerospace is a state corporation, the company is permitted to have vehicle maintenance and procurements done under the state system. While that option may not always be the most cost effective process, there may be opportunities to procure surplus vehicles at little to no cost and to have specified maintenance completed under the state contract in lieu of having to contract those services out by Alaska Aerospace.

Aviation Support – The existing PSCA helipad meets both current and future projected demands for helicopter support. As PSCA moves towards drone surveillance, the use of helicopters is expected to decrease. No additional helipads or helipad expansion is recommended.

In previous plans for PSCA, consideration has been given to building a short runway at the site that could be used to support spaceport operations, as well as provide an alternate landing runway for Kodiak Airport traffic that may be diverted due to weather. In addition, there has been interest in having runway at PSCA to sallow aviators an alternate airfield for training flights. The facility requirements chapter recommended an area be identified to meet this requirement.

The planning criteria for a potential runway would be based on the maximum sized aircraft expected to operate at the site. Historically, payloads that have been flown into Kodiak are on military aircraft, such as the C-5, C-17, or C-130. The Kodiak Airport runway lengths and orientation permit safe operations of all three of these aircraft types at Kodiak, therefore, it is reasonable to focus on meeting the requirements of these three aircraft types should a runway be built at PSCA.

The C-5 requires a minimum runway length of 8,300 feet for take-off when fully loaded. Empty take-off weight of 650,000 pounds requires a 5,000 foot long runway. For landing, the minimum runway length is 4,900 feet. The C-17 has a minimum runway length of 8,900 feet when fully loaded, and 3,000 feet with an empty take-off weight of 395,000 pounds. The C-17 has a minimum runway length of 3,500 feet for landing at maximum payload weight. The C-130J requires a 3,100 foot long runway for takeoff at maximum payload weight and 1,400 feet for takeoff at the empty weight. For landing, the C-130 requires 3,000 feet of runway length.

Based on the aircraft performance of these three aircraft, a minimum runway length of 5,000 feet is the minimum operational length that would support all three aircraft. However, if the C-5 is eliminated from the criteria, the minimum runway length is reduced to 3,500 feet. This excludes any additional safety areas at either end of the runway. The runway safety area would measure 4,500 in length and 200 feet in width.

Based on the size category of the aircraft a minimum runway width of 100 feet is required, along with another 50 feet on either side of the runway for a safety area. Should a runway be built at PSCA, it is recommended that the runway be served with non-precision markings and both runway edge and runway end lighting, to include runway end identification lights. The runway would be paved asphalt.

Optimum runway orientation is highly dependent on wind speed and direction. The predominant wind for the first half the year is from the north/northeast, while the remainder of the year winds come from the west/southwest. The average wind speed in winter is 13 miles per hour, with an average of 9 miles per hour in the summer. Wind conditions can be very gusty at times, ranging from 10 to 30 miles per hour. The most severe wind conditions occur during the winter months.

In addition to the runway, turnout areas at each end of the runway would be built to facilitate aircraft turning and at one end the turn-out would also be used for aircraft loading/unloading. The end used for loading and unloading would measure 200 feet in width and 500 feet in length. The other turnout would measure 200 feet in width and 200 feet in length.

When considering the boundaries of PSCA and the varied terrain at the site, there are very few alternative locations that could be considered for runway development that does not interfere with other existing and planned facilities or require extensive grading/fill to obtain a level surface. The following three alternatives provide the most realistic opportunities for developing a runway at PSCA.

Figure 5-34: Runway Alternative Sites

Development Alternative 1: Runway Alternative 1 locates the runway along the south side of the Burton Ranch Road. Building the runway in this location will require relocating the Burton Ranch Road approximately 200 feet to the north. This site would require grading, as the terrain in relatively level, but has a couple of ravines that would need to be filled and leveled as part of the grading process. This alternative is close to the PPF, so payloads could be easily transported from the runway to the PPF. The area is at the highest elevation of the three alternatives presented and does experience fog. For this alternative, it is recommended the load/unload turn-out be built at the west end of the runway, closest to the PPF and Pasagshak Road.

Development Alternative 2: Runway Alternative 2 is proposed on lowlands to the north-northeast of the Rocket Motor Storage Area. The terrain at this site is less level than at the previous alternative location and would require significant grading and fill to level out the area for a runway. Generally, the terrain rises in elevation from the shoreline towards the Pasagshak Road. The cost for developing this runway is estimated to be substantially more than the previous alternative due to the amount of grading and fill that would be necessary to construct a level runway.

This site is further from the PPF than the previous site and would require an access road also be built connecting the loading/unloading turn-out to Pasagshak Road. To minimize costs, the loading/unloading turn-out would be built at the runway end closest to Pasagshak Road.

Development Alternative 3: Runway Alternative 3 builds the runway infrastructure at the far end of Narrow Cape. While the terrain is relatively level, extensive clearing of trees and vegetation, as well as some grading would be required to develop a level runway in this area. Of greater concern is the requirement to then build an access road from the terminus of Pasagshak Road, at the low level on the east end of Twin Lakes, across wetlands and a creek, and up rising terrain to connect with the runway. This roadway extension would be expensive and would have the most significant impact on the physical environment. Building a runway in this area places the runway under an area subject to launch vehicle overflights for launches from PSCA.

No Build Alternative: While development of a runway at PSCA would be advantageous for ease of transporting payloads and personnel to the spaceport, it is not a requirement for PSCA to meet future launch projections. The use of the Kodiak Airport, as well as receiving launch vehicles at the Lash Dock and transporting them to PSCA via surface transport has proven successful. Having another runway environment at Kodiak to serve as an alternative to the Kodiak Airport and for flight training would be beneficial, but not critical to the spaceport operations.

SECTION EIGHT – Lodging Development Alternatives

Lodging requirements supporting PSCA have historically been provided by permanent, private lodging not located on PSCA property and by temporary, customer specific lodging provided on-site during operations. The PSCA ILMA does not permit permanent lodging to be built at PSCA. The facility requirements chapter identified the need for additional lodging capacity at or near PSCA to meet the future launch projections. Customers have identified the lack of sufficient lodging facilities at PSCA as one of the limiting factors in conducting launches from the spaceport. To resolve this impediment, lodging facilities are needed to meet current and future operations. This section will provide both temporary and permanent lodging alternatives for consideration.

Alternative 1: Since Alaska Aerospace is not in the lodging business and the current ILMA with ADNR does not permit permanent lodging to be constructed on PSCA lands, working with private sector providers to increase number of lodging rooms available within 20 miles of PSCA is a preferred alternative. This alternative is predicated on the continued availability of the 56 rooms at the Kodiak Narrow Cape Lodge (KNCL) for use by both commercial and government customers at PSCA, with additional capacity of up to 150 rooms being created in the vicinity of PSCA, but not on PSCA lands. Should this alternative become the preferred alternative, there would be limited action required of Alaska Aerospace, as this alternative is wholly dependent on the private sector for development.

Alternative 2*:* Expand off-site lodging capability to support PSCA operations. Under this scenario, Alaska Aerospace would consider the possibility of purchasing the KNCL, forming a joint venture with a private sector/native corporation to develop lodging capacity, or pursuing development of a company owned lodging facility. A location for this alternative would be dependent on many factors, to include land available for development, zoning requirements, funding mechanisms, willingness of the KNCL owner to discuss a purchase option or finding interested partners for development of such a facility that may have land available. This alternative would require Alaska Aerospace Board of Directors approval to pursue and may include Alaska Aerospace being financially involved in the development and operation of the facility.

Alternative 3*:* This alternative proposes to develop permanent lodging capability at PSCA. This would require changing the current ILMA to allow Alaska Aerospace to build permanent lodging at PSCA. Based on the demand projections, any facility owned and operated by PSCA should have flexibility in use, as most commercial customers will only need 25 rooms or less. So, while government customers may require up to 200+ rooms during missions, any facility installed at PSCA for both government and customers' needs to have the flexibility to warm-storage a significant number of rooms when not in use by customers. This facility should have as a minimum 200 rooms, each with individual bathrooms, with rooms flexibly designed to accommodate either single or double person occupancy, depending on customers' requirements. The facility must also have food servicing, laundry, internet access, and a common room that can be used for relaxation or converted to a small conference room.

Figure 5-35: Lodging Alternative 3A

Alternative 3A: This site was selected for consideration because it was the site that was previously used by the government for temporary lodging. The site measures 320 feet by 320 feet (102,000 Square feet) and is already graded, with a gravel base. The site has been used in both 2017 and 2019 for temporary lodging by the government. It has power, communication and data, water and wastewater capability, as well as being close to the Pasagshak Road, with an access road that does not interfere with Pasagshak Road use.

In order for this site to be made available for permanent lodging development, the PSCA ILMA with ADNR would have to be changed to permit long term lodging capability on PSCA land. This site is also within the QD for larger launch vehicle launches from LP-1, therefore, this site would have to be vacated during hazardous and launch operations.

Figure 5-36: Lodging Alternative 3B

Alternative 3B: This site is located along the north side of the Pasagshak Road, at the entranceway to PSCA. This site is outside the QD, therefore, personnel would not have to evacuate the site for launch operations. This site has power, communication and data capacity in close proximity to the site, making service extensions cost effective. Like Development Alternative 3A, for this site to be made available for permanent lodging, the ILMA with ADNR would have to be changed to permit long term lodging capability on PSCA.

The area is narrow, 200 feet by 400 feet (80,000 Square Feet), which would limit the layout of any potential lodge. Being located directly adjacent to the state road right-of-way for Pasagshak Road makes vehicle access to the site problematic. Providing adequate vehicle parking in a manner that does not compromise safety by being too close to the Pasagshak Road would be challenging and may require that vehicle parking be accommodated at the LCC parking lot, requiring guests to walk about 600 feet from the parking lot to the lodging facility, a parking area developed across the street in the area of the entrance amenities. A positive aspect of choosing this site is the ability to potentially expand the entranceway amenities areas by integrating some of the visitor aspect of PSCA into the lodging facility itself. This scenario provides an opportunity to develop a small exhibit center, interactive information display area, and concession services for visitors who come to PSCA to observe launches.

Figure 5-37: Lodging Alternative 3C

Alternative 3C: Also located at the PSCA entranceway, this site is located on the south side of the Pasagshak Road on the already graded land that was previously used by GCI for a satellite downlink antenna. This site also has power, communication and data capacity in close proximity to the site, making service extensions cost effective. The area is also fairly narrow, 150 feet by 300 feet (45,000 square feet), which would limit the layout and size of any potential lodge. It also lies directly adjacent to the state road right-of-way for Pasagshak Road which would make access to the site problematic for large numbers of personnel and vehicles.

While this site has the same locational potential of providing visitor services as Development Alternative 3B, the narrowness of the site and proximity to the Pasagshak Road right-of-way would restrict development concepts and not be as efficient as the previous development alternative.

This area is currently identified as an area for future development of a public viewing area, which would include seating, audio and visual presentation of launches from PSCA, as well as potentially offering vendors services to visitors. Should this site be used for lodging, another location would be identified for public viewing. Like Development Alternatives 3A and 3B, for this site to be made available for permanent lodging, the ILMA with ADNR would have to be changed to permit long term lodging capability on PSCA.

Figure 5-38: Lodging Alternative 3D

Alternative 3D: Situated at the northeast corner of PSCA lands under the ADNR ILMA, this site provides an ideal location for establishing permanent lodging. Like the three previous Development Alternatives, for this site to be made available for permanent lodging, the ILMA with ADNR would have to be changed to permit long term lodging capability on PSCA. This site is 2.0 miles from LP-1/LP-2 and 1.5 miles from Area 3, placing it outside the QD for all launch pads at PSCA. Therefore, personnel would not have to be evacuated from the facility during hazardous operations and launch periods.

The site measures 600 feet by 350 feet (210,000 square feet). This is sufficient to accommodate the proposed lodging facility and vehicle parking lot. The site is relatively level terrain and is adjacent to the Pasagshak Road. This site could also provide the public amenities of a small welcome and exhibit center, interactive displays, and concession services, but is over a half mile from the PSCA entranceway and rocket display area. The site does not currently have any utilities installed and would need a 4,500 foot extension from the LCC area.

No Build Alternative: This alternative relies on the status quo to have sufficient lodging available to meet future demands. As demonstrated by past missions, the lodging availability within 20 miles of PSCA is extremely limited.

The KNCL has not always been available to Alaska Aerospace customers at competitive per night rates. It is expected that the KNCL will be available for large missions where all or most of the 56 rooms are rented for an extended period;

however, for launch operations that are of short durations and have a small room number requirement, past history shows the KNCL may not be available, forcing customers to find accommodations further away from PSCA. Provided the KNCL lodge remains open and available to both government and commercial customers at or below the prevailing federal government per diem rates, the No Build Alternative would continue to provide sufficient lodging rooms to meet the projected commercial operators.

Should the KNCL be closed or removed from Kodiak, the No Build Alternative would create a serious negative impact to Alaska Aerospace being able to attract government and commercial customers. The 56 rooms available at KNCL provide the greatest number of rooms available between PSCA and the City of Kodiak. The KNCL has historically been used by government launch customers, and during most government missions, the facility has been filled with the overflow capacity either renting rooms in Pasagshak or using the commercial lodging facilities in Kodiak.

The Pasagshak community has a number of homeowners that offer rooms for rent. For the customers that are at PSCA for a short duration, with small room requirements, Pasagshak rentals provide a viable alternative. However, the number of rooms available are limited and based on demand projections it is expected that most of the year multiple companies will have personnel at PSCA supporting launch operations, exceeding the Pasagshak room capacity. At Kalsan Bay T, the Olds River Inn has four cabins available for lease. These cabins have been used in the past and provide excellent accommodations within 15 miles of PSCA.

The alternative to the KNCL, Pasagshak community and the Olds River Inn is for customers to obtain lodging in Kodiak. Kodiak has a number of commercial facilities available to meet future lodging demands. However, the distance between Kodiak and PSCA is 44 miles and requires an hour commute in each direction. This commute requirement has been considered a negative aspect of operating from PSCA by some customers, primarily due to the fact that the commute time impacts the amount of time personnel are available to work at PSCA. Therefore, a requirement to consider development to of additional permanent lodging in close proximity to PSCA was included in the previous chapter.

This alternative would be a constraining factor in the projected growth opportunities for PSCA, as some customers, primarily commercial customers, may determine the lack of lodging in close proximity to PSCA is neither cost nor operationally efficient. It would also continue to be problematic for government customers who would prefer not to have to make large investments to establish temporary lodging facilities at PSCA in order to conduct operations at the spaceport.

SECTION NINE – Land Use, Public Lands, Cultural Environment, and Operations Closure Alternatives

Department of Natural Resources, Interagency Land Use Management Agreement (ILMA)

As has been addressed in this report, ADNR is the landowner of the 3,717 acres comprising PSCA. Under the ILMA, aerospace operations are permitted at PSCA. The size and permitted uses of the ADNR lands are specified in the ILMA. One of the objectives of this plan is to determine the future land needs for PSCA to accommodate the projected launch demand. The second primary objective is to complete a new land survey of PSCA based on the determined area necessary to meet future demand, as determined from this planning process. This requirement will be addressed after a preferred alternative is identified in the next chapter to this report.

Development Alternative 1: Maintain the current ILMA and develop within the approved 3,717 acres. This alternative provides no change to the current boundary configuration and permitted uses at PSCA. Under this alternative all future requirements, as outlined in this chapter, could be accommodated.

Development Alternative 2: Maintain the current ILMA but constrain development within the approved 3,717 acres and release land not required for aerospace operations and development back to ADNR. Whether this development alternative could be adopted depends upon the specific locations of facilities that will be developed over the course of the planning period. Existing permitted land uses under the ILMA would continue.

Development Alternative 3: Convert the current ILMA into a land lease from ADNR. This alternative creates a number of advantages to making PSCA a successful commercial spaceport. It would allow for Alaska Aerospace to lease lands at the spaceport to other entities and customers. This would create new opportunities for Alaska Aerospace to expand the aerospace business at PSCA by offering land and/or facilities to commercial and/or government customers for long term lease. Doing this makes PSCA more competitive to the commercial market and provides Alaska Aerospace with a broader base. One example would be opening the lands at PSCA for lease to the private sector to develop permanent lodging facilities at PSCA to support launch customers.

This alternative also potentially changes the relationship between Alaska Aerospace and the Kodiak Island Borough (KIB). Under the current ILMA, Alaska Aerospace has been permitted to establish temporary lodging at PSCA for government customer support. These lodging facilities have been exempt from KIB taxation. Should PSCA lands be converted to a lease, permanent commercial facilities, to include lodging facilities, be constructed at PSCA which are not exempt under statue as aerospace operations facilities, would be subject to KIB taxes.

In addition, this alternative provides potential for Alaska Aerospace to generate revenues from non-launch operations. Similar to the Alaska Railroad model, leasing land and/or facilities to customers would generate revenues not currently allowed under the ILMSA. ADNR would also gain revenues from the leasing of PSCA lands to the commercial sector. Terms of the payment to ADNR from Alaska Aerospace would be negotiated as part of the lease agreement. If it is concluded that long-term lodging requirements are best met by developing a lodging facility on PSCA lands, identify the process for changing the ILMA to allow this development.

Use the survey completed as part of this Master Plan to verify the boundaries of PSCA and in creating alternatives for future development, cluster development areas to the maximum extent possible to preclude any boundary expansion with an objective of reducing the current acreage under the ILMA, if feasible to meet future demands.

United States Coast Guard LORAN Narrow Cape Navigation Site

The current USCG LORAN Site at Narrow Cape has been abandoned. The land at this site remains under lease between ADNR and the USCG. To maximize development while minimizing development in previously undisturbed areas, having these lands available to Alaska Aerospace for PSCA use would be beneficial.

Development Alternative 1: Transfer the land lease and all USCG facilities to Alaska Aerospace. This alternative would require the USCG to vacate their existing lease with ADNR for the lands at Narrow Cape, require ADNR to amend the existing ILMA to add the land area to the Alaska Aerospace agreement, and to transfer government-to-government the existing facilities and infrastructure of the LORAN site to Alaska Aerospace, a state-owned corporation.

As has been identified previously in this chapter, there are potential uses for the lands and facilities by Alaska Aerospace. Whether the eventual use is to establish telemetry tracking and data download antennas; build Launch Pad 3E; or utilize the facilities by customers for maintenance, fabrication, engineering, and administrative offices, using this area to meet future demands allows Alaska Aerospace to minimize development of other areas to accommodate the demands. This supports one of the primary principles of this planning process of meeting demand while reducing the operational footprint of PSCA at Narrow Cape

One concern is the environmental condition of the facilities and land at the USCG site. There are potential environmental issues related to contaminated soils and/or asbestos in facilities that will eventually require remediation. This issue would be a negotiated point in the land and facilities transfer from the USCG to Alaska Aerospace.

Development Alternative 2: Alaska Aerospace enter into a sub-lease agreement with the USCG for use of the lands and facilities. Alaska Aerospace previously discussed this option with the USCG but abandoned the effort in 2012 due to the lack of need, and projected revenues to pay for the lands and/or facilities. With the expanding commercial launch business that has been identified in this report, there now exists a need for additional land and infrastructure to support future operations. To meet these demands, use of the USCG land and/or facilities would reduce the need to develop other areas at PSCA, leaving the USCG land as is.

Under this alternative, the USCG would remain responsible for any environmental clean-up that may eventually have to be completed at the site and within the facilities from prior to the sublease effective date.   Because Alaska Aerospace is a state-owned corporation, no rental payment to the USCG would be expected. One risk to this alternative is the potential ability of the USCG to terminate the agreement if the USCG determines it is in the public's best interest. Under that scenario, it would be difficult for Alaska Aerospace to be able to enter into long term lease agreements with customers and/or install expensive equipment at the site when there exists the possibility that the USCG could terminate the sub-lease. That would cause significant disruption of operations and incur unnecessary expenses.

No Build Alternative: Under a No Build Alternative future demand would be met by developing other areas at PSCA. Sufficient land is available to Narrow Cape under the PSCA ILMA to meet future demand without acquiring the USCG land and facilities. However, as already identified, by not using the USCG land and facilities, this development would be completed in other areas of the spaceport and may include development is areas that are not already developed.

Public Land Use and Trails

Public access to Narrow Cape, Fossil Beach, and the Narrow Cape trail network is another primary objective of this planning process. Regardless of the development alternative eventually adopted, public access to the lands at Narrow Cape and road access to Fossil Beach will remain open to public use except during periods of hazardous and launch operations.

Alaska Aerospace is in the process of developing a public educational and viewing area at the entranceway to PSCA. Presently, this area, on the south side of the Pasagshak Road, has been graded for public parking, a new entrance sign installed, and a model rocket and rocket engine erected. The area will be further improved to include signage around the rocket display that provides educational information on space launch and the role that PSCA plays in providing access to space for both government and commercial customers.

Recognizing the importance that public access and the trail system at Narrow Cape is to the community, Alaska Aerospace is committed to preserving access, to include installing signage to inform the public of public parking areas and trail access points within the 3,717 acres of land under Alaska Aerospace control. To increase public use of some areas, Alaska Aerospace is installing a Disc Golf Course on the northwest end of PSCA land, by Surfers Beach, for use by the public.

As part of the alternative's evaluation process, Alaska Aerospace seeks to maximize the efficient use of existing lands within the designated spaceport 3,717 acres at Narrow Cape. Based on the number of potential alternatives for future development, it is possible that the land under the Alaska Aerospace ILMA could be reduced, with lands not identified for future development or needed as protection zones around active operational areas returned to ADNR. This option would be enhanced if the current USCG LORAN C Site were transferred to Alaska Aerospace, allowing the area and facilities to be used for some of the future facility requirements. Based on specific development alternatives selected as preferred alternatives in the next chapter, a recommendation on the PSCA land boundary will be developed with the objective of reducing the spaceport land area at Narrow Cape.

Cultural and Historical Environment

Alaska Aerospace remains sensitive to the cultural and historical significance of Narrow Cape to the residents of Kodiak. Previous environmental studies, including the *April 2016 Final Environmental Assessment Finding of No Significant Impact/Record of Decision for the Kodiak Launch Complex Launch Pad 3* did confirm that previous studies identified that "two archeological sites (KOD-81 and KOD-441) and one historic World War II era bunker complex (KOD-456) were identified within approximately one mile of the Kodiak Launch Complex (ADNR, 1994 and ENRI 1995)." As each potential development alternative is reviewed for possible selection as a preferred alternative, a review of the recommended development alternative in relation to the identified historical sites required and will be addressed in the Environmental Evaluation chapter to this report.

The *April 2016 Final Environmental Assessment Finding of No Significant Impact/Record of Decision for the Kodiak Launch Complex Launch Pad 3* also identified "five known AHRS sites in the general vicinity of the proposed improvements were noted during the research; three previously identified sites (from the 1994 survey): KOD-81, KOD-441, and KOD-456, and two new sites: an archeological site two miles from the Launch Pad 3 site (KOD-66) and the USCG LORAN Station (KOD-75). It was recommended that because there may be a potential to encounter archeological resources within development areas of preferred locations, it is prudent and feasible to conduct identification efforts in advance of construction once preferred development sites have been determined.

In selecting preferred alternatives, special attention should be applied to avoid the World War II historical structures on Narrow Cape. The only potential development this chapter identifies is a possible runway to support spaceport operations. In considering the eventual selection of a future runway alignment, special attention must be applied to the historical importance of this area to the need for a runway being built in this location.

As was stated in Chapter Two, "any development of previously undisturbed terrain would be subject to the provisions of the approved environmental documents. Should archeological resources be encountered, they would be protected, and a testing plan established to determine the value/importance prior to proceeding with development/construction in the area where the resources were found."

Alaska Aerospace supports a strong Science, Technology, Engineering, and Mathematics (STEM) program for students. In 2019, Alaska Aerospace interns developed a Space Launch Educational Kit for use by schools and community groups to demonstrate the principles of space launch. The kits allow hands-on, interactive activities that advance STEM education and are available to both Anchorage and Kodiak school districts. To future the STEM curriculum, a potential partnership between Alaska Aerospace and the Kenai Challenger Learning Center for Alaska would provide greater opportunities for students to experience the aerospace career by gaining access to PSCA for practical experience.

While PSCA is situated solely on State of Alaska lands, the requirement for community outreach is limited. However, Alaska Aerospace supports a broad-based community engagement program. To that end, senior management has engaged with the aviation, fisheries, political, and native organizations to better understand issues that are created by operating a spaceport at Narrow Cape. The use of this master plan, once finalized, will be a tool for Alaska Aerospace to explain how cultural and historical issues are mitigated and/or resolved against the preferred development at PSCA.

Roadway Closures

The Pasagshak Road and Burton Ranch Roads are public roads. Minimizing road closures to those permitted by the ILMA and in coordination with the Alaska Department of Transportation and Public Facilities that are done to protect the public from hazardous operations and launches.

Alternative 1 (Best Case Scenario) – This alternative uses the maximum projected launches to provide the parameters of expected road closures. Determination is made using the assumption that the road would only be closed for a three to four-hour period each day within a launch window and that the launch would occur on the first day of the launch window. Under this scenario, it is expected the road would be closed on one day for the wet rehearsal, followed by the day of launch. In addition, it is expected that hazardous operations (rocket fueling activities) for liquid fuel rockets would occur on the day of launch, while for solid fuel rockets a separate hazardous operation may be required prior to the launch window.

Therefore, two (2) government launches per year would result in a total of twelve hours (12) per launch, or twenty-four (24) hours per year divided between six (6) different days. For up to four (4) solid fuel rocket launches, there would be a forty-eight (48) hours of road closures divided between twelve (12) different days. For liquid fuel rocket launches a total of eight (8) hours of road closure over two (2) different days, per launch. This would result in an annual closure of two hundred and fifty-six (256) hours over sixty-four (64) different days. It must be stressed that of these sixty-four days, only three to four hours on any specific day would the road be closed for PSCA operations.

Alternative 2: (Worst Case Scenario) – This alternative uses the same maximum annual projected launches but assumes that extenuating circumstances (weather, rocket or range issues, etc) may delay launches, with the actual launch occurring on the last day of the launch window. In this scenario road closure could be expected to occur up to one hundred and ninety (190) days each year, for up to four hours on any given day.

To mitigate these impacts, improved communication and signage would be necessary to increase public awareness and reduce conflicts. Of special interest is the public access to the Burton Ranch area. Since this is private property located on the east side of PSCA, with the only access being the Burton Ranch Road that extends from the Pasagshak Road, special exceptions must be developed to permit access to the Burton Ranch area during launch windows. One option is to provide a "Follow-Me" car, as is done in construction zones, which would escort vehicles between the Burton Rach area and the open area of the Pasagshak Road. Another option could be to provide the driver of a vehicle a mobile communications device to report when entering/existing the close area. Once a preferred develop alternative is established, procedures for reducing impacts of road closure on the public and to/from Burton Ranch will be developed.

