Federal Aviation Administration

Draft Environmental Impact Statement
SpaceX Texas Launch Site

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

SPACEX TEXAS LAUNCH SITE

VOLUME I

EXECUTIVE SUMMARY AND CHAPTERS 1 – 14

APRIL 2013

Prepared by:

Federal Aviation Administration

Office of Commercial Space Transportation

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APPENDICES

TITLE: Draft Environmental Impact Statement for the SpaceX Texas Launch Site

AGENCIES: Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST), lead agency; National Aeronautics and Space Administration, cooperating agency; National Park Service, cooperating agency; U.S. Army White Sands Missile Range, cooperating agency; U.S. Army Corps of Engineers, cooperating agency

PUBLIC REVIEW PROCESS: This Draft Environmental Impact Statement (EIS) is submitted for review pursuant to the following public law requirements: Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA) (42 United States Code [U.S.C.] 4321 et seq.); Council on Environmental Quality NEPA implementing regulations (40 Code of Federal Regulations parts 1500 to 1508); Section 4(f) of the Department of Transportation Act (49 U.S.C. Section 303); Section 106 of the National Historic Preservation Act (16 U.S.C. 470); FAA Order 1050.1E, Change 1; Executive Order 11988 Floodplain Management; DOT Order 5650.2 Floodplain Management and Protection; Executive Order 11990 Protection of Wetlands; and DOT Order 5660.1A Preservation of the Nation's Wetlands. In accordance with the applicable requirements, the FAA is initiating a public review and comment period for the Draft EIS. The EPA's Notice of Availability of the Draft EIS in the *Federal Register* starts the 45-day public comment period. Comments on the Draft EIS are requested by June 3, 2013. A public hearing to receive comments on the Draft EIS will be held on May 7, 2013 from 5:00 p.m. to 8:00 p.m. at the International Technology, Education, and Commerce Center, located at 301 Mexico Boulevard, Suite G-1, Brownsville, Texas.

DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION, ABSTRACT: The FAA is evaluating Space Exploration Technologies Corp. (SpaceX's) proposal to construct a vertical launch area and control center area on private property in Cameron County, Texas, to launch the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of smaller reusable suborbital launch vehicles, which would require the FAA to issue launch licenses and/or experimental permits. Under the Proposed Action, SpaceX would construct a vertical launch area and a control center area to support up to 12 commercial launches per year. The vehicles to be launched include the Falcon 9, Falcon Heavy (up to two per year), and a variety of smaller reusable suborbital launch vehicles. SpaceX would be required to apply to the FAA for the appropriate launch licenses and/or experimental permits. Alternatives under consideration include the Proposed Action and the No Action Alternative. Under the No Action Alternative, the FAA would not issue licenses and/or experimental permits to SpaceX.

FOR FURTHER INFORMATION: For questions regarding the Draft EIS, please contact Ms. Stacey M. Zee, Environmental Specialist, Federal Aviation Administration, 800 Independence Ave., SW, Suite 325, Washington, DC 20591; phone 202-267-9305; or email Stacey.Zee@faa.gov. Comments on the Draft EIS should be submitted to: SpaceX EIS, c/o Cardno TEC Inc., 275 West Street - Suite 110, Annapolis, MD, 21401; submitted by email to faaspacexeis@cardnotec.com; or faxed to (410) 990-0455.

Responsible FAA Official:

-FOR-

Dr. George C. Nield
Associated Administrator for
Commercial Space Transportation

10 APR 13
Date

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EXECUTIVE SUMMARY

The Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST) has prepared this Draft Environmental Impact Statement (EIS) to evaluate the potential environmental impacts that may result from the FAA/AST proposal to issue launch licenses and/or experimental permits that would allow Space Exploration Technologies Corp. (SpaceX) to launch the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of reusable suborbital launch vehicles from a launch site on privately owned property in Cameron County, Texas (Exhibit ES-1).

SpaceX has proposed to construct and operate a private launch site in order to accommodate the number of launches that the company has on its launch manifest. The proposed private launch site is needed to provide SpaceX with an exclusive launch facility that would allow the company to meet tight launch windows. SpaceX intends to apply to the FAA/AST for launch licenses and/or experimental permits to conduct launches of the Falcon Program launch vehicles and a variety of reusable suborbital launch vehicles from the proposed launch site.

Issuing launch licenses and experimental permits is considered a major Federal action subject to environmental review under the National Environmental Policy Act (NEPA) of 1969 as amended (42 United States Code [U.S.C.] §4321, et seq.). The FAA/AST is preparing this EIS in accordance with NEPA, Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508), and FAA Order 1050.1E, Change 1, *Environmental Impacts: Policies and Procedures*, and all other applicable environmental legislation and regulation. Cooperating agencies include the National Aeronautics and Space Administration (NASA), the National Park Service (NPS), the U.S. Army White Sands Missile Range (WSMR), and the U.S. Army Corps of Engineers (USACE).

ES.1 PURPOSE AND NEED

ES.1.1 SpaceX Purpose and Need

SpaceX has proposed to construct and operate a private launch site in order to accommodate the number of launches that the company has on its launch manifest. The proposed private launch site is needed to provide SpaceX with an exclusive launch site that would allow the company to accommodate its launch manifest and meet tight launch windows. SpaceX intends to apply to the FAA/AST for launch licenses and/or experimental permits to conduct launches of the Falcon Program vehicles and a variety of reusable suborbital launch vehicles from the proposed launch site on privately owned property in Cameron County, Texas. The FAA/AST would likely issue launch specific licenses for the first few years of operation of the exclusive launch site.

ES.1.2 FAA Purpose and Need

The ***purpose*** of the FAA's Proposed Action of issuing launch licenses and/or experimental permits to SpaceX to conduct launches from the exclusive use launch site in Cameron County, Texas is to fulfill the FAA/AST's responsibilities as authorized by Executive Order (EO) 12465 (*Commercial Expendable Launch Vehicle Activities*, 49 FR 7099, 3 CFR, 1984 Comp., p. 163) and the Commercial Space Launch Act (51

ES-1. Regional Location of Proposed Launch Site

U.S.C. Subtitle V, ch. 509 §§ 50901-50923) for oversight of commercial space launch activities, including issuing launch licenses and experimental permits to operate reusable orbital and suborbital launch vehicles.

The ***need*** for the Proposed Action results from the statutory direction from Congress under the Commercial Space Launch Act to encourage, facilitate, and promote commercial space launch and reentry activities by the private sector in order to strengthen and expand U.S. space transportation infrastructure.

ES.2 PROPOSED ACTION

The Proposed Action, which is the Preferred Alternative, is for the FAA to issue launch licenses and/or experimental permits to SpaceX that would allow SpaceX to conduct launches of the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of reusable suborbital launch vehicles from a private launch site on privately owned property in Cameron County, Texas (Exhibit ES-1). Proposed operations would consist of up to 12 launches per year with a maximum of two Falcon Heavy launches, through the year 2022.

The requirements for obtaining and possessing a launch license and/or experimental permit are described in 14 CFR Parts 400-450. The completion of the environmental review process does not guarantee that the FAA would issue launch licenses and/or experimental permits to SpaceX to launch from the proposed privately owned site in Cameron County, Texas. The Proposed Action must also meet all the FAA safety, risk, and indemnification requirements. As part of the licensing process, SpaceX also would need to obtain a Letter of Authorization (LOA) from the Houston Air Route Traffic Control Center (ARTCC) to operate the Falcon 9 and Falcon Heavy in the proposed airspace before any launches could commence. SpaceX would also coordinate with the Secretariat of Communications and Transportation – Mexico regarding launch notifications.

To support these launches, SpaceX has proposed the construction of a vertical launch area and a control center area in Cameron County, approximately 17 miles east-northeast of the Brownsville/South Padre Island International Airport and approximately 5 miles south of South Padre Island. All facilities would be constructed through private funding, on currently undeveloped privately-owned property that would be purchased or leased by SpaceX. In addition, a new underground power line would be installed in the State Highway 4 road Right-of-Way from the control center area to the vertical launch area.

ES.2.1 Operational Activities

All Falcon 9 and Falcon Heavy launches would be expected to have commercial payloads, including satellites or experimental payloads. In addition to standard payloads, the Falcon 9 and Falcon Heavy may also carry a capsule, such as the SpaceX Dragon capsule. The Falcon 9 and Falcon Heavy use liquid fuels including liquid oxygen (LOX) and rocket propellant-1 (RP-1). Within the 12 launches per year, SpaceX may elect to have permitted launches of smaller reusable suborbital launch vehicles from this proposed site. A reusable suborbital launch vehicle could consist of a Falcon 9 Stage 1 tank. All launch trajectories would be to the east over the Gulf of Mexico. The majority of launches would be conducted between the hours of 7:00 a.m. and 7:00 p.m. However, there could be one nighttime launch per year. All launches, including pre-flight activities, would be conducted under the control of SpaceX, FAA/AST, and in accordance with the LOA from Houston ARTCC.

As part of the licensing and permitting process, SpaceX must implement a plan that defines the process for ensuring that any unauthorized persons, vessels, trains, aircraft, or other vehicles are not within the hazard area. The plan must include safety and security personnel for each launch and roadblocks and other security checkpoints. SpaceX also must develop and implement agreements and plans with local authorities whose support is needed to ensure public safety during all launch processing and flight, in accordance with 14 CFR § 417.111. SpaceX would coordinate with U.S. Customs and Border Protection, Cameron County; Cameron County and State of Texas law enforcement agencies; the City of Brownsville; the City of South Padre Island; NPS; Padre Island National Seashore (PINS); U.S. Fish and Wildlife Service (USFWS), Lower Rio Grande Valley National Wildlife Refuge (NWR); Texas Parks and Wildlife Department (TPWD); Texas General Land Office (TGLO); Texas Department of Transportation (TxDOT), and U.S. Coast Guard (USCG) on the preparation of a detailed closure plan that describes the procedures for land closure and water closure areas that would limit public access on launch day along State Highway 4, on Boca Chica Beach, and offshore areas.

SpaceX proposes to limit public access at two pre-defined checkpoints on State Highway 4 for up to 15 hours on launch day, with 6 hours being the closure time for a nominal launch. The 15 hour closure period allows for potential aborts and contingencies. Therefore, with 12 proposed annual launches, SpaceX proposes a maximum of 180 hours (this includes 15 hours per launch for each of the 12 launches) of annual closure. The two checkpoints include a soft checkpoint on State Highway 4, just east of Massey Way. Government personnel, SpaceX personnel, emergency personnel, and anyone with property beyond this soft checkpoint could pass, but the general public would be denied access. SpaceX may move the soft checkpoint further away from the launch site based on consultations with the USFWS. The second checkpoint would be a hard checkpoint, just after Boca Chica Village, which is a “no pass” area determined by the FAA approved hazard area. No one would be permitted to pass by this hard checkpoint during launch operations. SpaceX and law enforcement would monitor the area to the east of the checkpoints to ensure that the area is clear. In addition, SpaceX would coordinate with Cameron County, the City of Brownsville, USFWS, Lower Rio Grande Valley NWR, NPS, TPWD, TGLO, and TxDOT to identify a safe location on private land along State Highway 4, before the Massey Way soft checkpoint, for the public to view a launch event.

On the day of launch, the Boca Chica Beach would be closed to the public from the Brownsville Shipping Channel south to the U.S./Mexico border on the Gulf Coast. SpaceX would continue to monitor the beach area using all-terrain vehicles (ATVs) to ensure that the area is clear before launch. The beach closure for launch day would last up to 15 hours. As part of the licensing process, SpaceX would also develop a plan for clearing offshore areas. This plan would include coordinating with the USCG, issuing NOTMARs, and clearing the offshore area in order to ensure public safety. The USCG could conduct boat patrols to sweep the offshore area to make sure the area is clear; this would continue to take place until SpaceX is ready to load propellant to the vehicle (approximately 3 hours from launch). A final sweep of the closure areas by helicopter could also be implemented at this time to ensure the areas are clear.

On the day of launch, the launch vehicle on the transporter erector would be moved to the launch pad from the vertical launch area Hangar and connected to the launch stand. A wheeled vehicle, such as a small tug or other road equipment, would be used to pull the launch vehicle and transporter erector to the launch pad. Launch vehicles may be erected and de-erected several times prior to launch; the transporter erector is designed to make this operation quick and simple. On the day of launch, the launch vehicle would be erected and final system checks completed. Approximately 3 hours before launch, the vehicle would be loaded with propellant. Just before launch, the transporter erector would be retracted at least 12 degrees from the vehicle. The transporter erector would be moved into the Hangar after the launch. After the launch, SpaceX and the FAA would notify law enforcement when the area has been deemed safe. Individuals needing to conduct nesting sea turtle beach patrols (e.g., Sea Turtle Inc.) would be given one hour to check the beach for sea turtle nests prior to the beach being re-opened for the general public. After completion of the sea turtle patrols, the checkpoints would be raised and the area would be re-opened for the public.

ES.2.2 Construction Activities

The proposed vertical launch area is located at the eastern terminus of Boca Chica Boulevard (State Highway 4), in a sparsely populated coastal area off the Gulf of Mexico, approximately 3 miles north of the U.S./Mexico border. The vertical launch area is currently privately-owned and is leased by SpaceX. The approximate 56.5-acre property is completely undeveloped and consists of 25.43 acres of jurisdictional wetlands and 31.07 acres of sporadically vegetated sand dunes. The area surrounding the proposed vertical launch area is primarily used for recreational purposes.

Development of the proposed vertical launch area at this location would only occur within 20 acres of the entire 56.5-acre property. The rest of the property would remain open space. Construction at this location for the proposed vertical launch area would generally involve placing fill material to elevate land levels enough to avoid frequent flooding. Fill material would be sourced from on-site whenever possible. All on-site material would come from within the 20-acre project area. If necessary, additional clean fill material would be sourced from the local region. In addition, most of the larger facilities and those that must support heavy loads would be required to have pilings driven to support the facilities. As a result, most of the land area inside the proposed fence lines would be disturbed at some point. Proposed facility and infrastructure construction at the vertical launch area would include the following:

- Integration and Processing Hangar
- Launch pad and stand with its associated flame duct
- Water tower
- Lightning protection towers (four total)
- Retention basin for deluge water
- Propellant storage and handling areas
- Workshop and office area
- Warehouse for parts storage
- Roads, parking areas, fencing, security, lighting, and utilities

The command and control functions for a launch are required to be conducted at a safe separation distance from the actual launch site, which is approximately 2 miles away. As a result, the proposed control center area is approximately 2 miles west from the vertical launch area and north of Boca Chica Boulevard.

The proposed control center area consists of three parcels north of Boca Chica Boulevard and west of the proposed vertical launch area, which are all privately-owned. Only one of these parcels has existing infrastructure consisting of a concrete pad (a former swimming pool). Boca Chica Village, a small residential subdivision with a transient population, is adjacent to the three parcels that comprise the proposed control center area. The area surrounding the proposed control center area is primarily used for recreational purposes. The 4.0-acre control center area Parcel 1 is located the furthest from the proposed vertical launch area and is bounded on the southeastern side by Boca Chica Boulevard and the southwestern side by Remedios Avenue.

The 4.4-acre Parcel 2 is bounded on the southeastern side by Boca Chica Boulevard, the southern end is bounded by San Martin Boulevard, and the northwestern side is bounded by Esperson Street.

The 4.0-acre Parcel 3, which is the closest to the proposed vertical launch area, is located northeast of Eichorn Boulevard. Proposed facility and infrastructure construction at the control center area would include the following:

- Two launch control center buildings
- Two payload processing facilities
- Launch vehicle processing hangar
- Two radio frequency transmitter/receivers
- Generators and diesel storage facilities
- Roads, parking areas, fencing, security, lighting, and utilities
- A satellite fuels storage facility

Construction at this location would generally involve grading to level the land. As a result, most of the land area inside the proposed fence lines would be disturbed at some point.

ES.2.3 Personnel Levels

Approximately 30 full-time SpaceX employees/contractors would be present on-site at the vertical launch area and/or control center area in 2013. Full-time SpaceX employees/contractors are anticipated to work a single shift, between the hours of approximately 8:00 a.m. – 5:00 p.m. On a per-mission basis, launch campaigns (i.e., preparation for and conducting of a launch event) would be expected to last up to 2 weeks. During a launch campaign, an additional 100 local or transient workers would be working at the vertical launch area and/or control center area. During launch campaigns, the additional workers could work extended hours; however, 2 days prior to launch, full-time SpaceX employees/contractors and the local or transient workers would need to be on-site for up to 24 hours per day. Staffing on-site would return to normal levels (approximately 30 full-time SpaceX employees/contractors) within a day or two after the actual launch. By 2022, it is expected that there would be 150 full-time SpaceX employees/contractors working on-site. The EIS includes the full scope of facilities that would be necessary to support proposed operations at the launch site. At this time, it is not anticipated that there would be a need for expansion of facilities for the phased increase in workforce through 2022. However, if additional facilities are proposed in the future, a supplemental analysis would need to be prepared to address the potential impacts.

ES.3 NO ACTION ALTERNATIVE

Under the No Action Alternative, the FAA would not issue launch licenses and/or experimental permits to SpaceX for launch operations from the private site in Cameron County, Texas. Thus, SpaceX would not construct the proposed control center and vertical launch areas. For those parcels of land that SpaceX owns or leases, SpaceX could use the land at its discretion, in compliance with all applicable Federal, state, and local laws and regulations. The FAA is not aware of any defined SpaceX plans to develop the parcels of land that it owns or leases, if FAA does not issue the launch licenses and/or experimental permits as described above. For this EIS, it is assumed SpaceX would the leave the property undeveloped for the foreseeable future.

ES.4 PUBLIC INVOLVEMENT

The FAA provided several notifications of its intent to prepare an EIS and conduct scoping. Scoping for the development of the EIS began with the publication of the Notice of Intent (NOI) in the *Federal Register* on April 10, 2012 (77 FR 21619-21620). In the NOI, the FAA invited the participation of Federal, State, and local agencies, Native American tribes, environmental groups, citizens, and other interested parties to assist in determining the scope and significant issues to be evaluated in the EIS.

Advertisements were placed in the following newspapers a week before the scoping meeting for three consecutive days: The Brownsville Herald, Valley Morning Star, and El Bravo (in Spanish). Advertisements announced the FAA's intent to prepare an EIS; the dates, times, and location for the scoping meeting; and five ways for the public to provide comments.

Notification and coordination letters were sent to Federal, State, and local agencies; elected officials; American Indian Tribes; and special interest groups that the FAA determined would most likely be interested in the Proposed Action.

A public scoping meeting was held to solicit input from the public on potential issues that may need to be evaluated in the EIS. The scoping meeting was held on May 15, 2012, from 5:00 p.m. to 8:00 p.m., at the International Technology, Education and Commerce Center, located at 301 Mexico Boulevard, Suite G-1, Brownsville, Texas. The meeting format included an "open house" workshop. The "open house" format created a comfortable atmosphere for attendees – one in which they could speak individually with FAA and SpaceX representatives. During the scoping meeting, FAA and SpaceX project team representatives (i.e., FAA personnel, SpaceX personnel, and support contractors) were available to explain the proposed project and alternatives, answer questions about the project, and describe the environmental impact analysis process and related time line. Two Spanish-speaking project team representatives were available at the scoping meetings to aid in the discussions and help translate project information to Spanish speaking community members. Poster displays located throughout the open house provided information on the NEPA and Areas of Analysis, Proposed Action and Alternatives, Licensing and Permitting Process, SpaceX information, and the Public Involvement Process. In addition to poster displays, a video was provided by SpaceX during the open house workshop. The FAA provided an informational overview presentation from 6:00 p.m. to 6:15 p.m., followed by a public comment period from 6:15 p.m. to 8:00 p.m.

A total of 519 individuals signed in at the meetings, including Federal and State elected officials, the media, city government agencies, local community planning groups, and local school representatives. The public comment portion of the meeting from 6:15 p.m. to 8:00 p.m. allowed participants who signed up to offer a 3-minute statement. A stenographer captured these oral comments verbatim. The meeting yielded 52 oral comments, while scoping overall yielded a total of 588 comments, resolutions, and letters. Most comments expressed general support for the proposal. Several elected officials and local community leaders expressed their support for the Proposed Action. The primary issues raised during scoping consisted of socioeconomic benefits to Brownsville and nearby communities; potential unavoidable effects to pristine, sensitive habitat and the species that depend on it; cultural resources nearby; and decline of property values and quality of life in Boca Chica Village. To a lesser extent, scoping comments focused on increased traffic on State Highway 4, noise, and the evaluation of cumulative effects.

ES.5 OTHER ENVIRONMENTAL REQUIREMENTS

Preparation of this EIS, public review and comment, and issuance of a Record of Decision (ROD) would fulfill the FAA's requirements under NEPA. However, if the FAA decides to issue launch licenses and/or experimental permits to SpaceX, acquisition of other permits under other regulations would also be required, including, but not limited to, the following:

- Air quality permit(s) issued by the Texas Commission on Environmental Quality (TCEQ) for air emission sources (Texas Clean Air Act [CAA])
- Section 404 (Clean Water Act [CWA]) and Section 10 (Rivers and Harbors Act) permits issued by USACE for structures work and the discharge of dredge and/or fill of waters of the U.S. including wetlands
- Permits issued by the TGLO for coastal construction (Coastal Zone Management Act [CZMA], Texas Open Beaches Act, and the Dune Protection Act)
- Texas Pollutant Discharge Elimination System (TPDES) permit issued by TCEQ for water pollutant discharges (CWA)
- Construction permit issued by Cameron County for construction in the floodplain (Executive Order 11988, DOT Order 5650.2, and the National Flood Insurance Program)
- Utility permits issued by the Texas Department of Transportation for installation of utility lines
- Permit issued by the Cameron County Department of Health and Human Services for the design and operation of a septic system

ES.6 SUMMARY OF POTENTIAL ENVIRONMENTAL EFFECTS

Eleven resource areas were considered to provide a context for understanding and assessing the potential environmental effects of the Proposed Action including compatible land use (including farmlands and coastal resources); Section 4(f) properties; noise; visual resources and light emissions;

historical, architectural, archaeological, and cultural resources; air quality; water resources (including surface waters, groundwater, wetlands, floodplains, and Wild and Scenic Rivers); biological resources (including fish, wildlife, and plants); hazardous materials, pollution prevention, and solid waste; socioeconomics, environmental justice, and children's environmental health risks and safety risks; and natural resources and energy supply. For each resource area discussed in this EIS, the Region of Influence (ROI) was determined. The ROI describes the area that could be affected by the Proposed Action and the No Action Alternative. The environmental consequences associated with the Proposed Action and the No Action Alternative were analyzed for the appropriate ROI for each resource area. The description of impacts is separated into construction-related and operations-related impacts. Table ES.6-1 provides a summary of potential environmental impacts from the Proposed Action and the No Action Alternative.

Table ES.6-1. Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative

Resource Area	Proposed Action	No Action Alternative
Compatible Land Use (Including Farmlands and Coastal Resources)	***Construction:*** Construction of the proposed vertical launch and control center areas would change land uses from rural residential and recreational to developed, mixed use. Since Cameron County does not have a land use plan or zoning in unincorporated areas, changes from undeveloped, private land to mixed-use private land does not violate local land use ordinances. There would be no significant impacts related to compatible land use, including farmlands or coastal resources. ***Operations:*** There would be no significant impacts to farmlands or coastal resources. There would be significant impacts to land use compatibility as a result of increased personnel working on-site, traffic and noise that would occur from proposed operational activities and from increased noise during launches, particularly to Boca Chica Village (a residential area) and the surrounding parks, cultural resources, and National Wildlife Refuges (considered sensitive noise receptors). Short-term increase in the noise levels received in the community from the proposed launch of the Falcon Heavy are anticipated to be significant, but would only occur up to two times per year. Long-term noise levels for the proposed launch activities are expected to surpass the significance thresholds for impacts as defined by FAA Order 1050.1E. Public access to Boca Chica State Park, Lower Rio Grande Valley NWR, and Brazos Island State Park would be closed for safety and security reasons. SpaceX is working closely with the TGLO, the Cameron County Commissioners Court, the Cameron County Dunes Committee, the State Senator, and the State Representative to ensure that a temporary closure of a public beach and beach access would be allowable under Texas law. As of March 28, 2013, proposed legislation had been filed by State Senator Eddie Lucio, Jr. and State Representative Rene Oliveira that would amend the Texas Natural Resources Code Chapter 61 to allow for the TGLO and/or the Cameron County Commissioners Court to temporarily close a public beach and beach access for space flight activities, including launches. However, if the primary launch date falls on the major summer holidays of Memorial Day, Fourth of July, Labor Day, and/or summer weekends between Memorial Day and Labor Day weekends, additional approval from the TGLO would be required. The proposed legislation would also allow for a Memorandum of Agreement between the TGLO and Cameron County to further define specific requirements for beach and access closure requests, approvals, and related public notices.	No impacts would occur

Table ES.6-1. Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative

Resource Area	Proposed Action	No Action Alternative
Section 4(f) Properties	***Construction:*** The FAA has determined that construction of the vertical launch and control center areas would not result in a physical use or constructive use of a Section 4(f) property. The FAA also determined that increased visitation to the area to view launches or the launch facility would not result in induced impacts that would substantially impair the activities, features, or attributes of any Section 4(f) property. The FAA is consulting with the officials having jurisdiction over all of the Section 4(f) properties to determine whether the officials concur with FAA's determination. The results of this consultation will be provided in the Final EIS. ***Operations:*** Operations would not result in a physical use or constructive use of a Section 4(f) property. The FAA has determined that temporary closures of some Section 4(f) properties would not substantially reduce the use or enjoyment of the Section 4(f) properties, because impacts from closures during launches would be intermittent and temporary, and thus, would not constitute a constructive use of these properties. The FAA also determined that operations would not substantially diminish the attributes (i.e., quiet setting) that contribute to the enjoyment or quality of any Section 4(f) properties. The FAA is consulting with the officials having jurisdiction over all of the Section 4(f) properties to determine whether the officials concur with FAA's determination. The results of this consultation will be provided in the Final EIS.	No impacts would occur
Noise	***Construction:*** Intermittent construction noise would occur from proposed construction activities over 24 months at the vertical launch and control center areas. Construction would typically occur during normal working hours between 8:00 a.m. and 5:00 p.m., Monday through Friday. Construction activities, including impact pile driver hammering, could potentially create multiple, individual noise sources. Occupational noise exposure prevention procedures, such as hearing protection, would be required at the construction sites to comply with all applicable Occupational Safety and Health Administration occupational noise exposure regulations. Significant impacts to community noise levels and to workers at the construction sites from proposed construction related activities are not anticipated. ***Operations:*** Small increases in noise levels along State Highway 4 would be expected as a result of the operation of delivery trucks and other personnel vehicles. Operation of the facilities at the vertical launch and control center areas would typically occur during normal working hours between 8:00 a.m. and 5:00 p.m., Monday through Friday. Significant impacts to community noise levels from proposed daily operations are not anticipated. Short-term increases in the noise levels received in the community from the proposed launch of the Falcon Heavy are anticipated to be significant. Long-term noise levels as for the proposed launch activities are expected to surpass the significance thresholds for impacts as defined by the FAA Order 1050. 1E. The sonic booms generated by these launch events would impact the ocean surface 40 miles off the coast and would not be audible on land; therefore, sonic booms would not produce any significant impacts in the surrounding areas.	No impacts would occur

Table ES.6-1. Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative

Resource Area	Proposed Action	No Action Alternative
Visual Resources and Light Emissions	***Construction:*** Two sets of casual observers would be impacted by construction activities at both areas. The residents of Boca Chica Village would be impacted by the high visibility of construction equipment at both areas for extended periods of time. Visibility to travelers on State Highway 4 would be intermittent and for short periods of time. Impacts to both sets of casual observers from construction activities would be temporary, lasting only as long as construction activities were occurring. There would be no impacts from light emissions during construction phases of the project. ***Operations:*** The proposed vertical launch and control center areas would likely have a significant impact on the visual resources of the ROI. A visual simulation of the vertical launch area from a point along State Highway 4 at the eastern end of the Palmito Ranch Battlefield NHL indicates a moderate to high degree of contrast between the vertical launch area water tower and lightning protection towers and the current setting. The daytime operations at the control center area would have no impact on the light emission in the area during the daylight hours. Nighttime launch operations would result in considerably higher levels of light emissions than those currently present from Boca Chica Village.	No impacts would occur
Historical, Architectural, Archaeological, and Cultural Resources	***Construction:*** Construction of the proposed vertical launch and control center areas would not directly (physically) impact any historic property. No significant archaeological resources were found during the survey of the vertical launch and control center areas. Construction of the vertical launch and control center areas would indirectly impact one historic property through visual impacts. Section 106 consultation with applicable agencies on potential mitigation measures is ongoing. The FAA is in the process of developing a Memorandum of Agreement to mitigate the adverse effects on historic properties should the Proposed Action be implemented. ***Operations:*** There would be a significant increase in noise compared to current conditions. Auditory effects to historic properties would be short term and temporary. Three historic properties within the 5-mile APE may be physically damaged from vibrations caused by high noise levels from a Falcon vehicle launch. Section 106 consultation with applicable agencies on potential mitigation measures is ongoing. The FAA is in the process of developing a Memorandum of Agreement to mitigate the adverse effects on historic properties should the Proposed Action be implemented.	No impacts would occur
Air Quality	***Construction:*** The construction impacts on air quality would not be significant. The estimated emissions from construction of the vertical launch and control enter areas represent extremely small percentages of the Cameron County regional emissions and would not cause an exceedance of any NAAQS. ***Operations:*** The operational impacts from the Proposed Action on air quality would not be significant. The operational emissions for the proposed vertical launch and the control center areas represent extremely small percentages of the Cameron County regional emissions and would not cause an exceedance of any NAAQS.	No impacts would occur

Table ES.6-1. Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative

Resource Area	Proposed Action	No Action Alternative
Water Resources (Including Surface Waters, Groundwater, Wetlands, Floodplains, and Wild and Scenic Rivers)	***Construction:*** The Proposed Action would result in approximately 6.19 acres of wetland impacts including: the direct impact to approximately 3.34 acres of wetlands and the indirect impact to approximately 2.85 acres of wetlands. Based on the proposed footprint for the vertical launch area, SpaceX would be required to obtain an individual permit from the USACE, which would require compensatory mitigation to offset wetland impacts. Adverse impacts to surface water, groundwater resources, groundwater quality, and wetlands are expected to be less than significant if appropriate mitigation measures are implemented. There are no impacts to Wild and Scenic Rivers due to construction because the section of the Rio Grande deemed wild and scenic is over 400 miles west of the vertical launch and control center areas. Approximately 4.22 acres of floodplain Zone V10 would be filled in the proposed vertical launch area and approximately 4.37 acres of Zone A8 would be filled in the western portion of the vertical launch area. Based on the expected notable adverse impacts on some of the natural and beneficial floodplain values, the Proposed Action would result in a significant floodplain encroachment per DOT Order 5650.2. ***Operations:*** Operation of the vertical launch and control center areas would not result in additional impacts to surface water, groundwater resources, groundwater quality, wetlands, or floodplains. The Stormwater Pollution Prevention Plan (SWPPP) would implement the use of Best Management Practices (BMPs) during operation, which would prevent further impacts. Adherence to the Spill Prevention, Control, and Countermeasures Plan (SPCCP) and the Hazardous Materials Management Plan (HMMP) would reduce the potential for adverse impacts to water resources. There would be no impacts to Wild and Scenic Rivers.	No impacts would occur

Table ES.6-1. Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative

Resource Area	Proposed Action	No Action Alternative
Biological Resources (Including Fish, Wildlife, and Plants)	***Construction:*** A total of 15.74 acres of upland habitat and 3.34 acres of wetland habitat would be removed as a result of the construction of the proposed vertical launch and control center area facilities and infrastructure. The construction of buildings and roads at the vertical launch area would cut off the tidal influence to 2.85 acres of wetland. These indirect wetland impacts are comprised of 2.54 acres of high marsh vegetated wetlands and 0.31 acre of unvegetated wetland salt flats. These vegetation impacts would not be significant. The FAA has prepared a Biological Assessment (BA) and based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is likely to adversely affect* the piping plover and its critical habitat, the northern aplomado falcon, and the jaguarundi and ocelot. The FAA has determined that the Proposed Action *may affect, is not likely to adversely affect* the West Indian manatee. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. None of the proposed construction areas are located in any potential sea turtle nesting areas. Proposed construction activities would have no direct effect on sea turtle habitat in the terrestrial environment. ***Operations:*** Daily operations would not include disturbance to vegetation; therefore, there would be no significant impacts to vegetation with implementation of the Proposed Action. With implementation of proposed special conservation measures (SCMs) such as educating the public on safe and lawful areas they could watch the launch and developing a Lighting Management Plan, there would be no significant impacts on wildlife species (including state-listed wildlife species) as a result of the Proposed Action. Based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is likely to adversely affect* the piping plover and its critical habitat, the northern aplomado falcon, the jaguarundi and ocelot, and sea turtles. The Proposed Action *may affect, is not likely to adversely affect* the West Indian manatee. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS.	No impacts would occur

Table ES.6-1. Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative

Resource Area	Proposed Action	No Action Alternative
Hazardous Materials, Pollution Prevention, and Solid Waste	***Construction:*** Construction activities would require the use of hazardous materials, such as diesel fuel, gasoline, and propane to fuel the construction equipment; hydraulic fluids, oils and lubricants; welding gases, paints, solvents, adhesives, and batteries. Implementation of appropriate handling and management procedures, hazardous materials, hazardous wastes, and solid wastes generated during the construction of the vertical launch and control center areas would limit the potential for impacts. Therefore, there would be no significant impacts to the environment. ***Operations:*** Operations at both the vertical launch and control center areas would use products containing hazardous materials, including paints, solvents, oils, lubricants, acids, batteries, surface coating, and cleaning compounds. Hazardous materials such as propellants, chemicals, and other hazardous material payload components would be transported to the facilities in accordance with DOT regulations. Implementation of appropriate handling and management procedures, hazardous materials, hazardous wastes, and solid wastes generated during the operation of the vertical launch area (including launches) and control center area would limit the potential for impacts. Therefore, there would be no significant impacts to the environment.	No impacts would occur
Socioeconomics, Environmental Justice, and Children's Environmental Health Risks and Safety Risks	***Construction:*** Construction would have a beneficial impact on the ROI economy through direct spending and would generate economic activity that would lead to indirect job creation in areas such as the accommodation and food services and retail trade sectors. Construction activities would not be expected to result in significant effects to the housing market. Additionally, the Proposed Action would not be expected to strain the capacity or affect the quality of emergency response, medical, or public education services. The Proposed Action would not negatively affect children's environmental health and safety. Construction of the control center area would have negative visual impacts on residents of Boca Chica Village. ***Operations:*** Operational activities would not be expected to result in significant effects to the housing market or population in-migration. Population growth due to operation activities would not be expected to strain the capacity or affect the quality of emergency response, medical, or public education. While effects on property values cannot be quantified, potential effects to quality of life for Boca Chica Village residents can be qualitatively described. Operation of the Proposed Action would change the noise environment, visual viewshed, nighttime light emissions, traffic, and numbers of people in the vicinity. These changes would affect how Boca Chica Village residents experience their neighborhood; however, this would not be considered a disproportionate impact to environmental justice populations, or to the environmental health and safety of children.	No impacts would occur

Table ES.6-1. Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative

Resource Area	Proposed Action	No Action Alternative
Natural Resources and Energy Supply	***Construction:*** The energy required for construction activities would predominantly be associated with operating construction equipment and generators, which would require the supply of gasoline and diesel fuels. Construction may also have a minimal requirement for single-phase electrical power. No significant impact to the energy supply is anticipated as a result of construction. There would be a substantial requirement for aggregate (mineral materials such as sand and/or stone used in making concrete). It is anticipated the region surrounding Brownsville would have sufficient supply of aggregate to meet the requirements for the Proposed Action without impacting the availability for other uses in the area. The construction of the vertical launch and control center areas would not require significant quantities of groundwater. It is unlikely that the construction groundwater use would result in a significant impact in the region. ***Operations:*** It is estimated the proposed vertical launch and control center areas would have a total maximum electrical load of 3,000 kilowatts per hour. In addition to electricity, energy supply requirements for operations would include various propellant fuels, as well as diesel and gasoline to fuel the ground equipment necessary for launch operations. All propellants would be provided by regional or national suppliers and would be transported to the vertical launch and control center areas by truck. No significant impact to the energy supply is anticipated as a result of operations. Groundwater would be potentially used for two primary uses: the supply of the deluge water for each launch and for personnel use at the facilities. No significant impacts to municipal water supply in Brownsville, or groundwater supply in Cameron County, would occur as a result of the Proposed Action.	No impacts would occur
Secondary (Induced) Impacts	***Construction:*** Temporary impacts to the regional economy are anticipated due to construction of the vertical launch and control center areas; however, these would be short-term (approximately 24 months) and would not result in significant beneficial impacts to the economy. There would be no significant secondary impacts to public services. ***Operations:*** The operation of the vertical launch and control center areas would result in temporary impacts to the local and regional economy during launch campaign periods due to increases in transient employees and visitors. There is the potential for secondary impacts to land use due to the potential for amenities such as hotels, restaurants, shopping, etc. which may be developed to accommodate the needs of employees and visitors during launches. However, there are no known specific future development activities that would be dependent on the Proposed Action. Under the Proposed Action, the operation of the vertical launch and control center areas are not anticipated to have significant secondary impacts to public services.	No impacts would occur

ES.7 CUMULATIVE IMPACTS

Cumulative impacts are defined by the CEQ in 40 §CFR 1508.7 as:

> The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.

The CEQ regulations further require that NEPA environmental analyses address connected, cumulative, and similar actions in the same document (40 CFR §1508.25).

The cumulative impact analysis for this EIS focuses on the incremental interaction the Proposed Action may have with other past, present, and reasonably foreseeable future actions, and evaluates cumulative impacts potentially resulting from these interactions. These past, present, and reasonably foreseeable future actions include the La Plaza at Brownsville Multi-modal facility, the Artisan at Port Isabel, the South Padre Island Second Access project, the Rio Grande Wind Farm project (Wind Farm), the Brownsville/South Padre Rail Line project, Palmito Ranch Battlefield Viewing Platform, the port of Brownsville Liquefied Natural Gas (LNG) Facility, and the STARGATE project.

The Proposed Action has been evaluated for cumulative impacts on compatible land use; Section 4(f) properties; noise; visual resources and light emissions; historical, architectural, and cultural resources; air quality; water resources; biological resources; hazardous materials, pollution prevention, and solid waste; socioeconomics, environmental justice, and children's environmental health risks and safety risks; and natural resources and energy supply.

- **Compatible Land Use (Including Farmlands and Coastal Resources) —** When past, present, and reasonably foreseeable future projects are analyzed together, there would be changes to land use from two future projects (South Padre Island Second Access and Brownsville/South Padre Rail Line) in surrounding communities. Both local projects would involve converting land to transportation ROW; however, both projects include mitigation measures to minimize impacts. The proposed vertical launch area would change from vacant, undeveloped, open space, to a mixed-use facility. The proposed control center area would change from vacant, residential lots to a mixed-use facility. Since Cameron County does not have a land use plan or zoning in unincorporated areas, changes from undeveloped, private land to mixed-use private land does not violate local land use ordinances. The Proposed Action would significantly impact land use compatibility as a result of increased noise during launches. To the extent the potential compatible land use impacts from the proposed South Padre Island Second Access and Brownsville/South Padre Rail Line projects overlap with the Proposed Action's impacts, there would be cumulative impacts to land use within the surrounding communities. Since the Proposed Action would result in significant impacts related to land use compatibility (from operational noise), any cumulative land use compatibility impacts would be significant.

- **Section 4(f) Properties —** The Wind Farm project has the potential to have impacts on visual resources, which in turn could affect a Section 4(f) property (namely the Palmito Ranch Battlefield NHL). The proposed wind turbines would be approximately 13 miles from the eastern end of the Palmito Ranch Battlefield NHL. There would be minimal visual impact to the

Palmito Ranch Battlefield NHL because of the large distance to the Wind Farm. Although the Proposed Action operations would result in noise and visual impacts, as well as periodic brief closures of some Section 4(f) properties, the Proposed Action would not result in substantial impairment of any Section 4(f) property. Based on the minimal cumulative visual impact on the Palmito Ranch Battlefield NHL from the wind turbines, potential cumulative impacts are not expected to result in substantial impairment of any Section 4(f) property. Therefore, potential cumulative impacts on Section 4(f) properties would not be significant.

- **Noise —** One reasonably foreseeable future project (Brownsville/South Padre Rail Line) could have noise impacts. If the project is found to result in a significant increase in ambient noise levels, then appropriate abatement measures would be evaluated for incorporation into the project design where practicable. The Proposed Action would result in significant, but short-term and temporary, noise impacts. Hearing protection measures would be implemented to ensure the health and safety of Boca Chica Village residents. When the noise impacts of the Proposed Action are combined with potential noise impacts of the future project, there would be cumulative noise impacts. Since the Proposed Action's operational noise impacts would be significant, any potential cumulative noise impacts occurring during a launch would be considered significant.

- **Visual Resources and Light Emissions —** Present and reasonably foreseeable future projects (South Padre Island Second Access, Wind Farm, Palmito Ranch Battlefield Viewing Platform, and STARGATE) would have minimal or localized visual impacts. These projects would also produce incremental and localized increases in light emissions. The visual impacts and light emissions resulting from construction of the vertical launch area would be considered significant. Mitigation measures would be implemented to mitigate impacts to visual resources. When the visual and light emissions impacts are combined with the potential for visual and light emissions impacts of the future projects, there would be a cumulative impact on visual resources and light emissions. Since the Proposed Action would result in significant impacts on visual resources, any cumulative visual impacts from the projects listed above would be considered significant.

- **Historical, Architectural, Archaeological, and Cultural Resources —** Of the past, present, or reasonably foreseeable future actions, only two actions (Palmito Ranch Battlefield Viewing Platform and STARGATE) would have the potential for cumulative impacts to historical, architectural, archaeological, and cultural resources near the vicinity of the vertical launch and control center areas. A cultural resource survey completed for one of the projects determined that no NRHP-eligible archaeological sites would be impacted. A cultural resource study has not yet been conducted for STARGATE. Under the Proposed Action, construction of the vertical launch and control center areas would impact the setting of the Palmito Ranch Battlefield NHL. Three historic properties in proximity to the vertical launch area could be impacted by vibrations from high noise levels, which could cause physical damage to structural features. Additionally, increasing numbers of visitors and traffic in the area may result in secondary induced impacts to the historic properties. The FAA, in consultation with THC and consulting parties, is developing a Memorandum of Agreement to mitigate the impacts to the physical integrity and setting of the historic properties. When the impacts of the Proposed Action are considered in conjunction with the impacts of past, present and reasonably foreseeable future actions, the cumulative impacts to historical, architectural, archaeological, and cultural resources are not likely to be significant.

- **Air Quality —** The impacts to air quality from the implementation of the Proposed Action would be negligible. All areas surrounding the proposed vertical launch area and control center area are in attainment for criteria pollutants; thus, past and current projects have not impacted the air quality. Future projects would have temporary air quality impacts during construction activities. When the air quality impacts from the Proposed Action are combined with other past, present and reasonably foreseeable future projects, cumulative impacts are not likely to be significant.
- **Water Resources (Including Surface Waters, Groundwater, Wetlands, Floodplains, and Wild and Scenic Rivers)** — Under the Proposed Action, there would be adverse impacts to surface waters, groundwater resources, groundwater quality, and wetlands, as a result of construction and operation. However, those impacts are expected to be less than significant with appropriate mitigation. There would be no impacts to Wild and Scenic Rivers. With regard to floodplains, in order to comply with the local floodplain zoning required for participation in the National Floodplain Insurance Program (NFIP) and to obtain development permits, a hydraulic analysis of the floodplain associated with the vertical launch and control center areas would need to be conducted during the preliminary engineering design phase of the project to comply with the local county requirements. The hydraulic analysis would determine if the fill and construction of facilities within the floodplain would affect the base flood elevation. If the study determines that construction would not affect the base flood elevation, a "No-Rise" Determination would be submitted to the county. However, if the hydraulic study determined that the base flood elevation would be affected, further engineering design would need to be conducted to mitigate for the change in base flood elevation in order to comply with NFIP and Cameron County building regulations as required by the National Flood Insurance Act Title 42. Compliance with the NFIP as well as county regulations would ensure that the construction would have no significant impacts on floodplain storage and base flood elevation. Present and reasonably foreseeable futures projects (South Padre Island Second Access, Wind Farm, Palmito Ranch Battlefield Viewing Platform, and the Port of Brownsville LNG Facility) have the potential to impact wetlands. Therefore, the Proposed Action when combined with past, present, and reasonably foreseeable future projects would result in cumulative impacts to wetlands. However, final project engineering designs submitted for State and Federal permits would include evaluation of alternatives and avoidance and minimization measures to reduce potential impacts to wetlands. In addition, appropriate wetland mitigation would be implemented to ensure no net loss of wetlands. Therefore, the cumulative impacts would not be considered significant.
- **Biological Resources (Fish, Wildlife, and Plants) —** There would be no significant impacts to vegetation with implementation of construction and operational activities under the Proposed Action. Construction and operational activities associated with the Proposed Action *may affect,*

is likely to adversely affect the piping plover and its critical habitat, northern aplomado falcon, and the jaguarundi and ocelot. Construction and operational activities *may affect, is not likely to adversely affect* the West Indian manatee. With implementation of proposed SCMs and development of a Lighting Management Plan, there would be no significant impacts on wildlife species (including state-listed wildlife species) as a result of the Proposed Action. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS. Reasonably foreseeable future projects (South Padre Island Second Access, Wind Farm, the Port of Brownsville LNG Facility, and STARGATE) in the region have the potential to cause negative impacts to sensitive wildlife species and habitat, including the same species that may be affected under the Proposed Action. If mitigation measures proposed for the present and reasonably foreseeable future projects, and the SCMs and mitigation measures for the Proposed Action are implemented, cumulative impacts to biological resources would not be considered significant.

- **Hazardous Materials, Pollution Prevention, and Solid Waste** — The only action that would have the potential for cumulative impacts to hazardous materials, pollution prevention, and solid waste near the vicinity of the vertical launch and control center areas would be the Port of Brownsville LNG Facility. The proposed site for the Port of Brownsville LNG Facility is across from the spoil area and has the potential for impacts to hazardous materials, pollution prevention, and solid waste. Under the Proposed Action, there would be an increase in the number of hazardous materials in the area of the vertical launch and control center areas. However, with the implementation of appropriate handling and management procedures, no significant impacts to the environment are expected. When past, present, and reasonably foreseeable projects are analyzed in conjunction with the Proposed Action, cumulative impacts would not be significant.

- **Socioeconomics, Environmental Justice, and Children's Environmental Health Risks and Safety Risks —** The Artisan at Port Isabel, South Padre Island Second Access, Wind Farm, and the Port of Brownsville LNG Facility projects are anticipated to result in positive socioeconomic impacts to the area. Implementation of the Proposed Action would result in local construction expenditures, including construction wages, which would have a beneficial impact on the local economy through direct spending and would generate economic activity that could lead to indirect job creation in areas such as the accommodation and food services and retail trade sectors. Construction activities would not be expected to result in significant effects to the housing market. Additionally, the Proposed Action would not be expected to strain the capacity or affect the quality of emergency response, medical, or public education services. The Proposed Action would not adversely affect children's environmental health and safety. When past, present, and reasonably foreseeable projects are analyzed in conjunction with the Proposed Action, positive impacts to socioeconomics would occur within the region, and there would be no impacts to children's environmental health and safety risks.

- **Natural Resources and Energy Supply —** The Artisan at Port Isabel project is anticipated to require increases in electricity and water for residents. For the construction of the Artisan apartments, natural resources were expended in the form of lumber, aggregate, and fossil fuels (oil and gas), and those could be used for operations as well. It is anticipated that suppliers could accommodate these increases and no significant impacts would occur. Construction-related energy consumption for the South Padre Island Second Access project would be short-term in nature and could be offset by operational energy efficiencies gained through the use of an improved transportation facility over many decades. The project could improve fuel efficiencies as traffic moves from the existing roadway network to the new facility thereby improving traffic mobility across the project area. For the Wind Farm project, aggregate and fossil fuels would be used to build the foundations of the wind turbines and the offshore facilities. Construction-related energy consumption would be short-term. Upon completion, the project would contribute beneficial impacts to natural resources and energy supply by harnessing offshore wind resources to provide electrical generation capacity for current markets in Texas. The Port of Brownsville LNG Facility has the potential to have beneficial impacts to energy supply. Under the Proposed Action, there would be an increase in consumption of fuel, oil, propellants, electricity, aggregate, water, and groundwater. It is anticipated that local, regional, and nationwide suppliers would be able to accommodate the increases in consumption of fuel, oil, propellants, electricity, and aggregate and no significant impacts would occur. Additionally, the groundwater supply would also be able to accommodate the increased consumption and drawdown with no significant impacts to the groundwater supply. When past, present, and reasonably foreseeable projects are analyzed in conjunction with the Proposed Action, there would be a cumulative increase in the demand on energy supply and natural resources within the surrounding communities. However, the cumulative impacts would not be considered significant.

ES.8 MITIGATION AND SPECIAL CONSERVATION MEASURES

Mitigation measures that the FAA and SpaceX would implement to reduce or offset the potential environmental consequences of construction and operational activities include management plans and procedures, BMPs, and SCMs that would be implemented through construction and operation. Further measures may be considered in consultation with Federal and State agencies and implemented, if necessary.