Waterway Closures

Waterway closures to the south and southeast of Narrow Cape have been identified as an issue that needs improvement. In 2019, Alaska Aerospace increased public outreach to the fisheries community in Kodiak. Increased awareness of dates and times when closures to the waterways south, southeast, and southwest of PSCA will occur is necessary. Alaska Aerospace needs to use the annual fisheries opening schedules for areas around Kodiak to avoid closures where a significant impact would occur to the fishing community economy. Not scheduling launches during openings should minimize the hours of closure and to the maximum extent possible avoid specific hours when commercial fishing would be occurring within the launch closure area.

It is recognized that the waterway around Narrow Cape, and especially between Narrow Cape and Ugak Island, is used year-round as a safe passage for marine vessels, both large and small. Therefore, Alaska Aerospace must not solely focus on launch closures that may conflict with fisheries openings, but also manage closure times during periods when marine traffic may need to operate south of Narrow Cape. To accomplish this, scheduling launches in late afternoon and evening, as well as during the night (when operationally feasible) and around the sunrise period would reduce conflicts.

From an awareness perspective, investing in a marine transponder system at PSCA would improve the visibility of vessels operating in and around launch closure areas to the Launch Operations Team. It is understood not all vessels have a marine transponder system; however, for those that do visibility of specific locations and direction of travel would greatly assist the launch team director in determining any potential conflicts and allow for improved coordination between the spaceport and the marine vessel. In Alaska, the Alaska Marine Exchange provides Automatic Identification System (AIS) vessel tracking. With an AIS receiving station in Kodiak, the Alaska Marine Exchange has immediate capability to improve vessel tracking during launch windows.

Finally, improving communications capabilities between the launch site and the marine operators would reduce operations conflicts. Acquiring the appropriate radio communications equipment and establishing procedures for direct communications between commercial fishing vessel and the PSCA launch team would provide more timely and effective notice, ensuring marine vessels have adequate notice of launch timing and the ability to clear restricted areas prior to launch.

Airway Closures

Airway closures associated with launch activities has an impact of a variety of aviation users. Traffic between Kodiak and villages on the east side of the island can be disrupted when Temporary Flight Restrictions are in place. Since Kodiak is a non-radar environment, the ability to monitor aircraft movements around the Narrow Cape area does not exist. Therefore, when TFR's are in effect, the airspace within the TFR is essentially closed to air traffic.

Alaska Aerospace has initiated discussion with the Federal Aviation Administration (FAA) to work on solutions to this problem to mitigate the impact of PSCA launches on air traffic. Working with the Anchorage Air Route Traffic Control Center (ARTCC), Alaska Aerospace is striving to develop innovative solutions that include creating operational rules that permit limited transit of a TFR around PSCA during times when TFR's are active, but when launch activity would permit non-radar transit of the TFR area.

Concurrently Alaska Aerospace is working with the FAA in development of a new program to automate the way space launch vehicles transit through the National Airspace System (NAS). The Space Data Integrator (SDI) proof of concept project will integrate space vehicle missions in real time with traditional air traffic management systems to provide air traffic controllers with "situational awareness" of launch activities, allowing dynamic management of the airspace. As part of this development consideration is being given to establishing a communications system between PSCA, Anchorage ARTCC, and the Kodiak Control Tower to improve situational awareness of air traffic transiting Narrow Cape and the PSCA area during launch operations.

At the time of developing this chapter, none of these procedures have been approved for adoption by the FAA, although the FAA and Alaska Aerospace are evaluating options that may result in solutions that decrease the impact of TFR closures in the future.

SECTION TEN – Next Steps

This chapter has identified a series of potential alternatives designed to allow PSCA to expand facilities to meet projected future launch requirements. The process included an evaluation of operational requirements, regulatory requirements, and community interests as were identified in the earlier stages of this process. Input from the public received at the June 25, 2019 Public Informational Meeting held in Kodiak and work done by the Spaceport Planning Advisory Group (SPAG) framed the boundaries for potential alternatives consideration. These included:

- Repurpose existing developed areas and facilities to meet future requirements before developing new areas.
- Optimize developed areas within PSCA to minimize disturbing undeveloped lands.
- Development must be based on real demand, not a "Build it they will come" expectation.
- Lodging requirements at PSCA needs a comprehensive long-term solution.
- New development must adhere to state and federal environmental and OSHA requirements.
- Maintain maximum access to the public lands at Narrow Cape and Fossil Beach.
- Minimize impacts to established hiking trails in the Narrow Cape area.
- Mariner and aviator impacts by created spaceport closures require procedures be developed to reduce closure times and increase access.

Using the results of this chapter and recommendations provided by the SPAG and public comments received at a second Public Informational Meeting, a Preferred Alternative Development Plan will be created. This preferred alternative will balance the varied interests to provide a reasonable development plan that meets growth expectations and permit Alaska Aerospace to efficiently operate PSCA and maintain financial stability.

Figure 5-39: PSCA Display Model Rocket

Chapter Six – Pacific Spaceport Complex – Alaska Preferred Development Plan

SECTION ONE - Overview

Following a comprehensive assessment of facility requirements and development of potential alternatives, preferred alternatives were identified and are presented in this chapter as the Preferred Development Plan. Consideration of preferred alternatives used both a qualitative and quantitative demand dependent assessment to select the most conservative development plan to meet the forecast demand. This allows Alaska Aerospace to adjust actual investment in infrastructure improvements to an uncertain future in the space launch business, which allows the plan to be developed in a financially manageable means.

Selection of a preferred alternative is based on the alternative meeting demand needs, enhancing operations and safety, minimizing environmental effects, and providing future spaceport development flexibility. While the preferred alternative determination is created based on available information and design criteria, completion of required environmental documentation, as well as preliminary and final design documents, could require modifications to the alternatives as presented and result in additional impacts beyond those considered in this Master Plan, for which additional analysis and approvals may be required.

Goals and Objectives:

The preferred development plan presented in this chapter meets four of the goals and objectives of the original Master Plan:

1) Maintain safe operations,

2) Create operational efficiencies,

3) Identify essential land use requirements while minimizing the area of public land required for safe and efficient spaceport operations throughout the planning period, and

4) Address community interest in the development and operation of PSCA.

The next chapter will present an environmental evaluation to address environmental awareness, while a separate chapter will validate the financial sustainably of the preferred development plan.

Development Constraints

There are number of constraints on future development at PSCA. First and foremost are constraints that may limit optimal operations by customers. This includes:

- Having line-of sight between the telemetry antennas, the launch pads, and down-range trajectory of the vehicle,
- Quantity-Distance (QD) – QD is the foundation of Department of Defense explosives safety standards widely used in commercial operations that defines levels of protection from blasts based on relationships between the quantity of explosive material and distance between a launch pad and other infrastructure,
- Uneven terrain across the site,

- Launch limitations as defined by the Federal Aviation Administration Environmental Assessment for PSCA,
- Restrictions on types of development permitted at PSCA established within the existing ILMA,
- Retaining maximum public access of the Pasagshak/Fossil Beach Road,
- Access to the Burton Ranch area,
- Minimizing encroachments or creating limitations to the many trails in the Narrow Cape area and use of the public lands except during periods of launch and hazardous operations, and
- Impacts to waterways and airways during launch operations; and authorized use of the public lands under the current ILMA.

Public Input: In developing the preferred alternative, consideration was given to public input received from SPAG members, and the public at-large. SPAG meetings were held on January 30, 2019; May 15, 2019; and December 4, 2019. Public Informational Meetings were conducted on June 25, 2019 and January 22, 2020. Public input also included a letter from Old Harbor, dated October 30, 2018, addressing the airspace closures and a letter from the Sun'aq Tribe of Kodiak, dated December 4, 2019.

Public input to the development plan has been relatively positive, with a few dissenting comments. Generally, dissenting comments were consistent with past development and environmental public comments objecting to the construction and operation of the launch complex since its inception. It is noted that the SPAG included a cross-section of people representing a number of stakeholder interests in PSCA, which included both proponents and opponents to the development and operation of the spaceport.

Comments generally focused on:

- Road, marine and airspace closures,
- Pasagshak and Fossil Beach road closures,
- Public access to Fossil Beach,
- Public access to the Burton Ranch area,
- Public access to the public trail system at Narrow Cape,
- Minimizing the duration of launch windows and avoiding launches on weekends, holidays, and during commercial fishing openers/closures downrange of PSCA,
- Maximizing use of existing developed areas before disturbing undeveloped areas,
- Use of the abandoned USCG LORAN site,
- Use of Pasagshak Point,

- Possible environmental consequences of expanded launch activities, such as water drainage, wastewater disposal, fuel (type) storage and use, and soil contamination, as a few examples,
- Lodging development at PSCA,
- Status of the existing Interagency Land Use Management Agreement with the Department of Natural Resources,
- Potential commercial development on state lands at PSCA,
- Concerns about development of a runway at PSCA,
- Concerns about seismic activity at Narrow Cape and possible impact on PSCA, and
- Relationship between Alaska Aerospace and the Kodiak Island Borough.

SECTION TWO - DEVELOPMENT PLAN OVERVIEW

The preferred development plan for PSCA covers three primary areas:

1. Launch facility development;
2. Support facility development; and a
3. Land Use Boundary Plan

The preferred facility development plan is depicted in the following graphic, Figure 6-1.

Figure 6-1: PSCA Preferred Development Alternative

SECTION THREE - Launch Facility Development Plan

This section presents the launch facility developments that may be required in the next ten years to meet forecast demand, as identified in Section Two of this chapter.

Launch Pad 1 – As presented in the previous chapters, the demand to support liquid propellant launch vehicles is increasing with the development of new and enhanced rocket engines, to include new hybrid engines, and rockets. To provide increased capability at Launch Pad 1, it is recommended the facility be modified to support launch vehicles which use liquid propellants. This option is selected in lieu of developing a new launch pad for larger-sized liquid propellant /hybrid powered launch vehicles.

Under this recommendation, an area will be constructed near Launch Pad 1 to accommodate both rocket propellant (fuel and oxidizer) tanks, along with piping that connects the tanks to the launch pad and an access road that allows the transport of the tanks from existing paved roadway to the fueling pads. The rocket propellant pads will have berms to protect the launch structure from any unintended damage. Additionally, a water deluge system will be installed at Launch Pad 1 for noise, vibration, and heat suppression during the initial stage of lift-off. A water catchment system may be installed to collect the used water for water quality testing post launch if the current flame trench is not deemed suitable to meet water catchment requirements. Figure 6-2 depicts LP-1 development areas.

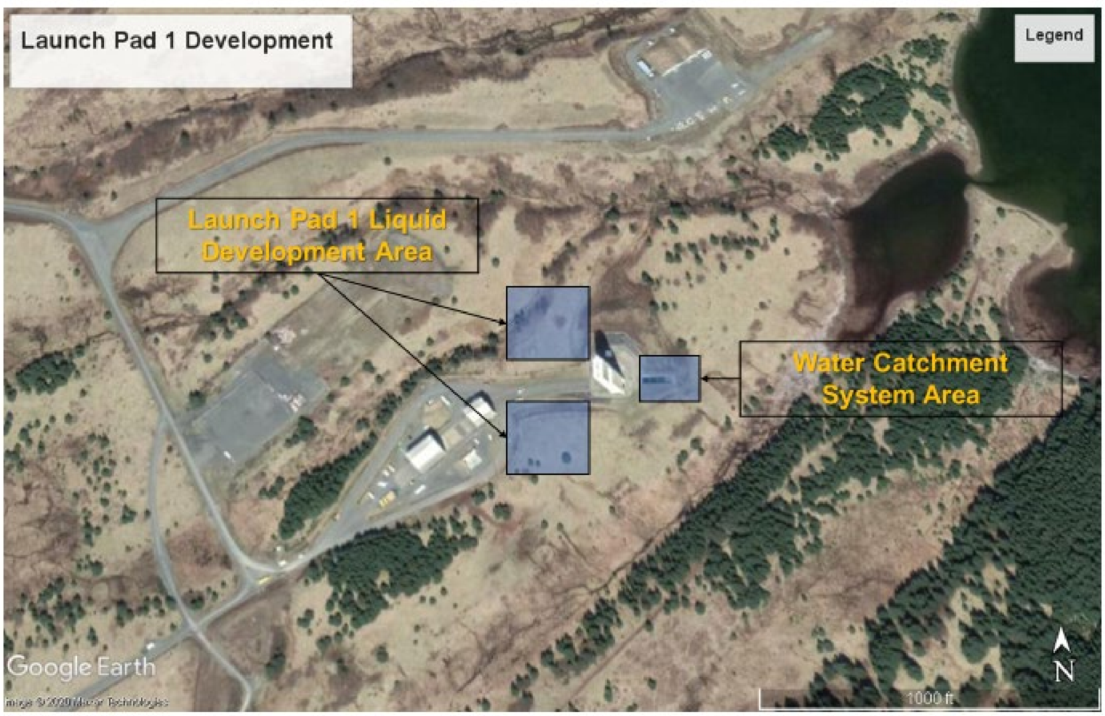


Figure 6-2: Launch Pad 1 Development

Launch Pad 2 – No further development is recommended.

Figure 6-3: Pad 3B Aerial Photo with Pad 3C and LP1 tower in the background

Multi-Use Launch Pad Area (Area 3) – The original three pads in Area 3 (Pads 3A, 3C, and 3D) were developed to support government launches. With the introduction of commercial launch customers, in lieu of developing a new commercial launch area, Alaska Aerospace received government approval to convert Pad 3C into a multi-use launch pad that could support both solid and liquid launch vehicles. With the addition of a second commercial customer, Alaska Aerospace constructed another small lift launch pad (Pad 3B) for commercial use, while retaining Pad 3D for future government use.

To limit expansion of small lift launch pads into undisturbed areas, this plan recommends Pad 3D be converted to a multi-use government/commercial launch pad that can be used for liquid, solid, and hybrid propellant boosters. The pad would be developed with a concrete launch pad and separate bermed pads (if required) for the placement of LOX and rocket propellant; a water deluge system with an environmentally approved water catchment system; enhanced communications and data systems; lighting; cameras; lightning rods; fencing; and an area for installation of a small vehicle integration facility, similar to that located at Pad 3B.

Pad 3C has a concrete launch pad; berms; communications and data systems; fencing; lighting; camera capability; and lightning rods. Improvements to Pad 3C include future construction of a small vehicle integration facility, similar to Pad 3B. Due to the close proximity of the existing access road, construction of the integration facility would likely need to be completed on the opposite side of the access road, with a road crossing to the launch pad. Therefore, it is recommended twenty thousand (20,000) square feet be reserved directly across the access road for future construction of a Pad 3C vehicle integration facility.

Pad 3A will be retained as a tactical and suborbital pad, which may also be used for staging and commodity storage of launch support equipment for Area 3 customers. The pad area should be expanded to approximately fifty thousand (50,000) square feet.

This concept best meets the spaceport's facility launch requirements, minimizes the need to further develop undisturbed land, minimizes costs, and creates the least potential environmental impacts. Figure 6-4 depicts the locations of future launch pad and support area development within the Multi-Use Launch Pad Area.

Figure 6-4: Multi-Use Launch Pad Development

High-Altitude Balloon Launch Area – To provide launch capability for future commercial stratospheric high-altitude balloon launch systems, this plan recommends that Area 5 be repurposed to support balloon launches. Located six hundred (600) feet north of Launch Pad 1 and extending nine hundred (900) feet southwest and aligned with the prevailing winds at Narrow Cape, Area 5 provides an ideal location to be reserved for future high-altitude balloon launch operations. The area has previously been disturbed and used for equipment staging. In 2016 the southwest section of this area was improved for potential use by the MDA but has never been used.

Development of this site for high-altitude balloon launches should only be completed once a viable customer has committed to using PSCA for launches. At that time the area would be improved to meet the specifications of the customer. Development of the site would also require that the site retain the ability to support potential MDA requirements. The future balloon launch area is shown in Figure 6-5.

Figure 6-5: High-Altitude Balloon Launch Development (Area 5)

Space Craft Assembly and Transfer Facility - No further development recommended.

Integration and Processing Facility - No further development recommended

Payload Processing Facility - No further development recommended. It is expected that commercial payload size requirements will be less than past government satellite sizes, allowing for internal reconfiguration to permit simultaneous processing of multiple payloads in the future. Internal reconfiguration would be completed to accommodate customer requirements, as needed.

Launch Vehicle Propellant Storage Area – With increased operations, especially of liquid propellant launch vehicles, having limited launch vehicle propellant storage at PSCA provides an ability for improved service to customers and increases safety by minimizing the number of tanker truck trips required to transport propellants from Kodiak to PSCA. Initially it is projected that two LOX tanks and one Helium tank should be acquired by Alaska Aerospace and installed in a new propellant storage area located adjacent to the Rocket Motor Storage Facility area, on the west side of the existing facilities. In addition, Alaska Aerospace should procure up to eighteen (18) Helium bottles used mostly for weather balloon launches.

As operations increase and the demand for greater volumes of propellant are generated, Alaska Aerospace should seek to secure a service contract for both storage and delivery of larger qualities of launch vehicle propellant. Should a local vendor not be available to support the propellant requirements, the Launch Vehicle Propellant Storage area can be expanded for larger capacity tanks. This plan recommends reserving sixty thousand (60,000) square feet of land directly west of the RMSF for future storage of liquid oxygen, helium, nitrogen, and other oxidizers.

This site is close to existing and planned launch pads, resulting in minimum distance for transporting propellants between the storage area and the individual launch pad tanks. The area is also adjacent to the RMSF access road and located near installed power. The proposed launch vehicle propellant storage area is shown in Figure 6-6.

Figure 6-6: Launch Propellant Storage Area Development

Launch Vehicle and Payload Storage Facilities – The two existing Rocket Motor Storage Facilities (RMSF) are sufficient for the near-term launch activities at PSCA. One facility was recently modified to accommodate both government and commercial sized vehicles. This plan recommends that the second existing facility also be modified to accommodate both government and commercial, liquid and solid propellant launch vehicles.

Depending upon customer demand, the projected launch forecast indicates sufficient future activities to warrant construction of additional storage facilities. However, the timing of such development is highly dependent on customer requirements. Therefore, it is recommended in this plan that the area east of the existing RMSF be reserved for future development launch vehicle storage. Figure 6-7 show the location of the RMSF reserve area.

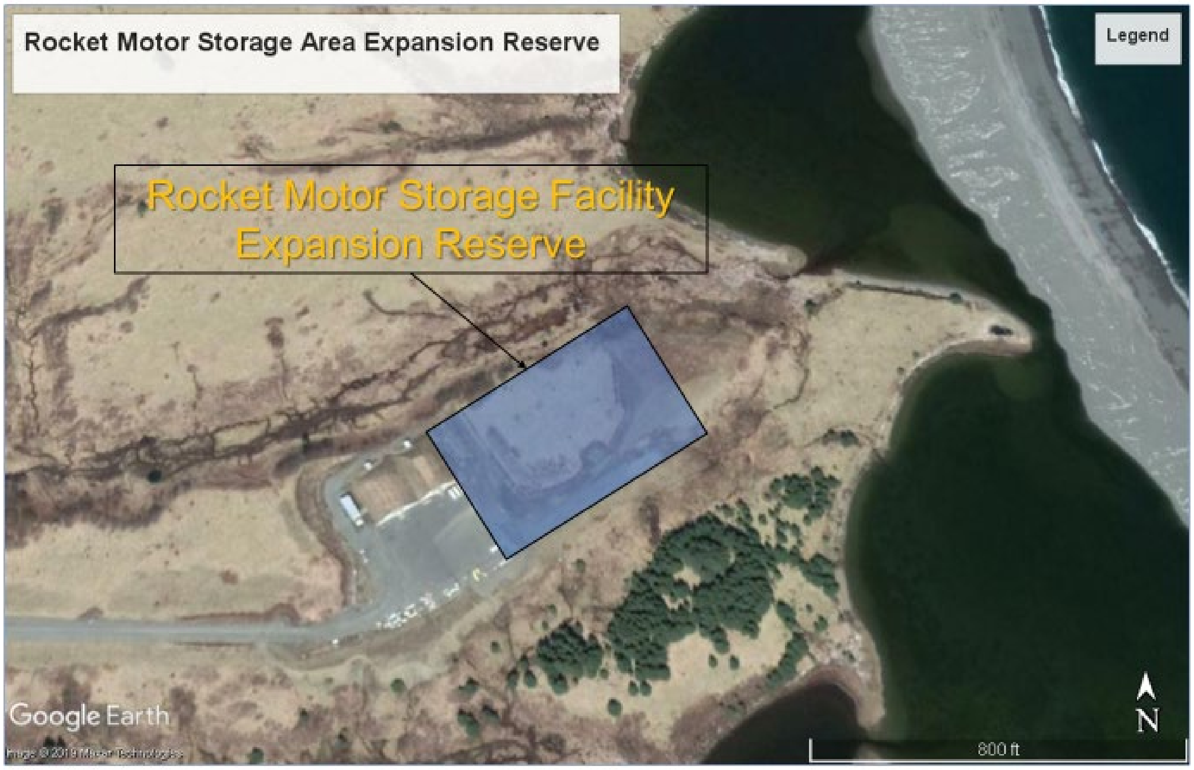


Figure 6-7: Rocket Motor Storage Expansion Reserve

SECTION FOUR - Support Facility Development Plan

This section presents the support facility developments that may be required in the next ten years to meet forecast demand.

Telemetry Instrumentation Antenna Locations

During the Master Plan development process members of the Spaceport Planning Advisory Group and the pubic affirmed that future needs for telemetry, downlink, and other antenna requirements should be accommodated to the maximum extent at the existing telemetry antenna site.

Once this area reaches capacity, the abandoned USCG LORAN site would be the preferred antenna expansion area. Both sites are shown in the following Figure 6-8.

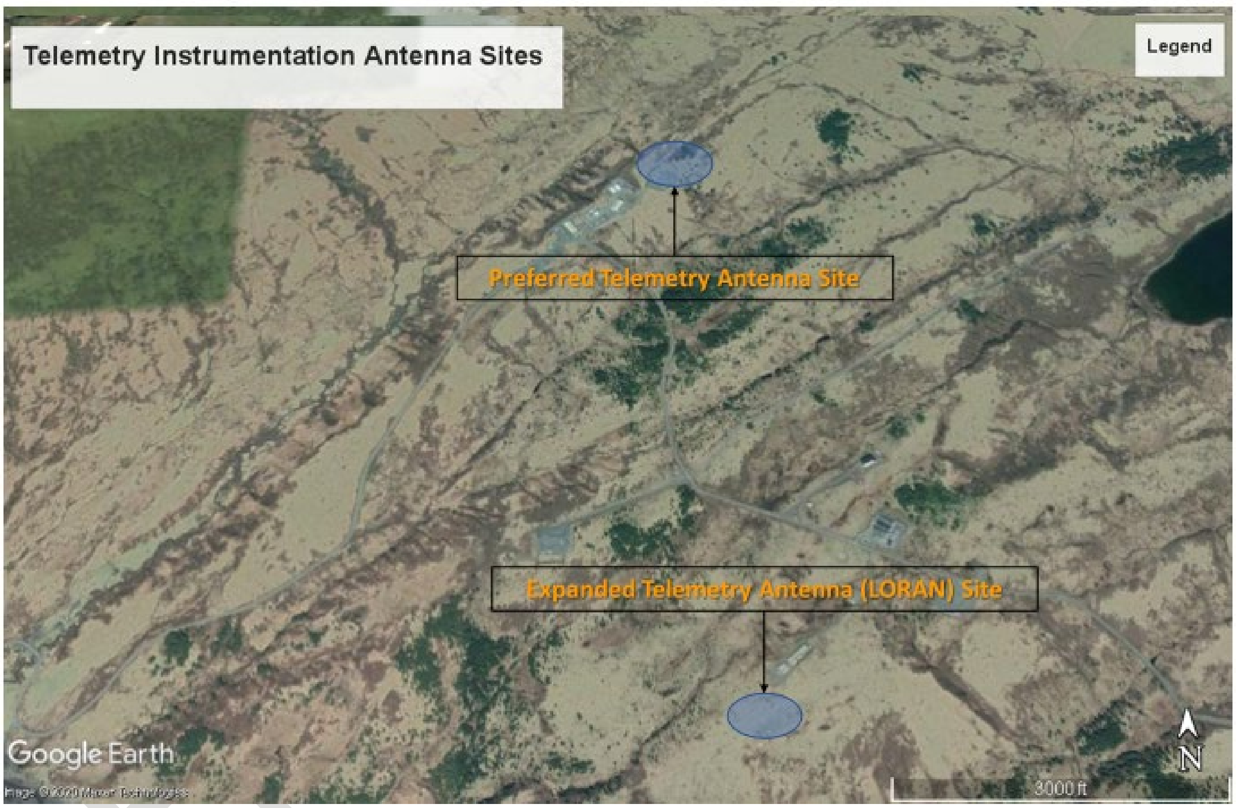


Figure 6-8: Telemetry Instrumentation Antenna Preferred Sites

Off-Axis Telemetry and Optics Site – There will be limited requirements, primarily by government customers, for use of Pasagshak Point as an off-axis site to track launches from PSCA. However, recognizing the public concerns about development at this site this plan recommends no permanent structures be built at Pasagshak Point, the access road could be improved, and an area no larger than one acre be maintained for off axis tracking on a temporary use basis.

Maintenance Support Facility (MSF) – No recommendation to expand the size of the MSF. Rather, a space utilization study will be completed to maximize the internal configuration of the MSF, which is expected to produce increased capability within the building.

Launch/Range Control Center (LCC/RCC) – The LCC (aka RCC) is the operational center for launch operations at PSCA. While operations will increase in the ten-year planning period, the RCC is adequately sized to accommodate the additional demand without the need to be expanded. This ability to handle increased operations by both government and commercial customers is met by acquisition of the Expanded Mission Control Center (EMCC), discussed below. With this additional capacity, Alaska Aerospace is able to simultaneously support launch campaigns for multiple customers.

There are a few internal modifications necessary within the RCC to better accommodate large numbers of people supporting launches, which is usually required for government operations. These include:

- Increasing the office size for Security to accommodate additional equipment, monitors, and personnel,
- Installing upgraded meteorological systems, such as a new weather tracking computer display system; new anemometer system; a wind and temperature profiler; and an automated balloon launch facility with upgraded radiosonde equipment,
- Improving the HVAC environment within the Tech Control Center to better control internal equipment temperature, and
- Increasing number of toilets in both the women and men's restrooms, and
- Upgrade/Replace cubicles with expanded office space.

To preclude constraints to meet potential future RCC expansion needs, the area west of the RCC, which is currently used as the facility vehicle parking lot, should be reserved. This would result in the need to reserve the area where the current balloon launch building is located for new vehicle parking. The reserve area is shown in Figure 6-9.

Figure 6-9: Range Control Center Future Expansion Reserve

Expanded Mission Control Center (EMCC) – Alaska Aerospace acquired this site and all associated facilities constructed in 2017 for use as a secondary launch operations center, thereby allowing more than a single customer to conduct launch operations at PSCA and to reduce conflicts between commercial and government launch control configuration requirements; depicted in Figure 6-10. No Further Development Recommended.

Figure 6-10: Expanded Mission Control Center

Area 1 – Instrumentation Pad – This area, shown in Figure 6-11, was developed specifically for government operations. The area should be retained for future government operations and restricted to temporary uses only. No permanent structures should be built on the site, other than the utility and communications/data infrastructure needed to support operations. The site is prominently visible from Pasagshak Road, therefore once it is no longer required for government operations it should no longer be used. It is recommended the area not be repurposed for other activities. When the government no longer requires this area, all infrastructure should be removed, except for the gravel pad and underground utilities. The gravel pad should remain to mitigate the need for developing undisturbed areas should there be potential future requirements in later years.

Figure 6-11: Instrumentation Site (Area 1)

Area 2 – Instrumentation Pad – Like Area 1, this area was developed for use by the government. It has supported both radar tracking, telemetry, and weather antenna equipment operations. During non-government operations, it has also served as a staging area for other development work at PSCA.

This site, identified in Figure 6-12 below, will be retained for future government operations, to include radar/telemetry operations, commodity storage, and/or staging. It is already developed, with supporting infrastructure, and is close to Pasagshak Road. When the government no longer requires the site, it should be retained as a commodity storage and equipment staging area to support both government and commercial launches from PSCA. Due to its close proximity to the launch pads, lodging facilities (temporary or permanent) should not be developed at this site.

Figure 6-12: Instrumentation Site (Area 2)

Commodities Storage – Commodities storage facilities should be located in areas that have already been developed, minimizing the need to develop previously undisturbed lands. Area 3, at the former Launch Pad 3A site, is a good location for such development. Launch Pad 3A is not planned for use as a launch pad and is close Pads 3B, 3C, and 3D. It is partially developed but would require expanding the gravel pad and extending power from the main power line along the area access road.

Likewise, an area directly adjacent to and west of the existing soft-sided storage facilities located behind the Maintenance Support Facility should be reserved for a third soft-sided storage facility to be installed when demand warrants the need.

The area adjacent and east of the existing RMSF is also a goof location for commodity storage. This area is identified for future RMSF expansion in later years, but before that expansion becomes necessary, the site is ideal for storage, as it is within a secured, fenced area.

Finally, it is recommended that Area 2 be reserved for commodity storage once the government no longer requires the site for launch operations. The preferred commodities storage areas are depicted in Figure 6-13.

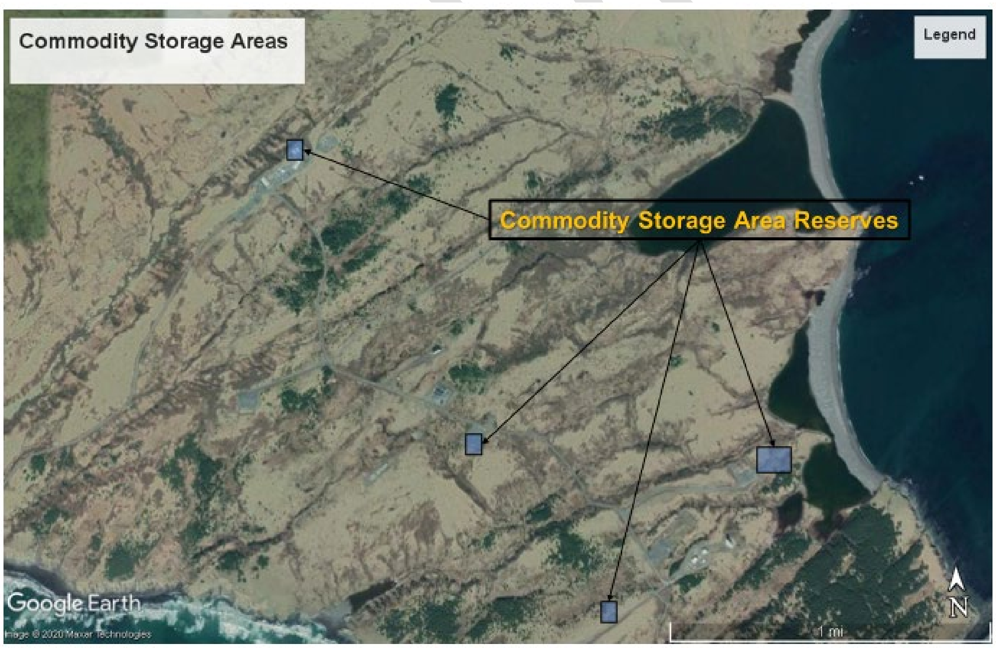


Figure 6-13: Commodity Storage Area Reserves

Vehicle Fuel Storage Tanks – As the spaceport vehicle fleet increases in size and customers require motor fuel, both gasoline and diesel fuels, the existing fuel tanks at PSCA will need to be increased. For the planning period, sufficient room is available at the existing fuel tank area to either replace the existing tanks with larger tanks or install additional tanks at the site to support the demand. It is recommended that any future increased vehicle fuel demand be accommodated at the existing fuel tank site, as shown in Figure 6-14.

Figure 6-14: Vehicle Fuel Tank Area

Light Manufacturing, Fabrication Facilities, and Warehousing - As the spaceport increases operations, demand for providing some light manufacturing, fabrication of flight hardware, and/or warehousing/storage of inventory supporting launch operations may occur. This demand will be directly related to an individual company's business model for successful/profitable operations from PSCA. In order to provide customers with the opportunity to consolidate operations and bring additional employment opportunities to Kodiak.

Development of these land uses must be located outside of the widest launch pad clear zone, resulting in the only location capable of supporting this type of development is north of the Pasagshak Road in the upper area of the spaceport west of the LOC. Therefore, the area directly adjacent to and west of the existing LOC is being reserved for these purposes when demand warrants the need. Figure 6-15 depicts this location.

Figure 6-15: Light Manufacturing and Warehouse Area

Fire Response Facility – To better provide for fire response, a separate Fire Response Facility (FRF) is should be constructed outside of the launch pad clear zone safety areas and in close proximity to the existing infrastructure and road system. The facility should be constructed to support both firefighting and emergency response vehicles and equipment. This plan recommends a new FRF be built between the current LCC and the EMC[2], as depicted in Figure 6-16.

Figure 6-16: Fire Response Facility

SECTION SIX - Ancillary Facilities

As PSCA grows over the next decade and the facilities recommended in this plan are developed, there will be a variety of ancillary requirements necessary to support the development. Each individual development will have specific ancillary requirements that will be included in the development plans for new facilities. For the Master Plan, these are addressed as a single recommendation to add systems, as necessary based on individual facility development. Systems that will need to be addressed with each development at PSCA include, but are not limited to:

- *Communications* – Increased communications capability may be necessary, depending on activity growth in the planning period. Alaska Aerospace should work with the local provider to ensure adequate communications, both secure and non-secure, capabilities exist at PSCA to meet customer requirements.
- *Fiber Optic and Copper Backbone Systems* – Additional fiber capacity is necessary to meet future demand. Alaska Aerospace should coordinate fiber requirements with GCI.
- *Closed Circuit Television (CCTV)* – As new facilities are constructed at PSCA, a determination as to whether CCTV capability is necessary to meet operational and safety requirements.
- *Page and Warning (P/AW)* - Installation of a P/AW system for paging and initiation of area warnings such as hazardous operations, lightning alerts, or to provide security may be required for new facilities constructed at PSCA. Determination will be made once the facility location and use are identified.
- *Operational Intercommunication System* – Required with any new development.
- *Timing Systems, Real-Time, Mission Clocks, Countdown Clocks* – None required at this time, but may be necessary based on future facility development and operational requirements.
- *Hazardous Vapor Detection System* – Only required to be installed in facilities that may store or use hazardous liquids.
- *Caution and Area Warning Systems (C/AW)* – The need for new C/AW systems will be determined based on the location and use of new facilities that may require a lighting system to alert people when operations are being conducted. This is important around areas where the launch pads and fueling systems are constructed.
- *Fire Protection, Alarm, and Reporting* – As required in any new facility construction.
- *Power Distribution* – Power is supplied by the Kodiak Electric Association. No additional commercial power is required. Instantaneous change-over back-up generator power with a UPS is required for any facility that operates during launch operations.
- *Cranes* – No additional permanent overhead cranes are necessary.

- *Security* – Security at PSCA is handled in a two-fold manner. Facility security will be handled by minimizing fencing to facilities and areas where public access must be restricted. This plan does not recommend enclosing PSCA with perimeter fencing. However, with new development at the spaceport additional security fencing is planned, especially in the vicinity of Area 3 to provide both security and safety for recreational users of the area. During operational missions, especially government missions, increased security is established which may include additional temporary fencing around restricted areas and road closures during hazardous operations and launch periods. Unlike other spaceports in the United States, where the entire complex is usually fenced and access is restricted, Alaska Aerospace will maintain maximum public access to the public lands at Narrow Cape, except as noted above.
- *Ground Vehicles* – Add vehicles as necessary to meet PSCA recruitments.
- *Spaceport Signage* - Reserve the option for improving vehicular and pedestrian wayfinding by installing new signage at all developed areas at PSCA. Also, installation of visitor information signs at the spaceport entranceway that advises visitors of the spaceport launch status are recommended. This would ensure non-spaceport visitors, such as those who are visiting Fossil Beach know the launch status of the spaceport.
- *Water and Wastewater Facilities* – An additional water well is recommended to provide additional water supply to support the increased water requirements for liquid propellant launch vehicle operations and to ensure a sufficient water supply is available during dry periods. Ideally, the new well should be situated in close proximity to the multi-purpose commercial launch area at PSCA. Wastewater will continue to be collected and removed from PSCA using commercial services.

Aviation Support – Alaska Aerospace has an identified helicopter landing area located directly in front of the Maintenance Support Facility. The existing helipad meets the aviation requirements for clearing the area and surveillance during launch operations.

During the original layout planning for the Kodiak Launch Complex, now PSCA, it was proposed a runway be constructed at the spaceport to reduce the transport time from the Kodiak docks and to improve access to the spaceport, especially for government customers. No action was ever taken to develop a runway at PSCA; however, with a runway included in the original conceptual plans for the spaceport, the Master Plan included the action for consideration.

Both the Spaceport Planning Advisory Group and the public voiced nearly unanimous objection to a runway being constructed at PSCA. Analysis confirmed that not building a runway at PSCA would have negligible impact on future growth and operations. Therefore, no runway is recommended. No additional aviation support facilities are required.

SECTION SEVEN – Lodging

Life Support Area (Area 4) - The existing Life Support Area was developed exclusively for use by the government for temporary lodging during launch operations. The site was used for the 2017 and 2019 launch campaigns, with lodging facilities removed once the launch campaigns ended.

This site is within the area that must be cleared of personnel for launches for safety measures. Therefore, it is not a site that could be considered for long term, permanent lodging. Figure 6-17 illustrates the Life Support Area in relation to both Launch Pad 1 and Area 3 commercial launch area clear zones, for which no personnel may be within during hazardous or launch operations.

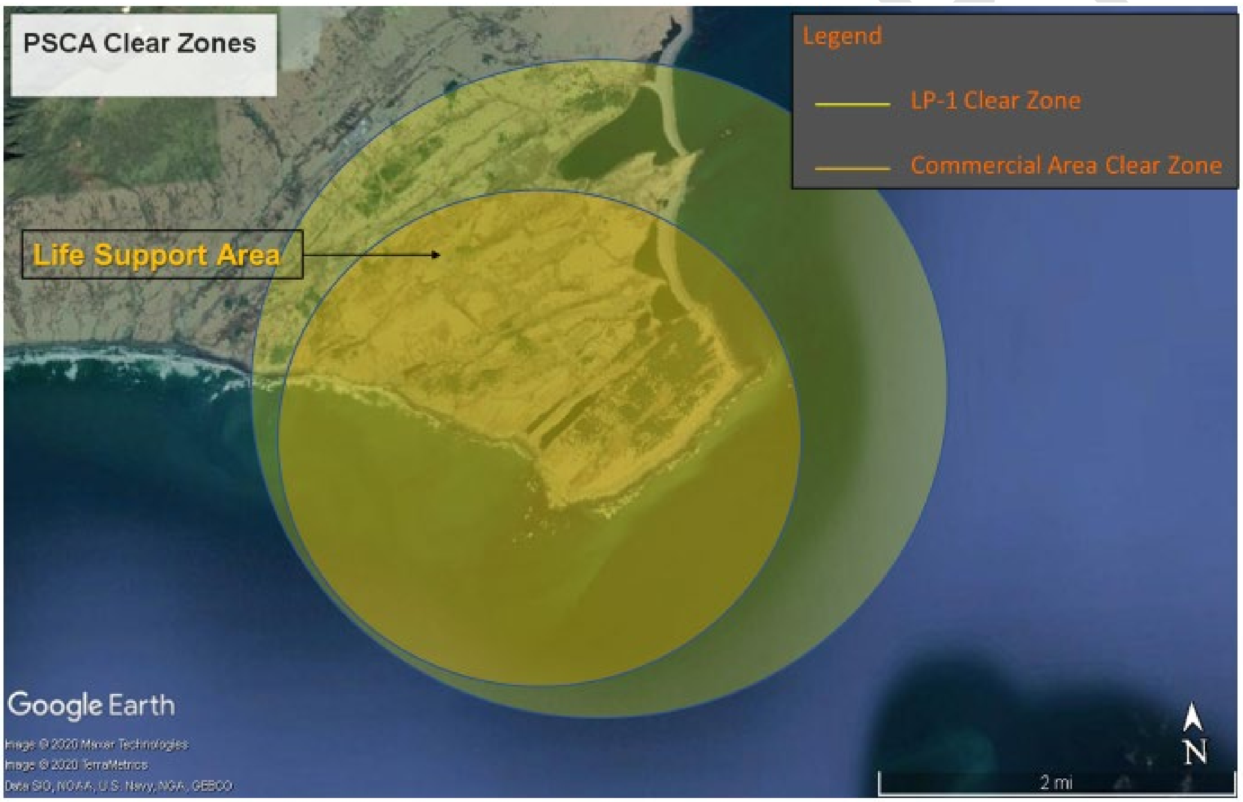


Figure 6-17: Clear Zone Map

The life support area has been fully developed with a gravel surface and utility extensions that can support temporary lodging up to 250 personnel. However, the existing ILMA prohibits long-term lodging facilities at PSCA and only permits this temporary Life Support Area activity, provided it does not extend into a permanent or semi-permanent lodging presence. To establish long term, permanent lodging at PSCA would require an amendment to the ILMA.

It is recommended this site be retained strictly for use by government customers, on a temporary, single use, mission essential basis. When the government no longer needs the site, structures should be removed, leaving only the underground utilities and gravel pad.

Lodging Requirements – Future projections show there exists demand by commercial launch customers for a small number of lodging bed-nights, per launch campaign. It is estimated this would range from between a half dozen to a couple dozen customer personnel at PSCA for launch operations. Government launches have a significantly larger number of personnel required, ranging from about twenty-five (25) or fifty (50) up to over two hundred and fifty (250), depending on the mission profile. In the past, to support the larger number of government personnel at PSCA, temporary lodging has been provided at the spaceport, while the smaller number of personnel have utilized a combination of a privately owned lodge near PSCA, bed and breakfast units in the Pasagshak area, to renting hotel rooms in Kodiak.

During the review of development options with both the Spaceport Planning Advisory Group and the public, there was consensus that building a large, permanent lodging facility at PSCA was not desired. Concern was expressed that building such a facility at PSCA, or in close proximity to the spaceport, could create a negative impact to the existing commercial hotels and bed and breakfast operations in Kodiak.

Additional concerns were voiced that providing year-round, permanent lodging facilities at or near PSCA would increase the number of non-spaceport related visitors to Narrow Cape, potentially having a negative impact on the recreational value of the area. With the Kodiak Narrow Cape Lodge already situated in close proximity to the spaceport, the expectation is that lodge should be sufficient for most mission requirements up to fifty-five 55 people, which should accommodate all commercial and many government operations.

Further review of this option by both Alaska Aerospace staff and outside firms confirmed that operating a large lodging facility at PSCA to support year-round activities at the spaceport may not be financially sustainable. It is recommended that Alaska Aerospace not develop long-term, permanent lodging at PSCA. However, one of the reasons some customers desire lodging close to PSCA is to reduce the extended commute between PSCA and Kodiak, especially during the winter season when the roads may be hazardous. To accommodate this concern, Alaska Aerospace should consider establishing a shuttle service to serve the Pasagshak area, the airport, and Kodiak hotels during launch campaigns, as well as continue working with local business to potentially establish non-Alaska Aerospace lodging facilities closer to the spaceport.

SECTION EIGHT - Public Lands, Cultural and Historical Environment, and Operations Closures

Interagency Land Use Management Agreement – This plan recommends that Alaska Aerospace maintain the current ILMA agreement, which is due for renewal in 2024, for the operations of PSCA. However, the Corporation should identify specific areas within the ILMA area that would benefit both Alaska Aerospace and ADNR by being able to lease land/facilities to both government and commercial entities. For these areas Alaska Aerospace should seek to modify the ILMA with ADNR to permit leases within designated developable areas of the spaceport.

These carve out areas would enhance Alaska Aerospace's abilities to attract long term customer commitments by ensuring to the customer both a firm duration of the lease agreement, as well as assurances that customers may conduct aerospace related activities, such as fabrication and light manufacturing of aerospace parts, innovation and technology development, launch vehicle and subcomponent systems final assembly, and systems modification work at PSCA. This would generate revenues for Alaska Aerospace and ADNR, would create a tax base for the Kodiak Island Borough, expand the aerospace capabilities in the state, and provide a stable base for sustained operations of PSCA.

As has been presented in this plan, it is feasible to reduce the current ILMA boundaries and to designate a portion of the spaceport at Narrow Cape as a non-development reserve. This is presented in the next section of this chapter titled "Land Use Plan."

USCG LORAN Site – This plan identified development alternatives that could be established at the current USCG LORAN. It is recommended this site be used as a secondary telemetry/downlink antenna site. It also has the potential of providing land and facilities that PSCA customers may desire for aerospace operations at PSCA, such as an additional launch site. When the LORAN operations were terminated in 2010 by the USCG, they initiated a discussion with Alaska Aerospace for transfer of the site lease and possible purchase of the facilities to Alaska Aerospace. At that time Alaska Aerospace had no projected use for the facilities and discussions ended in 2012. With the site abandoned, the LORAN tower dismantled, and potential use by Alaska Aerospace for spaceport development of the area identified in this Master Plan, Alaska Aerospace has reengaged the USCG concerning transfer of the lease and facilities. Depending on the outcome of discussions, this site may be available for future development as described in this document.

Public Land Use and Trails – Public access to Narrow Cape and the surrounding coastline and trail system is recognized as a high community value. As such, this plan recommends that the existing trails, as identified in the Kodiak Audubon Society Trails Map of Narrow Cape and the trails identified in the 2011 Kodiak Road Systems Trails Master Plan (KRSTMP) be marked with signage and excluded from consideration for future development. Specifically, the Narrow Cape Loop trail that starts above the bluff north of

Twin Lakes and proceeds down to Fossil Beach circumnavigates the shoreline of Narrow Cape back to Twin Lakes, which in the 2004 *Kodiak Trails Survey of Residents and Enthusiasts*, was ranked as the second most important wildlife viewing trail and third most important bird viewing trail within the Kodiak Island Borough, should be properly marked.

Trails located along the shoreline should be protected by a twenty-five foot setback inward from the shoreline where Alaska Aerospace would not develop. For the trails along the lower lands running from Fossil Beach, past Twins Lakes to the shore of TV Beach and the Gulf of Alaska, twenty-five feet on either side of the trail should be protected from development. The trail that runs from the bluff north of and above Fossil Beach to the Pasagshak/Fossil Beach Road should also have a twenty-five foot non-development setback inward from the bluff.

Finally, the trail that runs along the west side of TV Beach and the lakes north to Barry Lagoon should be protected from development with a twenty-five feet buffer on either side of the trail. All trails should be marked, and Alaska Aerospace will consult with local entities as to the proper marking, names, and locations that would be most useful to the public. One recommendation is to conduct a cooperative school competition with the Kodiak Island School District for naming trails. Another recommendation has been to name the trails after local birds found in the Narrow Cape area.

Public access along the Pasagshak to Fossil Beach road inside the spaceport boundaries will remain open to the public except during periods of hazardous and launch operations at PSCA. Improved public notification procedures will be used to disseminate road closure information, using the Alaska Aerospace web site, published notice in the local media, signage in the Bells Flats area notifying traveler's road closure periods, and social media as permitted by Alaska Aerospace customers.

Regulatory agencies, such as FAA and Alaska Department of Fish & Game have underscored Alaska Aerospace's responsibility to protect the public, grazing livestock, and wildlife from hazardous spaceport operations. Similarly, Alaska Aerospace has a responsible as essential critical infrastructure to ensure spaceport launch assets are protected and operational. While Alaska Aerospace will minimize the use of fencing, it is warranted on both accounts. This plan confirms that Alaska Aerospace will not be fencing the perimeter of the spaceport boundaries. Rather, keeping the public areas open to public access, except during hazardous and launch operations, is paramount. LP-1, LP-2, the SCAT and IPF are currently protected by a common fence line. Area 3's launch pads are not similarly protected. As Area 3 develops, any security fencing installed to protect the infrastructure investments will be tailored to the use case and will continue to accommodate the public trail system.

To better inform the public of spaceport operations, the entranceway to PSCA will be improved to provide signage that welcomes people to the spaceport and explains launch operations, rocket operations, and a history of the spaceport. The parking area will be graded, existing fencing on the south side of the road will be removed, and the area made available for public viewing of launches when authorized by our customers.

Cultural and Historical Environment – The Narrow Cape area has traditionally been used by both native and non-native Alaskans for fishing, hunting, berry-picking, and other subsistence purposes. The native population also historically transited the area, in pursuit of resources. Past environmental evaluations of the area have found no evidence of cultural resources in the area and the developed areas of PSCA have not uncovered any cultural or historical artifacts during construction.

The Narrow Cape area was used by the military, especially in the World War II period, for the establishment of coastal protection. Remnants of structures within the abandoned bunker complex of Narrow Cape remain and specific locations are on file with the Alaska Office of History and Archeology.

This development plan concentrates future development primarily in already disturbed areas and minimizes expansion in currently undisturbed areas to reduce potential impacts. A more comprehensive review of the cultural and historical aspects of this development plan is addressed in the Environmental Evaluation chapter.

Road, Marine, and Airspace Closures

Road closures – For safety during hazardous and launch operations the Pasagshak Road must be closed for short durations. Assuming thirty-eight (38) launches per year, each with three (3) hour launch periods, preceded by a three (3) hour closure period to ensure nobody is within the closed area during the launch period, over a three (3) day launch window, the road closure would account for a maximum of 684 hours per year out of 8,760 annual hours accounting for eight percent (8%) of the time (assuming each launch used all three days). With launches focused on evening hours, avoiding weekends, and assuming that many launches will happen within the first day or two of a launch window, and launching within the first hour of the closure, the potential impact to the public is projected to only be between three and four percent (3%-4%) of time. It should also be noted that, of these hours, most are anticipated to occur in the early morning, evening, or nighttime and will not usually occur on weekends or holidays.

For most commercial launches, the road closure would start at the entranceway to PSCA, allowing use of the Rocket Park area for parking and viewing launches. For some missions using larger launch vehicles, the road closure would occur along the Pasagshak Road just east of Surfer's Beach. This would allow Surfer's Beach to remain open for parking and viewing, as well as keeping the beach area open for public use.

For any road closures, a public notice would be published in the local newspaper, or other local public media resources. Closures would also be posted on the Alaska Aerospace web site and a Launch Hotline available for residents to call for timely launch information.

Additionally, signage would be used in the Bells Flat area to advise people of the road closure times for the spaceport.

Waterway Closures – Alaska Aerospace installed an enhanced radar tracking system to improve visibly of the surface waters surrounding PSCA. The USCG is responsible for publishing Notice to Mariners whenever waterways are closed for launches. Alaska Aerospace works closely with the USCG to provide accurate closure boundaries to minimize impacts to the waterways during launch campaigns. The exact boundary for waterway closures is calculated by a flight safety analysis of the specific type of launch vehicle and projected direction of flight. There is no standard waterway closure area applied to all launches. With small launch vehicles that will use PSCA for commercial launches, waterway closure areas will be able to be customized to the smallest area necessary to ensure safety to mariners.

Alaska Aerospace has established good communications with the commercial fishing industry. Before launches are scheduled, Alaska Aerospace staff reviews published openings and work with launch customers to maximize avoidance of these periods. While it may not be possible to avoid closures during all periods of commercial openings, maximum effort is made to adjust launch schedules to avoid conflicts. With the increased pace of future launch operations, Alaska Aerospace is also working with customers to maximize launches during early morning, evening, or nighttime periods.

Airspace Closures – Airspace closures, like waterway closures, impact the area around PSCA during launch operations. The Federal Aviation Administration (FAA) uses Temporary Flight Restrictions (TFR's) to close airspace to air traffic for a variety of reasons. TFR's are used to close airspace around PSCA whenever there is a scheduled launch operation. Alaska Aerospace has worked with the FAA and the launch vehicle operator to minimize the size of TFR's, based on the size and performance of launch vehicles utilizing PSCA. In doing so, Alaska Aerospace has already been able to reduce the size of the TFR for launches in 2020, which has removed some of the mountain passes between Kodiak and Old Harbor from being closed during launch operations. As launch customers demonstrate consistent abilities to launch payloads into orbit without incidents, the TFR's should be able to be reduced further.

Alaska Aerospace has also been designated a test spaceport for implementation of a new tracking system called Space Data Integrator. According to the FAA, *"The Space Data Integrator (SDI) is the first of several new capabilities that the Federal Aviation Administration (FAA) is developing to safely integrate commercial space vehicles into the National Airspace System (NAS). SDI will provide capabilities that will receive and distribute launch and reentry data for initial use within the NAS to ensure public safety and allow for improved situational awareness and improved airspace management decision making. SDI is designed to accept launch and reentry vehicle state data gathered from sources such as launch and reentry operators and spaceports. SDI will receive the data, process it, display it, and distribute it to the Traffic Flow Management System (TFMS) and other tools as appropriate. SDI allows the FAA to track the actual versus planned trajectory of commercial launch and reentry* *operations, the status of various mission events, and the display of aircraft hazard areas (AHAs). SDI will send vehicle position and AHAs to TFMS so that the FAA Joint Space Operations Group (JSpOG) can use the information to ensure safety and make better airspace management decisions and have improved situational awareness of how the mission itself affects broader traffic in the NAS."* While still in the test and development stage, PSCA is being used as the first non-federal government spaceport to evaluate the capability of this system to further reduce airspace restrictions caused by space launch activities.