Development of the specific plans and other BMPs during construction would be the responsibility of the contractor hired by SpaceX to construct the vertical launch and control center areas. The contractor would be required to apply the current construction industry BMPs in accordance with Federal requirements, TPDES permit requirements, and applicable regulations of the TCEQ. SpaceX would act in an oversight capacity to ensure that contractor performance meets these requirements.

Mitigation measures and SCMs are presented below in Table ES.8-1.

Table ES.8-1. Mitigation Measures and SCMs to Reduce Potential Impacts from the Proposed Action

Resource Area	Mitigation Measures and SCMs
Compatible Land Use (Including Farmlands and Coastal Resources)	Closure of nearby beaches and State Highway 4 would be necessary to ensure safety and security during wet dress rehearsals, static fires, and launch operations. Measures that SpaceX would implement to reduce impacts to land use due to these closures include the following: • SpaceX would become a Beach Guardian in the Adopt-a-Beach Program organized by the TGLO. SpaceX would adopt a 3-mile portion of Boca Chica Beach centered around the terminus of State Highway 4. At a minimum, SpaceX would: o Participate in the two annual cleanups organized by the TGLO o Organize a minimum of one additional cleanup of Boca Chica Beach. This additional cleanup would involve the community as much as possible and include features, paid for by SpaceX, such as: ▪ Guest educational speakers to teach the community about such topics as the area's wildlife, the area's history, the sources of the debris on the beach, and how the cleanup benefits the beach. These speakers can come from several sources, including the Cameron County Parks and Recreation Department and the nearby universities. o Organize SpaceX personnel to teach the community about such topics as the space program, rocket engineering, and the site design characteristics that are intended to minimize environmental impact. o Complete monthly cleanups of the beach, focusing on large pieces of litter. During each cleanup, SpaceX would record information about trash collected on data cards provided by the Adopt-A-Beach Program, and return the cards to TGLO.
Section 4(f) Properties	Measures that would be implemented to reduce the impacts on Section 4(f) properties include the following: • Using non-reflective material and light color, to the extent practicable, to disguise the proposed facilities, the water tower, and the lightning protection towers, so that they would blend in with the natural colors of the landscape.
Visual Resources and Light Emissions	Measures that would be implemented to reduce impacts on visual resources would include the following: • Prior to construction and operational activities, a Draft Lighting Management Plan would be provided to the NPS for review and comment. The Final Lighting Management Plan would be approved by the NPS and USFWS. Potential measures from the Lighting Management Plan, which SpaceX would adhere to include the following: o Where lighting is not essential for safety or security, timers would be installed to switch lights off in the evening. Where applicable and not a threat to security, motion-detector switches may be installed o The size, type, and number of exterior lights would be minimized and would be restricted to low pressure sodium, to the extent practicable o Directing, shielding, or positioning the lighting of the facilities to the extent possible (without decreasing safety and security) to minimize lateral light spread and decrease uplighting • Using non-reflective material and light color, to the extent practicable, to disguise the facilities, the water tower, and the lightning protection towers, so they would blend in with the natural landscape, thus minimizing impacts within areas visible from the Palmito Ranch Battlefield NHL.

Table ES.8-1. Mitigation Measures and SCMs to Reduce Potential Impacts from the Proposed Action

Resource Area	Mitigation Measures and SCMs
Historical, Architectural, Archaeological, and Cultural Resources	The adverse effects to the five historic properties could be reduced through a variety of mitigation measures, including: • Using non-reflective material and light color, to the extent practicable, to disguise the facilities, the water tower, and the lightning protection towers, so that they would blend in with the natural colors of the landscape • Documenting the sites through mapping, high resolution photography, detailed description, sampling, and evaluative testing • Adding interpretive signage about the historic sites in this area at the pullout for the historical marker across from the vertical launch area Section 106 consultation with THC and NPS on potential mitigation measures is ongoing. The FAA is in the process of developing a MOA with the Section 106 consulting parties to mitigate the potential adverse effects on historic properties. The final mitigation measures will be included in the Final EIS.
Air Quality	BMPs would address potential air quality impacts during construction or operations. The emission of any air pollutants as a result of ground disturbance, use of equipment, coatings application, or other construction activities would be controlled by incorporating the following BMPs: minimal idling of engines, watering of soils to be disturbed, water and dust abatement applied to dirt roads, use of low volatility coatings, and other recognized controls.
Water Resources (Including Surface Waters, Groundwater, Wetlands, Floodplains, and Wild and Scenic Rivers)	Mitigation measures that could be implemented to reduce and minimize impacts to water resources include the following: • Checking construction equipment daily for leaks of petroleum products, fuels, coolants, hydraulic fluids • Construction of on-site infrastructure to prevent downstream high water velocity erosion and to retain sediment • Construction of vegetated infiltration swales and bio-retention cells (rain gardens) with native plantings If a Department of the Army permit is authorized, it would be conditioned to require compensatory mitigation to offset the loss of function to waters of the U.S, resulting from the Proposed Action. Currently, SpaceX's compensatory mitigation plan proposes to preserve in-kind, high-quality wetlands at a ratio of five times the amount of wetlands impacted by the Proposed Action. The mitigation site would either be conveyed to a State or Federal natural resource agency or held by a third-party in a perpetual conservation easement.

Table ES.8-1. Mitigation Measures and SCMs to Reduce Potential Impacts from the Proposed Action

Resource Area	Mitigation Measures and SCMs
Biological Resources (Including Fish, Wildlife, and Plants)	The following SCMs would be implemented as part of the Proposed Action to avoid and minimize the effects of proposed construction and operational activities associated with the vertical launch and control center areas on vegetation, including wetlands; wildlife, including birds protected under the Migratory Bird Treaty Act (MBTA); and special-status species. In accordance with Section 7 of ESA, formal consultation is ongoing between the USFWS and the FAA regarding potential impacts to ESA-listed species under the jurisdiction of the USFWS. **Construction** 1) In conjunction with final design, a Stormwater Pollution Prevention Plan (SWPPP) would be prepared. The SWPPP would include Best Management Practices (BMPs) for erosion and sedimentation controls, including techniques to diffuse and slow the velocity of stormwater to reduce potential impacts (e.g., soil loss and sedimentation) to water quality during construction. All construction activities with the potential of impacting water quality due to potential runoff from the site would be conducted in accordance with SWPPP requirements. SpaceX would provide the Draft SWPPP to the USFWS for review and comment. 2) To the maximum extent practicable the following would be followed: a. The perimeter of all areas to be disturbed during construction or maintenance activities would be clearly demarcated using flagging or temporary construction fence, and no disturbance outside that perimeter would be authorized (in particular tidal flats and dunes). All access routes into and out of the proposed disturbance area would be flagged, and no construction travel outside those boundaries would be authorized. When available, areas already disturbed by past activities or those that would be used later in the construction period shall be used for staging, parking, and equipment storage. b. Construction speed limits would not exceed 35 mph on major unpaved roads and 25 mph on all other unpaved roads. Night time travel speeds would not exceed 25 mph. c. Roads would be designed and located where roadbed erosion into federally listed species habitat is avoided or minimized and the potential for entrapment of surface flows within the roadbed due to grading would also be avoided or minimized. d. The depth of any pits created would be minimized so animals do not become trapped. e. Materials such as gravel or topsoil would be obtained from existing developed or previously used sources, not from undisturbed areas adjacent to the property. f. Drip pans underneath equipment, containment zones used when refueling vehicles or equipment, and other measures would be implemented. g. Non-hazardous waste materials, litter, and other discarded materials, such as construction waste, would be contained within secured containers until removed from the construction site. All trash containers would have secured closures to prevent animal foraging. 3) Prior to entry into the project area, all equipment would be cleaned to prevent importation of non-native plant species, and inspected to ensure that hydraulic fittings are tight, hydraulic hoses are in good condition and replaced if damaged, and there are no petroleum leaks. 4) No excavated or fill material would be placed in delineated CWA Section 404 waters of the U.S. except as authorized by a permit from the U.S. Army Corps of Engineers (USACE). Concrete mixing and placement activities would be conducted to ensure discharge water associated with these activities would not reach surrounding water bodies or pools unless specifically authorized in a CWA discharge permit.

Table ES.8-1. Mitigation Measures and SCMs to Reduce Potential Impacts from the Proposed Action

Resource Area	Mitigation Measures and SCMs
Biological Resources (Including Fish, Wildlife, and Plants) *(Continued)*	5) SpaceX would designate a Field Contact Representative (FCR) that would be present during the beginning of the construction period to provide all construction personnel and SpaceX employees with an environmental worker-education briefing that would include but not be limited to the following: a. Information regarding endangered species with potential to occur in the area, impacts that may occur, conservation measures being implemented, their responsibilities under the Endangered Species Act, and avoidance and reporting procedures. b. Wildfire prevention measures would be implemented, including restricting smoking to areas clear of vegetation, ensuring no fires of any kind are ignited, and equipping vehicles with spark arrestors and fire extinguishers. c. The spread of noxious weeds would be limited by cleaning all equipment and vehicles at designated locations and by inspecting all vehicles to ensure absence of loose soil and plant debris before leaving the project areas. d. Requirements for safe handling and disposal of hazardous wastes would be implemented. 6) If proposed construction activities occur during the recognized avian breeding season (15 February through 31 August), construction would occur in accordance with the MBTA to avoid impacts to nesting migratory birds within the project area. Specifically, a biologist would check the proposed areas of construction activities, including laydown areas, for nests (in shrubs and on the ground) once before the construction phase has begun. If the biologist finds an active nest, construction workers would not directly or indirectly disturb the nest or adjacent areas until the biologist determines the nest is no longer in use. 7) To comply with the MBTA, project design and any above-ground utility upgrades within the control center area would incorporate raptor protection measures, as appropriate and applicable. For example, structures would be equipped with devices to discourage nest building and perching (e.g., monopole technology and visual fright devices). 8) SpaceX employees and construction personnel would be educated on the potential for vehicle collisions with wildlife, particularly ocelots and jaguarundis, and encouraged to reduce their speeds along State Highway 4 between the vertical launch and control center areas. 9) SpaceX would coordinate with the TxDOT regarding funding the installation of "Watch Out for Ocelots/Jaguarundis" or "Watch out for Wildlife" signs along State Highway 4. The number and placement of the signs would be determined by SpaceX coordinating with TxDOT and the USFWS. 10) SpaceX would coordinate with the TxDOT to maintain clear shoulders on road edges to allow drivers to more easily see wildlife, such as ocelots and jaguarundis, along the road edge and reduce incidents of vehicle/wildlife collisions. 11) SpaceX would designate an FCR who would be responsible for overseeing compliance with these conservation measures and any other required terms and conditions resulting from consultation between the FAA and USFWS. The FCR would have the authority to halt construction, operation, or maintenance activities that are in violation of these requirements. 12) A qualified biologist would conduct pre-construction monitoring for piping plovers, red knots, and aplomado falcons. Monitoring would be conducted within 1 mile of construction areas. The monitoring would include presence/absence surveys and would record the number and location of all candidate and federally listed species observed, including the piping plover, red knot, and aplomado falcon, as well as all migratory birds. A monitoring report would be sent to the USFWS approximately 2 weeks following the survey. 13) Prior to construction, SpaceX will provide the USFWS with monitoring plans tracking potential induced vegetative changes as a result of proposed construction activities, fencing, security, stormwater discharge, and launch activities, including pre-, during, and post-construction presence/absence surveys of piping plovers, aplomado falcons, red knots, and migratory birds. The draft monitoring plans would be made available to the USFWS for review and final comment prior to construction.

Table ES.8-1. Mitigation Measures and SCMs to Reduce Potential Impacts from the Proposed Action

Resource Area	Mitigation Measures and SCMs
Biological Resources (Including Fish, Wildlife, and Plants) *(Continued)*	14) Prior to construction and operational activities, a Draft Lighting Management Plan would be provided to the USFWS for review and comment. The Final Lighting Management Plan would be approved by the USFWS (and NPS) and implemented prior to construction activities to minimize overall lighting impact, including potential direct impacts and cumulative glow, on wildlife and adjacent sea turtle nesting beaches. Examples of lighting requirements that would be incorporated into the plan include: a. SpaceX would issue annual notices to all complex personnel prior to sea turtle nesting season reminding personnel of light use requirements and responsibilities. b. The USFWS may conduct on-site inspections coordinated with SpaceX to verify compliance and make recommendations for changes and revisions to the plan, limited to once per year. c. SpaceX would direct, shield, or position the lighting of facilities to the extent possible (without decreasing safety and security) to avoid visibility from the beach, minimizes lateral light spread, and decrease uplighting. Low-pressure sodium lighting would be used where possible. d. Where applicable, new lighting would be installed with multiple levels of control so that lighting levels can be matched with specific activities. e. Where lighting is not essential to safety or security, timers would be installed to switch lights off in the evening. Where applicable and not a threat to security, motion-detector switches may be installed. f. Should there be the need for additional local temporary lighting to support construction activities, the following requirements would be adhered to: • Whenever possible, lights shall be placed in such a way that they do not shine directly towards the beach. Additionally, no uplighting would be utilized to the maximum extent possible. • Lighting would be extinguished upon completion of work in that area. • The size, type and number of exterior lights would be minimized and would be restricted to low pressure sodium, to the extent practicable, during sea turtle nesting season. • Fixtures would be shielded or screened whenever practical. • Lighting would be monitored on a routine basis by anyone utilizing the lights. **Operations** 1) Educate the public on safe and lawful areas where they may watch launches. 2) SpaceX employees and contractors would be educated on the potential for vehicle collisions with wildlife, particularly ocelots and jaguarundis. SpaceX employees would then be mandated, with strict internal repercussions, to reduce their speeds along State Highway 4 between the proposed vertical launch and control center areas. Vehicles would be restricted to existing paved and dirt roads, parking areas, and authorized construction sites. Operators of vehicles within the vertical launch and control center areas would observe speed limits not to exceed 25 miles per hour. 3) As stated above in SCM 14, a Lighting Management Plan would be prepared prior to the start of construction activities. The Final Lighting Management Plan would be implemented as part of standard operational activities at the vertical launch area. 4) An FCR would conduct pre- and post-launch surveys for piping plovers, red knots, and aplomado falcons. Monitoring would be conducted within 1 mile of the vertical launch area the day before the launch and the day after the launch. The monitoring would include presence/absence surveys and would record the number and location of all candidate and federally listed species observed, including the piping plover, red knot, and aplomado falcon, as well as all migratory birds. A monitoring report would be sent to the USFWS approximately 2 weeks following the launch. 5) To the maximum extent possible, SpaceX would avoid launches at dusk and dawn during the most active time for jaguarundis and ocelots, and will avoid nighttime launches during sea turtle nesting season (March 15 – October 1).

Table ES.8-1. Mitigation Measures and SCMs to Reduce Potential Impacts from the Proposed Action

Resource Area	Mitigation Measures and SCMs
Hazardous Materials, Pollution Prevention, and Solid Waste	Measures that would be implemented to reduce impacts of hazardous materials and solid waste include the following: • Having spill response materials (e.g., sorbents, drain covers, mops, brooms, shovels, drum repair materials and tools, warning signs and tapes, and personal protective equipment) readily available for use in storage areas, during fueling, and during transport in the event of an unplanned release

ES.9 UNAVOIDABLE ADVERSE IMPACTS

Significant increases in noise from launch vehicle operations would result in an unavoidable adverse impact for Boca Chica Village residents. In addition, the proposed vertical launch and control center areas would likely have a significant adverse impact on the visual resources of the ROI. Construction of the facilities at the vertical launch and control center areas would markedly contrast with the existing landscape. The buildings and structures would introduce new features into what is generally an open, undeveloped landscape. The boxy forms, straight lines, and smooth textures of the facilities would stand in strong contrast to the gently undulating, horizontal lines of the sand dunes and tidal flats that currently characterize the landscape. There would be less of a contrast between the buildings and features of the control center area with those of the Boca Chica Village.

Construction of the proposed vertical launch and control center areas would indirectly impact the setting of the Palmito Ranch Battlefield NHL. Three historic properties in proximity to the vertical launch area (the Cypress Pilings, Palmetto Pilings, and Palmetto Pilings Historical Marker) could be impacted by vibrations from high noise levels, which could cause physical damage to structural features.

A total of 15.74 acres of upland habitat and 6.19 acres of wetland habitat would be removed as a result of the construction of proposed vertical launch and control center area facilities and infrastructure. Approximately 0.70 acre of critical habitat (unvegetated flats and depressional wetlands) for the threatened piping plover occur within the proposed project footprints for the vertical launch area and would be removed under the Proposed Action. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA to minimize the impacts to the piping plover. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS. Approximately 4.22 acres of floodplain Zone V10 would be filled in the proposed vertical launch area and approximately 4.37 acres of Zone A8 would be filled in the western portion of the vertical launch area. Based on the expected notable adverse impacts on the floodplain, the Proposed Action would result in significant floodplain encroachment per DOT Order 5650.2.

ES.10 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

There would be minor short-term impacts to land use during launches since public access to Boca Chica State Park, Lower Rio Grande Valley NWR, and Brazos Island State Park would be closed for up to 180 hours per year for safety and security reasons. In addition, short-term increases in the noise levels received in the community from the proposed launch of the Falcon Heavy are anticipated to be significant in terms of Federal government limits for permissible noise exposure.

From a long-term perspective, the Proposed Action would fulfill the mission of the FAA/AST, which is to ensure protection of the public, property, and the national security and foreign policy interests of the U.S. during commercial launch and reentry activities and to encourage, facilitate, and promote commercial space transportation. Some long-term negative impacts of fulfilling this mission for the Proposed Action would be the permanent fill of wetlands and floodplains, changes to the viewshed, nighttime light emissions, traffic, and numbers of people in the vicinity. These changes would affect Boca Chica Village residents, the surrounding parks, cultural resources, and National Wildlife Refuges.

ES.11 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The Proposed Action would involve irretrievable commitments of both nonrenewable and renewable resources. Fuel, construction materials, and labor would be expended during construction of facilities. Operating the new facilities would require energy to heat, cool, and light the buildings. Conducting maintenance activities and launch operations would also expend fuel, construction materials, and labor. Commitment of these resources would not be considered significant. The total amount of construction materials (e.g., concrete, insulation, wiring, etc.) required for the Proposed Action is relatively small when compared to the resources available in the region. The construction materials and energy required for facility development and operations are not in short supply. Moreover, the use of construction materials and energy is not anticipated to be excessive in terms of region-wide usage and would not have an adverse impact on the continued availability of these resources.

A total of 15.74 acres of upland habitat and 6.19 acres of wetland habitat would be removed as a result of the construction of proposed vertical launch and control center area facilities and infrastructure. Approximately 0.70 acre of critical habitat (unvegetated flats and depressional wetlands) for the threatened piping plover occur within the proposed project footprints for the vertical launch area and would be removed under the Proposed Action. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA to minimize the impacts to the piping plover. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS. A total of approximately 8.59 acres in two different floodplain zones would be permanently filled for construction of the vertical launch area. The Proposed Action would not result in the destruction of environmental resources such that the range of potential uses of the environment would be limited, nor impact the biodiversity of the region.

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ACRONYMS AND ABBREVIATIONS

$\mu g/m^3$	micrograms per cubic meters
ACHP	Advisory Council on Historic Preservation
AGL	above ground level
afy	Acre-feet per year
APE	Area of Potential Effects
ARTCC	Air Route Traffic Control Center
ASME	American Society of Mechanical Engineers
AST	Office of Commercial Space Transportation
ASTDR	Agency for Toxic Substances and Disease Registry
ATV	all-terrain vehicle
BA	Biological Assessment
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BMPs	Best Management Practices
BO	Biological Opinion
Ca	circa
CAA	Clean Air Act
CBRA	Coastal Barrier Resources Act
CCAFS	Cape Canaveral Air Force Station
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CNRAs	Coastal Natural Resource Areas
CO	carbon monoxide
CO_2	carbon dioxide
COTS	Commercial Orbital Transportation Services
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dB	decibel
dBA	A-weighted decibel
DNL	Day-Night Average Sound Level
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
E_c	Expected Casualty
EDR	Environmental Data Report
EIS	Environmental Impact Statement
ELI	Environmental Law Institute
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
°F	degrees Fahrenheit
FAA	Federal Aviation Administration
FCR	Field Contact Representative
FEMA	Federal Emergency Management Agency
FICAN	Federal Interagency Committee on Aviation Noise
FICON	Federal Interagency Committee on Noise
ft	foot/feet
ft^2	square foot/feet
ft^3	cubic foot/feet
FTA	Federal Transit Administration
FWCA	Fish and Wildlife Coordination Act
gal	gallons
GAO	Government Accountability Office
GCDs	Groundwater Conservation District
GHG	greenhouse gas
gpd	gallons per day
gpm	gallons per minute
gpy	gallons per year
GTO	Geostationary Transfer Orbit
HAP	hazardous air pollutant
HMERP	Hazardous Materials Emergency Response Plan
HMMP	Hazardous Materials Management Plan
HPS	High Pressure Sodium
hr	hour
Hz	Hertz
ISS	International Space Station
ITEC	International Technology, Education, and Commerce Center
kW	kilowatt
L_{Amax}	A-weighted maximum sound level
lbs	pounds
LEO	low Earth orbit
L_{max}	maximum sound level
LNG	liquefied natural gas
LOA	Letter of Authorization

LOX	liquid oxygen
LRGVDC	Lower Rio Grande Valley Development Council
MBTA	Migratory Bird Treaty Act
MGD	million gallons per day
mg/L	milligrams per liter
MGY	million gallons per year
MMH	monomethylhydrazine
MOA	Memorandum of Agreement
MOVES	Motor Vehicle Emissions Simulator
mph	miles per hour
MSAT	Mobile Source Air Toxic
MVEC	Magic Valley Electric Cooperative
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NCDC	National Climate Data Center
NEI	National Emission Inventory
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NFIP	National Flood Insurance Program
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NIHL	noise-induced hearing loss
NIOSH	National Institute for Occupational Safety and Health
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRI	Nationwide River Inventory
NSR	New Source Review
NTO	nitrogen tetroxide
NWR	National Wildlife Refuge
O_3	ozone
OASPL	overall sound pressure level
OSHA	Occupational Safety and Health Administration
PINS	Padre Island National Seashore
$PM_{2.5}$	particulate matter 2.5 microns or less in diameter
PM_{10}	particulate matter less than 10 and greater than 2.5 microns in diameter
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
PSF	Permanent School Fund
RCRA	Resource Conservation and Recovery Act
RF	radio frequency
RLV	reusable launch vehicle
ROD	record of decision
ROI	Region of Influence
ROW	Right-of-Way
RP-1	refined petroleum-1
SARA	Superfund Amendments and Reauthorization Act
SCM	Special Conservation Measure
SEDUE	La Secretaria de Desarollo Urbano y Ecologia
SEL	Sound Exposure Level
SEMARNAT	La Secretaria de Medio Ambiente y Recursos Naturales
SLC	Space Launch Complex
SO_2	sulfur dioxide
SpaceX	Space Exploration Technologies Corp.
SPCCP	Spill Prevention, Control, and Countermeasures Plan
SRM	Solid Rocket Motor
STEC	South Texas Electric Cooperative
SWAC	Solid Waste Advisory Committee
SWMP	Stormwater Management Plan
SWPPP	Stormwater Pollution Prevention Plan
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TCMP	Texas Coastal Management Program

TDS	total dissolved solids
TGLO	Texas General Land Office
THC	Texas Historical Commission
TNC	The Nature Conservancy
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
TSD	treatment, storage and disposal
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
UDMH	unsymmetrical dimethyl hydrazine
U.S.	United States
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAF	U.S. Air Force
U.S.C.	United States Code
USCB	U.S. Census Bureau
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program
UTB	University of Texas-Brownsville
VAFB	Vandenberg Air Force Base
VCR	Visual Contrast Rating
VOC	volatile organic compound
W	watt
WRAP	Western Regional Air Partnership
WSMR	White Sands Missile Range
yd^3	cubic yards

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1.0 INTRODUCTION

Space Exploration Technologies Corp. (SpaceX) has proposed to construct and operate a private launch site in order to accommodate the number of launches that the company has on its launch manifest. The proposed private launch site is needed to provide SpaceX with an exclusive launch facility that would allow the company to meet tight launch windows. SpaceX intends to apply to the Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST) for launch licenses and/or experimental permits to conduct launches of the Falcon Program launch vehicles and a variety of reusable suborbital launch vehicles from the proposed launch site.

Issuing launch licenses and experimental permits is considered a major Federal action subject to environmental review under the National Environmental Policy Act (NEPA) of 1969 as amended (42 United States Code [U.S.C.] §4321, *et seq*.). The FAA/AST is preparing this Environmental Impact Statement (EIS) in accordance with NEPA, Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508), and FAA Order 1050.1E, Change 1, *Environmental Impacts: Policies and Procedures*.

This EIS evaluates the potential direct, indirect, and cumulative environmental effects that may result from the FAA/AST proposal to issue launch licenses and/or experimental permits that would allow SpaceX to launch the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of reusable suborbital launch vehicles from a launch site on privately owned property in Cameron County, Texas (Exhibit 1.0-1). SpaceX proposes to construct a vertical launch area and a control center area to support up to 12 commercial launches per year with a maximum of two Falcon Heavy launches (Exhibit 1.0-2). The environmental analysis in this EIS for the proposed issuance of launch licenses and/or experimental permits to SpaceX focuses on proposed construction activities and operational activities associated with the Proposed Action.

1.1 BACKGROUND

Founded in 2002, SpaceX is a commercial space transportation company headquartered in Hawthorne, California. SpaceX developed the Falcon 1 and Falcon 9 vertical orbital launch vehicles, both of which were built with the goal of becoming reusable launch vehicles.

In order to control quality and costs, SpaceX designs, tests, and fabricates the majority of its components in-house, including the Merlin, Kestrel, and Draco rocket engines used on the Falcon launch vehicles and the Dragon spacecraft (SpaceX 2012). In 2006, the National Aeronautics and Space Administration (NASA) awarded SpaceX a Commercial Orbital Transportation Services (COTS) contract to design and demonstrate a launch system to resupply cargo to the International Space Station (ISS). On December 8, 2010, with the launch of the COTS Demo Flight 1 (C1) mission, SpaceX became the first privately funded company to successfully launch, orbit, and recover a spacecraft, called the Dragon capsule. In addition, on May 31, 2012, SpaceX successfully completed the COTS 2/3 mission that made Dragon the first commercial spacecraft to visit the ISS, as well as the first commercial cargo resupply vehicle to return to Earth from the ISS.

Exhibit 1.0-1. Regional Location of Proposed Launch Site

Exhibit 1.0-2. Location of Proposed Vertical Launch Area and Control Center Area

NASA also awarded SpaceX a contract to develop and demonstrate a human-rated Dragon capsule as part of its Commercial Crew Development program to transport crew to the ISS. SpaceX is planning its first Falcon 9 flight with a crewed Dragon in 2015, when it expects to have a fully certified, human-rated launch escape system incorporated into the spacecraft. This launch would take place at Cape Canaveral Air Force Station (CCAFS), in Florida.

Besides NASA contracts, SpaceX has signed contracts with private sector companies, foreign government agencies, and the United States (U.S.) military for its launch services at its collective launch locations. In 2009, SpaceX launched, for a paying customer, a satellite into low Earth orbit (LEO) with its Falcon 1 booster.

SpaceX plans to launch its first commercial geostationary satellite in 2013 from a Falcon 9 (SpaceX 2012). SpaceX executed four back-to-back successful launches to LEO and was the first commercial company in history to reenter a spacecraft from Earth orbit.

SpaceX has one former launch site, two current launch sites, and one testing facility, including:

- Omelek Island, Kwajalein Atoll, Marshall Islands – for launch of the Falcon 1 vehicle
- Space Launch Complex (SLC)-40, CCAFS, Florida – for launch of the Falcon 9 vehicle
- SLC-4E, Vandenberg Air Force Base (VAFB), California – currently under construction for launch of the Falcon 9 and Falcon Heavy vehicles
- McGregor Test Site, McGregor, Texas – for testing and development of SpaceX flight hardware

Five Falcon 1 launches occurred at Omelek Island, Kwajalein Atoll. After these launches of the Falcon 1, the site was no longer needed and SpaceX closed the site and returned the property to existing conditions.

Falcon 9 launches on the SpaceX manifest are currently planned for CCAFS SLC-40 and VAFB SLC-4E (Polar Launches); both the Falcon 9 maiden flights on June 4, 2010, and December 8, 2010, took place at CCAFS SLC-40. CCAFS is SpaceX's launch site for NASA flights, including all flights to the ISS.

SpaceX broke ground on a launch site at VAFB, on July 13, 2011. The SLC-4E launch site is also intended for use by the Falcon Heavy launch vehicle, which is scheduled to be brought on site in 2012 with a test flight to be scheduled in 2013. SpaceX plans to launch up to 16 flights per year by 2015 from VAFB (SpaceX 2012).

Since 2003, SpaceX has leased a 650-acre engine test site in McGregor, Texas from the City of McGregor. The test site is a portion of a larger area of property (approximately 9,700 acres) that was previously owned by the U.S. Navy and was the site of a Naval Weapons Industrial Reserve Plant from 1966 to 1995. The McGregor test site refitted the largest test stand at the facilities for Falcon 9 testing. Currently, SpaceX uses the site to test engines that are used in other SpaceX launch vehicles. In 2012, SpaceX constructed a concrete launch pad and additional support infrastructure at the facility for testing of the Grasshopper reusable launch vehicle (RLV). SpaceX proposes to conduct up to 70 annual suborbital launches and landings of the Grasshopper RLV from the McGregor test site and has applied to the FAA/AST for an experimental permit. The experimental permit was issued by the FAA/AST on

October 18, 2012. The McGregor test site is approximately 443 miles from the proposed launch site in Cameron County, Texas.

SpaceX's orbital launch manifest is continually growing, with approximately 40–60 launches financially committed and under contract. In order to accommodate these commercial launches with very tight launch windows, SpaceX proposes to construct and operate its own exclusive launch site. SpaceX's private launch site would allow SpaceX to do the following:

- Perform aerospace operations work
- Develop and operate a safe, economically -viable commercial launch site
- Develop a safe, economically -viable operations site
- Expand the commercial space launch industry by meeting SpaceX's demand for launch site services

SpaceX spent the past year identifying and screening potential sites for commercial launch activities. After extensive evaluation, the proposed location in southern Texas was identified by SpaceX as the only viable location for SpaceX to construct and operate its commercial Falcon vehicles. Please refer to Section 2.3, *Alternatives Considered but not Carried Forward*, for information on alternative sites considered by SpaceX.

1.2 FEDERAL AGENCY INVOLVEMENT

1.2.1 Role of the FAA

The FAA/AST licenses and regulates U.S. commercial space launch and reentry activity, as well as the operation of non-Federal launch and reentry sites, as authorized by Executive Order (EO) 12465, *Commercial Expendable Launch Vehicle Activities*, and the Commercial Space Launch Act of 2011 (51 U.S.C. Subtitle V, ch. 509, §§ 50901-50923). The FAA/AST's mission is to ensure public health and safety and the safety of property while protecting the national security and foreign policy interests of the U.S. during commercial launch and reentry operations. In addition, the FAA/AST is directed to encourage, facilitate, and promote commercial space launches and reentries.

The FAA has the responsibility, under the Commercial Space Launch Act, to do the following:

- Promote economic growth and entrepreneurial activity through use of the space environment for peaceful purposes
- Encourage the U.S. private sector to provide launch vehicles, reentry vehicles, and associated services by
    - simplifying and expediting the issuance and transfer of commercial licenses, and
    - facilitating and encouraging the use of government-developed space technology
- Ensure that the Secretary of Transportation provides oversight and coordinates the conduct of commercial launch and reentry operations, issue and transfer commercial licenses authorizing those operations, and protects the public health and safety, safety of property, and national security and foreign policy interests of the U.S.

- Facilitate the strengthening and expansion of the U.S. space transportation infrastructure, including the enhancement of U.S. launch sites and launch-site support facilities, and development of reentry sites, with Federal, State, and private sector involvement, to support the full range of U.S. space-related activities

The decision for the FAA to issue launch licenses and/or experimental permits is considered a major Federal action under NEPA. The FAA is responsible for analyzing the potential environmental impacts associated with licensing and permitting of commercial launch vehicles.

1.2.2 Role of Cooperating Agencies

As defined in 40 CFR 1508.6, a cooperating agency may be any Federal agency other than the lead agency that has jurisdiction by law or special expertise with respect to the environmental impacts expected to result from a proposal. An agency has “jurisdiction by law” if it has the authority to approve, veto, or finance all or part of the proposal (40 CFR 1508.15). An agency has “special expertise” if it has statutory responsibility, agency mission, or related program experience with regard to a proposal (40 CFR 1508.26). A lead agency must request the participation of cooperating agencies as early as possible in the NEPA process, use the environmental analyses and proposals prepared by cooperating agencies as much as possible, and meet with cooperating agencies at their request (40 CFR 1501.6[a]). A cooperating agency’s responsibility includes participation in the NEPA process as early as possible, participation in the scoping process, and, on the lead agency’s request, development of information to be included in the EIS and providing staff support in its preparation (40 CFR 1501.6[b]).

Four cooperating agencies are involved in this Proposed Action: NASA, National Park Service (NPS), U.S. Army White Sands Missile Range (WSMR), and the U.S. Army Corps of Engineers (USACE).

NASA provides special expertise with respect to potential environmental impacts from space launches and the operation of a launch site. NASA also has special expertise and interest in the operation of reusable suborbital rockets through its programs, which are intended to help foster the development of the commercial reusable suborbital transportation industry. Additionally, NASA uses Space Act Agreements and contracts, as well as competitions to promote technology development and demonstration. NASA’s partnerships with commercial suppliers and private enterprises are expanding such that NASA may have a direct or indirect contribution to a commercial payload. For these reasons, NASA requested to be a cooperating agency in the development of this EIS.

The NPS is a bureau of the U.S. Department of the Interior and manages the 397 units of the National Park System. NPS provides special expertise with respect to the National Register of Historic Places (NRHP), National Heritage Areas, National Wild and Scenic Rivers, National Historic Landmarks, and National Trails. NPS requested to be a cooperating agency in the development of this EIS based on the proximity of the proposed project area to the Palmito Ranch Battlefield National Historic Landmark and other historic properties.

The U.S. Army’s WSMR provides special expertise with respect to environmental issues concerning space launch vehicles. WSMR provides relevant information and analysis regarding any EIS documentation requirements that are unique to its NEPA implementation procedures that would not normally be addressed by the FAA/AST. WSMR requested to be a cooperating agency in the development of this EIS.

The USACE is responsible for regulating structures and work, including the deposition of dredge and/or fill material, in waters of the U.S. and provides special expertise with respect to environmental issues concerning these impacts. The FAA requested by letter that the USACE Regulatory Branch, Galveston District be a cooperating agency. USACE has agreed to participate as a cooperating agency and will provide the FAA with all relevant information regarding the identification and analysis of the least environmentally damaging practicable alternative. In addition, the USACE would be responsible for issuing Section 404 (Clean Water Act [CWA]) and Section 10 (Rivers and Harbors Act) permits for fill of waters of the U.S., including wetlands. The USACE may adopt this EIS for the issuance of any permits. The USACE Basic Project Purpose is to construct and operate an exclusive launch site on privately owned property. The project is considered to be "non-water dependent" as it does not require siting in or on a special aquatic site, such as a wetland, to meet the basic project purpose. The USACE Overall Project Purpose is to construct and operate a vertical launch area and control center area to launch the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of reusable suborbital launch vehicles from a launch site on privately owned property. The proposed private launch site is needed to provide SpaceX with an exclusive launch site that would allow the company to meet tight launch windows.

The FAA entered into a Memorandum of Agreement (MOA) with each of these cooperating agencies. The cooperating agencies are responsible for developing and verifying information, including portions of the EIS for which the cooperating agency has special expertise under 40 CFR §1506.1.

In addition, the FAA sent a letter to the U.S. Fish and Wildlife Service (USFWS) on April 30, 2012, requesting that USFWS participate as a cooperating agency in the development of the EIS. On May 7, 2012, the USFWS notified the FAA that the USFWS would not be participating as a cooperating agency. However, the FAA and USFWS continue to coordinate on the project and will conduct all required regulatory consultations as required by law.

1.3 PURPOSE AND NEED

1.3.1 SpaceX Purpose and Need

SpaceX has proposed to construct and operate a private launch site in order to accommodate the number of launches that the company has on its launch manifest. The proposed private launch site is needed to provide SpaceX with an exclusive launch site that would allow the company to accommodate its launch manifest and meet tight launch windows. SpaceX intends to apply to the FAA for launch licenses and/or experimental permits to conduct launches of the Falcon Program vehicles and a variety of reusable suborbital launch vehicles from the proposed launch site on privately owned property in Cameron County, Texas. The FAA/AST would likely issue launch specific licenses for the first few years of operation from the exclusive launch site.

1.3.2 FAA Purpose and Need

The ***purpose*** of the FAA's Proposed Action of issuing launch licenses and/or experimental permits to SpaceX to conduct launches from the exclusive use launch site in Cameron County, Texas is to fulfill the FAA/AST's responsibilities as authorized by EO 12465 (*Commercial Expendable Launch Vehicle Activities*, 49 FR 7099, 3 CFR, 1984 Comp., p. 163) and the Commercial Space Launch Act (51 U.S.C. Subtitle V, ch.

509 §§ 50901-50923) for oversight of commercial space launch activities, including issuing launch licenses and experimental permits to operate reusable orbital and suborbital launch vehicles.

The ***need*** for the Proposed Action results from the statutory direction from Congress under the Commercial Space Launch Act to encourage, facilitate, and promote commercial space launch and reentry activities by the private sector in order to strengthen and expand U.S. space transportation infrastructure.

1.4 FAA LICENSES, PERMITS, REGULATIONS, AND APPROVALS

The FAA statutory and regulatory requirements pertaining to commercial launches and individual launch operators are described in 14 CFR Chapter III, Parts 400-450. Under the Proposed Action, SpaceX would be the exclusive user of the site. Therefore, SpaceX is not required to apply for and obtain a Launch Site Operator License (14 CFR Part 420). SpaceX could apply for and obtain the following types of licenses and/or experimental permits:

- Launch-Specific License — "authorizes a licensee to conduct one or more launches, having the same launch parameters, of one type of launch vehicle from one launch site" (14 CFR Part 415.3[a]). A licensee's authorization to launch terminates upon completion of all launches authorized by the license or the expiration date stated in the license, whichever occurs first.
- Launch Operator License — "authorizes a licensee to conduct launches from one launch site, within a range of launch parameters, of launch vehicles from the same family of vehicles transporting specified classes of payloads" (14 CFR Part 415.3[b]). A launch operator license remains in effect for five years from the date of issuance.
- Experimental Permit — "authorizes launch and reentry of a reusable suborbital rocket" (14 CFR Part 437.7). An experimental permit lasts for one year from the date it is issued.

1.5 OTHER ENVIRONMENTAL REQUIREMENTS

Preparation of this EIS, public review and comment, and issuance of a Record of Decision (ROD) would fulfill the FAA's requirements under NEPA. However, if the FAA decides to issue launch licenses and/or experimental permits to SpaceX, acquisition of other permits under other regulations would also be required, including, but not limited to, the following:

- Air quality permit(s) issued by the Texas Commission on Environmental Quality (TCEQ) for air emission sources (Texas Clean Air Act [CAA])
- Section 404 CWA and Section 10 (Rivers and Harbors Act) permits issued by USACE for fill of wetlands
- Permits issued by the Texas General Land Office (TGLO) for coastal construction (Coastal Zone Management Act [CZMA], Texas Open Beaches Act, and the Dune Protection Act)
- Texas Pollutant Discharge Elimination System (TPDES) permit issued by TCEQ for water pollutant discharges (CWA)
- Construction permit issued by Cameron County for construction in the floodplain (EO 11988, U.S. Department of Transportation [DOT] Order 5650.2, and the National Flood Insurance Program)
- Utility permits issued by the Texas Department of Transportation (TxDOT) for installation of utility lines

- Permit issued by the Cameron County Department of Health and Human Services for the design and operation of a septic system

1.6 PUBLIC INVOLVEMENT

NEPA allows for an early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a Proposed Action. This public participation process is called scoping.

Scoping is a fundamental part of the EIS development process and promotes better decision making. Scoping not only informs the public about the Proposed Action and alternatives but also identifies issues and concerns early in the EIS process that are of particular interest to affected communities. Public input is used to assist resource specialists in data collection and analysis during the development of the Draft EIS.

1.6.1 Scoping Notification

Scoping for the development of the EIS began with the publication of the Notice of Intent (NOI) in the *Federal Register* on April 10, 2012 (FAA 2012a). In the NOI, the FAA invited the participation of Federal, State, and local agencies, Native American tribes, environmental groups, citizens, and other interested parties to assist in determining the scope and significant issues to be evaluated in the EIS.

The FAA provided several notifications of its intent to prepare an EIS and conduct scoping including the following:

- Publishing in the *Federal Register*
- Posting flyers for the scoping meetings in local libraries, gas stations, and within the surrounding communities (e.g., Boca Chica Village)
- Hand-delivering notices to the residents of Boca Chica Village
- Advertising in local newspapers
- Mailing notification and coordination letters
- Publishing information on the FAA/AST website:
  - http://www.faa.gov/about/office_org/headquarters_offices/ast/environmental/nepa_docs/review/documents_progress/spacex_texas_launch_site_environmental_impact_Statement/

The flyers and newspaper advertisements announced the FAA's intent to prepare an EIS; the date, times, and location for the public scoping meeting; and the various ways for the public to provide comments (Appendix A). Flyers were posted at the following locations:

- Main utility pole at each entrance of Boca Chica Village
- Nine mailboxes in Boca Chica Village
- Brownsville Public Library, Main Branch, Public Bulletin Board
- Brownsville Public Library, Southmost Branch, Public Bulletin Board

- South Padre Island City Hall
- South Padre Island Mayor's Office
- Port Isabel City Hall
- Brownsville School District Office
- International Technology, Education, and Commerce (ITEC) Center, Brownsville, Texas

Advertisements were placed in three local newspapers a week before the scoping meeting for three consecutive days (Table 1.6-1).

Table 1.6-1. Scoping Meeting Notice—Publication Dates for Newspapers

Newspaper	Dates	Page Number
The Brownsville Herald	May 9, 2012 May 10, 2012 May 11, 2012	C8 C3 C2
Valley Morning Star	May 9, 2012 May 10, 2012 May 11, 2012	B5 B5 B5
El Bravo (Spanish language)	May 9, 2012 May 10, 2012 May 11, 2012	7 5 5

Notification and coordination letters were sent to Federal, State, and local agencies; elected officials; American Indian Tribes; and special interest groups that the FAA determined would most likely be interested in the Proposed Action. These letters were sent following the publication of the NOI in the *Federal Register*. Each letter provided the FAA's notification of its intent to prepare an EIS and described the Proposed Action and No Action Alternative, background information on the Proposed Action, and details on public participation opportunities.

1.6.2 Scoping Meetings

An agency scoping meeting was conducted on May 15, 2012, from 9:00 a.m. to 11:00 a.m., at the Brownsville Economic Development Council Board Room, 301 Mexico Boulevard, Suite F-1, Brownsville, Texas. The following agencies attended the meeting: USACE, USFWS, National Oceanic and Atmospheric Administration (NOAA), NPS, TGLO, Texas Parks and Wildlife Department (TPWD), and the Texas Historical Commission (THC). During this meeting, the FAA gave a brief presentation of the Proposed Action and had an open discussion with agencies regarding issues and concerns. Following the agency scoping meeting, a site visit was conducted to introduce the agencies to the proposed vertical launch area and control center area.

Open House portion of the Scoping Meeting

A public scoping meeting was held to solicit input from the public on potential issues that may need to be evaluated in the EIS (Appendix A). The scoping meeting was held on May 15, 2012, from 5:00 p.m. to 8:00 p.m., at the ITEC Center, located at 301 Mexico Boulevard, Suite G-1, Brownsville, Texas. The meeting format included an "open house" workshop. The "open house" format created a comfortable atmosphere for attendees—one in which they could speak individually with FAA and SpaceX representatives. During the scoping meeting, FAA and SpaceX project team representatives (i.e., FAA personnel, SpaceX personnel, and support contractors) were available to explain the proposed project and alternatives, answer questions about the project, and describe the environmental impact analysis process and related time line. Two Spanish-speaking project team representatives were available at the scoping meetings to aid in the discussions and help translate project information to Spanish speaking community members. Poster displays located throughout the open house provided information on the NEPA—Areas of Analysis, Proposed Action and Alternatives, Licensing and Permitting Process, Public Involvement Process, and SpaceX information. In addition to poster displays, a video was provided by SpaceX highlighting SpaceX's mission and activities. The FAA provided an informational overview presentation from 6:00 p.m. to 6:15 p.m., followed by a public comment period from 6:15 p.m. to 8:00 p.m.

Meeting attendees were welcomed at the entrance and asked to sign in. Scoping Factsheet Booklets (English and Spanish versions) containing copies of the poster displays with additional project information were handed out to meeting participants. Comment forms provided to those attending the scoping meetings were designed to either be filled out and submitted at the scoping meeting comment table or filled out later and mailed to the FAA. The public was invited to comment on the proposal prior to, as well as during and after, the scoping meetings. Everyone who signed up to speak during the meeting was given the opportunity.

A total of 519 individuals signed in at the meetings, including Federal and State elected officials, the media, city government agencies, local community planning groups, and local school representatives. The public comment portion of the meeting from 6:15 p.m. to 8:00 p.m. allowed a 3-minute statement from attendees who signed up to speak. A stenographer captured these oral comments verbatim. The meeting yielded 52 oral comments and 301 written comments. Most comments expressed general support for the proposal. Several elected officials and local community leaders also expressed their support for the Proposed Action.

Public Comment portion of the Scoping Meeting

1.6.3 Public Comments

The public had five ways to provide comments during the scoping period: 1) provide written comments during the scoping meeting, 2) provide comments orally during the scoping meeting, 3) submit comments electronically to faaspacexeis@cardnotec.com, 4) fax comments to (410) 990-0455, and 5) mail written comments to: Ms. Stacey M. Zee, Environmental

Protection Specialist, Federal Aviation Administration, SpaceX EIS–c/o Cardno TEC Inc., 275 West Street–Suite 110, Annapolis, MD 21401.

Overall, there were a total of 588 comments, resolutions, and letters of support received during the comment period from April 10, 2012, to May 30, 2012. Numerous comments were received after the scoping comment period ended and have been addressed in this EIS. Table 1.6-2 summarizes the number of comments submitted through the various methods made available to the public.

Table 1.6-2. Summary of Comments Received Method

Method of Comment Submittal	Supporting Comments	Opposing Comments	General	Total Number of Comments Received
Written Comment at Scoping Meeting	298	1	2	301
Oral Comment at Scoping Meeting	51	0	1	52
Email	90	20	15	125
Fax	6	0	0	6
Mail	103	1	0	104
Total	**548**	**22**	**18**	**588**

Note: Duplicate comments submitted via different methods were only counted once.

The public generally expressed support for the Proposed Action in their communities. The primary issues raised during scoping consisted of: socioeconomic benefits to Brownsville and nearby communities; potential unavoidable effects to pristine, sensitive habitat and the species that depend on it; nearby cultural resources; beach closures at Boca Chica Beach prior to and during launch events; security due to the location in relation to the U.S./Mexico border; and decline of property values and quality of life in Boca Chica Village. To a lesser extent, scoping comments focused on increased traffic on State Highway 4, noise, and the evaluation of cumulative effects.

1.7 EIS DOCUMENT STRUCTURE

The EIS is broken down into the following Chapters:

- Chapter 2 describes the Proposed Action and reasonable alternatives, including the No Action Alternative
- Chapter 3 presents the environmental baseline or affected environment for the environmental resource areas subject to potential impacts from implementation of the Proposed Action
- Chapter 4 provides the analysis of potential environmental impacts to the environmental resources with implementation of the action alternatives and the No Action Alternative
- Chapter 5 describes the potential cumulative impacts that could arise from implementing the action alternatives
- Chapter 6 discusses mitigation measures and environmental commitments that would be undertaken by SpaceX to address identified environmental impacts, should the FAA decide to issue launch licenses and/or experimental permits to SpaceX

- Chapter 7 discusses unavoidable adverse impacts
- Chapter 8 addresses the relationship between local short-term uses of the environment and enhancement of long-term productivity
- Chapter 9 presents irreversible and irretrievable commitment of resources
- Chapter 10 contains the list of preparers and contributors
- Chapter 11 lists those agencies, organizations, and persons who requested copies of this EIS
- Chapter 12 lists the references cited in the document
- Chapter 13 presents a glossary of terms used in the EIS
- Chapter 14 contains an index of common terms

The resources areas addressed in this EIS are consistent with the requirements of FAA Order 1050.1E, Change 1, and include analyses of the environmental resource areas listed below:

- Compatible Land Use (Including Farmlands and Coastal Resources)
- Section 4(f) Properties
- Noise
- Visual Resources and Light Emissions
- Historical, Architectural, Archaeological, and Cultural Resources
- Air Quality
- Water Resources (Including Wetlands, Floodplains, Surface Waters, Groundwater, and Wild and Scenic Rivers)
- Biological Resources (Including Fish, Wildlife, and Plants)
- Hazardous Materials, Pollution Prevention, and Solid Waste
- Socioeconomics, Environmental Justice, and Children's Environmental Health Risks and Safety Risks
- Energy Supply and Natural Resources
- Secondary (Induced) Impacts

Additional resources areas were also considered including airspace, health and safety, and ground traffic and transportation.