SECTION NINE - Land Use Plan

This section presents the land use plan recommended to meet demand over the next ten years. Consistent with one of the goals and objectives, an analysis was conducted to ascertain whether the boundaries of the lands used by Alaska Aerospace under the ILMA could be reduced. Evaluating a combination of the locations of existing facilities, clear areas that must be maintained for hazardous and launch operations, and natural topography of Narrow Cape, it was concluded that the boundaries could be reduced along the northwestern edge of the spaceport, as well as a small adjustment excluding Barry Lagoon from being within the boundaries of PSCA.

It was also recognized that retaining the published trails at Narrow Cape was a high public interest, therefore development recommendations avoided conflicts with the trail system and has been depicted on the PSCA Land Use Plan, below. Finally, the Narrow Cape area south of Twin Lakes and the established launch areas at PSCA has been recognized as an area of high importance to maintain a natural state, undeveloped, and available for public use. The area will be retained in the ILMA to preclude potential development and/or conflicting uses being created by other agencies or entities. However, in acknowledgment that this area should be retained in its natural state, the Land Use Plan has designated the area as such and Alaska Aerospace will request the current ILMA be changed to identify this area as a "Non-Development Public Access Reserve."

To maximize the use of already developed areas at PSCA, it is recommended Alaska Aerospace pursue securing the leased lands of the USCG abandoned LORAN-C site, currently under lease by the USCG from the Department of Natural Resources.

As Alaska Aerospace is a state-owned corporation established to create an aerospace sector in Alaska and operates the only spaceport in the United States that operates without any federal or state operating funding, the company must generate sufficient revenues from PSCA operations to remain financially viable. The current ILMA does not permit Alaska Aerospace to lease any lands at PSCA to either government or private sector agencies or entities. In order to ensure the long-term viability of the spaceport, it is recommended the ILMA be adjusted to permit Alaska Aerospace limited land lease authority, limited to areas where activities would be directly related to aerospace operations at PSCA. By doing this, Alaska Aerospace would have the ability to increase revenues while concurrently securing longer term commitments from customers. Additionally, since the land is owned by ADNR, any lease agreement with customers may also provide a financial return to ADNR and the State of Alaska. It is recommended this concept be introduced with the forthcoming ILMA extension negotiations.

The preferred Land Use Boundary Plan is depicted in Figure 6-18. This depiction is notional and not intended to be the absolute boundary determination. A boundary survey will be completed upon completion of the Master Plan and the new boundary coordinates will be submitted to ADNR for inclusion in the ILMA as the defined PSCA boundary. The boundary is also not intended to indicate restrictions on adjacent land use beyond those already in place with the current ILMA.

Figure 6-18: Preferred PSCA Boundary and Trail Map

SECTION TEN – Composite Development Plan

The recommended development plan for PSCA is shown below in Figure 6-19.

Figure 6-19: Composite 2020-2030 Development Plan Map

Site 1 – Launch Pad 1: Develop liquid propellant launch pad capabilities.

Site 2 – Pad 3D – Develop as a multi-use government and commercial launch pad.

Site 3 – Reserve area for future Vehicle Integration Facility construction to support Launch Pad 3C.

Site 4 – Pad 3A – Develop as a multi-Use Tactical Launch Pad with Commodity Storage and Equipment Staging Area capabilities.

Site 5 – High-Altitude Balloon Launch Area.

Site 6 – Develop pad area and reserve for future launch vehicle propellant storage tanks.

Site 7– Reserve area for construction of up to three additional Rocket Motor Storage Facilities.

Site 8 – Primary Instrumentation/Telemetry Antenna Field

Site 9 – USCG LORAN site transferred to AAC and reserved as a future Instrumentation/Telemetry Antenna expansion area and/or potential launch pad (Launch Pad 3E).

Site 10 – Launch Control Center and vehicle parking area extension reserve.

Site 11 – Expanded Mission Control Center

Site 12 – Long Range Radar Site (Area 1) – Reserved for government use.

Site 13 – Radar Telemetry Site (Area 2) – Reserved for government use, after which the site can be repurposed as a commodity storage and/or equipment staging area.

Site 14 – Vehicle Fuel Storage Tanks; Expanded capacity accommodated at existing site.

Site 15 – Life Support Area – Reserved for future temporary lodging for government missions. This site will not be used for permanent lodging facilities by either the government or commercial customers. When no longer needed for temporary government lodging all above ground structures will be removed, leaving only the utilities and gravel pad for future government use.

Site 16 – Reserved for light manufacturing, assembly/fabrication facilities, or commercial warehouses.

Site 17 – New Fire Response Facility

Chapter Seven – Pacific Spaceport Complex – Alaska Environmental Evaluation

SECTION ONE – Introduction

This Chapter presents an overview of environmentally sensitive features and land uses on and surrounding the spaceport and identifies potential impacts to these features and land uses resulting from the preferred development plan. The purpose of conducting this evaluation is to provide information that assists spaceport management in considering the potential environmental issues which may require further environmental review and help expedite any subsequent environmental work by providing baseline information for the associated Master Plan projects.

This Master Plan effort does not include the preparation of a stand-alone environmental assessment pursuant the National Environmental Policy Act (NEPA). However, the potential environmental effects associated with implementation of the preferred development plan have been considered in accordance with NEPA requirements and are presented in this chapter. The National Environmental Policy Act of 1969 (NEPA) requires environmental processing for all development projects that require a federal action for implementation. This chapter provides general analysis and identifies areas of potential environmental impacts, but it is by no means inclusive. It is intended as an information source for any future formal environmental studies related to development projects that may be necessary under NEPA regulations.

The FAA Office of Commercial Space Transportation (FAA/AST) is delegated the responsibility to ensure NEPA compliance in spaceport licensing and development. FAA/AST has published specific guidance to enhance, protect, and restore the environment surrounding spaceport operations. Should a development project require further environmental review under NEPA requirements, FAA/AST would conduct the environmental review process, separate from this Master Plan process.

As stated by FAA/AST "Under the Environmental Review for Licensed/Permitted Commercial Space Transportation Activities, Commercial Space Transportation analyzes the environmental impacts of proposed licensed and permitted actions, including the licensing of launch and reentry activities, the operation of launch and reentry sites, and the issuing of permits for suborbital reusable rockets. It then takes the appropriate action required under NEPA."

The following environmental areas are addressed in this chapter:

- Air Quality
- Water Quality
- Wetlands
- Fish and Wildlife
- Plants and Vegetation
- Coastal Resources

- Floodplains
- Wild and Scenic Rivers
- Soils and Farmland
- Department of Transportation Act Section 4(f)
- Natural Resource and Energy Supply
- Light Emissions and Visual Effects
- Compatible Land Use
- Public Use
- Hazardous Materials, Pollution Prevention, and Solid Waste
- Historical, Archeological, Architectural, and Cultural Resources
- Noise
- Socioeconomic, Environmental Justice, and Children's Environmental Health and Safety Risks
- Launch Failure and Emergency Procedures
- Seismic Conditions

A qualitative analysis was conducted to identify the potential environmental issues associated with both construction and operation of the improvements included as part of the preferred development plan. The 1996 *Environmental Assessment of the Kodiak Launch Complex* and 2016 *Final Environmental Assessment Finding of No Significant/Record of Decision for the Kodiak Launch Complex Launch Pad 3* were used as primary reference documents and are incorporated into this plan by reference.

Most proposed improvements would occur within previously developed areas on spaceport property; therefore, permanent adverse impacts to sensitive receptors, such as nearby residents, are not anticipated. Social impacts are likely to be positive, as many of the proposed Master Plan projects have the potential to create temporary and permanent jobs and provide direct, indirect, and positive effects on the local economy. The following qualitative analysis considers how compatible proposed facilities are with existing environmental features and identifies potential strategies or general measures to avoid or minimize potential impacts.

The National Environmental Protection Act (NEPA) established Categorical Exclusions (CE) as '"A class of actions that a Federal agency has determined do not individually or cumulatively have a significant effect on the human environment and for which, therefore, neither an environmental assessment nor an environmental impact statement is normally required." The Department of Transportation has established CE's for the Federal Aviation Administration that delegates to the Office of Commercial Space Transportation certain CE's. This environmental evaluation will highlight some of the areas where CE's may apply towards future development activities at PSCA.

SECTION TWO – Environmental Evaluation

Air Quality – The U.S. Environmental Protection Agency (EPA) has established federal air quality standards to protect public health and welfare, as defined in the Clean Air Act of 1990, as amended. The Clean Air Act authorizes the EPA to establish National Ambient Air Quality Standards (NAAQS) which have been codified in 40 CFR 50. Air quality control regions are classified as either Class I, II, or III.

This classification system indicates the degree of air quality deterioration that the state/Federal government will allow while not exceeding national standards. As stated in past FAA approved PSCA Environmental Assessments (EA's), Kodiak has been designated a Class II area of attainment area. Air quality at Narrow Cape is classified as unimpaired.

Launches of solid propellant rockets from PSCA are projected to average two per year through the planning period. The 1996 Kodiak Launch Complex Environmental Assessment identified the emissions produced by solid propellant launch vehicles and are incorporated in this plan by reference. That study concluded that "In all cases, adverse air quality impacts due to rocket launches are not expected" (page 4-6). The approval of this EA set the limit for solid propellant launches at nine per year. This plan is within the limits of the current FAA approved Environmental Assessments for launch operations at PSCA and is not expected to create any additional air quality issues pertaining to solid launch vehicles.

The primary potential change in air quality may occur due to an increased number of liquid propellant launch vehicles operating from PSCA. The 2016 Kodiak Launch Complex Launch Pad 3 EA introduced liquid propellant launch vehicle operations at PSCA and the information and conclusions are incorporated in this plan by reference, which concluded "there would be no pollutant levels that approach or exceed the NAAQS" (page 4-3). Again, this was predicated on a maximum number of nine medium/small launches per year.

Forecast launch projections indicate the majority of liquid propellant launch vehicles using PSCA are expected to use a propellant combination of LOX and RP-1 (refined kerosene). The primary emissions emitted include carbon dioxide, water vapor, soot, and oxides of nitrogen (NOx). RP-1 is a highly refined petroleum-based product, with similar characteristics to aviation jet fuel (Jet A-1). On average, less than 1,000 up to about 1,500 Kilograms of kerosene (RP-1) is used for a single small lift vehicle launch. This would equate to between 36,000 thousand Kilograms and 54,000 kilograms of RP-1 being used at PSCA per year. As a comparison, the Boeing 737 used for service between Kodiak and Anchorage, burns about 2,400 kilograms of Jet A-1 per hour, or approximately 5,000 kilograms on each roundtrip flight.

Alaska Aerospace has initiated a written revision to the current PSCA EA to increase the number of PSCA launches from 9 to 36 per year. Should it be concluded that the increased number of annual launches at PSCA would have an adverse effect on air quality, the plan will provide mitigation recommendations. It is not expected that any further evaluation of air quality would be required as a result of other developments recommended in this Master Plan.

Water Quality – The primary water quality concern is the potential impacts created by the atmospheric deposition of launch combustion products to nearby surface waters and potential impacts to groundwater. Both the 1996 EA and 2016 EA addressed water quality and are incorporated into this document by reference.

The two primary contamination concerns relate to aluminum oxide from solid propellant launch vehicles and RP-1 from liquid propellant launch vehicles. Solid propellant rocket propellants are made from a wide variety of substances, selected for low cost, acceptable safety, and high performance. Typical ingredients are ammonium perchlorate (a granular oxidizer), powdered aluminum (a propellant fuel), and hydroxyl-terminated polybutadiene, or HTPB (a propellant fuel that is liquid during mixing and that polymerizes to a rubbery binder during curing). The main by-product of burning solid propellant engines is the production of hydrochloric acid. The primary mitigating factor in reducing water quality degradation from solid propellant launches is the amount of rainfall in the area. The annual rainfall at Kodiak provides an excellent dilution factor to avoid water quality degradation at the projected number of annual launches, as was noted in the 1996 EA. Since the soil at Narrow Cape is acidic and receives substantial rainfall and snowfall throughout the year, any residual propellant that reaches the surface is diluted and expected to be below environmentally acceptable limits.

Liquid propellant rocket engines, like airplane engines, are designed to maximize propellant burn for efficient operations. The primary chemical exhaust from RP-1 is carbon dioxide and water, which does not directly or indirectly affect water quality. However, some residual propellant (unburned) may be deposited on surface waters.

Twin Lakes is located southwest of LP-1 and south of Area 3. Winds from the north/northeast during launches could result in small amounts of hydrochloric acid (from solid propellant rockets) or carbon dioxide (from liquid propellant rockets) reaching the lakes surface. The potential of a launch causing measurable change in surface water quality is minimal, as was concluded in both the 1996 and 2016 EA's.

Deluge water at launch pads would be captured in a catchment system around the launch pad for retention and testing, as is already done at Pad 3B. If water quality tests validate there are no harmful materials or contaminates in the water, it would be released into the surrounding area. If the water is found to be contaminated according to ADEC Water

Quality standards, it would be contained and removed through a commercial contaminated wastewater disposal vendor in compliance with state and federal requirements.

The previous EA's discussed the potential impacts rocket motor casings may have on the Gulf of Alaska and North Pacific Ocean ecosystem. Launch vehicle debris over the ocean is projected to increase with implementation of this plan as there would be additional landings of rocket motor casings in the ocean from the additional launches. Launch vehicle motor casings are constructed of inert materials which includes aluminum, steel, rubber, graphic epoxy, composite fiber. Upon impact with the ocean, the first stage of the launch vehicle could expel residual RP-1 and LOX into the Gulf of Alaska or North Pacific Ocean. Due to the small volume of this release into the open ocean, impacts on water quality would be less than significant. Spent launch vehicle motors descend into the ocean after all propellants have been burned. They rapidly sink to the ocean floor creating an environment habitat for aquatic ecosystems, such as "colonization by sponges, shrimp, seaweed, sea anemones, tubeworms and other sea organisms. The habitat also attracts numerous fish (*Sea Life Flourishes on Sunken Ships***,** Liz Osborn**,** CurrentResults.com, 2006)."

Many launch companies are testing the ability to re-use spent launch vehicles. SpaceX developed a sophisticated method to return the segments back to earth, landing on a barge or back at the launch site. Once retrieved the motors are refurbished, they and used again for future launches. Rocket Lab is also in the development stages of recycling spent launch vehicles. By using this method, companies may be able to reduce costs of manufacturing new motors, as well as decrease the number of motors being deposited in the ocean.

The previous EA's determined that water quality would not be negatively impacted by up to nine PSCA launches of either solid or liquid propellant launch vehicles per year. However, Alaska Aerospace is seeking to increase the number of launches to 36 per year, using both liquid and solid propellant rockets. The FAA is currently developing a revision to the current EA that would accommodate this requested increase, which also meets the forecast demands of this Master Plan. As part of that process, a review of water quality impacts is being addressed. Should the revised EA require mitigation to accommodate the increased number of launches, Alaska Aerospace would be required to comply with the requirements prior to increasing the launch numbers above nine per year.

Wetlands – "Wetlands have a distinct characterization of being an area that is flooded by water, either permanently or seasonally, with a water table that stands at or near the land surface for a long enough period of time each year to support aquatic plants." (Keddy, P.A. (2010) *Wetland Ecology: Principles and Conservation* (2nd ed.), New York: Cambridge University Press). The key elements of a wetland are that they must have soil saturation or flooding, have the presence of hydric soils, and the presence of wetland plants.

Wetlands are primarily regulated under Executive Order 11990, Protection of wetlands (42 FR 26961), the Clean Water Act (33 U.S.C. Sections 1251-1387), and the Fish and Wildlife Coordination Act (16 U.S.C. Section 661-667d). As described in the 2016 EA, "Detailed hydrology, vegetation and soil assessment, and wetland delineation and mapping for Narrow Cape was conducted by ENRI in 1994 with the aid of a differential GPS" (page 3-35). The United State Fish and Wildlife Service (USFWS) also completed a comprehensive inventory of wetlands at Narrow Cape. The wetlands map of Narrow Cape is incorporated into this document by reference and is used as the baseline for Figure 7-1 in this document.

There are a number of wetlands distributed around the Narrow Cape area. The predominate wetland type at PSCA is the Palustrine wetland, defined as a non-tidal wetland with ocean derived salinity of less than 0.5%. These wetlands are scattered across the uplands of the spaceport. The USFWS wetland inventory map of Narrow Cape, as depicted on Figure 7-1, shows that all areas where development is recommended in this plan are outside of inventoried Palustrine wetlands at Narrow Cape, suggesting there would be no adverse impacts to Palustrine wetlands.

Barry Lagoon, Twin Lakes and other low-lying bodies of water close to the shoreline at PSCA are classified as Estuarine wetlands. These wetlands are defined as a system of deep-water and wetland tidal habitats that are usually semi-enclosed by land and contain brackish water, ocean water occasionally flooded by fresh water from the land. There are no projects recommended for development under this plan that would be on or near Estuarine wetlands, therefore, there would be no adverse impacts to Estuarine wetlands.

Along the shoreline, primarily on the eastern edge of PSCA Marine wetlands are present. Marine wetlands are characterized as wetlands predominantly comprised of tidal salt water from the ocean. Development under this plan would not occur in or near Marine wetlands, therefore there would be no adverse impacts to Marine wetlands.

Preservation of wetlands at Narrow Cape was a significant consideration when determining the preferred development plan. Great care was given when selecting locations for development to meet future demands to avoid impacting designated and mapped wetlands at the spaceport. Alaska Aerospace is extremely conscious of the need to preserve wetlands. Therefore, placement of new facilities was predicated on avoiding disruption to known wetlands. There are no wetlands within the footprints of any development recommended under this plan.

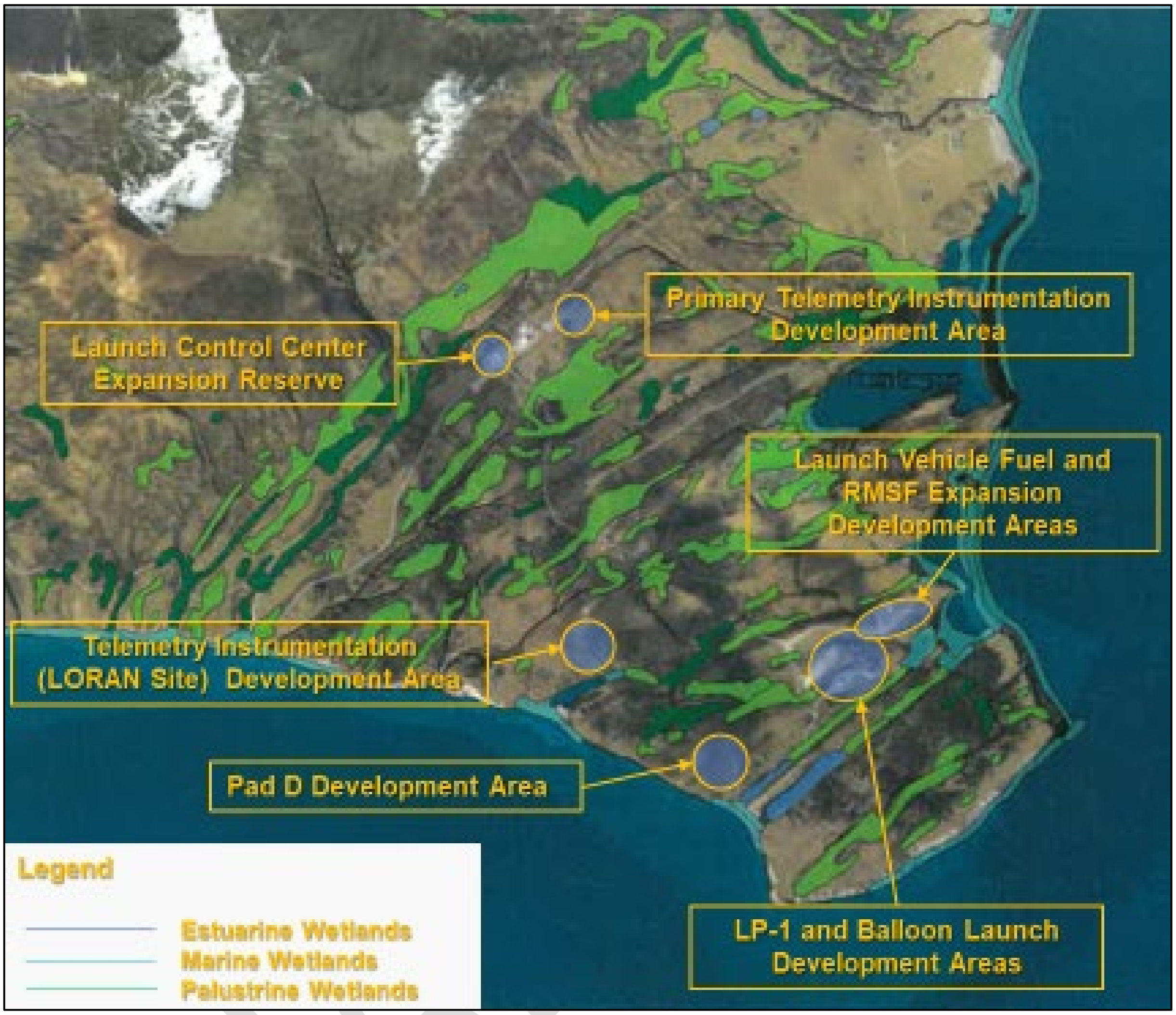


Figure 7-1: Project Overlay Wetlands Delineation Map (USFWS, National Wetlands Inventory)

Fish and Wildlife – Abundant fish and wildlife are present in the Narrow Cape area. The regulatory requirements for protection of the fish and wildlife are administered by both the federal and state governments. As identified in the 2016 EA, "Statutes, regulations and Executive Orders protect biotic resources, including the Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA), Fish and Wildlife Coordination Act (FWCA), Marine Mammal Protection Act (MMPA), Magnuson-Stevens Fishery Conservation and Management Act, and the Bald and Golden Eagle Protection Act" (page 3-8). The 2016 EA provides a comprehensive documentation of the fish, birds, terrestrial mammals, and marine mammals that habitat in and around the Narrow Cape area. This 2016 EA discussion of Fish and Wildlife is incorporated into this document in full by reference.

- *Fish* – There are three anadromous streams near PSCA that support fish habitat. One crosses the Pasagshak Road outside the western boundary of PSCA and is the closest anadromous stream to the launch pads at PSCA, located approximately one mile northwest of Pad 3D. The second stream is just west of the first stream, about 1.25 miles from Pad 3D. The third stream is located on the Burton Ranch, over 1.5 miles from the launch pads at PSCA.

  The 2016 EA stated that "Streams and lakes within KLC are relatively small and shallow, limiting freshwater fishery resources. ADF&G has identified this includes stickleback, Dolly Varden char, rainbow trout, and sculpin, as documented in the ENRI, 1995 report. Figure 13 in the 2016 EA also show numerous non-anadromous surface waterbodies that may support resident fish which ADF&G recommended be incorporated by reference into this report.

  Twin Lakes is located below the bluff where Pad's 3B, 3C, and 3D are situated. There is no sustained fish in Twin Lakes due to the lack of oxygen and winter freeze. Therefore, ADFG must stock the lakes each year to provide sport fishing opportunities. According to ADF&G, "Both lakes (Twin Lakes) likely supports stickleback and Dolly Varden year-round." East Twin Lake is stocked with fingerling size rainbow trout and "there is a resident rainbow trout population of all life stages in this lake that is similar to a wild population."

  There are various species of fish that inhabit the near-shore and off-shore areas around Narrow Cape. These include salmon, flounder, sole, pollack, cod, skate, and halibut, among others. The area also has a vibrant collection of crabs in the shallow near shore areas, as well as jellyfish, sea urchins, limpets, mussels, snails, cockles, and many other species.

  "According to the National Oceanic and Atmospheric Administrations (NOAA) National Marine Fisheries Service (NMFS), Essential Fish Habitat (EFH) for all life stages (Marine Immature and maturing adults, and marine juveniles) of chinook, chum, coho, pink, and sockeye salmon are present in the marine waters up to the shoreline around Narrow Cape and portions of the anadromous streams near Narrow Cape" (NOAA 2012).

  The 1996 EA and 2016 EA concluded there are no mitigation requirements associated with the construction of PSCA and LP-3 because construction would not occur near any fish-bearing stream or body of water and therefore would not have an adverse effect on the fish population. This environmental evaluation also confirms that no construction will occur near any fish-bearing stream or body of water, therefore it is not expected any adverse impacts would be created by construction and operation of the proposed development plan.

- *Terrestrial Mammals* – There are 12 species of terrestrial mammals in the Narrow Cape area. These include the beaver, red fox, mountain goat, Sitka black-tailed deer. There are also cattle, horse, bison, and elk in the vicinity of Narrow Cape. These are introduced species used mainly for hunting, and farming. As was stated in the 2016 EA, potential direct and indirect effects in terrestrial mammals would be minor and isolated (page 4-8). The most common effect would be a reaction to the noise generated by rocket launches. There also is the possibility of some animals being injured or killed during any launch event. However, none of the terrestrial mammals at Narrow Cape are threatened or endangered and the likelihood of injury or death is extremely low. For safety and security, each launch pad has perimeter fencing designed to keep both people and wildlife outside of the launch area during launch operations. As such, there have been no documented wildlife deaths or injuries caused by hazardous or launch operations in the twenty-two years of spaceport operations. Therefore, it is not expected any adverse impacts would be created by construction and operation of the proposed development plan.
- *Marine Mammals* - Narrow Cape has a variety of marine mammals in the area. These include the Steller sea lion, harbor seal, gray whale, fin whale, humpback whale, orcas, northern sea otter, northern fur seal, Dall's and harbor porpoises, and others. Of special note is that the gray whale and humpback whale transit the near-shore of Narrow Cape and Ugak Island on an annual basis. The critically endangered North Pacific right whale also ranges in the area.

  The 1996 EA provided a comprehensive description of the marine mammal environment around the Narrow Cape area (pages 3-25 through 3-29) and is incorporated into this document by reference. Of specific note, that report highlighted the presence of Steller sea lion and harbor seal in the area year-round, while the northern fur seal is present predominantly between January and April. There are Steller sea lion and harbor seal haulouts on both Kodiak and Ugak Islands, with Ugak Island, south of Narrow Cape, as the closest Steller sea lion haulout site to the spaceport. The surrounding waters are also critical habitat for the Western Distinct Population (DPS) segment of the Endangered Species Act (ESA) listed Steller sea lion. Ugak Island also includes multiple key harbor seal haulout sites where breeding, pupping, and molting activity occurs. The Southwest Alaska DPS of the threatened sea otter is prevalent at Narrow Cape in all months of the year and the surrounding waters are critical habitat for this species.

  The gray whale migrates past east side of Kodiak Island in the spring and fall seasons. The southside of Kodiak Island (Marmot Island to Kaguyak Bay) is a known biologically important area for gray whale feeding (June – August). It has been observed that the gray whale spends long periods of time around Ugak Bay, especially in the fall. Once listed as an endangered species under the ESA, the gray whale recovered and was delisted in 1994.