NEPA requires that Federal agencies to include analysis of potential transboundary effects extending across the border and affecting another country's environment. Because of the proximity of the proposed vertical launch area to the U.S./Mexico border, the FAA has considered the potential for transboundary impacts. For the purposes of this EIS, transboundary impacts are addressed in Section 3.3 and 4.3, *Noise*, as the potential for transboundary impacts would only occur from noise during launches.

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2.0 PROPOSED ACTION AND ALTERNATIVES

This chapter describes the Proposed Action, the No Action Alternative, and alternatives considered but not carried forward for further analysis.

The CEQ regulations establish a number of policies for Federal agencies, including "…using the NEPA process to identify and assess reasonable alternatives to the Proposed Action that will avoid or minimize adverse effects of these actions on the quality of the human environment" (40 CFR 1500.2 [e]). SpaceX developed evaluation factors that were applied to the potential locations for operation of the Falcon 9 and Falcon Heavy launch vehicle program. With these factors in mind, alternative sites were examined by SpaceX. Section 2.3, *Alternatives Considered but Not Carried Forward,* describes alternative sites considered by SpaceX in its planning process and the reasons for which those sites were found to be infeasible. The alternatives carried forward in the EIS are based on the purpose and need as outlined in Section 1.3, *Purpose and Need*.

2.1 PROPOSED ACTION

The Proposed Action, which is the Preferred Alternative, is for the FAA to issue launch licenses and/or experimental permits to SpaceX that would allow SpaceX to conduct launches of the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of reusable suborbital launch vehicles from a private launch site on privately owned property in Cameron County, Texas (Exhibit 1.0-1). Section 1.4, *FAA Licenses, Permits, Regulations, and Approvals*, lists the types of launch licenses and/or experimental permits the FAA could issue to SpaceX. In addition to issuing new launch licenses and/or experimental permits, this EIS also includes the renewal of launch licenses and/or experimental permits, through 2022. The FAA could renew a launch license and/or experimental permit if requested, in writing, by SpaceX at least 60 days (for experimental permits) or 90 days (for launch licenses) before the permit or license expires. Any future activities proposed by SpaceX that require FAA approval, and are not covered in this EIS, would require additional environmental analysis conducted in compliance with NEPA, CEQ Regulations, and FAA Order 1050.1E, Change 1.

As part of the Proposed Action, SpaceX would construct a vertical launch area and a control center area (Exhibit 1.0-2) to support its launch activities. All facilities would be constructed through private funding, and on currently undeveloped private property that would be purchased or leased by SpaceX. In addition, new underground power and data lines would be installed in the State Highway 4 (Boca Chica Boulevard) Right-of-Way (ROW) from the control center area to the vertical launch area.

Proposed operations would consist of up to 12 launches per year with a maximum of two Falcon Heavy launches. All Falcon 9 and Falcon Heavy launches would be expected to have commercial payloads, including satellites or experimental payloads. In addition to standard payloads, the Falcon 9 and Falcon Heavy may also carry a capsule, such as the SpaceX Dragon capsule. SpaceX may also elect to launch smaller suborbital launch vehicles from this proposed site. All launch trajectories would be to the east over the Gulf of Mexico.

The requirements for obtaining and possessing a launch license and/or experimental permit are described in 14 CFR Parts 400-450. The completion of the environmental review process does not guarantee that the FAA would issue launch licenses and/or experimental permits to SpaceX to launch from the proposed privately owned site in Cameron County, Texas. The Proposed Action must also meet the FAA safety, risk, and indemnification requirements. As part of the licensing process, SpaceX also would need to obtain a Letter of Authorization (LOA) from the Houston Air Route Traffic Control Center (ARTCC) to operate the Falcon 9 and Falcon Heavy in the proposed airspace before any launches could commence. SpaceX would also coordinate with the Secretariat of Communications and Transportation–Mexico regarding launch notifications.

2.1.1 Operational Activities

The Falcon launch vehicle program, including all its models, is designed for minimal vehicle assembly and processing on the launch pad. The goal is to launch within a few days to several weeks of payload arrival at a launch site. The Falcon 9 and Falcon Heavy launch vehicles are described below, as are the operational parameters for these vehicles.

Falcon 9 Launch Vehicle

2.1.1.1 Falcon 9 Launch Vehicle

The Falcon 9 is a medium-lift class launch vehicle with a gross lift-off weight of approximately 1,100,000 pounds (lbs) with an approximate length of 224 feet (ft). The Falcon 9 uses liquid oxygen (LOX) and highly refined kerosene, also known as rocket propellant-1 or refined petroleum-1 (RP-1), as propellants to carry payloads into orbit.

<u>First and Second Stages</u>

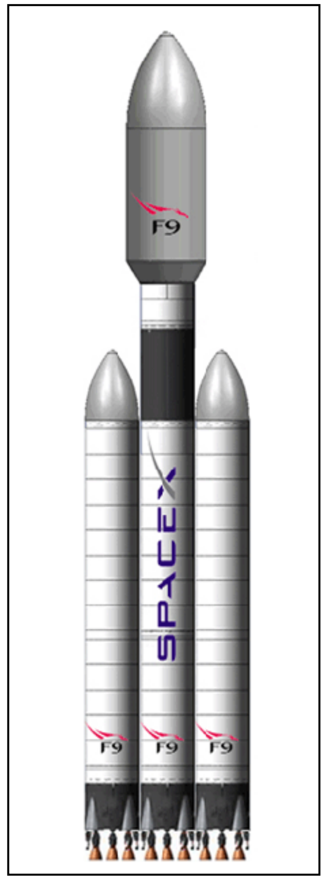
The first stage of the Falcon 9 is approximately 12 ft by 150 ft, and includes nine Merlin 1D engines. The Merlin engine produces 146,000 lbs of thrust and contains a pump-fed gas generator cycle, turbine exhaust roll control, and hydraulic thrust-vector control. The first stage consists of aluminum LOX and RP-1 tanks that hold approximately 62,000 gallons (gal) of LOX and 38,000 gal of RP-1.

The second stage is approximately 12 ft by 41 ft, not including the fairing and payload, and uses one Merlin vacuum engine. The fairing (the top portion of the vehicle where the payload is encapsulated) would be 17 ft by 35 ft, and a smaller version may also be used. The second stage consists of approximately 15,000 gal of LOX and 9,000 gal of RP-1 in tanks with a common bulk head.

The Falcon 9 launch vehicle uses helium gas stored in high pressure composite over-wrapped cylinders to pressurize the propellant tanks for both first and second stages. The helium flow is controlled through solenoid valves. Both stages include radio frequency (RF) transmitters.

2.1.1.2 Falcon Heavy

The Falcon Heavy is a heavy-lift class launch vehicle with a gross lift-off weight of approximately 3,400,000 lbs. It could place satellites/payloads into LEO and Geostationary Transfer Orbit (GTO). It has a width of 36 ft and an overall length of approximately 224 ft.



Falcon Heavy Launch Vehicle

<u>First and Second Stages</u>

The Falcon Heavy consists of a standard Falcon 9 with two additional boosters supporting the first stage flight. The booster pods are slightly modified versions of the Falcon 9 first stage. Thus, each is 12 ft by 100 ft and has nine Merlin 1D engines (for a total of 27 engines). Like the Falcon 9 vehicle, the Falcon Heavy uses LOX and RP-1 for its propellants. Thrust on lift-off is approximately 3.9 million lbs of force.

The Falcon Heavy second stage, identical to the Falcon 9 second stage, is 12 ft by 41 ft, and uses LOX and RP-1 propellants. The fairing for the Falcon Heavy would be larger to accommodate larger payloads—it may be up to 50 ft in length. Like the Falcon 9, both stages include RF transmitters.

The center core engines are throttled down after liftoff and up to two engines may be shut down as the vehicle approaches maximum acceleration. After the side boosters drop off, the center core engines throttle back up to full thrust. The center engine in each side core continues to burn for a few seconds after separation to control the trajectory of the side booster.

Table 2.1-1 describes the general characteristics of different types of launch vehicles and shows a comparison of the Falcon launch vehicle program and other companies' launch vehicles. The Falcon 9 is comparable in size to the Atlas V launch vehicle (United Launch Alliance–Lockheed Martin and Boeing). Compared to the NASA Space Shuttle, the Falcon 9 is slightly shorter (Shuttle is 184 ft) and weighs much less at lift-off (Shuttle's weight at lift-off was 4.5 million lbs). The Falcon Heavy is comparable to the Delta IV Heavy (United Launch Alliance–Lockheed Martin and Boeing) but can carry more than twice the payload of the Delta IV Heavy.

Table 2.1-1. General Characteristics of Launch Vehicles, including the Falcon 9 and Falcon Heavy*

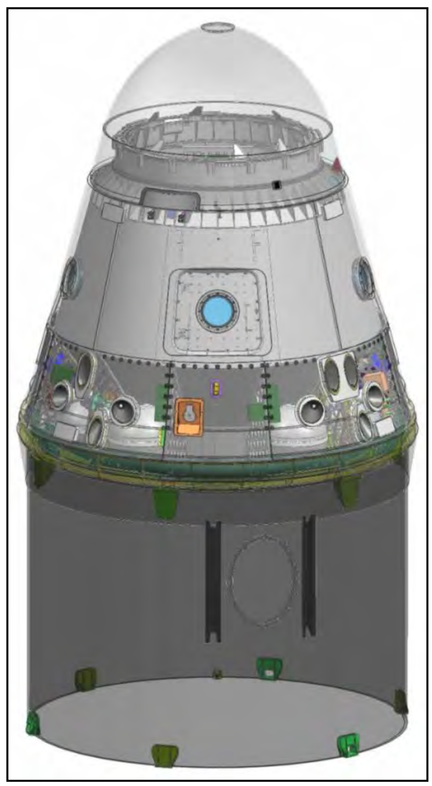
Parameter	Falcon 1	Falcon 9	Falcon Heavy	Atlas IIAS	Atlas V**	Delta IV	Titan IV
Length (ft)	68 ft	**223 ft**	**223 ft**	156 ft	194 ft	230 ft	183 ft
Width (ft)	5.5 ft	**12 ft**	**12 ft, with two 12-ft boosters**	10 ft	12.5 ft	16.4 ft	14 ft
Stages	2	**2**	**2**	2	2 + 1 SRM	2	2 + 2 SRM †

Table 2.1-1. General Characteristics of Launch Vehicles, including the Falcon 9 and Falcon Heavy*

Parameter	Falcon 1	Falcon 9	Falcon Heavy	Atlas IIAS	Atlas V**	Delta IV	Titan IV
First Stage Propellant	LOX/RP-1	**LOX/RP-1**	**LOX/RP-1**	LOX/RP-1	LOX/RP-1	LOX/LH_2	Liquid and solid*
Weight (lbs)	60,000 lbs	**1,100,000 lbs**	**3,400,000 lbs**	413,500 lbs	774,000 lbs	1,630,000 lbs	2,070,000 lbs
Thrust at Lift-off	454 KN/ 102 Klbf	**5,844 KN/ 1,314 Klbf**	**17,532 KN/ 3,942 Klbf**	3,546 KN/ 797 Klbf	2,891 KN/ 650 Klbf	2,891 KN/ 650 Klbf	15,100 KN/ 3,400 Klbf††

Notes: SRM = solid rocket motor; LH_2 = liquid hydrogen; KN = kilonewtons; Klbf = kilopounds-force; ft = feet; lbs = pounds; LOX = liquid oxygen; RP-1 = rocket propellant-1
† Indicates Titan IV first stage contains a core rocket engine using hypergolic propellants and two solid rocket motors using 88% Hydroxyl Terminated Polybutadiene fuels.
†† Indicates thrust level was from Titan IVB-12 launch.
*The Atlas, Delta, and Titan vehicles are not part of the SpaceX Falcon launch vehicle program and would not be launched from the proposed SpaceX Texas Launch Site.
** Indicates these characteristics are for the Atlas V 411 configuration, such as flown for the Atlas V NROL-28 launch.

Within the 12 launches per year, the Proposed Action also includes permitted launches of reusable suborbital launch vehicles. A reusable suborbital launch vehicle could consist of a Falcon 9 Stage 1 tank with a maximum propellant (LOX and RP-1) load of approximately 6,900 gal.


SpaceX Dragon Capsule

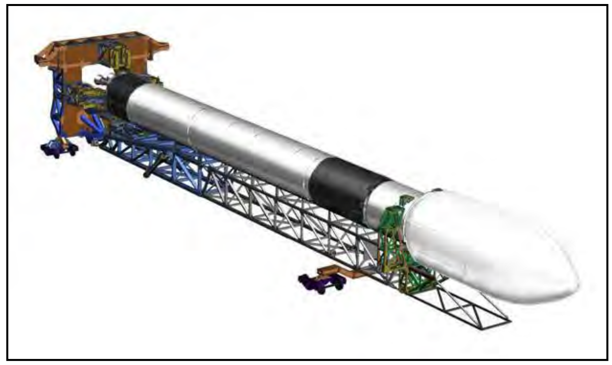
2.1.1.3 Payloads

All Falcon 9 and Falcon Heavy launches would be expected to have payloads, including satellites or experimental payloads. Most payloads would be commercial; however, some could be Department of Defense payloads, NASA payloads, or a Federal contribution to a commercial payload. This contribution can be monetary (e.g., funding a technology demonstration) or physical, such as providing a secondary payload/instrument.

Primary Payload Processing

SpaceX anticipates that primary commercial payload processing would occur at the control center area. The control center area and associated facilities are described in Section 2.1.2.2. Primary payload processing activities include payload checkout, spacecraft propellant loading, and payload encapsulation in the fairing. Radiating, a common standard communication check before launch, of the payload would occur during processing. Once primary payload processing is completed, the payload would be trucked to the vertical launch area prior to launch. In addition to standard payloads, the Falcon 9 and Falcon Heavy vehicles may carry a capsule, such as the SpaceX

Dragon capsule, which is being developed to deliver cargo and experiments to LEO. The Dragon capsule's dry weight could range from 8,000 to 15,000 lbs depending on its cargo and configuration. Dry weight is the weight of the payload without the associated propellant weight. For missions where Dragon is payload, Dragon would re-enter Earth's atmosphere at a pre-planned trajectory and would be tracked to a soft-landing in the Pacific Ocean (off the California coast). Dragon has an electronic locator beacon and would be located and recovered by a pre-positioned salvage vessel. Recovery would occur within 24 hours of re-entry. The recovered Dragon would be returned to SpaceX facilities in either Hawthorne, California; Vandenberg Air Force Base, California; or McGregor, Texas.



Falcon 9 on Transporter-Erector

Most payloads would almost always include some additional propellants on board, either for orbit maintenance or orbital insertion burns. Payload propellants may include hypergolic fuels such as unsymmetrical dimethyl hydrazine (UDMH), monomethylhydrazine (MMH), and nitrogen tetroxide (NTO), as well as pressurized gasses including helium and nitrogen, and some solid propellants. Hypergolic describes a propellant that ignites on contact with an oxidizer.

Quantities would vary but could total up to 4,840 lbs for combined weight of MMH and NTO for the Falcon 9 and up to 12,000 lbs for the Falcon Heavy. The propellant weight for the Dragon capsule is relatively fixed and is approximately 2,850 lbs. Total payload weights (dry weight plus propellant weights) could be up to 17,850 lbs for the Falcon 9 and 50,000 lbs for the Falcon Heavy. Prior to use, propellants would be stored in sealed containers at the control center area. Payloads would be fueled in either the Payload Processing Facility or the Integration and Processing Hangar (hereafter Hangar), and any residual propellants would be returned to the storage facility. A small amount of ordnance, such as small explosive bolts and on-board batteries, would also typically be used. Any hazardous materials would be handled in accordance with Federal, State, and local laws and regulations. SpaceX would establish an emergency response team, and spills would be contained and cleaned up per the procedures identified in the SpaceX Hazardous Materials Emergency Response Plan (HMERP).

Ground transportation support during a launch campaign (preparation for and the actual launch event) would be minimal. This support would consist of a truck to deliver a crane and four delivery trucks for delivery of the first stage, second stage, interstage, and payload. In addition, fuel and helium trucks would make weekly deliveries.

The first and second stages would arrive separately, likely from either Hawthorne, California or McGregor, Texas, via over-sized truck (similar in size to a mobile home) and two security escorts, and would be placed in the Hangar. Once at the Hangar, the stages and boosters would be checked and prepared for mating. During vehicle operations, vehicle integration, and checkouts, radiating in RF bands would occur. Only non-ionizing radiation would be used. Vertical launch area operations and vehicle processing for the Falcon 9 and the Falcon Heavy would be virtually identical.

Upon completing any necessary primary payload processing, the payload would be delivered to the Hangar. The payload would then be mated to the launch vehicle. The 16.5-ft payload is attached to the Falcon 9 vehicle and loaded on the transporter-erector. Payloads would be delivered to the Hangar for final payload processing and vehicle assembly. The Hangar and immediate vicinity would be used for all unloading, storage, and any necessary final payload processing. The bridge cranes would be used during the integration of the launch vehicle and its payload. Approved safety procedures, to accommodate both non-hazardous and hazardous payload processing, such as ordnance installation and loading of liquid propellants onto the second stage, would be in place. The Hangar would be certified to meet National Fire Protection Association requirements for electrical systems and equipment, including crane consoles.

2.1.1.4 Gas, Fuel, Oil, and Solvent Storage

Helium would be used as a pressurant for the main tanks during flight. It would also be used as a purge during fueling operations and at engine start. Helium would be obtained from commercial sources via a tanker and would be stored in above ground storage tanks within the vertical launch area fence line.

LOX and RP-1 would be stored in dedicated propellant storage areas within the vertical launch area. The vertical launch area and associated facilities are described in Section 2.1.2.1. The Falcon 9 vehicle (first and second stage combined) requires approximately 77,000 gal of LOX and 47,000 gal of RP-1. Storage would be required for the quantities used by the Falcon Heavy vehicle, including 350,000 gal of LOX and 200,000 gal of RP-1, including additional amounts for losses and quick launch turn-around. Losses include LOX that is lost when it boils off in storage or when lines and tanks are chilled. RP-1 would be lost if there was an aborted launch attempt. The storage locations for all Falcon program liquid propellants would afford the appropriate level of separation and protection.

All tanks and containment systems would be cleaned, tested, and certified before first use; all tanks would be tested to the U.S Department of Transportation (DOT), American Society of Mechanical Engineers (ASME) Section VIII Pressure Vessel Code requirements, or American Petroleum Institute storage tank requirements, as applicable. Permanent over-ground lines would be installed to connect both the LOX and the RP-1 storage areas to the launch pad. These piping systems would be designed, installed, and tested in accordance with ASME B31.3 Piping Code requirements.

First and second stage fueling of LOX and RP-1 would be done with quick disconnect fittings typically used in the aerospace industry. Gaseous nitrogen would be used on the system for cleanliness purges, and liquid nitrogen would be used for cooling purges on an as-needed basis. Gaseous nitrogen would be created from liquid nitrogen delivered to the site by commercial truck.

In addition, approximately 100 gal of isopropyl alcohol would be on site per launch for additional cleaning operations, though only 20 gal would be required for various cleaning operations during launch preparation. Solvent flushes would be performed during operation of the launch vehicle programs. Small volumes (less than 300 gal) of heavy gear oil, hydraulic oil, and cutting oil (less than 5 gal), and a limited supply of various solvents and adhesives would be stored in the shop area in the Hangar or at the pad for general use in the maintenance of ground equipment. An oxygen/acetylene torch with its associated gases (carbon dioxide [CO_2] and argon) may also be used on a limited basis. Welding equipment would be maintained on site for occasional use.

2.1.1.5 Pre-Launch Activities

Pre-launch activities would include mission rehearsals and coordination with governmental agencies and media outlets to provide notifications of upcoming launch activities. After final systems checkout, there would typically be a mission rehearsal without propellants on board (referred to as a dry dress rehearsal) plus a mission rehearsal with propellants on the vehicle (referred to as a wet dress rehearsal) to verify full launch readiness. The goal of dress rehearsals is to verify that all vehicle and ground systems are functioning properly, as well as to verify that all procedures are properly written. In a wet dress rehearsal, ground operators step through the flight procedures. The entire launch countdown is executed, with a pre-programmed abort just before the engine startup sequence, and thus, before ignition. Two dress rehearsals (usually within 32 days of launch) are typical in a launch preparation schedule to allow for team training and for coordination of activities between the mission-specific SpaceX crew and operations personnel.

In addition to conducting dress rehearsals to verify full launch readiness, SpaceX might conduct static fires. The goal of a static fire is to verify engine control and performance. A static fire is identical to a wet dress rehearsal, except engine ignition occurs. During a static fire test, the launch vehicle engines are ignited for approximately two seconds and then shut down.

Dry dress rehearsals would not require restricted public access in the vicinity of the proposed vertical launch area and control center area. However, wet dress rehearsals and static fires would require restricted access in the immediate vicinity of the vertical launch area and control center area. Public access to the area during a wet dress rehearsal or static fire would be similar to the closure described below for a launch (see Section 2.1.1.6, *Launch Day Activities*). However, a closure for a wet dress rehearsal or static fire would be shorter than a closure for a launch. Closures for a wet dress rehearsal or static fire would typically be three hours or less. The number of closure hours for wet dress rehearsals and static fires would be included in SpaceX's proposed annual maximum of 180 hours of closure (see Section 2.1.1.6, *Launch Day Activities* for further discussion of closures).

Approximately two weeks in advance of the launch, the County Commissioner's Court would be notified of the proposed launch date, the expected beach closure times, and backup closure dates and times. SpaceX would post written notices of the launch date and time and the proposed beach closure in several businesses and local offices in the area and within the County, as well as an advertisement in local newspapers advising of the beach closure. SpaceX would also coordinate with the Secretariat of Communications and Transportation–Mexico with regard to launch activities. In addition, SpaceX would coordinate with U.S. Customs and Border Protection, Cameron County and State of Texas law enforcement agencies, the U.S. Coast Guard (USCG), and Houston ARTCC in order to ensure public safety and allow for the issuance of Notice to Mariners (NOTMAR) and Notice to Airmen (NOTAM). Approximately 3-6 days prior to launch, the public would be notified of the upcoming launch through local media and through the use of NOTMARs and NOTAMs. SpaceX would also inform the cities of

Brownsville and South Padre Island; NPS; PINS; USFWS, Lower Rio Grande Valley National Wildlife Refuge (NWR); TPWD; TGLO; and TxDOT of the launch schedules.

2.1.1.6 Launch Day Activities

Launch day activities would include:

- temporary restrictions on public access on State Highway 4 (Boca Chica Boulevard)
- temporary closure of Boca Chica Beach
- temporary closure of areas offshore of Boca Chica Beach
- surveillance of areas within the vicinity of the vertical launch area to ensure public safety
- pre-launch operations (i.e., final system checkouts)
- the launch
- post-launch operations

As part of the licensing and permitting process, SpaceX must implement a plan that defines the process for ensuring that any unauthorized persons, vessels, trains, aircraft, or other vehicles are not within the hazard area. The plan must include safety and security personnel for each launch and roadblocks and other security checkpoints. SpaceX also must develop and implement agreements and plans with local authorities whose support is needed to ensure public safety during all launch processing and flight, in accordance with 14 CFR § 417.111. SpaceX would coordinate with U.S. Customs and Border Protection; Cameron County and State of Texas law enforcement agencies; the cities of Brownsville and South Padre Island; NPS; PINS; USFWS, Lower Rio Grande Valley NWR; TPWD; TGLO; TxDOT; and the USCG on the preparation of a detailed closure plan that describes the procedures for land closure and water closure areas that would limit public access on launch day along State Highway 4, on Boca Chica Beach, and offshore areas.

SpaceX proposes to limit public access at two pre-defined checkpoints on State Highway 4 for up to 15 hours on a launch day, with 6 hours being the typical closure time for a nominal launch. The 15-hour closure period allows for potential aborts and contingencies. Therefore, with 12 proposed annual launches, SpaceX proposes a maximum of 180 hours (this includes 15 hours per launch for each of the 12 launches) of closure per year. The two checkpoints include a soft checkpoint on State Highway 4, just east of Massey Way. Government personnel, SpaceX personnel, emergency personnel, and anyone with property beyond this soft checkpoint could pass, but the general public would be denied access. SpaceX may move the soft checkpoint further away from the launch site based on consultations with the USFWS. The second checkpoint would be a hard checkpoint, just before the control center area, which is a "no pass" area determined by the FAA approved hazard area (see Section 2.1.1.8, *Launch Failures*, for further discussion of the FAA approved hazard area). No one would be permitted to pass by this hard checkpoint during launch operations. Exhibit 2.1-1 shows the proposed launch day closure areas that SpaceX would implement to ensure that unauthorized persons remain out of the hazard area. Monitoring would be done by vehicle along existing roads including State Highway 4. SpaceX and law enforcement would monitor the area to the east of the checkpoints to ensure that the area is clear. In addition, SpaceX would coordinate with Cameron County, the City of Brownsville, USFWS–Lower Rio Grande Valley NWR, NPS, TPWD, TGLO, and TxDOT to identify a safe location on private land along State Highway 4, before the Massey Way soft checkpoint, for the public to view a launch event.

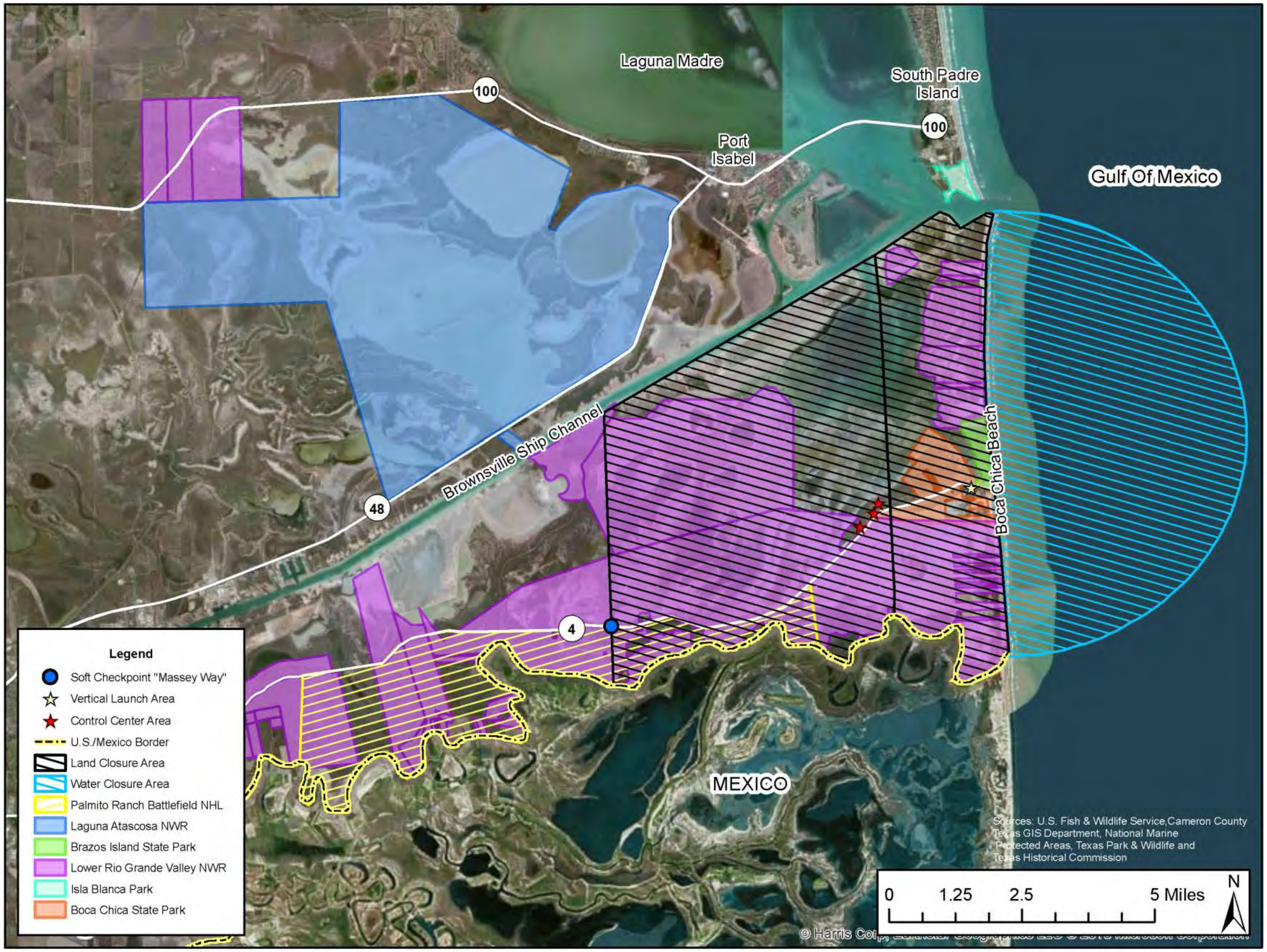


Exhibit 2.1-1. Proposed Launch Day Closure Areas

On the day of launch, the Boca Chica Beach would be closed to the public from the Brownsville Shipping Channel south to the U.S./Mexico border on the Gulf Coast (see Exhibit 2.1-1). SpaceX would continue to monitor the beach area using all-terrain vehicles (ATVs) to ensure that the area is clear before launch. The beach closure for launch day would last up to 15 hours. As part of the licensing process, SpaceX would also develop a plan for clearing offshore areas. This plan would include coordinating with the USCG, issuing NOTMARs, and clearing the offshore area in order to ensure public safety. The USCG could conduct boat patrols to sweep the offshore area to make sure the area is clear; this would continue to take place until SpaceX is ready to load propellant to the vehicle (approximately 3 hours from launch). A final sweep of the closure areas by helicopter could also be implemented at this time to ensure the areas are clear.

On the day of launch, the launch vehicle on the transporter erector would be moved to the launch pad from the vertical launch area Hangar and connected to the launch stand (refer to Section 2.1.2.1, *Vertical Launch Area*, for more detailed information on the launch pad). A wheeled vehicle, such as a small tug or other road equipment, would be used to pull the launch vehicle and transporter erector to the launch pad. Launch vehicles may be erected and de-erected several times prior to launch; the transporter erector is designed to make this operation quick and simple. On the day of launch, the launch vehicle would be erected and final system checks completed. Approximately 3 hours before launch, the vehicle would be loaded with propellant. Just before launch, the transporter erector would be retracted at least 12 degrees from the vehicle. The transporter erector would be moved into the Hangar after the launch. After the launch, SpaceX and the FAA would notify law enforcement when the area has been deemed safe. Individuals needing to conduct nesting sea turtle beach patrols (e.g., Sea Turtle Inc.) would be given one hour to check the beach for sea turtle nests prior to the beach being re-opened for the general public. After completion of the sea turtle patrols, the checkpoints would be raised and the area would be re-opened for the public.

<u>Deluge Water System</u>

One water tower would be constructed at the vertical launch area as a deluge water system for sound and vibration suppression. The deluge water would be injected into the rocket exhaust plume and flame trench and sprayed on the launch pad deck. During a launch event, the water tower would discharge approximately 50,000-200,000 gal of water. Details of the water tower and collection system are provided under Section 2.1.2.1, *Vertical Launch Area*.

2.1.1.7 Nominal Trajectories

The majority of launches would be conducted between the hours of 7:00 a.m. and 7:00 p.m. However, there could be one nighttime launch per year. SpaceX would conduct all launches, including pre-flight activities, and all launches would be coordinated with the FAA/AST and Houston ARTCC. The Falcon 9 and Falcon Heavy launch trajectories would be specific to each particular mission. However, all launches would be conducted to the east over the Gulf of Mexico, similar to what is depicted in Exhibit 2.1-2.

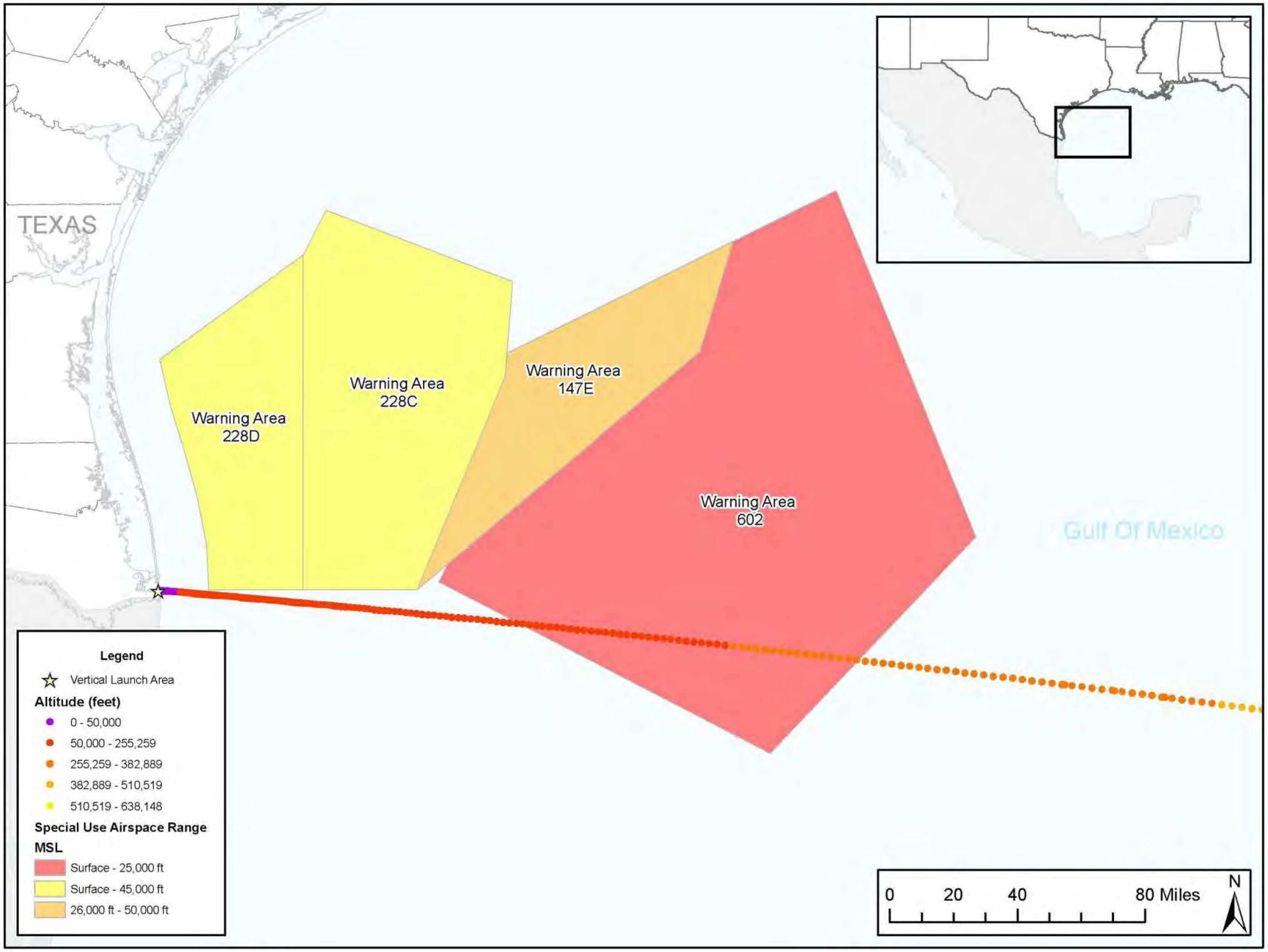


Exhibit 2.1-2. Example Falcon Heavy Trajectory

As part of the licensing and permitting evaluation process, the FAA conducts a policy review, payload review, financial determination, and safety review. SpaceX would complete an Expected Casualty (E_c) Analysis as part of its license and/or permit application and the FAA would evaluate this analysis as part of the safety review to ensure that the results meet 14 CFR 400 regulations. All approved trajectories would be based on specific launch vehicle performance and characteristics and would satisfy 14 CFR 400 regulations. In addition to an E_c Analysis, SpaceX would perform a Flight Safety Analysis. The FAA would evaluate this Flight Safety Analysis to ensure that the resulting hazard areas meet 14 CFR 400 regulations.

2.1.1.8 Launch Failures

Although unlikely, a launch could fail. A launch failure of the Falcon 9 or the Falcon Heavy on the launch pad represents the most substantial potential for impact. Should this occur, a number of possible outcomes could result, the most likely being a fire on the launch pad. An explosion on the launch pad would likely spread debris. The FAA evaluates SpaceX's Ground Safety Analysis (14 CFR 417.405) which identifies each hazard, each associated cause, and each hazard control that a launch operator must establish and maintain to keep each identified hazard from affecting the public. In the event of a launch failure, the debris impacts would be expected to be contained within the FAA approved hazard area.

<u>Flight Termination System</u>

The launch vehicle would be equipped with either a thrust termination or a destructive flight termination system, or both, in the event the vehicle varied from the planned trajectory. The vehicle would break up and debris could land in the Gulf of Mexico.

2.1.1.9 Recovery Efforts

<u>First Stage</u>

After a launch, the first stage of the Falcon 9 would land in the Gulf of Mexico, approximately 550 miles downrange, and would potentially be recovered by a salvage ship. The salvage ship would locate the first stage through telemetry signals from the stage. The recovered first stage would be returned to SpaceX facilities in Hawthorne, California. If the expended first stage could not be located, it would likely be due to damage. It would subsequently sink, and therefore it would not be recovered.

<u>Second Stage</u>

The second stage would go into orbit with the payload. It would be left in orbit and safed per FAA regulations (14 CFR Part 417.129), such as venting the vehicle and ensuring that the batteries would discharge.

2.1.2 Construction Activities

SpaceX plans to construct facilities, structures, and utility connections in order to support the launch of the Falcon 9 and Falcon Heavy launch vehicles. The facilities would be located in two areas: vertical launch area and control center area. The command and control functions for a launch are required to be conducted at a safe separation distance from the actual launch pad, which is approximately 2 miles away. As a result, the proposed control center area is approximately 2 miles west from the vertical launch area and north of Boca Chica Boulevard (Exhibit 1.0-2).

While the majority of the construction would occur during the day, small amounts of construction, such as pouring of concrete, would occur at night. All construction staging areas would occur within the proposed project boundaries and no additional areas would be required for staging. The proposed schedule for all construction activities is a 24-month period from start to finish. Construction activities would not begin until after the NEPA process and other required consultation and permitting requirements are complete.

2.1.2.1 Vertical Launch Area

Proposed facility and infrastructure construction at the vertical launch area would include the following:

- Integration and Processing Hangar (Hangar)
- Launch pad and stand with its associated flame duct
- Water tower
- Lightning protection towers (four total)
- Retention basin for deluge water
- Propellant storage and handling areas
- Workshop and office area
- Warehouse for parts storage
- Roads, parking areas, fencing, security, lighting, and utilities

The approximate 56.5-acre property, leased by SpaceX, is located directly adjacent to the eastern terminus of State Highway 4 (Boca Chica Boulevard), immediately south of Brazos State Park, approximately 5 miles south of Port Isabel and South Padre Island, approximately 18 miles east of Brownsville, and approximately 3 miles north of the U.S./Mexico border on the Gulf Coast of Texas (Exhibit 1.0-2 and 2.1-3).

Development of the vertical launch area at this location would only occur within 20 acres of the entire 56.5-acre property. The rest of the property would remain open space. Construction at this location would generally involve placing fill material to elevate land levels high enough to avoid frequent flooding. Fill material would be sourced from on-site whenever possible. All on-site material would come from within the 20-acre project area. If necessary, additional clean fill material would be sourced from the local region. In addition, most of the larger facilities and those that must support heavy loads would be required to have pilings driven to support the facilities. As a result, most of the land area inside the proposed fence lines would be disturbed at some point.

<u>Integration and Processing Hangar</u>

The Hangar at the vertical launch area would be used for the preparation of the launch vehicle for launch and the final fueling and integration of the payload onto the vehicle. It would require approximately 43,200 square feet (ft^2) of space (360 x 120 x 65 ft high) and would be constructed of pre-fabricated steel framework with steel or aluminum sheet walls. To support the Hangar, approximately 30 concrete pilings, 3 ft in diameter, would be installed with an impact pile driver. The Hangar would be

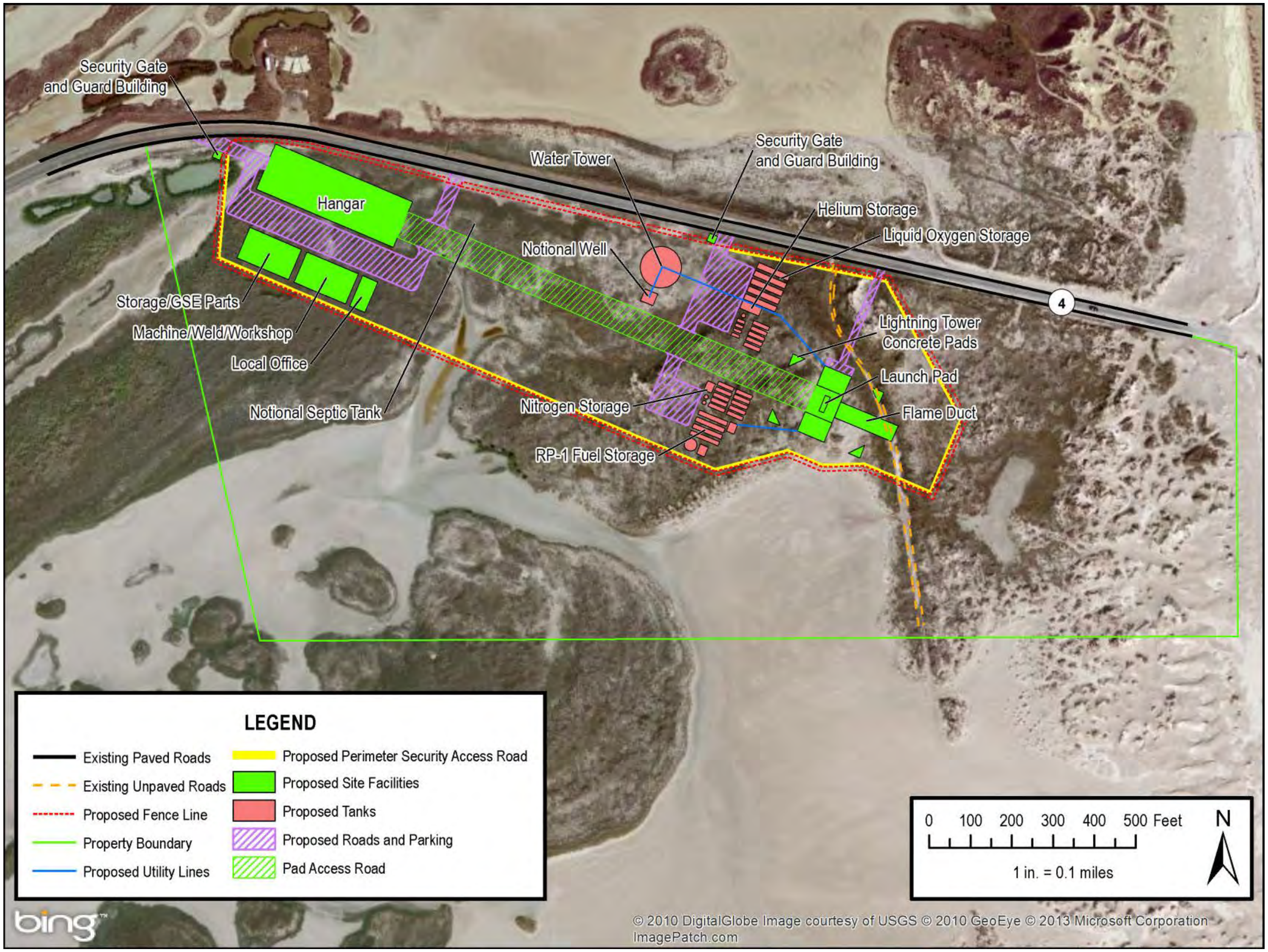


Exhibit 2.1-3. Proposed Vertical Launch Area Site Layout

air conditioned, and the fueling facilities would have a scrubber system (up to two active scrubbers) to minimize emissions to the environment in the event of a payload fuel spill inside the facility. The scrubbers consist of “scrubbing towers,” storage tank with liquid level indicator, service panel, circulation pump, and a liquid separator with liquid level indicator. The system would be mounted on a “low boy” trailer for easy transport. Spill containment for the scrubber system would depend on the materials used in these systems, and then if required would be sized for 110 percent of the maximum credible spill as required by law. Containment would be constructed of a non-porous material, such as concrete or a non-reactive plastic. The concrete would be lined with a leak-proof barrier that is compatible with the materials handled. The scrubber systems are monitored by testing the residual fluid contained in the scrubber.

Launch Pad

The concrete road from the Hangar to the launch pad would be approximately 75,110 ft^2. The launch pad and stand are used to translate the launch vehicle to a vertical position and to support it on the pad prior to launch. It consists of a concrete and steel structure with a flame duct, a launch mount, and upper deck. To support the launch pad and stand, approximately 20 concrete pilings, 3 ft in diameter, would be installed with an impact pile driver. The height of the entire launch pad would be approximately 50 ft and would require approximately 17,900 ft^2 of space. The flame duct would extend southeast from the launch pad to direct the heat and combustion products and the initial sound blast toward the Gulf of Mexico. The pad would also include two concrete and steel wings to protect equipment that is required to be very close to the pad. All pad lighting would consist of high pressure sodium light fixtures. However, for safety reasons SpaceX may occasionally require bright spotlighting for short durations (1-2 days maximum) when illuminating the launch vehicle for the proposed one night launch event per year. These spot lights are typically metal halide. The number of pole lights would be finalized during the site design process. SpaceX will coordinate with NPS, USFWS, and all other appropriate agencies on the preparation of a detailed Lighting Management Plan.

The Falcon vehicle system transporter erector would serve as the service tower for vehicle umbilical support while the launch vehicle is vertical. Additionally, four lightning protection towers, not to exceed 200 ft in height, would be constructed adjacent to the launch pad.

Deluge Water System

One water tower would be installed at the vertical launch area for sound and vibration suppression. The water tower would contain at least 250,000 gal and would be approximately 250 ft high, which is required to provide sufficient pressure to the pad systems. Approximately 50,000-200,000 gal would be discharged during a launch event. During a launch, approximately half of the water would be vaporized. All water not vaporized would be contained in a retention basin underneath the pad. This water would then be sampled and analyzed to determine if the water contained controlled contaminants at levels that exceed the TCEQ water quality standards. Appropriate sampling protocols and water quality criteria would be developed in coordination with TCEQ and in accordance with Texas Surface Water Quality Standards. Water containing contaminants that exceed the water quality criteria would be removed and hauled to an approved industrial wastewater treatment facility outside of the vertical launch area. All other water not containing prohibited chemicals would be pumped back to the water tower. The water for the deluge system would be withdrawn from the underlying aquifer.

Propellant Storage and Handling Areas

The propellant storage areas would include storage and handling equipment for the propellants and gases that fuel the launch vehicle. There are four primary areas: LOX area, RP-1 area, helium area, and nitrogen area. Each area would include storage tanks or vessels, including their supports and containment area where required; fluid pumps; gas vaporizers; and other components necessary to control flow to the launch vehicle. In addition, each area would include a concrete or asphalt parking area for delivery trucks for refill of the storage tanks. The total area necessary for propellant storage and handling would be 28,550 ft^2.

Workshop and Office

The workshop and office areas would support construction and maintenance of the vertical launch area systems. The workshop would include machining and welding equipment along with other tools as needed. The office area would be used to provide personnel working at the vertical launch area with easy access to company network files and information. The workshop would be approximately 10,800 ft^2 (80 ft x 135 ft) and approximately 40 ft in height, and the office is expected to be approximately 3,200 ft^2 (80 ft x 40 ft). Construction of both facilities would be similar to the Hangar construction—pre-fabricated steel framing with steel or aluminum sheet walls. To support these facilities, approximately 20 concrete pilings, 3 ft in diameter, would be installed with an impact pile driver.

Access Roads and Infrastructure

Roads and utilities would be required to provide access, power, and water to the facilities within the vertical launch area. The exact layout and area of required access roads would be determined by the final selected site layout and design; however, an estimation of the total parking and road area is approximately 2.45 acres. The combined parking areas of the vertical launch area and the control center area would be designed to accommodate up to 250 personnel. Roads would be constructed of concrete or asphalt, depending on the planned use. The perimeter access road would be dirt/gravel. Throughout the area, there would be exterior lighting, security fences, and gates.

Utilities would include power, potable water, fire protection water, and a septic system. Primary power for the vertical launch area would be provided by commercial power from the control center area to the vertical launch area. Power and data lines would be installed underground within the ROW along State Highway 4 (Boca Chica Boulevard). A total of approximately 1,000-3,000 kilowatts per hour (kW/hr) would be required by the vertical launch and control center areas during launch operations. For the purpose of this EIS, both commercial power and a total of 10, 300-kW generators would be used for the vertical launch and the control center areas. Generator operations are expected to be used as emergency power sources that could be required at any time due to a power outage, and as supplemental power for use during the final stages of the launch schedule. It is anticipated that the generators could be used continuously for the final 48-hours prior to launch.

The site deluge water would also be used for fire protection. Potable water would either be delivered by truck to a holding tank at the vertical launch area, or a well and water distribution lines would be installed to provide potable water to the area. The septic system would consist of a mobile above ground processing unit and holding tank.