The humpback whale is also present in the Gulf of Alaska and has been seen in Ugak Bay and the near-shore areas of Narrow Cape, especially during summer months. The DPSs of humpback whales occurring in the area include the Western North Pacific (WNP) (endangered), Mexico (threatened), and Hawaii (not listed). The waters surrounding the spaceport are biologically important areas to humpback whale feeding (July – September) and proposed critical habitat (at April 2020). Orcas (killer whales), harbor porpoises, Dall's porpoises, Pacific white-sided dolphins, Risso's dolphins, North Pacific right whales, and pilot whales are also prevalent in the waters surrounding Kodiak Island.

It is unlikely that any land-based construction activity at the spaceport would have an adverse effect on any marine mammals in the Narrow Cape area, including those in the haulout, breeding, and pupping areas of Ugak Island. During launch operations the primary concern would be potential noise impacts, especially to the Stellar sea lions and harbor seals in the Ugak Island haulouts. The 1996 EA provides a comprehensive analysis of potential impacts (pages 4-38 through 4-45) and is incorporated into this document by reference. The National Marine Fisheries Service issued a Letter of Authorization in 2015 to cover the taking of Steller sea lions and Pacific harbor seals during launch operations. As part of the authorization, Alaska Aerospace has been required to maintain a pre and post flight count of Steller sea lions and Pacific harbor seals on Ugak Island. It is expected that increasing annual launches from the current authorized level of nine per year to thirty-six per year could increase the exposure to noise levels for both the Steller sea lions and Pacific harbor seals. As such, a written reevaluation is being considered by the FAA which specifically includes NMFS consultation concerning potential impacts that may be created by the increased number of launches.

Impacts to marine vegetation and habitats may slightly increase with an increased number of launches from PSCA annually. The number of ocean landings is projected to increase to 36 annually. This higher level of operations in the Gulf of Alaska and North Pacific Ocean should not increase impacts to marine and estuarine vegetation and habitats to a significant level. It is highly unlikely that marine mammals would be killed or injured by the sinking of rocket motor casings. In the meantime, based on the number of launches projected at PSCA, impacts to the marine environment, as well as to terrestrial vegetation and habitats, caused by rocket motor casings being dropped back into the ocean is not expected to create any increased adverse impacts.

Accidental collisions between marine animals and vessels associated with recovering first-stage landings are not expected to create significant impacts because vessels recovering first-stages would be stationary or operating a very slow speed. Vessel operators would comply with all applicable State and Federal laws and regulations when transiting between the spaceport and the first-stage landing site or barge in the Gulf of Alaska and North Pacific Ocean, if done in the future for recovering reusable stages.

ADF&G guidance for the mariners and aviators is "When safe navigation allows, vessels will remain 500 yards (about ¼ mile) offshore from haulout sites and aircraft remain a 1,500-foot minimum altitude when traveling over marine mammals to avoid disturbances."

Terrestrial Birds – Kodiak Island has an abundant bird population with 221 documented species (1996 and 2016 EA). In 1994 ENRI conducted an extensive bird survey within the area of the spaceport at Narrow Cape which revealed the spaceport area as a seasonal habitat for approximately 143 species (2016 EA, page 3-10). The 1996 EA provided a comprehensive listing of the habitat classifications and typical species in each habitat expected to be found around PSCA in Table 3.5-1 (page 3-19) and is incorporated into this document by reference. The Kodiak Audubon Society conducts annual counts of birds in the Narrow Cape area.

The potential effect to land birds from launch-related noise and emissions associated with small-lift launch rockets at PSCA was evaluated in the 1996 EA. Effects were determined to be minor and temporary within a 6-mile radius of the launch pad. During previous launches, birds were typically flushed from the area in response to the noise of the launch but returned within minutes. The extended duration over which elevated noise levels occur would be minimal, about an additional 60 seconds. As such, the 2016 EA determined that additional noise-related effects on birds from launching medium-lift rockets are not anticipated. However, noise may be a factor if launches are increased to thirty-six per year. Noise impacts are being addressed through a written reevaluation process currently being administered through the FAA.

As stated in the 2016 EA, "The vehicle launch emission products of concern include hydrogen chloride, carbon monoxide, and aluminum oxide. Birds flying directly through the exhaust plume immediately post-launch could be exposed to minor concentrations of hydrochloric acid (HCl), which would irritate eye and respiratory tract membranes (FAA, 1996). Liquid fuels generate high concentrations of carbon monoxide near the launch pad. However, it is assumed that most birds would be frightened away by the noise of the launch and would not come into direct contact with the exhaust plume. Downwind HCl concentrations are expected to be benign and physiological effects to birds are not expected (FAA, 1996). Aluminum oxide is known to have a low toxicity for humans and would also not be expected to affect resident wildlife populations (USAF, 1989)."

Bald and Golden Eagle – Both the bald and golden eagles are protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Both are common throughout the year on Kodiak Island and have been seen in the Narrow Cape area. Nesting sites were monitored by the U.S. Fish and Wildlife Services for the first five spaceport launches where it was determined that operations at the spaceport did not create a negative impact on the eagles. In 2013 a Narrow Cape Bald Eagle Nest Survey was conducted by Robin Corcoran, Kodiak National Wildlife Refuge, which found three active eagle nests within the boundaries of PSCA. All were situated along the shoreline and not within any developed or operational areas of the spaceport, the closest being 1.3 miles from the proposed Launch Pad 3. That report is incorporated within this document by reference. According to the 2016 EA, aerial surveys have validated that there are still bald eagle nesting sites in the Pasagshak and Narrow Cape areas.

The 2016 EA Figure 15 on page 3-11 depicts the results of the 2013 Bald Eagle Nest Survey. The 2016 EA concluded no adverse impacts were expected by construction and operations of Launch Pad 3 (Area 3), as there are no active nests within ¼ miles of the launch site (page 4-8). The preferred development plan for this Master Plan is not expected to create any increased impacts to the eagle nest within the vicinity of PSCA.

Marine Birds – As referenced in the 1996 EA, "Two systematic surveys of marine birds in the vicinity of the proposed KLC site were conducted in 1994" (page 3-21). From these surveys thirty-eight species were observed; "however, no seabird colonies were found in the immediate vicinity of the proposed …KLC site or on Ugak Island" (page 3-21). That report did find that the Aleutian tern had a nesting area within the proposed launch area back in the mid-1970's, but no activity was observed during the bird surveys. Likewise, Aleutian and Arctic tern nesting areas were observed outside of the KLC area, in the vicinity of the Burton Ranch, that had been used in the mid-1980's.

The area around Narrow Cape is active with marine birds year-round, primarily because of the shallow waters and abundant food source supply. Eider and sea ducks are common in the Narrow Cape area. It has been noted that the harlequin duck population is declining globally; however, the harlequin duck appears to have a healthy population in the Narrow Cape area, especially during the winter months.

The 1996 EA concluded that the affect to marine birds in the vicinity of the spaceport would be brief, concentrated around the few minutes associated with the actual launch of a rocket, and not expected to have a measurable adverse impact. Currently, Alaska Aerospace is requesting an environmental written reauthorization to increase the number of launches from nine per year to thirty-six per year. That process will address whether increase operations may create an adverse impact on marine birds. In the meantime, provided there is no increase in the number of launches from PSCA per year, it is not expected there would be any increased adverse impacts to marine birds by construction of the preferred development plan.

The 2016 EA states that "Steller's eiders occur in the Kodiak Island area primarily during the winter months (mid-October through March); however, they are not common in the nearshore areas around Narrow Cape (FAA, 1996)." In addition, during bird counting events related to the first seven launches from PSCA found that "Small rafts of Steller eiders were seen on two occasions totaling approximately 30-60 individuals." The EA references a 2002 study which indicated that "it was apparent from the data that rocket launches were not affecting bird numbers to any significant degree, and certainly not to the degree attributable to natural factors such as weather."

Other marine birds listed as endangered or threatened that have historically been in the vicinity of Narrow Cape include Yellow-billed loons, short-tailed albatross, and Kittlitz's murrelet. None have been counted in the Narrow Cape area in many years. Figure 7-2 shows that the Narrow Cape area, and all of the spaceport property is used by marine birds.

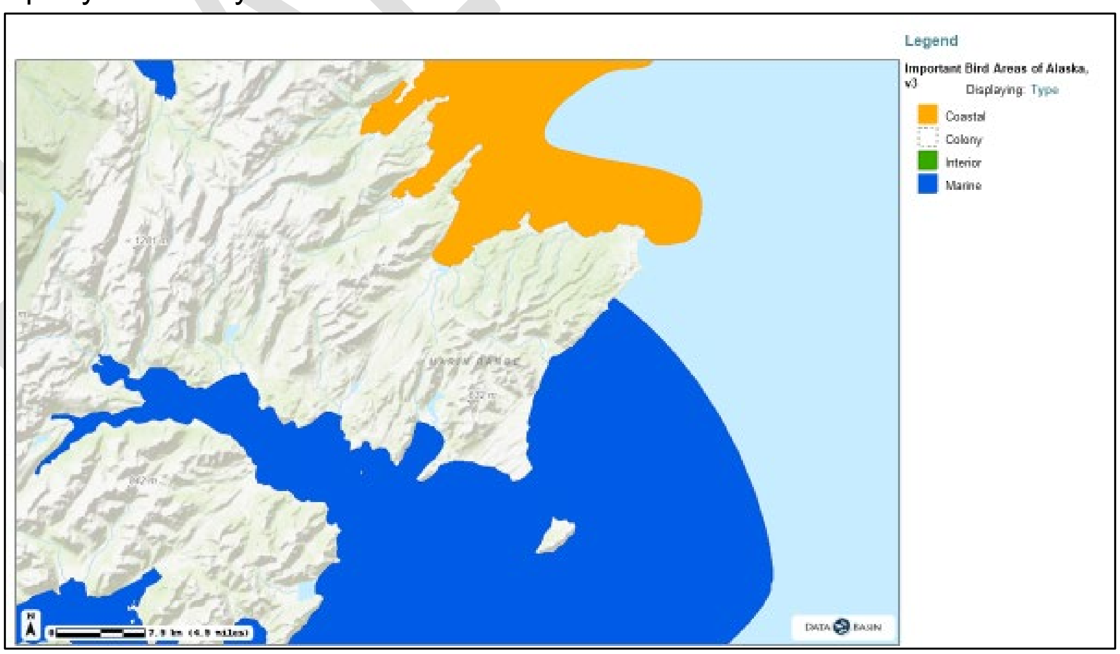


Figure 7-2 Important Bird Areas (Alaska Audubon Society)

Threatened and Endangered Species – There are no threatened or endangered terrestrial birds or terrestrial mammals in the vicinity of PSCA. However, as noted in the 2016 EA, "there are several federally-listed marine mammals present in the waters offshore and on Ugak Island. Additionally, there are two marine bird species listed as threatened or endangered within the actin area: Steller's eider and short-tailed albatross" (page 4-10). There are also two candidate bird species that could occur within the planning are: the Kittlitz's murrelet and the yellow-billed loons.

Both the Northern sea otter and the Stellar sea lion are present in the area around Narrow Cape and on Ugak Island. These marine mammal species are included on the Threatened and Endangered list. The 2016 EA presents a comprehensive assessment of these species and a mitigation plan, which includes a mammal monitoring program and is incorporated into this plan by reference. No other potential threatened or endangered species issues were discovered. Therefore, no increased adverse impacts are expected by pursuit of this development plan.

Plants and Vegetation – The 1996 EA for construction of the Kodiak Launch Complex provided a detailed vegetation study and was used as the basis in this document for potential plant impacts. That document is incorporated into this Master Plan by reference.

The 1996 EA recognized that indirect impacts to plants and vegetation could occur from launch exhaust products generated by solid propellant launch vehicles, which includes hydrogen chloride, aluminum oxide, carbon monoxide, carbon dioxide, and nitric oxides during operations. The 2016 EA identified water vapor, carbon dioxide, and oxygen as additional elements that would be produced with the addition of liquid propellant launch vehicles at PSCA. However, no negative impacts to vegetation or plants were identified.

The 1996 EA concluded "there could be minor damage to vegetation in the immediate area of the proposed KLC launch pad" (page 4-24), it did not conclude that the damage would have a significant impact. The EA concluded that soil damage would be negligible, "Therefore, indirect impacts to vegetation by changes in soil chemistry are not expected to occur" (page 4-25).

The 2016 EA included an analysis of introducing liquid propellant launch vehicles at PSCA. That EA explained that "the principle product of potential concern from liquid propellant launch vehicles is carbon monoxide, which does not have an adverse effect on plants in the volumes presented during a medium-lift rocket launch" (page 4-13). The document concluded "No permanent adverse direct or indirect effects are anticipated in association with launch activities" (page 4-14). The current EA written reevaluation addressing the increase from 9 to 36 launches will provide the most current review of impacts and provide any mitigation, if necessary. No additional evaluation is anticipated as a result of this plan above the work currently being done on the written reevaluation.

In addition to potential launch operations impacts, potential impact to vegetation caused by construction was also reviewed. The focus of this Master Plan is to maximize the use of already disturbed land to accommodate future development requirements. As such, the only land surface that is expected to be disturbed during development would be:

- *LP-1* - The area directly adjacent to Launch Pad -1 would need to be graded, leveled, and improved for installation of the LOX and RP-1 propellant tank areas and the water deluge system. The areas being considered for this development include both areas previously disturbed during construction of the original launch facilities and some undisturbed land immediately adjacent to the disturbed areas. Based on the final location and design of the new infrastructure, an additional environmental review process may be necessary. That will be determined as part of the design process should the modification be pursued.
- *Pad 3D* - Pad 3D development would require an expanded area; however, this area was identified in the 2016 Kodiak Launch Complex Launch Pad 3 EA as the preferred site for development of the new LP-3 infrastructure. That EA concluded that, while there would be direct effects on vegetation during construction activities, the disturbed areas consist primarily of meadows and "Direct effects to plants would be minor due to the limited area to be disturbed, and would not affect overall plant community composition or structure" (page 4-13). That study also concluded that "direct effects to rare plants from proposed construction or modifications are not expected" (page 4-13). It is not expected additional review of vegetation and plants will be necessary for developing Pad D into a multi-use launch pad.
- *Integration Facility for Pad 3C* – Pad 3C is already built; however, when constructed it lacked any facility for launch vehicle and payload integration. Under this plan an area across the road from the launch pad would be developed to provide an integration facility. The integration facility pad would disturb about 12,500 square feet of overbrush and soil and be constructed with a crushed gravel sub-base with a concrete floor. Areas that were disturbed for construction, but not developed would be revegetated. It is not expected additional review of vegetation and plants will be necessary for developing this facility.
- *Launch Propellant Storage Area (LPSA)* – The LPSA is located immediately adjacent to the existing Rocket Motor Storage Facility (RMSF) area. This area was not previously disturbed during development of the RMSF. In previous studies, including those completed for construction of the current RMSF, no significant disturbance to vegetation or rare flora was found. Given the small area of impact proposed, no further detailed vegetation surveys are needed within the study area. Land excavation for this site would be carefully planned and conducted according to best management practices to minimize soil erosion and plant disturbance.

Areas that were disturbed for construction, but not developed would be revegetated.

Any construction of propellant storage facilities at this site, would require approval of a facilities development plan prior to construction to ensure that sufficient environmental protection safeguards are incorporated into the design and construction. Above ground storage tanks and facilities with a storage capacity under 1,320 gallons (gal) are regulated by the Alaska State Fire Marshal. Tanks with a storage capacity between 1,320 gal and 420,000 gal, and not already regulated, are regulated by both the EPA and State Fire Marshal.

The area is in an active seismic area, susceptible to earthquakes that could cause environmental contamination to soils and the surrounding area from damage to tanks built underground. This plan recommends that only above ground propellant storage facilities be used. To prevent soil and vegetation contamination environmental barriers, berms, and catchment basins would be used.

Due to the types of propellants expected to be stored at this site, LOX, Liquid Helium, RP-1, and Propylene, it is also recommended that double wall tanks be used. As example, LOX and other pressurized commodities stored at the site require double walled tanks. To explain, LOX tanks are stationary, vacuum-insulated pressure vessels that consist of an inner and an outer pressure vessel. The inner tank is designed for the storage of low-temperature, liquefied oxygen. The space between the inner tank and outer vessel is often filled with perlite, a grained insulation material. This provides optimum storage for LOX while providing a system that maximizes environmental protection during both storage and operations.

- *Rocket Motor Storage Facility Expansion Area* – The RMSF expansion area is located immediately east of the existing facilities and was included under the original RMSF development plans, which projected a total of five facilities being constructed at PSCA. As with the LFSA, land excavation for this site would be carefully planned and conducted according to best management practices to minimize soil erosion and plant disturbance. Areas disturbed for construction, but not developed, would be revegetated.
- *USCG LORAN Site* – This site is being recommended for potential future development. Specifically, this plan recommends using the land west of the developed facilities under the USCG Lease Agreement with ADNR for use as an Expanded Telemetry Instrumentation Antenna Site or potential additional future commercial launch pad. This area is currently undeveloped, and a comprehensive vegetation study has not been completed. Should development occur in this area Alaska Aerospace may require an update to the current EA.

Placing earthen fill into previously excavated land with material compatible with the natural features of the site, provided the land is not delineated as a wetland; or minor dredging or filling of wetlands or navigable water for any categorically excluded action, provided the fill is of a material compatible with the natural features of the site, and the dredging and filling qualifies for an U.S. Army Corps of Engineering nationwide or regional general permit, as well as minor trenching and backfilling where the surface is restored and the excavated material is protected against erosion and run-off during the construction period, as stated in the List of Federal Agency CE's may allow certain aspects of these projects to qualify as a CE and not require additional environmental review.

Coastal Resources – Kodiak does not have an adopted Coastal Zone Management Program. Kodiak also does not have a coastal barrier resource or coral reef system; therefore, projects in this plan are not subject to the Coastal Zone Management Act (CZMA). No further evaluation of coastal resources are required in constructing projects recommended in this plan.

Floodplains – The 2016 EA identified Executive Order (EO) 11988, Floodplains Management as the controlling document for evaluating the impacts of floodplains at PSCA. That EO "seeks to avoid impacts associated with the occupancy and modification of floodplains. Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps are not available for this area; however, localized studies were conducted by ENRI, found the coastal plateau of the proposed KLC LP-3 and associated structures are not within a floodplain (ENRI 1995).

Based on the elevated terrain at Narrow Cape, with a generally sloping direction towards the ocean, potential flood areas are limited. Based on a historical review of the lowlands within the boundaries of PSCA and the abundant amount of rain received in the area annually, flooding is not expected to be an issue for future development as most development is planned for high grounds not susceptible to flooding. The one exception is development of the launch vehicle propellant storage area and RMSF expansion reserve. However, these two sites are located in an area that slopes towards the ocean and are above sea-level. No documentation was found to indicate these areas are situated in known floodplains. Therefore, the proposed projects are not expected to have any impact on floodplains and need not be evaluated further.

Wild and Scenic Rivers – The Wild and Scenic Rivers Act of 1968 defines "Wild and Scenic Rivers" as those rivers having remarkable scenic, recreational, geological, fish, wildlife, historic, or cultural values. As previously identified in the 2016 EA, "There are no rivers with this designation located on Kodiak Island, (page 3-37). Therefore, a Wild and Scenic Rivers evaluation is not required.

Soils and Farmland – Construction of facilities under this plan would cause limited disturbance to soils at PSCA. All facility construction is recommended to be above ground and would not adversely impact underlying bedrock. While there would be minor temporary surface soil disturbance during construction periods, projects would be carefully planned and constructed according to best management practices to minimize soil erosion and plant disturbance. Once construction is complete, areas that were disturbed but not developed would be revegetated. Minor trenching and backfilling where the surface is restored and the excavated material is protected against erosion and run-off during the construction period, as stated in the List of Federal Agency Categorical Exclusions may allow certain aspects of these projects to qualify as a Category Exclusion and not require additional environmental review.

The 1996 EA provided a comprehensive description of the geology and soils around PSCA and Narrow Cape and is incorporated into this plan by reference. The soils at Narrow Cape generally consist of a weathered bedrock subsurface, covered by volcanic ash from the 1912 Novarupta Volcano Katmai eruption on the Alaska Peninsula. Topsoil in the area is generally a thin layer of decayed vegetation. The soils are well drained and strongly acidic. As stated in the 1996 EA, "as a result, Ph changes to area streams and lakes from acid deposition are expected to be small and transitory. In addition, local topography would also mitigate possible impacts of acid deposition from rocket combustion products" (page 4-11).

The protection of farmland is addressed in the Farmland Protection Policy Act (FPPA) (7 U.S.C. Sections 4201 – 4209), which was included in the Agriculture and Food Act of 1981. While the Narrow Cape area is used for grazing of livestock, such as cattle and bison, under the Kodiak Game Ranch Grazing permit, the 2016 EA stated "There are no designated prime/unique farmlands or farmland of local/statewide importance located on Kodiak Island, (page 3-37). "There are two original Federal grazing units that blanket virtually the entire plan area (Pasagshak/Narrow Cape)," *Pasagshak/Narrow Cape Area Plan*. One is currently owned by the Burton Family, known as the Kodiak Cattle Company. These grazing rights overlay the Alaska Aerospace ILMA for PSCA. No change is this relationship is recommended in this plan.

Department of Transportation Act Section 4(f) – This section refers to using land from publicly owned parks, recreation areas (including recreational trails), wildlife and waterfowl refuges, or public and private historic properties. There are no designated parks/recreational areas, wildlife or waterfowl refuges, or historic sites in the vicinity of PSCA. The only 4(f) resource near PSCA is the Pasagshak State Recreation Site, located 4.0 miles from the commercial multi-use launch area (Area 3) and 4.4 miles from LP-1. This plan does not recommend any constructive use of the Pasagshak State Recreation Site for future spaceport operations.

The most significant potential impact to the Pasagshak State Recreation Site would be associated with launch noise. The 2016 EA determined that noise impacts to the recreational site would be minimal, (page 4-4). It concluded that “Because there would be no direct or indirect use of any 4(f) resource, there would be no significant impacts of 4(f) resources from the proposed action” (page 4-5). With the Master Plan determination that launches could increase from 9 to 36 per year, Alaska Aerospace is conducting a new noise impact analysis to determine whether there is any change to the previous determination based on the increased activity. This noise evaluation will be included in the current written reevaluation process being completed to support increased launch activities as presented in this Master Plan. The potential noise impacts and mitigation measure are addressed in the Noise section of this chapter.

Natural Resource and Energy Supply - The primary natural resource used at PSCA is groundwater, which is used to fill the spaceports 150,000 gallon storage tank located adjacent to the Payload Processing Facility. This water is used to supply water to spaceport facilities and for emergency fire suppression. The water system at PSCA is classified as a “Non-Transient Non-Community Class a Public Water System certified by the ADEC. The ADNR issued a Certificate of Appropriation which permits Alaska Aerospace to use 1.03 acre-feet (335,627 gallons) of groundwater per year. PSCA uses an average of 110,000 gallons of groundwater per year. This plan recommends groundwater storage capacity be increased by 50%, primarily to support the increased water use by installation of water deluge systems at the spaceport. That would increase total storage capacity and use of groundwater up to 225,000 gallons, which is within the permitted limit established by ADNR in the current Certificate of Appropriation.

Energy is supplied to PSCA by the Kodiak Electric Association (KEA). Under the proposed development plan, primary power would continue to be supplied by KEA. Development of the proposed facilities at PSCA would have negligible impact on the existing energy supply, as KEA has sufficient power capabilities to support the additional facilities and increased launch numbers through the planning period.

PSCA has on-site back-up power generators at all primary facilities, as described in Chapter Two. Diesel fuel for use in the generators is stored within above-ground, self-diked storage tanks. These fuel storage tanks also hold fuel for use in heating facilities at PSCA. The use of back-up generators would increase with the increased number of launches projected during the planning period. Currently, back-up generators average about 250 hours per year. Increasing launches to 36 per year would significantly increase the use of back-up generators to nearly 4,000 hours per year. This would require increased amounts of diesel fuel to be stored and used on-site and increased carbon monoxide discharged into the atmosphere.

Since the generators are used as back-up power sources for PSCA and must be operated during launches to ensure uninterrupted power to all systems is available in the event that commercial power from KEA is interrupted, and since no other alternative fuel exists for this purpose, the increased storage and consumption of diesel fuel is unavoidable and has been minimized to the maximum extent possible. This is compliant with energy supply and usage guidelines established by the Federal government under Executive Order 13123. Furthermore, the increased use of diesel generators at PSCA is not expected to create an adverse environmental impact of air quality, as described earlier in this chapter. Therefore, no mitigation measures should be necessary.

Light Emissions and Visual Effects – There are no Federal statutory or regulatory requirements for classifying or assessing light emissions and visual impacts. The 2016 EA provided a comprehensive overview of light emissions and visual impacts and is incorporated into this report by reference.

Lighting at LP-1 would not be appreciably increased by development of liquid fueling capability at the site. Limited increased lighting, primarily security lighting around the area, would be installed with construction of the liquid propellant storage area and eventual expansion of the RMSF and Pad 3D. Additionally, lighting would be installed around the high-altitude balloon launch area. These external lights would be used primarily during launch campaigns or on an as-needed basis. This development is not expected to create significant lighting impacts.

Visual effects, not light associated, include visual aspects of structural development at PSCA, sometimes referred to as "viewshed impacts." The 1996 EA stated that "Scenic values of the Narrow Cape area are considered high" (page 3-43), primarily based on the topography and vegetation. The construction of additional facilities at PSCA would impact the existing viewshed; however, this would be a minimal addition to the structural development already at the spaceport. Viewshed impacts associated with this plan include development of Pad 3D, installation of a water deluge system and propellant berms at LP-1, and installation of new telemetry instrumentation antennas at the LORAN site.

Pad 3D development would be situated further from the ridge line above Fossil Beach and is not expected to be visible from the beach area. The pad, while having minimal structural development, would be visible from the hiking trails that cross the lower Narrow Cape area.

Development of liquid propellant pads and berms at LP-1 would have minimal visual impacts, as they would be developed adjacent to the already developed Launch Service Structure and associated buildings in the area. Installation of a water deluge tower would be visible, as it would rise between 100 and 150 feet above the ground.

The USCG LORAN site has been identified as a secondary area for installation of telemetry instrumentation antennas. Should Alaska Aerospace secure access to the area and experience a requirement for telemetry instrument and/or downlink antennas that cannot be accommodated at the existing telemetry instrumentation site, this site would be used to meet that demand. Installation of new antennas at this site is expected to also include installation of radomes to protect the antennas from the weather. Figure 7-3 illustrates the antennas in the existing PSCA telemetry instrumentation site with, radomes, and is presented as a visual example of what may be installed at the USCG LORAN site in the future.

Figure 7-3: PSCA Telemetry Instrumentation Antennas with Radomes

From a viewshed perspective, these antennas would not be visible from Fossil Beach or from the Pasagshak Road while approaching PSCA but would be visible when using the Pasagshak Road to access Fossil Beach after passing the Burton Ranch Road. They would also be visible when using Narrow Cape trails. Installation of the new facilities in this plan is not expected to create significant viewshed impacts.

Compatible Land Use - PSCA is located on the east side of Kodiak Island in area known as Narrow Cape and is situated on lands zoned under the Kodiak Island Borough as a "Conservation District." As a state-owned corporation operating under Alaska Statute 26.27.120, Alaska Aerospace retains the authority to "exercise its corporate powers within a municipality specifically in all portions of a space-related facility or territory to the same extent and in the same manner as in areas of the space-related facility or territory not within the boundaries of a municipality." As such Alaska Aerospace has statutory immunity from complying with local land use regulations and not required to seek local government zoning approvals for space-related activities at PSCA.

According to the Kodiak Island Borough Community Development Department "*Pasagshak/Narrow Cape Area Plan,*" June 1999, the entire Narrow Cape area is zoned Conservation, with the exception of the Pasagshak Subdivision (page 8). The report also identifies the Fossil Beach/Narrow Cape area as "a prime recreational area with natural amenities." While identifying local interest in potentially designating these areas into a state park status, the report acknowledged that the first step would require the state, as landowner, to initiate action to incorporate this area into a state park system. There are currently no actions pending to establish Fossil Beach/Narrow Cape area as a state park or recreational area. Based on the projected growth of PSCA within this planning period, it is recommended that no action be taken by the state to establish the area as a park or recreational area. With that said, it is the intent of this Master Plan to maximize public access and use of the land, except in areas of facility development, as presented in this plan, and during hazardous and launch operations, consistent with current requirements.

The state entered into an ILMA with Alaska Aerospace in 1994 to develop a spaceport at Narrow Cape, which is now known as the Pacific Spaceport Complex – Alaska. The *Pasagshak/Narrow Cape Area Plan* depicts the ILMA on the document Land Use Plan which is incorporated into this plan by reference.

Land Use and Comprehensive Planning is a nationally recognized process that focuses on the development and implementation of policies to manage the location, timing, type, and density/intensity of land development. It entails significant interaction of diversified interests to develop a plan for compatible land uses. The *Pasagshak/Narrow Cape Area Plan* provided an excellent compilation of the varied interests and conflicts of the area and is incorporated in this document by reference.

The *Pasagshak/Narrow Cape Area Plan* found user conflicts in the area, of which one was the concern about development at PSCA. Specifically, the plan states "Concern has been expressed about the potential conflicts between established uses and the industrial nature of the Kodiak Launch Complex and related areas" (page 12). The plan states that the main concern relates to potential cumulative negative impacts. "A recommended land use goal stated in the plan is that additional industrial activity in the plan area not directly related to the KLC be prohibited" (page 12). This is consistent with the direction being taken by Alaska Aerospace. The intent is to maximize use of already developed areas at PSCA, minimize expansion into undisturbed areas, and retain public access to the lands of Narrow Cape and Fossil Beach except during period of hazardous and launch operations when access may be restricted for public safety.

Public Use - Narrow Cape is a wide expanse of state lands that has traditionally been used for numerous recreational experiences. The 1996 EA concluded the availability of Narrow Cape for recreation purposes would not be substantially impacted by the development of a spaceport, as was proposed in 1996. This was determined because the ILMA between ADNR and Alaska Aerospace limits the areas that can be restricted from public access at Narrow Cape to only those areas that are actively developed and used for spaceport operations, unlike other spaceports in the U.S. that restrict access to the entire spaceport complex, i.e. Vandenberg AFB, Cape Canaveral, Wallops Flight Facility, the Mid Atlantic Regional Spaceport, White Sands, and the Reagan Test Center.

There is an exception that the entire 3,717 acres can be closed to the public during hazardous and launch operations. The 1996 EA concluded that “these short-duration closures of Narrow Cape would not have an appreciable impact” (page 4-64). The 2016 EA confirmed that while the Narrow Cape area is not considered 4(f) resources under federal guidelines, is an important recreational resource in the area.

The 2016 EA further concluded that “launch activity provides positive effects in the form of unique recreational opportunities, as there are relatively few places in the world where the public can witness rocket launches. That fact withstanding, Alaska Aerospace understands the public recreational value of the Narrow Cape beyond rocket launch viewing, such as hiking, picnicking, whale-watching, birding, and other activities. That is partially the reason this Master Plan focused on minimizing development of undeveloped areas and preserving the recreational aspects of the area.

Under the preferred development plan limited additional development would occur at PSCA which requires the use of currently undisturbed public areas at Narrow Cape. In fact, recognizing the importance of public use of the area, Alaska Aerospace maximized development in clusters around currently developed areas; has recommended reducing the boundary of the spaceport along the western edge of the spaceport; and recommends the Narrow Cape area south of the Twin Lakes which is currently not developed, be designated a Public Use Reserve, as shown in Figure 6-16 in Chapter Six. This area will be retained within the existing ILMA spaceport boundaries, but in designating the area a Public Use Reserve there will be no development within that area, the area remains open for public use except during hazardous and launch operations, and the designation ensures no non-compatible development will occur within the reserve by other entities.

While the Narrow Cape area is not designated section 4(f) under the Federal guidelines, the public uses the area for a number of recreational activities. One of the more highly recognized activities is use of the trails around Narrow Cape, including those that cross PSCA, as depicted on the Kodiak Audubon Society Trails Map (Figure 7-4) below. This Master Plan supports continued use of the Narrow Cape trail system, except when closed for hazardous and launch operations at the spaceport. Development of the preferred alternative will create increased periods when the area must be closed for hazardous and launch operations. However, these will be short durations with maximum effort made to avoid weekends, holidays, and peak recreational activity times. Development of the preferred alternative is not expected to create significant impacts to the use of the existing trail system.

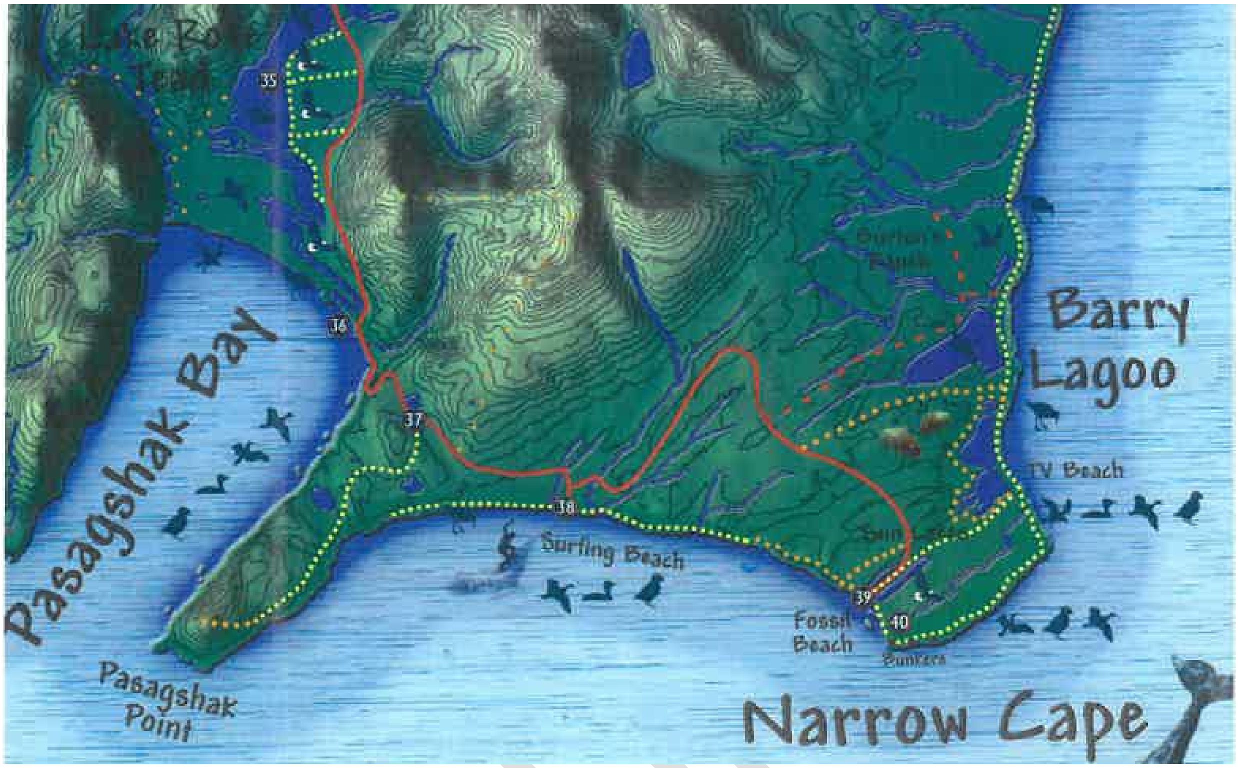


Figure 7-4: Narrow Cape Trail System **(Courtesy of Kodiak Audubon Society)**

Hazardous Materials, Pollution Prevention, and Solid Waste - The 1996 EA provided a comprehensive evaluation of hazardous materials expected to be used at PSCA, including Table 4.12-1 (page 4-70) which listed the hazardous materials expected for use at the spaceport. The information provided in that EA, including Table 4.12-1, are incorporated into this document by reference.

Under the proposed development plan, PSCA is projected to support up to 36 launch operations per year within the planning period. This increase in operations will increase the amount of hazardous materials that will be used at the site. The handling of hazardous materials at PSCA is strictly regulated, with containers properly marked in accordance with the U.S. Department of Transportation authority to regulate the transportation of hazardous materials from the Hazardous Materials Transportation Act (HMTA), as amended. As such, Alaska Aerospace maintains a comprehensive program to ensure the safety of transporting hazardous materials associated with spaceport operations. These procedures are outlined in the 2016 EA (page 3-19) and are incorporated into this plan by reference.

In addition to transporting hazardous materials, Alaska Aerospace maintains limited hazardous materials at PSCA to support spaceport operations. The 2016 EA provided additional information and Table 8 (page 3-20) presented a summary of Facility Fuel/Oil Storage for PSCA. This report and Table 8 are incorporated by reference into this document.

As such, increased environmental protection measures would be necessary to preclude a fuel spill from contaminating soils and water. The EPA developed the *Spill Prevention, Control, and Countermeasure* (SPCC) rule "to help facilities prevent a discharge of oil into navigable waters or adjoining shorelines. This rule is part of the U.S. Environmental Protection Agency's oil spill prevention program and was published under the authority of Section 311(j) (1) (C) of the Federal Water Pollution Control Act (Clean Water Act) in 1974. The rule may be found at Title 40, Code of Federal Regulations, Part 112." A facility is covered by the SPCC rule if it has an aggregate aboveground oil storage capacity greater than 1,320 U.S. gallons and there is a reasonable expectation of an oil discharge into or upon navigable waters of the U.S. or adjoining shorelines.

In the ILMA, Section 10, *Fuel and Hazardous Substances*, specifies that Alaska Aerospace shall provide secondary spill containment for fuel and hazardous materials, except for short-term storage of small volumes. This is defined as "containers with a volume of 55 gallons or less which are in place for 7 days or less, provided that the total combined volume in place without containment on a pad or work area does not exceed 660 gallons for fuel, hydraulic fluid, or lubricants or 55 gallons of other hazardous substances."

PSCA currently uses over 20,000 gallons of petroleum-based products ranging from gasoline and lubricating fluids to diesel fuel per year. As operations increase, it has been projected that the use of petroleum-based products will increase to a maximum of 50,000 gallons, with the fuel storage tanks being replaced with new, increased capacity tanks but remaining in the existing location.

The Alaska Department of Environmental Conservation created the *Aboveground Storage Tank Operator Handbook Second Edition*, 2003, which states "The purpose of secondary containment is to prevent petroleum products from flowing onto the land or into the water should there be a spill. Spill containment measures, including secondary containment are required by the Environmental Protection Agency (EPA). The handbook recommends secondary containment specifications include:

- Must be large, high and strong enough to hold the contents of the largest tank plus 10% for local precipitation.
- Must be constructed or lined with material that will hold petroleum products and prevent them from seeping into the ground.
- The liner should be covered with sand or gravel to prevent ripping and to provide protection from the weather.

To meet both state and federal environmental controls on potential fuel spill pollution protection, PSCA would install a fuel spill secondary containment system that meets or exceeds state requirements at all locations where fuel is stored.

PSCA currently has a hazardous fuel tank at the Payload Processing Facility to store small quantities of hydrazine-based hypergolics. Hydrazine is used primarily for payload maneuvering engines and as a monopropellant for terminal descent of satellites and spacecraft. PSCA currently has the ability to store up to 550 gallons of hydrazine. As operations increase, it is expected that this may need to be increased. The spaceport is approved to store up to 1,190 gallons of hydrazine. Provided the increased quantities are stored in the same location, using either a larger storage tank or additional storage tank that meets approved SPCC requirements, and storage does not exceed 1,190 gallons, no additional environmental review is necessary. In addition, hazardous waste is handled according to the Resource Conservation and Recovery Act (RCRA) regulations regarding the proper labeling, marking and placarding requirements for hazardous waste containers.

Pollution prevention is outlined in the PSCA Operations Manual, Emergency Response Plan, and SPCC, which includes Best Management Practices. The PSCA SPCC satisfies the federal requirement that facilities that have above ground oil storage tanks with a capacity of greater than 1,320 gallons must have an approved prevention, containment and clean-up plan. Development of the proposed improvements at PSCA are not expected to create have any increased negative affect on pollution prevention at PSCA.

Solid waste is containerized at PSCA and periodically picked up by a local commercial vendor and disposed of at the Kodiak Island Borough Landfill. Development of the proposed improvements at PSCA are not expected to cause any environmental affects at PSCA.

Historical, Archeological, Architectural, and Cultural Resources – The Narrow Cape area has a number of historic, archeological, and cultural interests. Subsistence is one of the highest interests in the area. As identified by the Sun'aq Tribe of Kodiak, the lands and waters on and around Narrow Cape are used for subsistence. Narrow Cape is also used for hunting and gathering. Likewise, the residents of Old Harbor, located approximately 20 miles southwest of PSCA, have used the coast and adjacent waterways around Narrow Cape for subsistence.

The 2016 EA stated that "Subsistence permits are available from the Alaska Department of Fish and Game to participate in subsistence fishing in the Kodiak Management Area, which encompasses the waters of the Western Gulf of Alaska surrounding the Kodiak Archipelago and along that portion of the Alaska Peninsula that drains into the Shelikof Strait, and subsistence hunting, except for marine mammals (page 3-31)." The 1996 EA concluded that "Given the documented limited use of the Narrow Cape area and the fact that restriction of the area would be limited and temporary in nature, no impacts to subsistence harvesting activities on Kodiak Island are expected (page 4-67)." Both documents have a detailed presentation on subsistence and are incorporated into this document by reference.

"In August 1994, the Alaska State Office of History and Archeology conducted an archeological and historic resource survey of the Narrow Cape area where the proposed KLC would be built (page 3-45)." "Evidence of cultural resources was not noted during the survey (page 3-45)." Two archeologically significant sites were identified and cataloged in the State Historic Preservation Office. In addition, historic World War II bunkers were located on the outer end of Narrow Cape. There is low probability of discovering new historic sites at Narrow Cape.

In regard to potential archeological impacts, both the 1996 EA and 2016 EA concluded there would be minimal potential for encountering any archeologically significant sites when constructing facilities at PSCA. However, since the area has been traditionally used in the past, the 2016 EA required mitigation whenever construction is being completed at PSCA. This mitigation recommendation is included on page 4-17 of the 2016 EA and is adopted into this document by reference.

Noise – There are two primary noise considerations for the operations of PSCA. The first is road noise, while the second is noise generated by rockets during launches. Narrow Cape and the spaceport complex are located at the end of the Pasagshak Road which terminates at Fossil Beach, with a branch extending eastward to the Burton Ranch. The entire area is a rural setting with limited road noise created by occasional road traffic. Local noise sensitive areas are the residential area at Pasagshak Bay, the Burton Ranch, as well as to a lesser degree the settlement of Chiniak. Based on a projection of increased road traffic supporting operations at PSCA, road noise will remain minimal and is not expected to cause any significant adverse impact with full development of projects proposed in this plan.

Noise generated by individual rocket launches is not expected to increase as a result of this development plan because the smaller, liquid propellant launch vehicles will generate less noise than the larger, solid propellant launch vehicles which have historically launched from PSCA. The original 1996 EA concluded that the noise generated by an individual launch from PSCA would have a minimal adverse impact on the environment. This determination was based on the fact that during launch operations, public access to the spaceport is restricted to a distance at least two miles from the launch pad. The 1996 EA found that when launching a solid propellant rocket from LP-1, the people closest to the launch pad (two miles) would experience about a 94 dBA, which is less than a chainsaw and about the equivalent of a gas-powered lawn mower.

Kodiak city is located a sufficient distance from PSCA to not be impacted by noise from launches at the spaceport. The recreational areas of Pasagshak State Recreational Area and Narrow Cape are within the area where noise from rocket launches at PSCA may be heard, but the noise level is not expected to exceed noise limits.

In 2012 a *Noise Impact Analysis, Kodiak Launch Complex Launch Pad 3 Project* was completed for PSCA, using the launch activity level of solid propellant rockets from LP-1. This report concluded there would be no notable changes to the overall noise environment with the construction of a new Launch Pad 3 at PSCA and there are "no currently developed areas outside of the KLC that were identified with noise effects (page 4-20). That report is incorporated into this plan by reference. This analysis did not include liquid propellant launch vehicles and did not quantify noise from an increased number of launches as projected in this report.

A *Super Strypi Launch Noise Impact Analysis* report was completed for Alaska Aerospace in 2015 by Michael Minor and Associates which conducted a technical noise analysis for a new solid propellant launch vehicle, named the Super Strypi. The Super Strypi is a smaller launch vehicle than has been historically launched from PSCA and is the new solid propellant rocket currently in the test and development phase that is projected to launch from PSCA during the period of this report.

The noise analysis included actual noise measurements from a test launch at the Pacific Missile Range Facility at Barking Sands, Hawaii on November 3, 2015. This analysis concluded (page 1):

> "1. The Super Strypi launch vehicle produces noise levels that are generally lower than previous launch vehicles used at KLC.
> 2. The acoustical energy from the Super Strypi is lower than previous launch vehicles used at KLC.
> 3. Noise from using the Super Strypi launch vehicle will not increase the overall noise signature from KLC as long as the number of annual launches remains that same and may actually be lower if the Super Strypi is used in place of other launch vehicle types."

The 2015 *Super Strypi Launch Noise Impact Analysis* report is incorporated into this report by reference and included as Appendix A to this document.

The potential noise issue for PSCA comes from the increased number of annual launches generally associated with demand for the new entrant small and ultra-small liquid propellant launch vehicles. The primary noise associated with liquid propellant rocket launches is during the initial seconds of engine ignition and lift-off from the launch pad. To dampen the impact of noise, a water deluge system is used, which sprays the launch pad with large quantities of water during ignition and initial lift-off. As a result, along with the fact that these small liquid propellant motors generate substantially less thrust than the larger solid propellant rocket motors, noise generated by the small and ultra-small launch vehicle class is measurably less than the noise created by the launch vehicles addressed in both the 1996 and 2016 EA's.

Construction of noise abatement measures at commercial launch sites, such as noise barriers to diminish launch vehicle engine exhaust blast or noise may be permitted under a Categorical Exclusion.

Increased facilities and increased operations will require the use of additional diesel-powered generators at PSCA. To ensure uninterrupted power is available for launch operations, diesel generators are operated concurrently with commercial power during launch periods. In the event commercial power is interrupted, the diesel generators ensure continued power to all systems necessary to conduct operations.

PSCA is situated in a remote area with very little noise generation. The 2016 EA states "Based on measured data, and the level of activity at the KLC, noise levels at all noise sensitive properties are well below the FAA residential land use compatibility level of 65 dBA (A-weighted decibel) day-night average sound level (Minor, 2012)." Noise around diesel generators varies, depending on the generator size and power output. A 50kw diesel generator can typically produce around 85 dB(A) noise levels. Therefore, when personnel are in close proximity to these generators, ear protection equipment is used. During launch operations, the area around the launch site is closed to all personnel and the public. While the ambient noise around facilities using diesel generators would increase, no personnel would be within one mile of any launch pad, the public would be restricted to no closer than about two miles to any launch pad, and other personnel would be located within facilities during launch operations. Therefore, both the single noise and cumulative noise of diesel generators would not create any measurable impacts. Because there are no currently developed areas outside of the PSCA that were identified with noise effects, no mitigation measures are required.

It is the cumulative effect of noise, not the single event that may create a noise impact as PSCA experiences up to 36 launches per year towards the end of the planning period. Therefore, Alaska Aerospace has initiated a rewrite to the previous EA's to address this potential cumulative effect. To exceed nine annual launches per year, the written reevaluation must result in either No Significant Findings or a recommended mitigation plan that would be implemented prior to exceeding nine launches per year to ensure no long term adverse impacts are created by the noise generated by these additional launches.

Socioeconomic, Environmental Justice, and Children's Environmental Health and Safety Risks – The primary areas of interest when conducting a socioeconomics evaluation are the economic activity, employment, income, population, housing, public services, and social conditions of the area. PSCA is located in a sparsely populated, rural area but does have an effect on the Kodiak economy and socioeconomic condition of the Kodiak Island Borough.

The 2016 EA provided a description of the regulatory framework associated with this topic. "Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* requires Federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their activities on minority and low-income populations. An associated memorandum requires an environmental justice analysis of all environmental effects considered in NEPA documents, including human health, economic and social effects (EPA, 1994)."

Executive Order 13045, *Protection of Children from Environmental Health Risk and Safety Risks* also requires federal agencies to identify and assess environmental health and safety risks that may disproportionately affect children. The 2016 EA also identified that "Section 810 of the *Alaska National Interest Lands Conservation Act (ANILCA)* requires Federal agencies to evaluate the potential effect that proposed actions may have on customary rural subsistence practices."

The 2016 EA provided a comprehensive review of environmental justice, environmental health and safety risks for children, the local economy, subsistence issues, and other socioeconomic issues and the data, analyses, and information from that report is incorporated into this document by reference. The 2016 EA concluded that the proposed action was consistent with Executive Order 12898 and Executive Order 13045.

As part of the original spaceport development EA in 1996, it was concluded that no adverse economic impacts to minority or low-income communities would be created by development of the spaceport. Rather, that report presented several positive aspects for developing a spaceport at Narrow Cape, to include:

- Construction would stimulate the local economy.
- Post construction employment at the spaceport would have a disproportionately high beneficial economic impact since wages cycle through the economy, creating indirect effects.
- Visiting launch customers would add economic value to the community.
- Expenditures by the spaceport and launch customers would result in a small beneficial economic impact on the community.
- Socioeconomic impacts to commercial fishing and shipping would be minimal
- Impacts to minority communities or communities of low income are not highly adverse and disproportionate.

The proposed development projects in this document are not expected to create any significant increased socioeconomic, environmental justice, and children's environmental health and safety risks as minimal additional facility construction is planned. Rather, expansion of PSCA to meet projected launch demands would create a positive economic impact on Kodiak and provide a unique educational benefit to children having access to a high-tech aerospace industry in Kodiak.

Initially, it is expected that employment opportunities during the construction phases will require the current level of contract construction and labor support, thereby extending job opportunities in the construction workforce for a number of years. To support the increased number of launches, PSCA is expected to increase the number of employees that work at the spaceport and live in Kodiak and the residential areas near PSCA. Increased launches at PSCA will also provide greater economic advantages to the logistics, transportation, and material/commodity support businesses on Kodiak, creating a positive economic benefit to the community. With increased launches, the number of launch company personnel that visit Kodiak to support launches will provide a steady benefit to the lodging, car rental, and food establishments at Kodiak.

Increased launch operations will have an impact on both the commercial fishing and aviation communities, as waterways and airspace south and southwest of Narrow Cape must be closed for short periods during launch windows. As described in the previous chapter, Alaska Aerospace is working with the commercial fishing industry, air taxi operators, FAA, and USCG to develop procedures and processes that minimize launch impacts for both the fishing and aviation communities.

To further minimize these impacts, Alaska Aerospace is pursuing shorter launch windows over fewer days. Furthermore, it is now the policy of Alaska Aerospace to not schedule launches over weekends, on holidays, and attempt to avoid peak daytime periods between 10:00 am and 4:00 pm, unless required by the launch operator to meet mission objectives. Certain customer requirements may dictate launches to be conducted during these times, but Alaska Aerospace strives to reduce launch times that are the most inconvenient for other groups that use Narrow Cape and the surrounding waters and airspace.

The 2016 EA determined that the construction and operation of LP-3 would generally not affect customary rural subsistence practices. It should be noted that the Sun'aq Tribe of Kodiak has expressed specific concern with further development that may "impact their ability to continue participating in traditional and customary subsistence activities (fishing, hunting, berry picking, plant gathering, etc.), economic opportunities (through fishing and transportation via plane, helicopter, or boat), an recreational/other tourism-related opportunities (hiking, bird watching, whale watching, and surfing) on these public lands" (Sun'aq letter to Alaska Aerospace dated December 4, 2019).

Closures of Narrow Cape and the associated waterways and airways for hazardous and launch operations will have a temporary effect on subsistence activities and the economic and recreational activities identified by the Sun'aq Tribe of Kodiak; However, these closures will be limited, with Alaska Aerospace reducing the hours per day and the number of days a launch window may be scheduled. Therefore, the impact is expected to be minimal and manageable.

Launch Failure and Emergency Procedures – There have been three launch failures at PSCA since originally built in 1996 and one launch vehicle incident at Pad 3B. The first occurred in 2014 with the failure of the solid propellant launch vehicle from LP-1 supporting the Space and Missile Defense Command Advanced Hypersonic Weapon test program. This launch failure resulted in damage to PSCA facilities, especially those in close proximity to LP-1, as well as contamination of the surrounding vegetation from the burning of unspent propellant. Environmental clean-up and facility reconstruction were completed by August 2016. Remediation of the contaminated area was certified complete by the ADEC.

The second and third launch failures occurred in 2018. Both involved a small liquid propellant commercial launch vehicle being tested at PSCA. In both cases the vehicles successfully launched from LP-2, but experienced a system failure shortly after lift-off, impacting the ground in close proximity to LP-2. In both cases unburned propellant contaminated a small area in and around the impact site. Both sites were fully remediated, with contaminated dirt removed from the site, bagged into environmental containment sacks, and shipped off-island for final remediation. The impact areas were revegetated and no long-term environmental consequences have been experienced.

The Pad 3B incident caused an explosive fire that destroyed the launch vehicle on the pad and caused some grass fire damage in close proximity to the launch pad itself. The incident was reported to ADEC, clean-up has been completed, and repairs to the pad are on-going.

Due to the limited number of launches, with the location of the launch pads away from other facilities and along the coastline, the likelihood of an impact on biological resources which creates long term environmental impacts is low. Debris scatter that could occur over the Gulf of Alaska or North Pacific Ocean during a launch abort would also have a low probability of impacting aquatic species.