Security

Security would be maintained around the vertical launch area in order to protect the general public from the potential hazards of the site and also to prevent unauthorized access to the systems and materials on the site. Two security gate and guard buildings would be required, at approximately 400 ft^2 per building. Security systems would include two gates controlling access to the vertical launch area monitored by guards stationed at small guard buildings at the gates, and by a fencing system that extends around the perimeter of the vertical launch area.

The guard buildings would be used to control access and would be manned 12 hours a day with card key access during non-manned hours. The lighting on the guard buildings would be finalized during the design process. However, the exterior lights could consist of 135 watt (W) low pressure sodium "full cutoff" wall mounted fixtures and vapor proof, F32, T8, amber sleeved, fluorescent tube fixtures mounted on the ceiling underneath the overhangs. All guard buildings would be lit with exterior lights from dusk to dawn due to safety and security concerns.

The vertical launch area would be surrounded by two 6-ft tall perimeter chain-link fences, approximately 10 ft apart, to maintain personnel and visitor safety and facility security. The outside perimeter fence would include a system to detect unauthorized access. This outside fence would enclose approximately 20 acres. In addition, a 7-ft wide dirt access road would be developed inside the inner fenceline for security patrol. Site lighting would be necessary for personnel safety, but it would be designed so that none of the lighting is visible seaward of the dunes. All site lighting would consist of HPS light fixtures. The number of pole lights would be finalized during the site design process.

2.1.2.2 Control Center Area

The proposed control center area would be located immediately adjacent to Boca Chica Village approximately 2 miles west of the proposed vertical launch area and north of Boca Chica Boulevard (Exhibit 1.0-2). The proposed control center area would consist of three parcels (Exhibit 2.1-4a and 2.1-4b). The 4.0-acre Parcel 1 is located the furthest from the proposed vertical launch area and is bounded on the southeastern side by Boca Chica Boulevard and the southwestern side by Remedios Avenue (Exhibit 2.1-4a).

The 4.4-acre Parcel 2 is bounded on the southeastern side by Boca Chica Boulevard, on the southern end San Martin Boulevard, and on the northwestern side by Esperson Street.

The 4.0-acre Parcel 3, which is the closest to the proposed vertical launch area, is located northeast of Eichorn Boulevard. Exhibits 2.1-4a and 2.1-4b show the proposed site layout for the control center area. Proposed facility and infrastructure construction at the control center area would include the following:

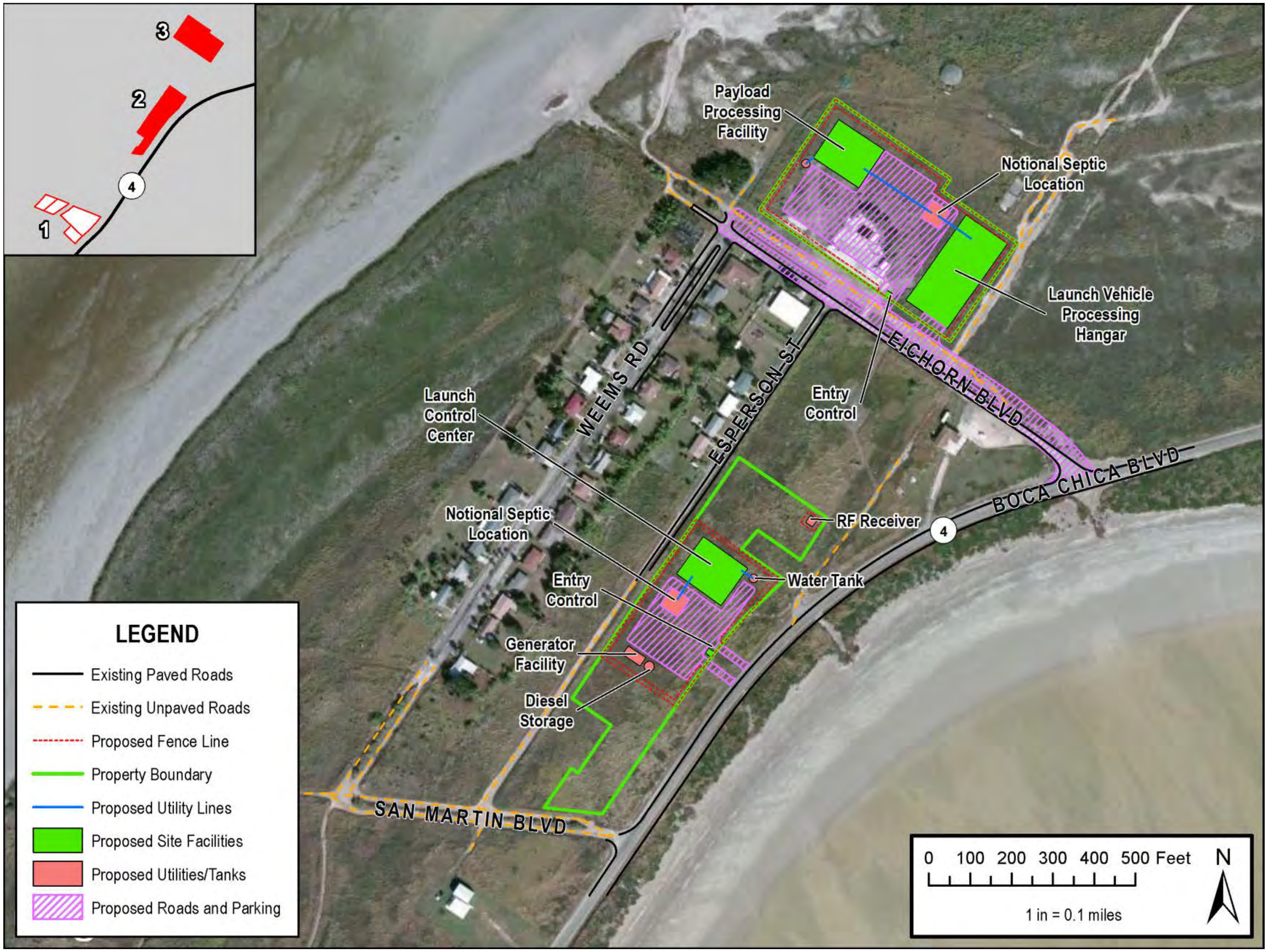


Exhibit 2.1-4a. Control Center Area Site Layout – Parcels 2 and 3

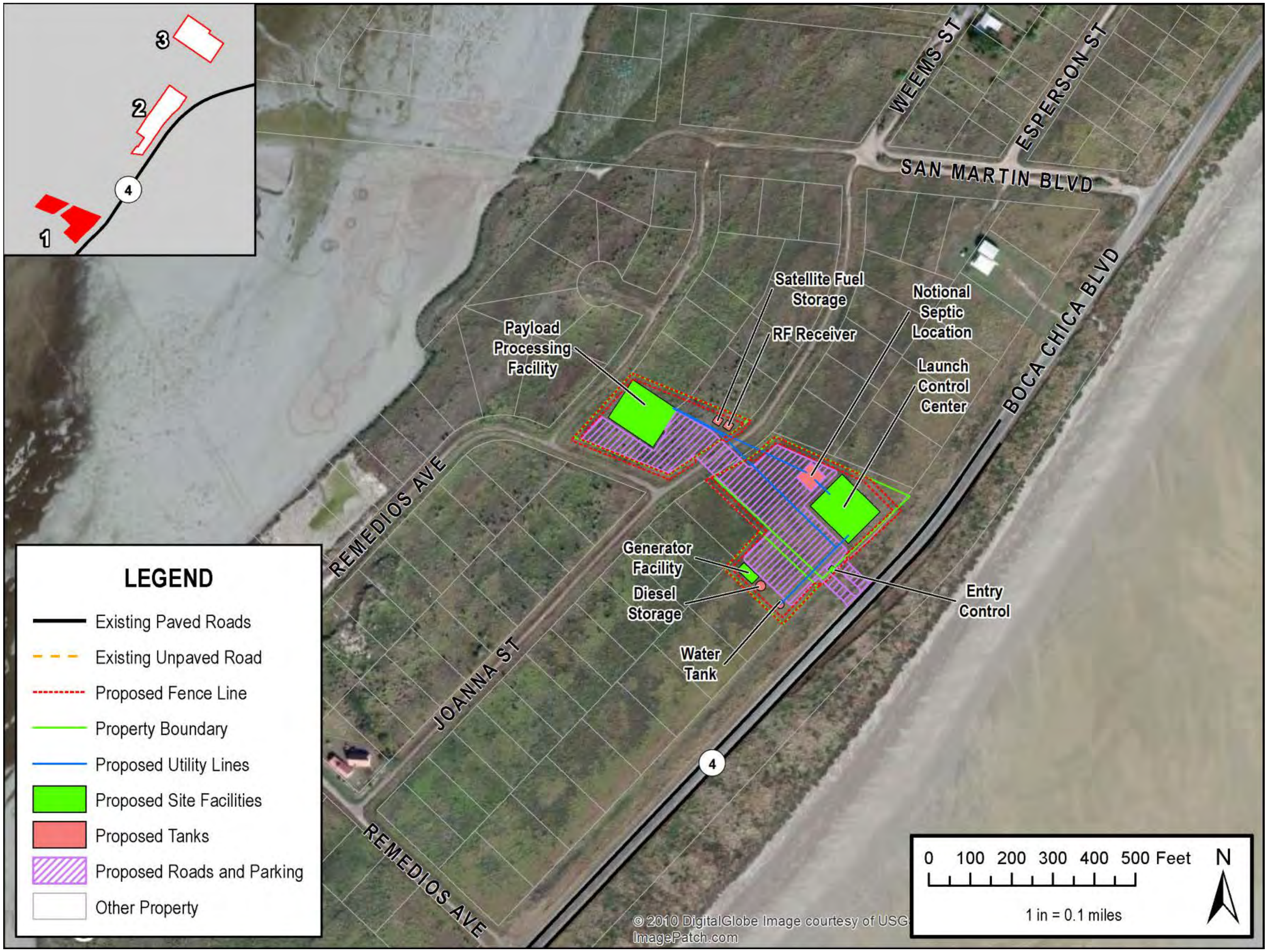


Exhibit 2.1-4b. Control Center Area Site Layout – Parcel 1

- Two launch control center buildings
- Two payload processing facilities
- Launch vehicle processing hangar
- Two RF transmitter/receivers
- Generators and diesel storage facilities
- Roads, parking areas, fencing, security, lighting, and utilities
- A satellite fuels storage facility

Construction at this location would generally involve grading to level the land. As a result, most of the land area inside the proposed fence lines would be disturbed at some point.

Launch Control Center Buildings

The one-story control center buildings would be approximately 14,186 ft^2 and used for command and control of the launch vehicle, payload, and ground systems during launch and test operations. Each control center building would consist primarily of several large rooms for control consoles, conference rooms, and support rooms. In addition, each facility would house office areas for site personnel.

Payload Processing Facilities

The payload processing facilities would be used to conduct final processing of payloads prior to integrating them with the launch vehicle. This processing would include final spacecraft checkouts, RF checks, payload fueling, and other activities as required. The facilities would be designed to support the processing of two payloads simultaneously, to allow for a better throughput. Each building would be approximately 14,669 ft^2.

Launch Vehicle Processing Hangar

The proposed 30,774 ft^2 launch vehicle processing hangar would be used to conduct refurbishment of flown stages, or for pre-integration preparation of the launch vehicle stages before they go to the pad hangar for final integration. Use of this facility would improve the overall vertical launch area throughput by minimizing the vehicle's activities associated with the launch vehicle in the vertical launch area Hangar. This facility would be similar to the Hangar at the vertical launch area, but shorter.

RF Transmitter/Receiver

One or more antenna dishes would be required to receive data from the launch vehicle in flight, and to possibly communicate commands to the vehicle as needed. The most likely requirement would be for S-band reception. The antenna mounts would be approximately 20 ft^2, and would be located within the site fence line in an optimal location for good reception. Antenna dishes would be no larger than 20 ft in diameter and 30 ft high.

Access Roads, Infrastructure, and Fencing

Similar to the vertical launch area, roads and utilities would be required to provide access, power, and water to the facilities within the control center area. The exact layout and area of required access roads would be determined by the final selected site layout and design; however, an estimation of the total parking and road area is approximately 4.86 acres. Roads would be constructed of asphalt. Throughout the area there would be exterior lighting, security fences, and gates.

Utilities would include power, potable water, fire protection water, and septic systems. Primary power for the control launch area would be provided by commercial power. Power and data lines would be upgraded and installed underground within the ROW along State Highway 4.

Satellite Fuels Storage

The last facility included in the control center area would be a small storage facility for satellite fuels. Spacecraft, such as the Dragon capsule, typically use different propellants than the launch vehicle, usually a form of hydrazine. This propellant would arrive at the site in closed shipping containers and would be stored for a period of time at the site prior to loading onto the spacecraft. The storage facility would consist of an approximate 20 x 20 ft (400 ft^2) area, protected overhead by a roof, and secured by floor-to-roof fencing. The area would include spill containment to support the expected storage volume.

2.1.3 Personnel Levels

Approximately 30 full-time SpaceX employees/contractors would be present at the vertical launch area and/or control center area in 2013. Full-time SpaceX employees/contractors are anticipated to work a single shift, between the hours of approximately 8:00 a.m.–5:00 p.m. On a per-mission basis, launch campaigns (i.e., preparation for and conducting of a launch event) would be expected to last up to two weeks. During a launch campaign, an additional 100 local or transient workers would be working at the vertical launch area and/or control center area. During launch campaigns, the additional workers could work extended hours; however, 2 days prior to launch, full-time SpaceX employees/contractors and the local or transient workers would need to be on-site for up to 24 hours per day. Staffing on-site would return to normal levels (approximately 30 full-time SpaceX employees/contractors) within a day or two after the actual launch. Table 2.1-2 shows the number of full-time SpaceX employees/contractors working on site plus the local/transient workers necessary during launch campaigns that would be present between 2013 and 2022.

Table 2.1-2. Personnel for Proposed SpaceX Texas Launch Site Operations

Year	Full-time SpaceX Employees/Contractors Working On-Site	Full-time SpaceX Employees/Contractors plus Additional Local/Transient Workers during Launch Campaigns
2013	30	130
2014	75	175
2015	100	200
2016	100	200
2017	110	210
2018	130	230
2019	150	250
2020	150	250
2021	150	250
2022	150	250

Source: SpaceX 2012.

The EIS includes the full scope of facilities that would be necessary to support proposed operations at the launch site. At this time, it is not anticipated that there would be a need for expansion of facilities for the phased increase in workforce through 2022. However, if additional facilities are proposed in the future, a supplemental analysis would need to be prepared to address the potential impacts.

2.2 NO ACTION ALTERNATIVE

CEQ regulations (44 CFR §1502.14) require agencies to consider a "no action" alternative in their NEPA analyses to compare the effects of not taking action with the effects of the action alternative(s). Thus, the No Action Alternative serves as a baseline to compare the impacts of the Proposed Action.

Under the No Action Alternative, the FAA would not issue launch licenses and/or experimental permits to SpaceX for launch operations from the private site in Cameron County, Texas. Thus, SpaceX would not construct the proposed control center and vertical launch areas. For those parcels of land that SpaceX owns or leases, SpaceX could use the land at its discretion, in compliance with all applicable Federal, state, and local laws and regulations. The FAA is not aware of any defined SpaceX plans to develop the parcels of land that it owns or leases, if FAA does not issue the launch licenses and/or experimental permits as described above. For this EIS, it is assumed SpaceX would the leave the property undeveloped for the foreseeable future.

2.3 ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD

SpaceX developed the following evaluation factors that were applied to SpaceX's identified potential locations for operation of the Falcon 9 and Falcon Heavy launch vehicle program:

1. Latitude—The launch site must be in a low-latitude for optimal performance and faster Earth rate.
2. Trajectory—The launch site must be able to support LEO and GTO.
3. Safety—The most favorable launch site would be a coastal site, so that the launch vehicle flies over water and not populated land.
4. Accessibility—The launch site must be easily accessible for delivery of hardware.
5. Climate and Winds—The launch site must have an optimal weather conditions that include low winds, low cloud ceiling, and temperatures above 41 degrees Fahrenheit (F°).
6. Size—The launch site must be large enough to incorporate all the necessary facilities, structures, and utility connections in order to support the launch of the Falcon 9 and Falcon Heavy launch vehicles.
7. Diversity—The launch site must be in a different location than other ranges that SpaceX utilizes in order to diversify risk and operations.
8. Schedule Flexibility—The launch site must have a high probability of meeting tight launch windows.
9. Airspace—The launch site must be located in an area with limited airspace disturbance.

With these factors in mind, alternative sites were examined by SpaceX. This section describes alternative sites considered by SpaceX in its planning process, which for the reasons given below, were found to be infeasible. These alternative sites were not carried forward for further analysis in the EIS.

2.3.1 SpaceX Off-Site Alternatives

SpaceX eliminated international sites due to political risk, National Security concerns, and International Traffic in Arms Regulation concerns. Within the U.S., most sites were eliminated due to safety concerns, as there are very few sites in the nation which are in a sparsely populated area and would not result in overflights over populated areas. Given those constraints, the search was narrowed down to three potential areas: Puerto Rico, Florida, and Texas.

2.3.1.1 Puerto Rico

Within Puerto Rico, SpaceX looked at several sites, with the former Roosevelt Roads Naval Station being the most reasonable from a trajectory standpoint. However, SpaceX eliminated this alternative from further analysis because it did not meet evaluation factor 4, due to the challenge of transporting SpaceX hardware from the U.S. mainland to Puerto Rico, as well as land use and accessibility limitations.

2.3.1.2 Florida

Within Florida, SpaceX looked into three areas: north of CCAFS, CCAFS, and south of CCAFS. The area north of CCAFS was eliminated because the coast is heavily populated, and higher latitudes are not optimal for performance. The launch manifest at CCAFS is very crowded (both from SpaceX and other companies). This crowded manifest at CCAFS allows less flexibility for SpaceX's commercial launch manifest, especially for flights which have tight launch windows. The requirements for government launches and commercial launches are very different and are handled differently on the launch site. Thus, in the same way that there are military and commercial airports, it is efficient and beneficial to both SpaceX and the government to have separate launch sites for its commercial launches and its government launches. SpaceX looked for sites along the coast south of CCAFS. Unfortunately, no land was identified due to the fact that most of Florida's eastern coast is heavily populated, which would violate flight safety rules. Additionally, Road 1A runs down the entire coast and most potential sites (coastal or inland) would thus overfly this road. This alternative did not meet evaluation factors 1, 4, 8, and 9. For these reasons, these locations were not considered to be a viable alternative.

2.3.1.3 McGregor, Texas

As discussed in Section 1.1, *Background*, SpaceX has an existing leased 650-acre engine test site in McGregor, Texas. From this site, launch vehicles would have a trajectory that passes through the continental U.S. over several populated towns and cities. This alternative did not meet evaluation factors 2, 4, 7, and 8. For these reasons, the McGregor, Texas site was not considered a viable alternative.

2.3.1.4 Kenedy County and Willacy County, Texas

Within Texas, the factors used in the site evaluation were refined by SpaceX even further to include the following:

1. No more than 70 miles north of the U.S./Mexico border to maintain minimum acceptable performance
2. No more than 10 miles inland (not including the barrier island of South Padre)
3. A minimum of 30 acres
4. No existing residences within 1 mile of the launch site
5. No existing residences within 1 mile of the possible trajectory (east/southeast)

Applying the first and second criteria (above) resulted in over 700 square miles of Willacy and Kenedy counties. Kenedy County was quickly ruled out given the land ownership in the proposed area was held by trusts, which disallowed the proposed use. Willacy County was eliminated from further consideration for various reasons including possible trajectory over residences and the need to build road networks through government-owned land.

2.3.2 SpaceX On-site Alternatives

Applying the third through fifth criteria, as discussed above in Section 2.3.1.4, *Kenedy County and Willacy County, Texas*, resulted in the identification of 14 potential sites. After these potential sites were identified, SpaceX further refined the evaluation criteria for vertical launch area site development to include the following: 1) Proximity and orientation to water; 2) Slope; 3) Property size; 4) Proximity to critical infrastructure; 5) Existing land use/land cover; 6) Presence and/or proximity to community centers (e.g., schools/churches/hospitals); 7) Presence and/or proximity to contaminated sites; and 8) Low density population.

Two properties met the criteria listed above: the TGLO Parcel 608 and the Walsh/Arnett property (Boca Chica area). The TGLO Parcel 608 is a 20-acre spoil cell (at low-tide) adjacent to the Laguna Atascosa Wildlife Refuge. At high-tide, only 8 acres of land were exposed, so extensive fill amounts would be required to elevate the land to avoid frequent flooding. Access to the property was only available by the Laguna Madres or Arroyo Colorado River or through the Laguna Atascosa Wildlife Refuge. Roads would have to be built through the Refuge to access Parcel 608. Further, safety concerns with this property included the numerous small semi-permanent house-boats located east of the property in the Laguna Madre. These properties are state-owned and leased for hunting/fishing to the public, and there was no certainty that they could be relocated or cleared for launches. Therefore, Parcel 608 was eliminated from further consideration.

The Walsh/Arnett property includes 50 acres of beachfront and highway frontage. This was considered an optimal location for trajectory and was the only property that was deemed appropriate based on the evaluation criteria. Therefore, this site was carried further as the proposed launch site in Cameron County, Texas.

With regard to Section 404(b)(1) of the CWA (33 U.S.C. 1344), the Proposed Action is not a water dependent activity. Therefore, it is necessary to consider practicable alternatives to the Proposed Action that do not involve impacted wetlands, namely using only upland areas (non-wetland areas) to construct the vertical launch and control center areas. However, due to the nature of the area, wetlands are found throughout the property. A site that meets all the criteria discussed above, in a configuration that avoids all wetlands, is not available anywhere in the property selected by SpaceX. Alternative site layouts were reviewed to avoid and minimize impacts on wetlands and are discussed below.

2.3.2.1 SpaceX Former On-Site Alternative 1

The site layout depicted in Exhibit 2.3-1 was the original site layout and is the most optimal for SpaceX in terms of a launch perspective. This layout allowed for the hangar and the pad to be at the approximate north-south midpoint of the property. This site layout also allowed for ample separation from State Highway 4, which is helpful for both site security reasons and to allow for longer access roads. The longer access roads also enable easier launch vehicle transport and integration. However, this layout was dismissed due to the potential for the direct impact to approximately 5.79 acres of wetlands (areas shown in blue in Exhibit 2.3-1).

2.3.2.2 SpaceX Former On-Site Alternative 2

The site layout depicted in Exhibit 2.3-2 was the second site layout and is the second most optimal for SpaceX in terms of a launch perspective. However, this layout was dismissed due to the potential for direct impact to approximately 4.02 acres of wetlands (areas shown in blue in Exhibit 2.3-2).