Alaska Aerospace maintains an active emergency response plan in the event of a launch failure. Due to the comprehensive plan and precautions routinely taken for every launch at PSCA, there have been no injuries as a result of any launch mishap at PSCA. Fires resulting from an explosion on the pad, during launch, or in flight could result in a temporary loss of habitat lasting a few weeks up to a few months, but minimal impacts have been experienced from past incidents.

The extent of potential impacts caused by a launch vehicle failure on the launch pad or shortly after lift-off would depend on the type of propellant, the conditions of the accident, and the nature of the terrestrial and water resources affected. Terrestrial and marine/estuarine animals could suffer injury or mortality from associated chemicals, heat, and noise. Habitats may also be temporarily degraded or permanently destroyed. Overall, environmental impacts caused by launch failures are not expected to have a long term adverse impact on the environment.

Seismic Conditions – PSCA is in an area that is prone to seismic activity. Kodiak lies northwest of the tectonic Pacific Plate, which meets the North American Plate along the Aleutian subduction zone (Megathrust), so defined because the Pacific Plate is moving northwest and under the North American Plate. This creates constant pressure that ultimately is released resulting in earthquake activity along the Aleutian Chain and Kodiak Island. The 1996 EA provided a description of the seismicity of Narrow Cape and is incorporated into this document by reference.

The Alaska Geological and Geophysical Survey has a comprehensive fault line map that shows Narrow Cape with a series of fault lines traversing the area from southwest to northeast. Figure 7-5 depicts the known Narrow Cape area fault lines with proposed development locations.

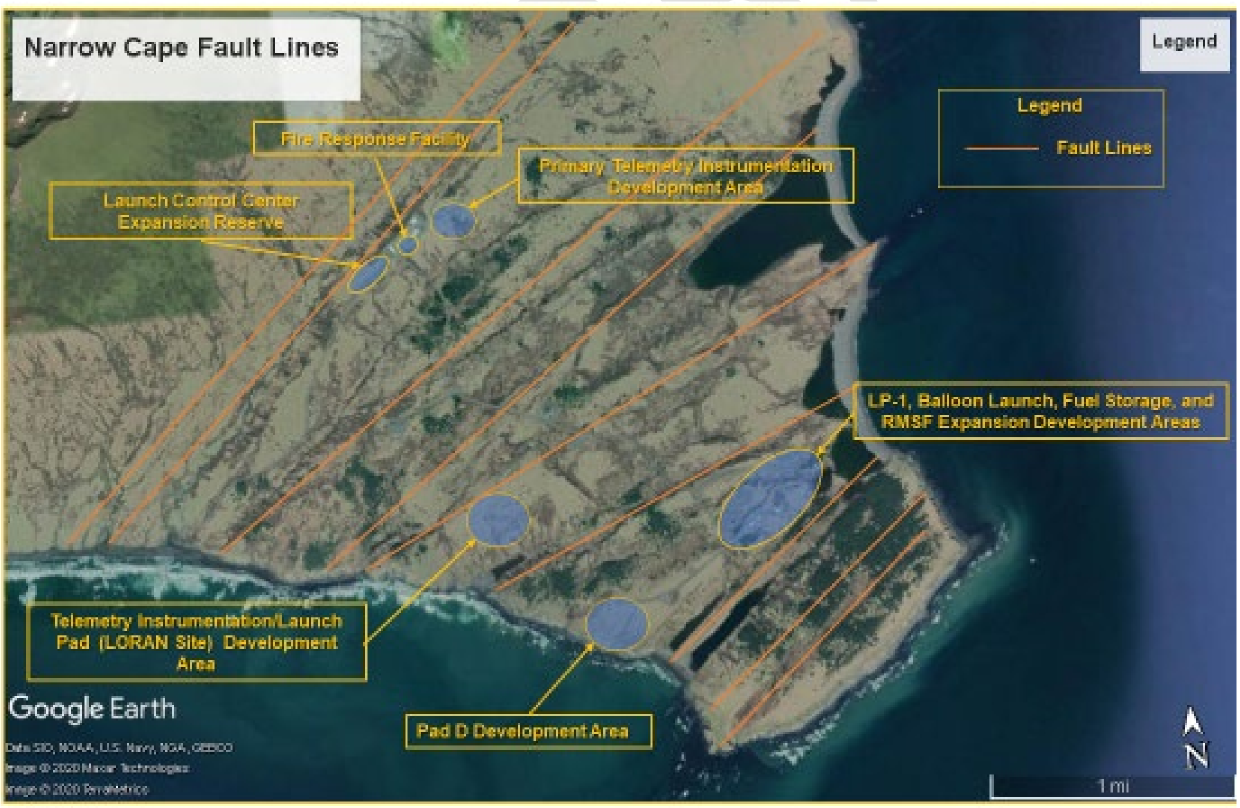


Figure 7-5: Narrow Cape Fault Lines and Proposed Development
(Fault Lines are general areas and not specific – Taken from Alaska Geological and Geophysical Surveys Map)

Due to the seismic activity probability at Narrow Cape, underground fuel storage tanks are not recommended. Only above ground fuel storage tanks are recommended for use at PSCA. All facilities constructed at PSCA would require foundations designed to resist predicted maximum seismic loads. In addition, structural design must include seismic design features that resist structural damage from projected earthquake magnitudes for the area. Compliance with the National Institute of Buildings Sciences, Building Seismic Safety Council, *Earthquake- Resistant Design Concepts, December 2010*, should be incorporated into design standards for structures being built at PSCA.

SECTION THREE - Cumulative Impacts

NEPA environmental analyses must address the cumulative effects of projects on the environment. Specifically, those elements that may be connected, cumulative, and have similar actions in the same document must be presented. The FAA, through FAA Order 1050.1E, Environmental Impacts: Policies and Procedures, Change 1, is the federal agency responsible for enforcing this provision through a comprehensive review of the recommended development and the potential impacts associated with said development.

This chapter is not an Environmental Assessment or Environmental Impact Statement for development of the projects presented in this Master Plan. Rather, this chapter presented an overview of the environment and potential areas that may require additional review if built. Since the majority of sites have already been developed in past years at PSCA to support needed operations, construction impacts are limited to seven primary areas:

Under the proposed development plan, construction projects included in this plan would create minor and, in most cases, temporary environmental effects. The primary concern during construction of any project is minimizing the area of disturbance and protection from soil erosion. In all instances, once construction is complete, any disturbed area not developed would be revegetated. In regard to the prevention of soil erosion,

The areas where construction impacts may be created include:

- Development of liquid propellant capability at LP-1
- Construction of a High-Altitude Balloon Launch Area.
- Development of Pad 3D
- Installation of an Integration Facility across the access road from Pad 3C
- Installation of a Liquid Propellant Storage Facility
- Construction of additional Rocket Motor Storage Facilities
- Development of the Expanded Telemetry Instrumentation Area at the existing USCG LORAN site

Based on the information provided in this chapter, there are four areas that may require further evaluation to meet the forecast demand of increasing launches at PSCA up to 36 per year. It is recognized that the increased number of launches creates a cumulative effect as each additional launch further adds to the impacts already experienced from previous launches.

Air Quality – The previous EAs for PSCA determined there would be temporary air emissions from construction projects at PSCA. This is projected to be consistent with any future development projects completed at the spaceport. Past EAs concluded that the cumulative impact of construction to air quality would be negligible. Projects constructed under the preferred development plan would create less disturbance than those addressed under the previous studies. Therefore, it is expected that construction of the projects proposed in this

Master Plan will create minimal air quality impacts and not require further environmental review.

The 1996 EA addressed only solid propellant rockets being launched from LP-1. That study concluded air quality impacts would be minimal and have no expected adverse effect to the air quality of Narrow Cape. The 2016 EA introduced liquid propellant rocket operations to PSCA and expanded the areas for launches to include Area 3 on the southwest end of the spaceport above Fossil Beach. That EA concluded there would be in an increase in annual emissions over previous operations and cumulative to the air quality emissions from past construction and operations activities at PSCA. However, the 2016 report found that, provided Alaska Aerospace did not exceed the authorized launches, the “cumulative impact would not be significant” (page 4-28).

Under this plan, operations would be increased to 36 annual launches from PSCA to include both solid and liquid propellant launch vehicles. Launch pad development and improvements would be concentrated in the same areas where launch pads already exist, with the one exception that a launch pad may be developed near the USCG LORAN site if Alaska Aerospace gains access to that leased area. To address the projected operations increase, Alaska Aerospace initiated a written reevaluation of the previous EA’s to determine whether the increased launch operations would meet environmental standards. Therefore, a determination as to the effects on air quality an increase to 36 annual operations may have on the environment will be addressed in that document.

Water Quality – Development of the preferred alternatives at PSCA are not expected to create an increased adverse impact to the water quality of Narrow Cape. During each project’s construction phase, water containment barriers would be used in areas where ground disturbance could cause increased particulates infiltrating the ground water and drainage systems.

Potential water quality impacts caused by operational launches may increase with the additional launches being projected at PSCA. This increase is expected to be solely related to increased emissions from liquid propellant launch vehicles, as solid propellant launch vehicles are projected to remain around two launches per year throughout the planning period. The 1996 EA predicated environmental conclusions based on nine launches per year, all being solid propellant vehicles. Therefore, there should be no increased water quality effects caused by solid propellant vehicles as a result of implementing the preferred development plan.

The 2016 EA provided a comprehensive assessment of water quality cumulative impacts that included evaluation of liquid propellant launch vehicles. In that EA it was determined that the exhaust created by a liquid propellant launch vehicle “does not directly or indirectly affect water quality: (page 4-23). That study identified the potential water quality issue to be related to the water deluge system used to suppress noise, vibrations, and to cool the launch pad during initial lift-off. As stated on page 4-24, “Deluge water would be captured in a containment pond at the end of the flame trench providing an area for the water to evaporate or to be drained into the surrounding area after testing the water to verify no presence of harmful materials.”

Construction of Pad 3B included installation of a deluge water containment concrete trench that collects all water for water quality testing. The system has proven reliable. That design, or similar type of water containment system, is retrofitted at Pad 3C and would be installed in Pad 3D for long term use of these pads for liquid propellant launch vehicle operations.

Increasing the number of launches at PSCA to 36 per year, with the significant majority of these launches using liquid propellant vehicles and launching primarily from pads 3B, 3C, and 3D with the water containment systems installed as described in this plan, there is not expected to be any measurable increase in either surface or ground water contaminants; however, this issue will be addressed in the current written reevaluation process.

Noise – Previous noise analyses conducted at PSCA determined there would be no significant cumulative impacts related to noise under the current launch limit of nine launches per year. However, this Master Plan is predicated on the projected increase in launches up to 36 per year by 2030. Recognizing that this increase in operations would result in additional noise events and include smaller liquid propellant launch vehicles than previously evaluated, Alaska Aerospace initiated an environmental written reevaluation to determine any potential cumulative impacts that might occur with the increased number of launches annually. The results of that reevaluation will address any potential impacts and mitigation that may be necessary due to noise generated by the 36 annual launches from PSCA.

Fish and Wildlife (Marine Mammals) – The predominant issue concerning marine mammals in the vicinity of Narrow Cape involves the potential impacts of noise generated by each launch from the spaceport. The current EA’s established a marine mammal monitoring program that has been used since the first launch from the spaceport in 1998 and continues today. The primary focus of developing the preferred alternative concerns the increased number of launches from PSCA which would result in increased noise events that may impact marine mammals in the local area.

Both the 1996 and 2016 EA’s determined that the noise impacts to marine mammals on Ugak Island should not create any negative impacts; however, the National Marine Fisheries Service (NMFS) required that annual counts be conducted of marine mammals using Ugak Island. In addition, Stellar sea lion and harbor seals on Ugak Island must be counted before and after each launch to determine if any impacts were created by the launch activities from PSCA. These counts have been taken over the past twenty years with no quantifiable impact to the populations attributable to rocket launches from PSCA. Because this Master Plan is projecting an increase in launches up to 36 per year, this topic will specifically be addressed in the written reevaluation process for FAA authorization to increase launches at PSCA.

SECTION FOUR - PROJECT DEVELOPMENT
RECOMMENDED ENVIRONMENTAL ANALYSES

This final section provides a project-by-project recommendation, as presented in Chapter Six - *Preferred Development Alternative*, on whether further environmental analysis may be necessary. Projects are presented in Figure 7-6 and described, as follows:

1. *LP-1:* Add liquid propellant launch vehicle capability to LP-1: Further environmental analysis may be necessary, depending on the siting of the propellant tanks pads and water deluge system.
2. *Pad 3D Development:* No further environmental analysis necessary, as the area has already been addressed in the 2016 LP-3 EA.
3. *Construction of Pad 3C Integration Facility:* No further environmental analysis necessary.
4. *Pad 3A Multi-Use Commodity Storage and Equipment Staging Area Development:* No further environmental analysis necessary.
5. *Construction of High-Altitude Balloon Launch Pad:* No further environmental analysis necessary as the area has already been disturbed during the initial construction of the spaceport and development will occur within the already disturbed area.
6. *Construction of Launch Vehicle Propellant Storage Tanks:* Additional environmental analysis may be necessary prior to constructing this area and installing tanks. This area is adjacent to the existing RMSF, but has not previously been developed.
7. *Identification of Rocket Motor Storage Facility Reserve*: No environmental analysis necessary in reserving the land. Additional environmental analysis may be necessary when construction of the expanded RMSF becomes necessary.
8. *Primary Telemetry Instrumentation Antenna Field Expansion:* No further environmental analysis necessary as the area has already been addressed in the 1996 EA.
9. *Telemetry Instrumentation Antennas and/or Liquid Propellant Launch Pad Development at the USCG LORAN Site*: Additional environmental analysis should be conducted prior to constructing any antennas or constructing a launch pad at this site, as the area being recommended has not yet been developed, but is immediately adjacent to the abandoned USCG LORAN facilities. Caution should be noted that the existing USCG facilities at the site may have environmental contamination which should be addressed, and may have to be remediated, prior to installing antennas at this location.

10. *Launch Control Center Expansion Reserve:* No environmental analysis necessary in reserving the land or for expanding the facility, as the expansion area will be in an area already developed as part of the original construction of the spaceport.

11. *Expanded Mission Control Center:* No further environmental analysis necessary as the area was used during the initial construction of PSCA and was covered under the 1996 EA.

12. *Light Manufacturing and Warehouse Development Area*: Additional environmental review may be necessary to determine if this area requires an environmental assessment. The site is located along the developed Pasagshak Road near the entranceway to PSCA, but the area has not previously been developed.

13. *Instrumentation Site (Area 1):* No additional development recommended.

14. *Instrumentation Site (Area 2):* No additional development recommended.

15. *Installing Larger Vehicle Fuel Storage Tanks:* No further environmental analysis necessary as the tanks will be placed in the same location as is currently being used for fuel storage tanks and complies with existing environmental standards.

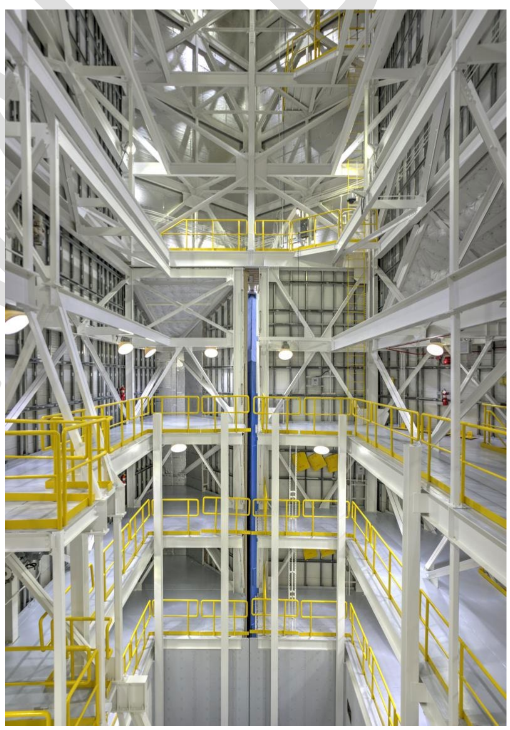
16. *Drilling a New Water Well and Installing a Second Water Storage Tank:* No further environmental analysis necessary.

17. *Life Support Area:* Reserved for future temporary lodging requirements. No further environmental analysis is necessary, provided the area is used consistent with past uses.

18. *Fire Response Facility*: No further environmental analysis is necessary, as the facility will be built in an area previously disturbed by the original construction of the Launch Control Center and surrounding area.

Figure 7-6: Preferred Development Plan

Chapter Eight - Pacific Spaceport Complex – Alaska Capital Investment Financial Analysis



SECTION ONE – Overview

Implementation of the projects identified in this Master Plan requires a significant financial investment. Potential project development costs need to be identified to provide spaceport management with the ability to understand the financial impacts project development costs may have on the long-term spaceport budget.

This chapter presents an estimated cost for construction of each project, using a Rough Order of Magnitude (ROM) cost estimate, along with identifying potential funding sources. From this information Alaska Aerospace will be able to make reasonable financial decisions on future development and be able to establish quantifiable costs for customer proposals.

The cost estimates used a number of factors for determining the ROM. Planning and design costs will vary among projects based on the complexity of the design work and advance planning that is necessary to prepare to construct the project. ROM estimates do cover the basic construction costs, as well as preparatory costs such as drainage, erosion mitigation, mobilization and demobilization, as well as a project contingency cost. Environmental and any potential hazardous material mitigation costs will be dependent on whether additional environmental work is necessary before a project can be constructed. These potentially additional costs are not factored into the ROM presented in this Master Plan.

To conservatively manage the development plan, projects are not projected to be built at specific time intervals, rather projects will be pursued only when the customer demand exists, the necessary environmental reviews have been completed, and the ability to finance the project has been met.

SECTION TWO – PSCA Financial System

As a state-owned corporation, Alaska Aerospace operates its own financial system and is expected to operate without state financial support. The Corporation receives an annual external audit and submits an annual report to the Governor and Legislature.

The spaceport's fiscal year runs from July 1st through June 30th and its financial statements are presented on the full accrual basis in accordance with Generally Accepted Accounting Practices (GAAP). While Alaska Aerospace is a state-owned corporation, the company does not receive state operations or sustainment general funds. Revenues must cover expenses. As a state-owned corporation, Alaska Aerospace maintains the ability to generate capital improvement funding from a number of sources. Alaska Statue (AS Sec. 26.27.100) authorizes Alaska Aerospace to:

a. *Make and execute contracts and other instruments;*

b. *In its own name acquire property, lease, rent, convey, or acquire real and personal property, except that a project site or part of a project site may not be acquired by eminent domain;*

c. *Issue bonds and otherwise incur indebtedness, in accordance with AS 26.27.150, in order to pay the cost of a project or projects to construct or improve launch facilities or other space and aerospace projects or in order to provide money for the corporation's purposes under this chapter; the corporation may also secure payment of the bonds or other indebtedness as provided in this chapter. AS 26.27.150 states "The Corporation may issue bonds in its discretion for any of its corporate purposes and may issue refunding bonds for the purpose of paying or retiring bonds previously issued by it. The Corporation may not, without prior legislative approval, issue bonds, other than refunding bonds,*

    1) *In a total amount in excess of $1,000,000 each calendar year; or*

    2) *If the annual debt service on all outstanding bonds issued and proposed to be issued exceeds $1,000,000 in a fiscal year."*

d. *The corporation may issue bonds including but not limited to bonds on which the principal and interest are payable:*

    1) *Exclusively from the income and revenue of the space-related project financed with the proceeds of the bonds,*

    2) *Exclusively from the income and revenue of designated space-related projects whether or not they are financed in whole or in part with the proceeds of the bonds,*

3) *From its revenue or other assets generally, or*

4) *Exclusively from rents, fees, charges, or other revenue collected or*

5) *Received by the corporation. Bonds may be additionally secured by a pledge of a grant or contribution from the federal government or from another source, or by a pledge of income or revenue of the corporation, or by a mortgage of a space-related project or other property of the corporation.*

e. *Pledge rents, fees, charges, or other revenue from the use of its services or facilities as security for bonds of the corporation;*

f. *Undertake to finance or develop a space-related project with any agency or authority of the state, its political subdivisions, agencies or authorities of other states, the federal government, foreign governments, or private entities:*

g. *Accept gifts, grants, or loans from, and enter into contracts or other transactions regarding them with, a federal agency or an agency or instrumentality of the state, a municipality, private organization, or other source;*

h. *Enter into contracts or agreements with a federal agency, agency or instrumentality of the state, municipality, or public or private individual or entity, with respect to the exercise of its powers, and do all things necessary or convenient to carry out its corporate purposes and exercise the powers granted in this chapter;*

i. *Own, acquire, construct, develop, create, reconstruct, equip, operate, maintain, extend, and improve launch sites, launch pads, landing areas, ranges, payload facilities, laboratories, space business incubators, facilities for the construction of rockets and other launch vehicles, and other space facilities and space-related systems, including educational, cultural, tourism, and parking facilities, and space-related initiatives; and*

j. *Charge fees, rents, or other charges for the use of a facility, structure, or service developed, operated, or provided by the corporation including fees, rents, and other charges in excess of the actual operating cost of the use of the facility, structure, or service;*

All procurement contracts, budgets, capital improvement programs, and grants for the spaceport in excess of $200,000 are acted upon by the Alaska Aerospace Board of Directors. The Board's management goal is to operate the spaceport as a financially self-sustaining enterprise fund although the State does have authority to provide both operations and capital improvement funds, if submitted to the Legislature by the Board for approval. To date, Alaska Aerospace has not issued any bonds to finance capital projects. Since 2014, Alaska Aerospace has received limited Federal funding under the Spaceport Infrastructure Enhancement Program for construction of specific infrastructure at PSCA that supports U.S. Government programs.

In 2015 Alaska Aerospace received 2.5 Million. In 2017, 2018, 2019 and 2020 an average of $4.2 Million was received for each fiscal year. These funds have been used for a variety of projects that included modifying Launch Pad Two (LP-2) for liquid fuel launch operations; upgrading the Launch Operations Control Center; establishing a fixed Range Safety and Telemetry unit and modernizing mobile systems, developing a small launch vehicle launch pad, processing, infrastructure, and support capabilities in Area 3; purchasing state-of-the-industry weather radar; enhancing spaceport safety and security features, and a variety of other assorted spaceport support requirements. It is expected this program will continue, so long as there exist federal infrastructure facility requirements at PSCA.

Alaska Aerospace has also partnered with commercial customers to develop new infrastructure supporting expansion into small liquid propellant launch vehicle operations at PSCA. Both Launch Pads 3B and 3C included some private sector investment funding towards launch pad modifications and new construction. This model has proven successful in securing private sector commitments for operating from PSCA and is expected to be continued in the future.

Construction of new infrastructure at the spaceport can be accomplished relatively quickly, but the pre-construction process, including any required environmental review, can be lengthy which may require Alaska Aerospace to proceed with capital project investments ahead of final customer commitments.

With the changing economic environment caused by the global coronavirus pandemic and the projected uncertainty in private investment funding for space enterprises, the timing for development of new infrastructure at PSCA is expected to more fluid than previously anticipated based on customer requirements. A downturn could reduce annual revenues to Alaska Aerospace, but will also reduce financial requirements for new facilities until such time as customers have the financial ability to operate from PSCA. As such, this Master Plan recommends infrastructure investments be tied closely with necessary customer requirements.

Alaska Aerospace develops a balanced operating budget for Board of Directors approval each fiscal year. The budget includes all projected capital improvement program requirements, as well as capital equipment needs.

SECTION THREE – Capital Improvement Program

PND Engineers, Inc., and Alaskan engineering company, provided Alaska Aerospace with Rough Order of Magnitude (ROM) estimates for the primary Capital Improvement Program (CIP) development projects recommended under this plan. Alaska Aerospace then conducted an internal review of past construction costs to determine the most reasonable cost estimates for future projects at PSCA. The cost estimates presented herein were prepared for financial planning purposes only. Actual project costs will be defined through subsequent design and bidding. The costs do not include any general contractor markups. No cost escalation was included. The cost estimates are presented in ranges and provided in current (2020) dollars.

It is important to note that the CIP cost estimates and timing developed for future years are considered based on the current assessment of future needs, but must be viewed as preliminary, reflecting a Master Plan level of detail subject to refinement with regard to timing and final cost estimates in subsequent implementation steps. Some of the future projects may be replaced by new projects as priorities and conditions dictate. Some projects that would be paid by customers will be dictated by the availability of the customer's funding.

The CIP is divided into two sections in this Master Plan. The first section presents the estimated construction costs for projects recommended for development within the planning period. The second section presents land area reserves that are being identified in this Master Plan to recognize these areas for potential future expansion. Cost estimates are not presented for these reserves, as determination for specific use (types of structures, if any) would need to be calculated when the area is developed for the identified purpose.

The total CIP project costs are estimated to range between $22.4 and $32.1 Million over the next decade, with potential for additional cost should any of the reserves be developed.

Projects:

- **Launch Pad 1** – This project increases Launch Pad 1 capabilities by adding infrastructure to support liquid propellant launch vehicles. Depending on the final design, specific location of newly installed systems, and type of equipment purchased, the cost of this project is estimated to range between $7.0 and $8.6 Million.

- **Pad 3A** – Pad 3A will be expanded for development as a multi-Use Tactical Launch Pad with Commodity Storage and Equipment Staging Area capabilities. The project is estimated to cost between $1.0 and $1.5 Million.

- **Pad 3C** – Pad 3C is already developed to support both liquid and solid propellant launch vehicles. Enhancements to Pad 3 C some upgraded systems, such as lighting and cameras, as well as construction of a launch Vehicle Integration Facility (VIF). The VIF will be located on the north side of the existing Area 3 access road and will include security fencing, utilities, lighting, and cameras would also be installed. The project is estimated to cost between $2.8 and $3.2 Million.

- **Pad 3D** – Pad 3D was originally identified as the primary location for construction of Launch Pad 3. Based on market demands, the site was downgraded and developed to support government non-orbital test missions. The site is currently graded, with a gravel surface, fenced, and has utilities service available. To meet future projected demand for light and small lift orbital launch vehicles, this site will be converted to a multi-use government and commercial launch pad. The area will be expanded to include a concrete launch pad, launch support infrastructure, enhanced communications and data systems, lighting, cameras, lightning rods, security fencing and an area for installation of a small VIF. The project is estimated to cost between $3.5 and $4.0 Million.

- **Pad 3E** – Pad 3E is located within the USCG LORAN lease area. The site has the potential for development as either an alternative telemetry instrumentation site or an additional launch facility. Alaska Aerospace is pursuing the transfer of this area from the USCG to Alaska Aerospace to be include within the PSCA ILMA for use in aerospace operations at the spaceport. In the event this occurs, and a customer selects this site for launch pad development, this site would be developed similar manner to the recommended changes for Pad 3D. Due to the size of the USCG leased area, this site could serve a dual purpose of supporting both a launch pad and as the alternate telemetry instrumentation antenna site. The site already has an access road and utilities, although it is expected some utilities, such as power and communications, may need to be upgraded. Costs estimates for development at this site is very dependent on whether it is used for construction of a launch pad, installation of telemetry instrumentation antennas, or both. Development as a telemetry instrumentation site alone is estimated between $1.2 and $1.7 Million while launch pad development costs range between $1.9 and $4.0 Million, depending on the facilities required to support the specific launch vehicle type to use the launch pad.

- **High-Altitude Balloon Launch Area** – To support future commercial stratospheric high-altitude balloon launch systems, Area 5 would be repurposed. The area was used for equipment staging and storage during the original construction of Launch Pad 1. The site would be graded level, a compacted gravel surface added, with a small storage and launch vehicle preparation facility purchased and installed. Lighting, lightning rods, cameras, and a paved pad for parking propellant tanks for inflating the balloon would also be installed. Depending on the type of use the future customer may desire, the area has sufficient space to also locate a customer reception and flight preparation facility. The project is estimated to cost between $900,000 and $1.5 Million.

- **Off-Axis Telemetry and Optics Site** – This site is used on a temporary basis for telemetry and optics tracking when customers require a site that provides an angled view for tracking launches. The site is a popular public recreational site, not located within a state or federal designated recreational area. Bull Lake is also located in close proximity to the designated off-axis telemetry and optics site, for which ADF&G has expressed interest in maintaining access to the lake, as it is stocked by ADF&G for public fishing. Therefore, Alaska Aerospace recommends minimal investment in this area sufficient to support PSCA launch operations, such as grading and leveling the access road from Pasagshak Road. The project is estimated to cost between $200,000 and $500,000.

- **Launch Vehicle Propellant Storage Area** – An area west of the RMSF has been identified as a future Launch Vehicle Propellant Storage Area for storage of liquid oxygen, helium, nitrogen, and other oxidizers. Initially it is projected the existing two LOX tanks and one Helium tank will be installed in the new Launch Vehicle Propellant Storage Area. The area is also planned to meet the need for additional LOX and helium tanks as well as for the potential future storage of liquid fuels, such as RP-1. To support this the area will be graded and leveled, with a compacted gravel surface. The project is estimated to cost between $2.3 and $3.0 Million.

- **Rocket Motor Storage Facility (RMSF) Modifications** – Previous chapters identified the need to modify the two RMSF bays to accommodate smaller, commercial rockets. In 2018/2019 one of the bays was modified using Federal Spaceport Infrastructure Enhancement funds. It is recommended that the second RMSF bay also be modified to maximize the use opportunities of the existing RMSF before expansion of the facility is considered. The modifications are estimated to cost between $500,000 and 750,000.

- **Fire Response Facility –** This project will construct a new Fire Response Facility in the vicinity of the LCC and MSF. The project includes construction of a metal framed facility to support a two-vehicle bay heated garage, with a small office area, storage area, restroom, and work area for competing minor maintenance on the vehicles. The site already has utilities, communications, and data connections in close proximity and has previously been disturbed during spaceport construction. No new road construction is necessary. Depending on the final location and structural design, support equipment, and layout of the interior of the facility, the project estimate ranges between $1.0 and $2.5 Million.

- **Water and Wastewater Facilities –** To provide increased water capacity for the increased operations at PSCA, an additional water well will be drilled in the vicinity of Area 3. Estimated cost is $150,000.

- **Motor Vehicle Fuel Storage Tanks** – As PSCA operations increase, the need for additional/larger motor vehicle fuel storage will occur. Alaska Aerospace estimates that adding a 500-gallon gasoline tank and a 1,000 gallon diesel fuel tank to the existing location, to include an environmentally approved catchment system is estimated to cost between $40,000 and $55,000.

- **Launch Control Center (LCC) Internal Reconfiguration –** The primary reconfiguration priority within the LCC expands the security office to accommodate increased equipment and personnel activities. This will result in a reconfiguration of the LCC front reception area. It is estimated this reconfiguration will cost between $50,000 and $70,000. In addition, the restrooms require reconfiguration to increase the number of toilets. Estimated cost for the restroom reconfiguration is between $60,000 and $75,000. Finally, improvements to the meteorological systems within the LCC are necessary. These include new weather tracing computer display systems, a new anemometer system, installation of a wind profiler, and an automated weather balloon launch facility. Meteorological system upgrades are estimated at between $500,000 and 600,000. The combined project is estimated to cost between $610,000 and $745,000.

- **Enhanced PSCA Entrance and Visitors Area –** Continuing Alaska Aerospace's public outreach, the entranceway to PSCA has seen a number of improvements. These include removing the old satellite receiving dish, installing a model display rocket, removing fencing, and working with ADOT to install a mileage sign for Fossil Breach and the Burton Ranch. Additional work will include grading the entire area to allow for vehicle parking and providing an area for launch viewing and other amenities. Future improvements may include informational display signs and a launch count-down viewing system to allow visitors a real-time launch viewing experience. Total estimated cost is between $1.7 and $3.0 Million.

Throughout the planning period there will be other equipment acquisitions, facility modifications, upgrades and repairs that will be required to sustain a state-of-the-industry spaceport at PSCA. It is expected a new fire fighting vehicle and new ambulance will be procured, as well as new emergency response Personal Protection Equipment (PPE) will be purchased. An optic tracking systems and additional Tracking and Command Destruct antennas may be added to the site as demand increases.

To increase operational efficiencies and reduce costs, a new automated weather balloon launch facility will be purchased to replace the current manual systems. As communications and data systems improve, new and upgraded fiber and cable will be installed, as well as high-speed software to support systems improvements offered on the commercial market. Cybersecurity is of paramount importance to the operations at PSCA, both government and commercial. Cybersecurity upgrades will be accomplished as the software and equipment is developed. New radio systems for security and emergency personnel will be procured, as well as new safety signage at strategic locations around the spaceport. Upgraded and additional back-up generators will be added as demand requires. These additional items will increase the total capital expenditures between $10.6 and $12.8 Million

Land Use Reserves: Part of the Master Plan identified a number of locations at PSCA that should be reserved for future development beyond the planning period, or if demand was created in excess of the forecasts developed for this document. These areas are listed below, without costs estimates associated to each project. Should the demand materialize to warrant development of these area, separate cost estimates would be required for management to determine the viability of development.

- Launch Control Center and vehicle parking area extension reserve.
- Reserve an area directly adjacent to the existing soft-sided storage units north of the MSF for the addition of a third unit, when a requirement exists.
- USCG LORAN site transferred to AAC and reserved as a future Telemetry Instrumentation Antenna expansion area and/or potential launch pad.
- Long Range Radar Site (Area 1) – Reserved for government use.
- Radar Telemetry Site (Area 2) – Reserved for government use, after which the site can be repurposed as a commodity storage and/or equipment staging area.
- Life Support Area – Reserved for future temporary lodging for government missions. This site will not be used for permanent lodging facilities by either the government or commercial customers. When no longer needed for temporary government lodging all above ground structures will be removed, leaving only the utilities and gravel pad for future government use.
- Reserve area for construction of up to three additional Rocket Motor Storage Facilities.
- Reserve four small areas around the spaceport for customer required commodity storage facilities.
- Light manufacturing, fabrication facilities, warehousing, or commercial customer operations warehouse reserve area.

SECTION FOUR – Capital Investment Program Funding Plan

Capital Improvement Projects Funding Sources

Based on the identified Master Plan capital improvement projects and their associated costs, as well as capital equipment requirements, a proposed funding plan was developed for the spaceports projects identified in the Master Plan. For purposes of this analysis, 2018 dollars were used. In developing the funding plan, the overriding objective was to maximize the use of external resources (i.e. federal appropriation and grants, third party funds, etc.) and minimize the amount of funding from Alaska Aerospace financial reserves. It is projected that the costs for the CIP will be funded from a combination of sources:

1. Federal Spaceport Infrastructure Enhancement Program
2. Third Party Customer Financing
3. Alaska Aerospace Retained Earning and Discretionary Funds
4. Federal Aviation Administration (FAA/AST) Space Transportation Infrastructure Matching (STIM) Grant Program
5. Conventional Commercial Loans
6. Alaska Aerospace Bonds

A description of the eligible funding sources for the Airport's Master Plan CIP is presented in the following paragraphs.

Federal Spaceport Infrastructure Enhancement Program – In FY 2015, infrastructure improvement funding for non-federal commercial spaceports that support the National Security Strategy was included in the Department of Defense budget. With this funding, Alaska Aerospace invested in Telemetry and Flight Termination Upgrades, Launch Processing Configuration and Preparation Training and Certification Process, and Site Security and Communications Systems Enhancements. This program proved cost-effective for expanding capabilities needed by the Federal government for planned and future operations at PSCA. Therefore, the budget was increased for 2017, 2018, 2019, and 2020. It is expected this program will be congressionally continued, although funding levels may fluctuate in future years.

Third Party Customer Financing - Third party funding can be available for certain facilities at the commercial spaceport: including launch pads, payload and/or launch vehicle integration facilities, equipment storage facilities, launch control centers, and other purposes. While private funding can be provided in many different forms, a typical approach is for private parties to fund and construct facilities at the spaceport which they will be using, and paying a negotiated user fee to the spaceport for the duration of time they use the facility. For third party financed projects it is imperative that a provision be included in the Agreement that calls for the improvement to revert to the spaceport at the end of the term so that the spaceport is not required to "purchase" the asset back. No buyback has been factored into the financial plan.

Alaska Aerospace Retained Earning and Discretionary Funds – The Alaska Aerospace financial plan includes a provision to maintain retained earnings for capital use, primarily to address annual maintenance requirements. This fund can also be used for capital investments, as well as for new or replacement infrastructure, facilities, or equipment.

Conventional Commercial Loans – Alaska Aerospace has authority to secure loans for development of infrastructure. Conventional commercial loans are loans that are provided by a bank, credit union, savings institution or other traditional financial institution and are secured by a first lien position on the subject property being financed. Rates differ between each lender and depend on the overall credit risk of the businesses applying for the loan. The State of Alaska established the Alaska Industrial Development and Export Authority (AIDEA) to assist financing for qualified Alaska businesses. AIDEA has the ability to provide loan funding to Alaska Aerospace for qualified projects. While the Small Business Administration (SBA) has some favorable loan programs available to qualified businesses, being a government-owned corporation, Alaska Aerospace is not eligible for SBA loans. Alaska Aerospace Board of Director approval is necessary for securing any conventional commercial loan.

Alaska Aerospace Bonds – Alaska Statute 26.27.050 established the Alaska Aerospace Corporation fund in the corporation. The fund consists of appropriations made to the fund by the legislature, and rents, fees, or other money or assets transferred to the fund by the corporation. Amounts deposited in the fund may be pledged to the payment of bonds of the corporation or expended for the purposes of the corporation under this chapter. While issuance of bonds is a viable option for infrastructure development, this plan recommends bonding capabilities be reserved for future development only in the areas identified as "Reserved" in this plan. Alaska Aerospace Board of Director approval is necessary for issuing bonds.

Federal Aviation Administration (FAA/AST) Space Transportation Infrastructure Matching (STIM) Grant Program – Congress provided AST with the authority to offer grant funding to commercial spaceports to "ensure the resiliency of the space transportation infrastructure of the United States." Under federal authorization, the AST may make project grant awards to "sponsors", per 51 U.S.C. 51102. Per 51 U.S.C. 51101(6), a "sponsor" is a public agency that submits an application for a project grant/ Per 51 U.S.C. 51101(5), a "public agency" is a State or agency of a State, a political subdivision of a State, or a tax-supported organization. The authorization legislation states that Federal monies may fund up to fifty percent (50%) of the total project cost in conjunction with state and local funding.

In FY2010, a total of $500,000 was allocated for STIM Grants awarded to four different projects:

1. New Mexico Spaceport Authority – $43,000
2. Alaska Aerospace Corporation – $227,195
3. Jacksonville Aviation Authority – $104,805
4. East Kern Airport District – $125,000

In FY2011, a total of $500,000 was allocated for STIM Grants to three different projects:

1. Virginia Space – $125,000
2. East Kern Airport District – $125,000
3. New Mexico Spaceport Authority – $249,378

The funding for the 2010 and 2011 projects was provided from within existing AST authorized operations. Congress never appropriated funds for the STIM program, as such AST, has not continued the STIM program under its existing structure.

As the commercial space market evolves, the spaceport industry is pursuing congressional establishment of a Spaceport Improvement Program within AST. Should this program be enacted, it will most probably replace the STIM program, which would again provide a federal funding mechanism for commercial spaceports to secure capital infrastructure investment funds through a recognized and funded program. For this Master Plan it is assumed that this program, or something similar, may be authorized and funded towards the end of the planning period.

PSCA PAD 3B Construction Photo

Capital Improvement Projects Funding Recommendations: The following table presents the projects with potential funding sources. Funding sources may vary depending on the amount of funding available under any of the identified programs, as well as any contractual agreement for infrastructure development that may be consummated between Alaska Aerospace and either government and/or commercial customers. The funding sources presented below may not represent that actual funding mechanism used by Alaska Aerospace in the development of any spaceport infrastructure.

Projects	Funding Sources
Launch Pad 1 - Develop liquid propellant launch pad capabilities	*Federal Spaceport Infrastructure Enhancement funds,* *Customer Financing,* *Conventional Commercials Loans,* *Alaska Aerospace Issued Bonds*
Pad 3A – Develop as a multi-Use Tactical Launch Pad with Commodity Storage and Equipment Staging Area capabilities.	*Conventional Commercials Loans, and* *Alaska Aerospace Issued Bonds* *Federal Spaceport Infrastructure Enhancement funds, and* *Alaska Aerospace Retained Earning and Discretionary Funds*
Pad 3C – Pad modifications and Vehicle Integration Facility construction to support Launch Pad 3C.	*Customer Financing,* *Federal Spaceport Infrastructure Enhancement funds, and* *Alaska Aerospace Retained Earning and Discretionary Funds*
Pad 3D – Develop as a multi-use government and commercial launch pad.	*Customer Financing,* *Federal Spaceport Infrastructure Enhancement funds,* *Alaska Aerospace Retained Earning and Discretionary Funds,* *Conventional Commercials Loans, and* *Alaska Aerospace Issued Bonds*
High-Altitude Balloon Launch Area	*Customer Financing, and* *Federal Spaceport Infrastructure Enhancement funds*
Off-Axis Telemetry and Optics Site	*Federal Spaceport Infrastructure Enhancement funds, and* *Alaska Aerospace Retained Earning and Discretionary Funds*
Launch Vehicle Propellant Storage Area/Tanks	*Federal Spaceport Infrastructure Enhancement funds, and* *Alaska Aerospace Retained Earning and Discretionary Funds*
Rocket Motor Storage Facility (RMSF) Modifications	*Federal Spaceport Infrastructure Enhancement funds, and* *Alaska Aerospace Retained Earning and Discretionary Funds*
Fire Response Facility	*Federal Spaceport Infrastructure Enhancement funds, and* *Alaska Aerospace Retained Earning and Discretionary Funds*
Water and Wastewater Facilities	*Federal Spaceport Infrastructure Enhancement funds, and* *Alaska Aerospace Retained Earning and Discretionary Funds*
Motor Vehicle Storage Tanks	*Alaska Aerospace Retained Earning and Discretionary Funds*
Launch Control Center Internal Reconfiguration	*Alaska Aerospace Retained Earning and Discretionary Funds*
Enhanced PSCA Entrance and Visitors Area	*Alaska Aerospace Retained Earning and Discretionary Funds*

Table 8-1: CIP Funding

SECTION FIVE – Economic Impact to Kodiak

Alaska Aerospace was created, in part, to create an aerospace industry in Alaska. Diversifying the Alaskan economy is essential for the long-term economic vitality of the state. Since 2014, Alaska Aerospace has not received any state general funds for operations and sustainment, rather the Corporation has transformed into a self-sustaining business that has produced a small operating profit before depreciation over the past five years.

This Master Plan has identified a growth potential that will significantly improve the Corporations financial profile and provide the opportunity for the state to expand the aerospace market, it also will generate a significant positive economic impact for Kodiak. This section presents the economic impact that could be experienced in Kodiak with increased launch activities at PSCA, as presented in the mid-level forecast. Information will be presented for both government and commercial launches, using historical revenues to present the expected direct and indirect economic benefit to Kodiak.

Pacific Spaceport Complex – Alaska Operations: Alaska Aerospace, through direct staff and contractors, employs twelve (12) full-time and eighteen (18) part-time staff based in Kodiak that generates over $2.4 Million in annual salaries and benefits. In addition, Alaska Aerospace purchases power from KEA, numerous supplies from Kodiak vendors, uses local transportation and logistics companies, and contracts mostly with local construction firms for projects at PSCA. These combined expenditures have generated a positive economic impact to Kodiak in excess of $3.5 Million annually.

Government Launches: Government launches currently produce the most direct and indirect economic impacts to Kodiak, as these launches usually entail a significant number of visitors to the island for a relatively longer period of time than is experienced with commercial customers. To calculate the full economic impact to Kodiak, an analysis is presented that shows the direct and indirect economic impact, excluding the contract value paid to Alaska Aerospace for each of the launch campaigns. For this analysis, an average of government missions conducted between 2014 and 2018 was evaluated to determine the average direct and indirect benefits.

To determine the direct economic benefits the approximate number of customer personnel that came to Kodiak to support the campaign is identified, along with the campaign in days. These was multiplied together to determine the number of room nights (hotel/BnB rooms) used during the campaign. This number was then multiplied by the US Government Per Diem and Lodging rate paid to each government and contractor employee which results in the direct financial impact created the personnel supporting the campaign. Added to this was the estimated car rental payments and support expenses paid to Kodiak business during the campaign. This results in the estimated direct economic impact for Kodiak.

The following information only addresses the average of three launch campaigns.

- Personnel: 175 (Average)
- Length of Stay: 90 Days (Average)
- Number of Room Nights: 10,000
  (Number of Personnel, times the Number of Days, minus visitors that stayed at the Kodiak Narrow Cape Lodge)
- Per Diem Rate: $74.00 daily rate (Summer Rate)
- Lodging Rate: $152.00 per night (Summer Rate)
- Daily Rate Per Person: $226.00
- Direct Personnel Income: 10,000 X $226.00 = $2,260,000
- Car Rental Income: $225,000
- Support (Logistics, Transportation, Purchases) = $250,000

Total Direct Economic Impact = $2.7 Million

Analysis finds that the average for each government launch generated about $2.7 Million in direct economic value to Kodiak resulting in a total direct economic benefit of approximately $8.1 Million. The following presents an analysis of the average indirect economic impact of these three campaigns.

The indirect effect is the economic impact outside of the Alaska Aerospace economic impact generated specifically to support the launch campaign, such as fishing/hunting trips, boat charters, personal expenses on clothing, leisure activities, entertainment, etc. It also includes the contractor services used to support the government launch operations at PSCA. Indirect economic impacts can be monetary or non-monetary and are particularly important to assess in relation to the local community's economy.

A standard indirect multiplier used at many government locales ranges between 1.2 and 1.4 for aerospace operations. Since PSCA is situated a relatively long distance from PSCA and those who stayed in town for room and board usually spent most of their leisure time in Kodiak and not at PSCA, as well as the fact that all three government missions at PSCA required extensive local contractor support (such as construction activities and logistics support), a higher government multiplier is warranted for use in this analysis. Applying a 1.4 multiplier to the average for the three government missions' results in the following total economic benefit equates to a $3.2 Million indirect economic benefit. The combined direct and indirect economic benefits is:

Direct Economic Benefit = $8.1 Million

Indirect Economic Benefits = $3.2 Million

Total Economic Benefit = $11.3 Million.

Total direct and indirect economic impact to Kodiak of the three government missions was approximately $11.3 Million.

Commercial Launches: The evaluation of commercial launches used the same criteria as was presented for government launches. The primary difference is in the number of customer personnel that are required to be at PSCA for a launch, as well as the duration of the launch campaign. Alaska Aerospace has supported three commercial launch campaigns at PSCA since 2018. All three launches experienced extended launch campaigns due to a number of unique circumstances not expected to be experienced once the commercial launch vehicle becomes operational.

All commercial launch customers seek to minimize the duration and cost of launch in order to be competitive in the emerging small satellite market. An analysis of the minimal launch requirements that must be conducted in order to safely process and launch a rocket at PSCA. Since each launch campaign period will most probably be slightly different for each customer, based on the type of launch vehicle, type of payload being launched, weather, and other factors, the following analysis was developed using an average campaign period of two weeks. This includes seven days for pre-launch preparation, one launch rehearsal day, one day off, a four-day launch window, and one day post-launch. The following presents the direct and indirect economic impact estimate for a single commercial launch campaign.

- Personnel: 6 (Average)
- Length of Stay: 14 Days
- Number of Room Nights: 84
- Per Diem Rate: $72.00 daily
- Lodging Rate: $180.00 p/n
- Daily Rate Per Person: $252.00
- Direct Personnel Income: 84 X $252.00 = $21,000
- Car Rental Income: $2,100
- Support (Logistics, Transportation, Purchases) = $2,500

Total Direct Economic Impact =	$25,600
Total Indirect Economic Impact =	$10,240
Total Economic Impact =	*$35,840*

Future Direct and Indirect Economic Impact Projections: The combined direct and indirect economic impacts for both government and commercial launches were calculated against the projected forecast demand for the ten year planning period to present the potential economic impact to Kodiak with full development of this Master Plan, excluding induced impacts and potential revenues generated through taxes by the Kodiak Island Borough for private sector commercial development on leased lands at PSCA. The following figure presents the projected cumulative direct and indirect economic impact for Kodiak and includes the annual economic benefit of the operations and sustainment benefits generated by the workforce employed and facility expenses at PSCA:

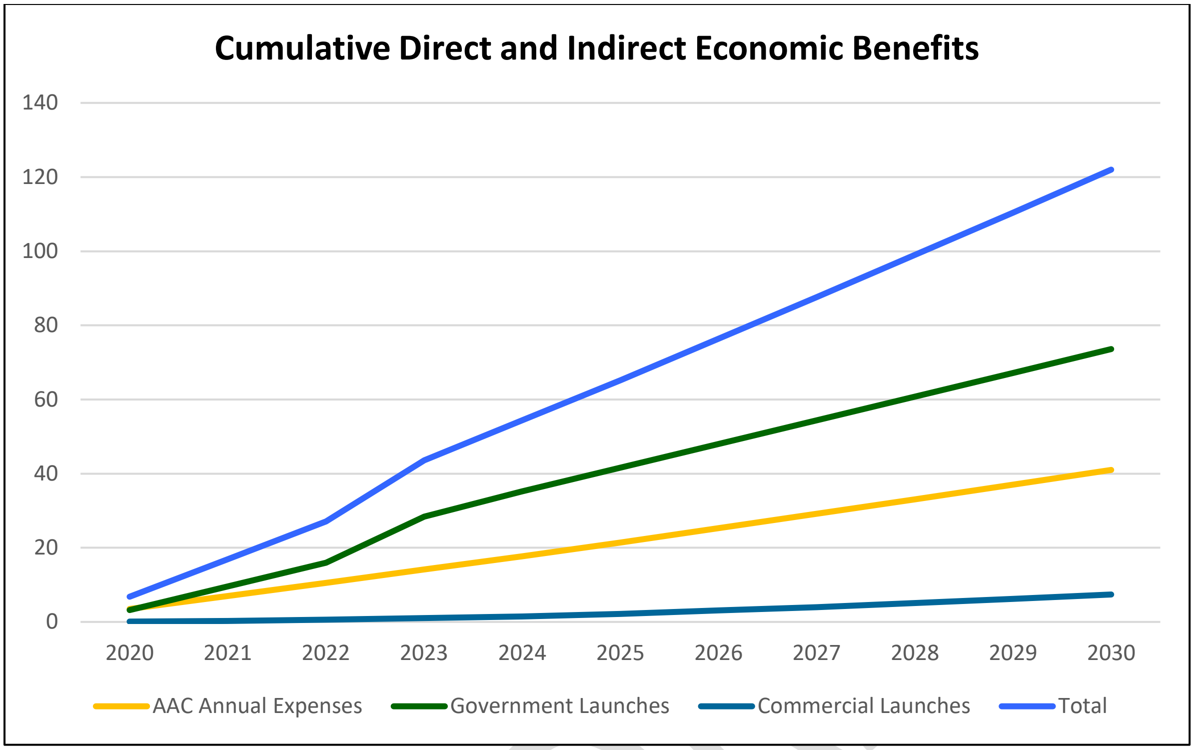


Figure 8-1: Cumulative Direct and Indirect Economic Benefits in Kodiak

Additional Economic Impacts Over Time – While the above economic analysis shows a positive cumulative economic impact exceeding $120 Million direct and indirect economic benefit to the community over the planning period, in addition to the contract value gained directly by Alaska Aerospace for services performed to support each launch from PSCA, it is also expected that increased launches will require an increased number of personnel being permanently employed by Alaska Aerospace or its subcontractors who will reside in Kodiak. Additionally, with a busy launch schedule for commercial customers, it is expected some launch companies will permanently assign a small number of employees in Kodiak to support their spaceport operations, resulting in additional permanent residents in Kodiak.

As commercial launch operations increase, the need to reduce logistics costs for the customer is expected to result in a demand for some light manufacturing, final assembly, and repair/maintenance work being located in Kodiak, with some activity also at PSCA. This Master Plan identified a location for a customer(s) built light manufacturing and warehousing facility at PSCA to ensure the capability to grow the aerospace business is available. This planning process will not be developing an economic model for this potential development, but rather once the market matures Alaska Aerospace should contract for a comprehensive Economic Impact Study to quantify the realized benefits from the growth in aerospace at PSCA and in Kodiak.

SECTION SIX - Summary

Implementing and funding the Spaceport's Master Plan Capital Investment Plan will largely be a function of federal and third-party funding sources available at the time of specific project implementation. Due to the conceptual nature of the Master Plan, implementation of most of these capital projects and capital equipment requirements should occur only after further refinement of their costs and timing. The financial feasibility of the Master Plan is based on a number of factors, most notably of which is the level of external funding sources the spaceport is able to secure to fund the various projects. There is no guarantee funds will be made available in any given year, or if they are, that they will be funded at the full eligibility levels. As stated previously, capital infrastructure investment should only be completed when the customer is secured.

The financial analysis presented in this section has been provided to show the financial feasibility of implementing the recommended development plan for the spaceport. The capital projects recommended in the Master Plan appear to be financially feasible provided management remains fiscally conservative and only implements construction of projects based on firm contract commitments to conduct business at PSCA.

In conclusion, development of the preferred development alternative for PSCA provides the spaceport with an ability to expand the aerospace business in Alaska; diversify the customer base at PSCA; increase revenues for Alaska Aerospace; generate significant new revenues for Kodiak and the Kodiak Island Borough; and retain the recreational, cultural, and wildlife experiences for the public who visit Narrow Cape.