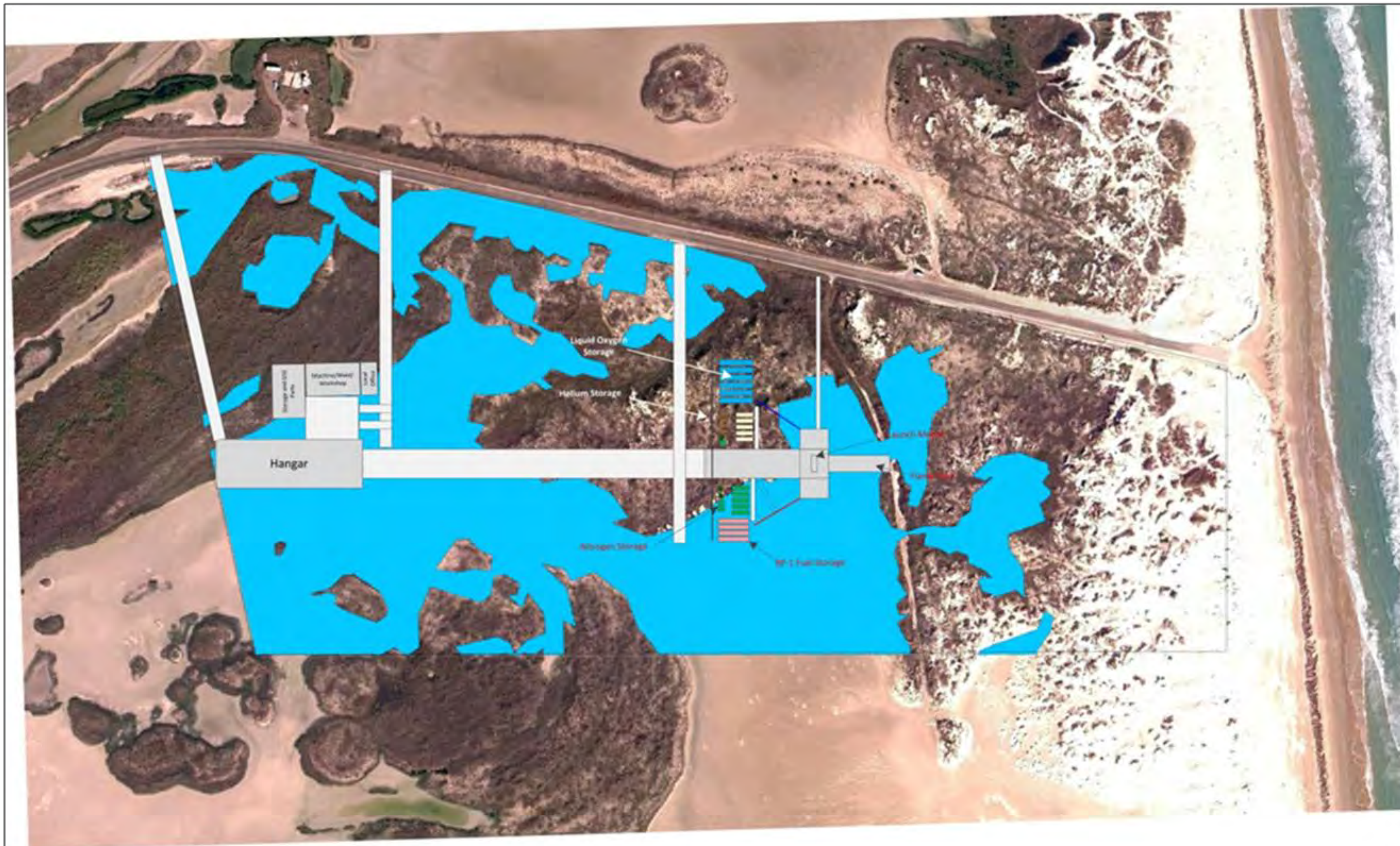


Exhibit 2.3-1. SpaceX Former On-Site Alternative 1

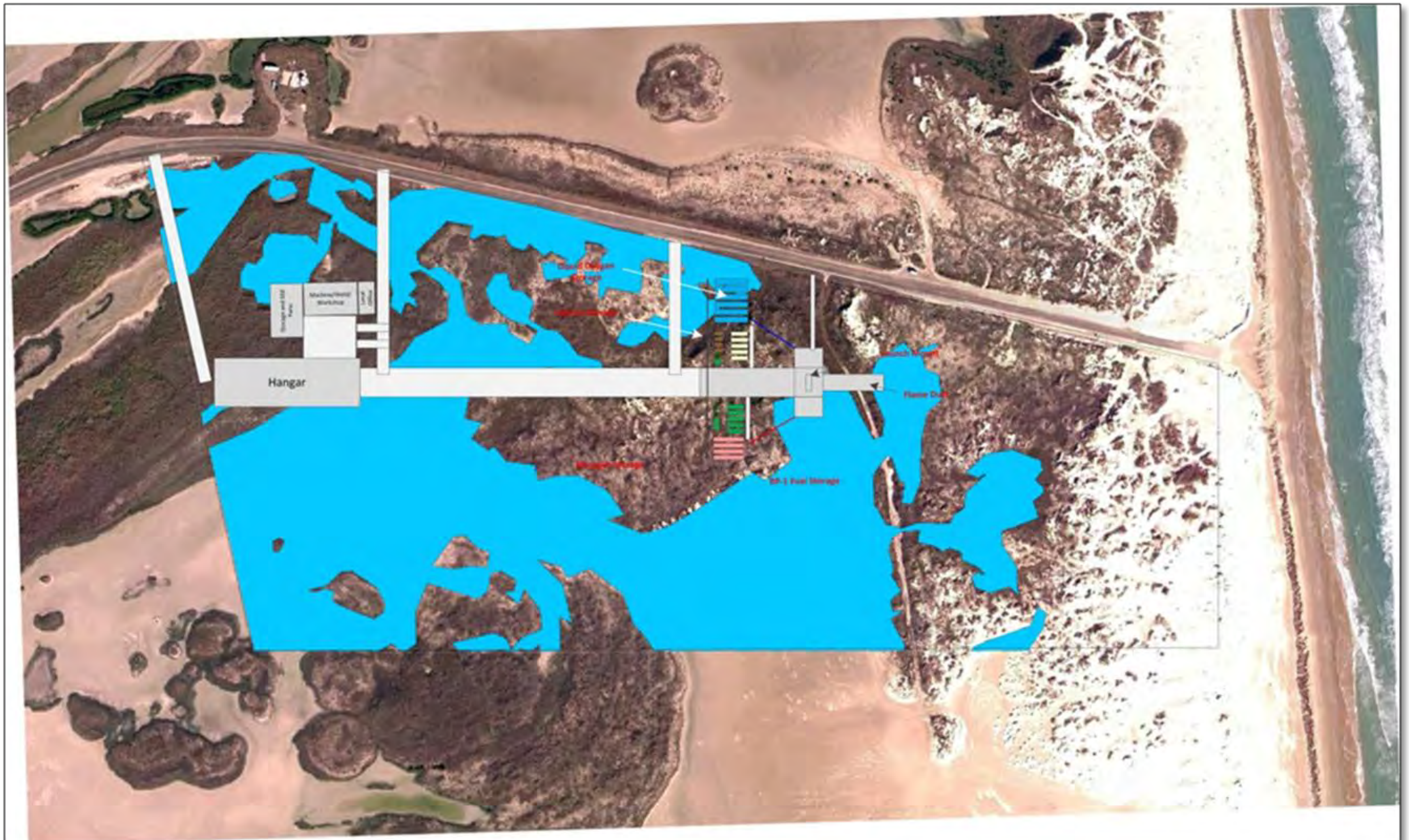


Exhibit 2.3-2. SpaceX Former On-Site Alternative 2

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3.0 AFFECTED ENVIRONMENT

This section describes the existing conditions of the area that could be affected by the Proposed Action and the No Action Alternative as described in Section 2.0 of this EIS. The information in the following sections serves as a baseline from which to identify and evaluate environmental consequences resulting from the Proposed Action and the No Action Alternative. Each section provides a definition and description of the resource area, the regulatory setting, the region of influence (ROI), and the existing conditions.

3.1 COMPATIBLE LAND USE (INCLUDING FARMLANDS AND COASTAL RESOURCES)

3.1.1 Definition and Description

Land Use

Land use often refers to human modification of land for residential or economic purposes. Land use categories typically include agriculture, forestry, residential, commercial, industrial, transportation, utilities, mining, recreation, and communication. Land uses are frequently regulated by management plans, land use plans, comprehensive plans, and local zoning and ordinances. These plans and regulations assist in identifying where future development can occur, ensuring consistency with surrounding land uses, and protecting specially designated or environmentally sensitive uses. Land use is interrelated with other resource areas including noise, socioeconomics, biological resources, and cultural resources.

Compatible land use means the use of the land is normally compatible with the outdoor noise environment at the location (14 CFR 150.7). Compatible land use analysis considers the effects of noise on special management areas, such as National Parks, National Wildlife Refuges, and other sensitive noise receptors. The concept of land use compatibility corresponds to the objective of achieving a balance or harmony between the Proposed Action and the surrounding environment.

Within land use, there are certain classifications that are afforded special protection by the DOT such as Section 4(f) properties, Farmlands, and Coastal Resources. Section 4(f) properties are a special class of public lands or resources whose “use” by agencies in the DOT is restricted unless no feasible and prudent alternative exists. For the purposes of this EIS, Section 4(f) properties are described separately in Section 3.2.

Farmlands

Some farmlands are protected by the Farmland Protection Policy Act (Public Law 97-98, Sections 1539-1549; 7 U.S.C. 4201, et seq.), which minimizes “the extent to which Federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses.” Prime farmland soils are defined as those that have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and are also available for these uses. Areas considered unique farmland have ideal soil quality, growing season, and moisture supply needed to economically produce sustained higher yield crops. Unique farmland is land, other than prime farmland, that is used for the production of specific high-value food and fiber crops. Lastly, there are farmlands of statewide or local importance determined by the appropriate state or local agencies (American Farmland Trust 2006).

Based on the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) web soil survey (NRCS 2012a), the soils underlying the vertical launch area are comprised of Galveston fine sand, hummocky (90 percent Galveston); Mustang fine sand, saline (90 percent Mustang); Mustang fine sand (95 percent Mustang); and Coastal beach (100 percent). The Galveston fine sand is in the taxonomic class mixed, hyperthermic Typic Udipsamments. Mustang fine sand is in the taxonomic class siliceous, hyperthermic Typic Psammaquents. The control center area is underlain by Galveston fine sand, hummocky, which is classified as partially hydric soils. All of the soils on-site have very high wind erosion potential. Conversely, all of the soils on-site have very low water erosion potential (NRCS 2012a). No prime farmland, unique farmland, or farmland of statewide of local importance are present within the proposed vertical launch area or control center area sites (NRCS 2009); therefore, farmlands will not be discussed further in this EIS.

Coastal Resources

Texas exercises its authority to implement the Texas Coastal Management Program (TCMP) under the CZMA through 31 Texas Administrative Code (TAC) §501.3, which defines Coastal Natural Resource Areas (CNRAs) as those areas that include coastal barriers, coastal historic areas, coastal preserves, coastal shore areas, coastal wetlands, critical dune areas, critical erosion areas, gulf beaches, hard substrate reefs, oyster reefs, submerged land, special hazard areas, submerged aquatic vegetation, tidal sand or mud flats, water of the open Gulf of Mexico, and water under tidal influence.

3.1.2 Regulatory Setting

Federal

Land Use

Specific guidance relevant to land use is given in the NEPA implementing regulations which require consideration of "possible conflicts between the Proposed Action and the objectives of Federal, regional, State, and local land use plans, policies and controls for the area concerned" (see 40 CFR 1506.2(d)) and indirect effects including "growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate" (see 40 CFR 1508.8). The FAA Order 1050.1E addresses potential land use impacts in terms of compatible land use, noise contours, and noise sensitive areas. Noise is discussed in Section 3.3.

Coastal Resources

CZMA of 1972 (16 U.S.C. §1451 et seq.) was enacted to provide management of the nation's coastal resources and is administered by NOAA's Office of Ocean and Coastal Resource Management. The CZMA promotes the "effective management, beneficial use, protection, and development" of the nation's coastal zone; those goals are met through active state involvement to enact the CZMA.

The Coastal Barrier Resources Act (CBRA) of 1982 is administered by the USFWS to preserve the ecological integrity of areas that protect the U.S. mainland from storms, to provide important habitats for fish and wildlife, and to protect coastal barrier islands. The Act created the Coastal Barrier Resources System barrier islands and coastal areas within 24 states (including Texas), in which Federal financial assistance for development-related activities in designated areas is prohibited.

EO 13158, issued in 2000, directs Federal agencies to work with both governmental and non-governmental agencies at the Federal, State, local, and tribal levels, within existing legislation, to increase protection to ocean resources by strengthening and expanding a national system of Marine Protected Areas. Its goal is to protect and avoid harm to the extent practicable, those marine areas that are afforded special protection for reason such as natural resource conservation or cultural resources preservation.

State

<u>Land Use</u>

Land use in the project area is regulated under the Open Beaches Act (Texas Natural Resources Code Title 2, Subtitle E, Chapter 61), which states that the public has "free and unrestricted right of ingress and egress to and from state-owned beaches bordering on the seaward shore of the Gulf of Mexico." The Dune Protection Act (Texas Natural Resources Code Title 2, Subtitle E, Chapter 63) requires the commissioners court of any county with public beaches bordering on the Gulf of Mexico to establish a dune protection line on the Gulf shoreline. The Open Beaches Act and the Dune Protection Act are enforced by the TGLO. The TGLO is responsible for ensuring that construction activities affecting the Texas coast and affecting the beach and dunes are performed according to State law under the Open Beaches Act and the Dune Protection Act.

<u>Coastal Resources</u>

In Texas, TGLO administers the federally approved TCMP. TCMP consistency reviews are conducted on activities permitted by the USACE within the TCMP boundary. A Federal Consistency Review (Appendix B) is conducted by the TGLO on behalf of the Coastal Coordination Council when construction occurs within the Texas coastal zone boundary. Project plans are submitted from the USACE to the TGLO.

Local

<u>Land Use</u>

Land use is regulated by all levels of government. Typically the most immediate governmental jurisdiction, such as county or local municipalities, is most likely to control land use and have site-specific stipulations. The proposed vertical launch area is located entirely within Cameron County. With the exception of *The County of Cameron Building Regulations* as required by the National Flood Insurance Act Title 42, which allows the county to participate in the National Flood Insurance Program (NFIP) and regulates development within the floodplain, the county does not have a comprehensive land use plan or zoning regulations in unincorporated areas (Cameron County 2012). Although there is no zoning and land use plan for the location of the vertical launch and control center areas, nearby communities, namely, the cities of Brownsville, Port Isabel, and South Padre Island, all have comprehensive plans. The Town of Laguna Vista is currently working on a comprehensive plan that is expected to be finalized by the end of 2012. These plans promote future development and commercial growth while making sound use of land resources and existing infrastructure. These plans also encourage infill and preservation of existing neighborhoods to reduce urban sprawl and its associated impacts.

<u>Coastal Resources</u>

Local governments have beach access and dune protection plans that are in effect and define access points, parking requirements, and vehicular access for area beaches. The Cameron County Commissioners' Court current Dune Protection and Beach Access Plan was adopted in September 20, 1994, and amended on August 29, 2006, and August 26, 2010. The TGLO rules under the Open Beaches Act and the Dune Protection Act require local governments to issue permits when proposed construction is within 1,000 ft landward from mean-high tide and to ensure that construction does not restrict access or use of local beaches by the public. Before issuing a construction permit, the local government sends the permit files to the TGLO for comment.

3.1.3 Region of Influence

The ROI includes the proposed vertical launch and control center areas and adjacent private and public lands. In addition, the ROI includes the State Highway ROW from the control center area to the vertical launch area. The proposed vertical launch area and control center area are located within the Texas Coastal Zone Boundary defined in the TCMP rules (31 TAC §503.1).

Impacts due to noise from launch events include nearby communities and points of interest within the Day-Night Average Sound Level (DNL) 65 dBA (A-weighted decibel) noise contour (please see Section 3.3, *Noise*, for a more detailed explanation of noise metrics). The 65 dBA contour is established as the standard for noise sensitive areas in FAA Order 1050.1E.

Growth inducing effects are estimated for Cameron and Willacy Counties, which are included within the Brownsville-Harlingen-Raymondville, Texas combined statistical area.

3.1.4 Existing Conditions

3.1.4.1 Overview

The proposed vertical launch area would be located on privately-owned land in Cameron County, Texas, near the cities of Brownsville and South Padre Island, approximately 3 miles north of the U.S./Mexico border (Exhibit 1.0-2). The proposed vertical launch area and control center area are in a sparsely populated coastal area off the Gulf of Mexico characterized by of sand and mud flats. The proposed control center area consists of three parcels north of Boca Chica Boulevard and west of the proposed vertical launch area. Only one of these parcels has existing infrastructure consisting of a concrete pad (a former swimming pool). Boca Chica Village, a small residential subdivision with a mostly transient population, is adjacent to the three parcels that comprise the proposed control center area. Current infrastructure and utilities in this area are limited (for more information, please see Section 3.11 *Energy Supply and Natural Resources*).

The proposed vertical launch area is directly adjacent to the eastern terminus of State Highway 4 (Boca Chica Boulevard). This road provides the only access to Boca Chica Beach. The State of Texas owns and operates 200 ft in fee title as a ROW for State Highway 4 from the end of the road at the coast approximately 6 miles inland, adjacent to the proposed vertical launch area (TxDOT 2012).

The land surrounding the proposed vertical launch and control center areas is primarily used for recreational purposes and includes Boca Chica State Park, the Lower Rio Grande Valley NWR (Boca Chica Tract), the South Bay Coastal Preserve, Brazos Island State Park, Isla Blanca Park, and the Palmito Ranch Battlefield National Historic Landmark (NHL) (Exhibit 3.1-1).

State parks are managed by the TPWD and are considered public lands. Boca Chica State Park, although owned by the TPWD, is leased by USFWS. Under the Open Beaches Act, Boca Chica State Park is considered public land up to the high tide line or the line of vegetation. Isla Blanca Park, approximately 5.5 miles north of the proposed vertical launch area, is managed by the Cameron County Parks and Recreation Department and is considered public land.

The NWR System (which includes Preserves) is managed by the USFWS and is considered public land set aside for the conservation of fish, plants, and wildlife. Portions of the proposed vertical launch area are located within the USFWS designated Coastal Federal Resource System unit T-12, an undeveloped coastal barrier protected under the CBRA.

NHLs and National Historic Parks are managed by the NPS. The Palmito Ranch Battlefield NHL, approximately 3 miles southwest of the proposed vertical launch area, is considered public land. For more information regarding historical, architectural, archaeological and cultural resources, see Section 3.5.

Coastal resources, as defined by 31 TAC §501.3, are present in the area. The property boundary for the proposed vertical launch area is immediately adjacent to critical dune areas, and an area of sand dunes occurs on the eastern portion of the property. These areas are defined as a protected sand dune complex on the Gulf shoreline parallel to and within 1,000 ft of mean high tide designated by a dune protection line established by local governments. Cameron County established a dune protection line, which changes as the shoreline changes (Cameron County 2010). There are no Marine Protected Areas in the vicinity of the Proposed Action. As of March 2012, the Lower Rio Grande Valley NWR is listed as Eligible for a Marine Protected Area, but is not a member. Boca Chica State Park was deemed not eligible as a Marine Protected Area (NOAA 2012a). Additional, eligible preserves located in south Texas are the Laguna Atascosa NWR and the Padre Island National Seashore (NOAA 2012a).

Special hazard areas are designated by the Federal Emergency Management Agency (FEMA) as having special flood, flood-related erosion, or mudslide hazards. The proposed vertical launch and control center areas are located within Zones A8 and V10 of the Flood Insurance Rate Map for Cameron County, Texas, and are designated as special hazard areas according to 31 TAC §501.3 of the TCMP. Zone A is defined by FEMA as areas that are subject to inundation by the 1-percent-annual-chance flood event. Zone V includes areas along coasts that are subject to inundation by the 1-percent-annual chance flood events with additional hazards associated with storm-induced waves. The proposed vertical launch area boundary is located outside of the defined coastal shore area (100 ft landward of the mean high water mark on submerged lands) along the Gulf of Mexico and is not within a critical erosion area designated by the TGLO in the Texas Coastwide Erosion Response Plan (TGLO 2009).

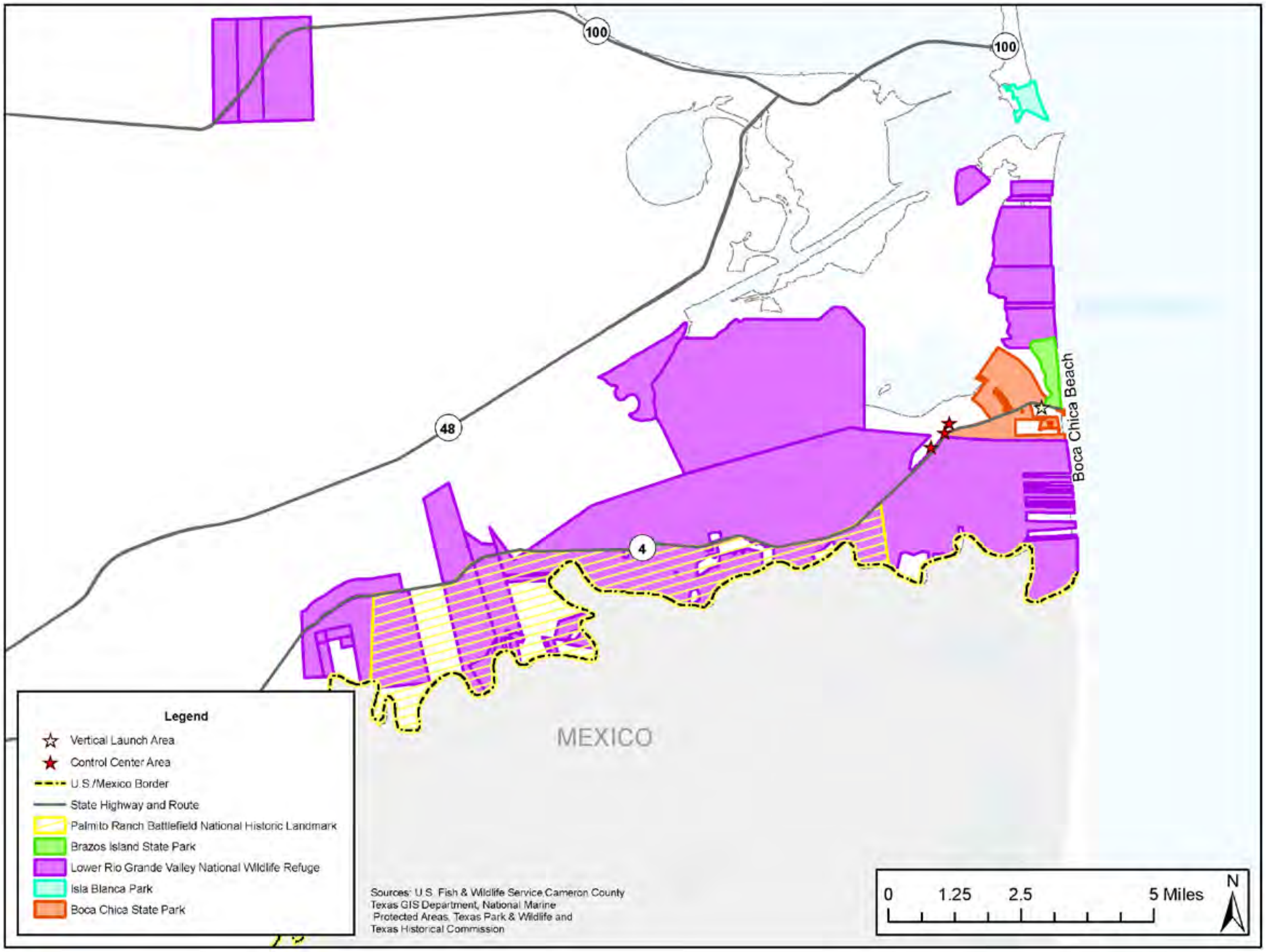


Exhibit 3.1-1. Land Use within the ROI for the Proposed Action

3.1.4.2 Land Ownership

The majority of the land within the ROI is state-owned managed by TGLO. TGLO's core mission is to manage state lands and mineral-right properties. TGLO earns money for the Permanent School Fund (PSF) by leasing state lands for energy and mineral development (TGLO 2012a). State lands include beaches, bays, estuaries and other submerged lands, extending a distance of 10.3 miles off the coast (Harte Research Institute for Gulf of Mexico Studies 2012).

State-owned submerged lands are included in the water closure area for launch day activities as depicted in Exhibit 3.1-2. There are currently no active leases within the state-owned submerged lands.

Currently there are no wells or oil and gas leases on or adjacent to the proposed vertical launch and control center areas. However, there are four oil and gas leases, approximately 2 miles off the coast, directly east of the ROI and two gas wells less than 1 mile southwest of the proposed control center area (Exhibit 3.1-2).

The four oil and gas leases are owned by Sanchez Oil and Gas Corporation and all four leases are approaching their expiration. Leases MF108399, MF108400, and MF108401 expired in October 2012 and lease MF109556 expires in October 2013 (TGLO 2012b). While Sanchez Oil and Gas Corporation has performed exploration drilling in this area in the past, currently there is minimal drilling being performed in the Gulf of Mexico, particularly within 3 miles of the coastline. The cost of insurance has increased significantly and shallow wells (less than 3 miles from coastline) are typically only finding natural gas. With the low price of natural gas, this type of drilling is not economical. The renewal of the oil and gas leases is not a simple process and since Sanchez has not been successful in finding oil in past exploration drilling and has not shown any interest in drilling in this location, renewal of these leases is not anticipated (TGLO 2012c).

The two wells noted on Exhibit 3.1-2 are also owned by Sanchez Oil and Gas Corporation and include Well 1 (061-30523) and Well 2R (061-30526). Both are classified as gas wells, although Well 2R does have some minimal oil production as well. Well 1 went out of production in April 2012. Well 2R continues to produce, but is a low-yielding well.

Currently, there are no existing wind farms in the vicinity of the proposed vertical launch area. However, there are two wind leases owned by Baryonyx off the Gulf Coast in the vicinity of the Rio Grande Valley. The Rio Grande North (TGLO Wind Lease WL000013) wind lease comprises 21,672 acres and the Rio Grande South (TGLO Wind Lease WL000011) wind lease comprises 19,794 acres (Baryonyx Corporation 2013). The Rio Grande South wind lease is located approximately 10 statute miles[1] from the proposed vertical launch area and is approximately 6.5 statute miles north of the water closure area. The Rio Grande North site is approximately 6 miles further north of the Rio Grande South site.

[1] A statute mile is 5,280 feet, and is a term used to differentiate between land miles and nautical miles.

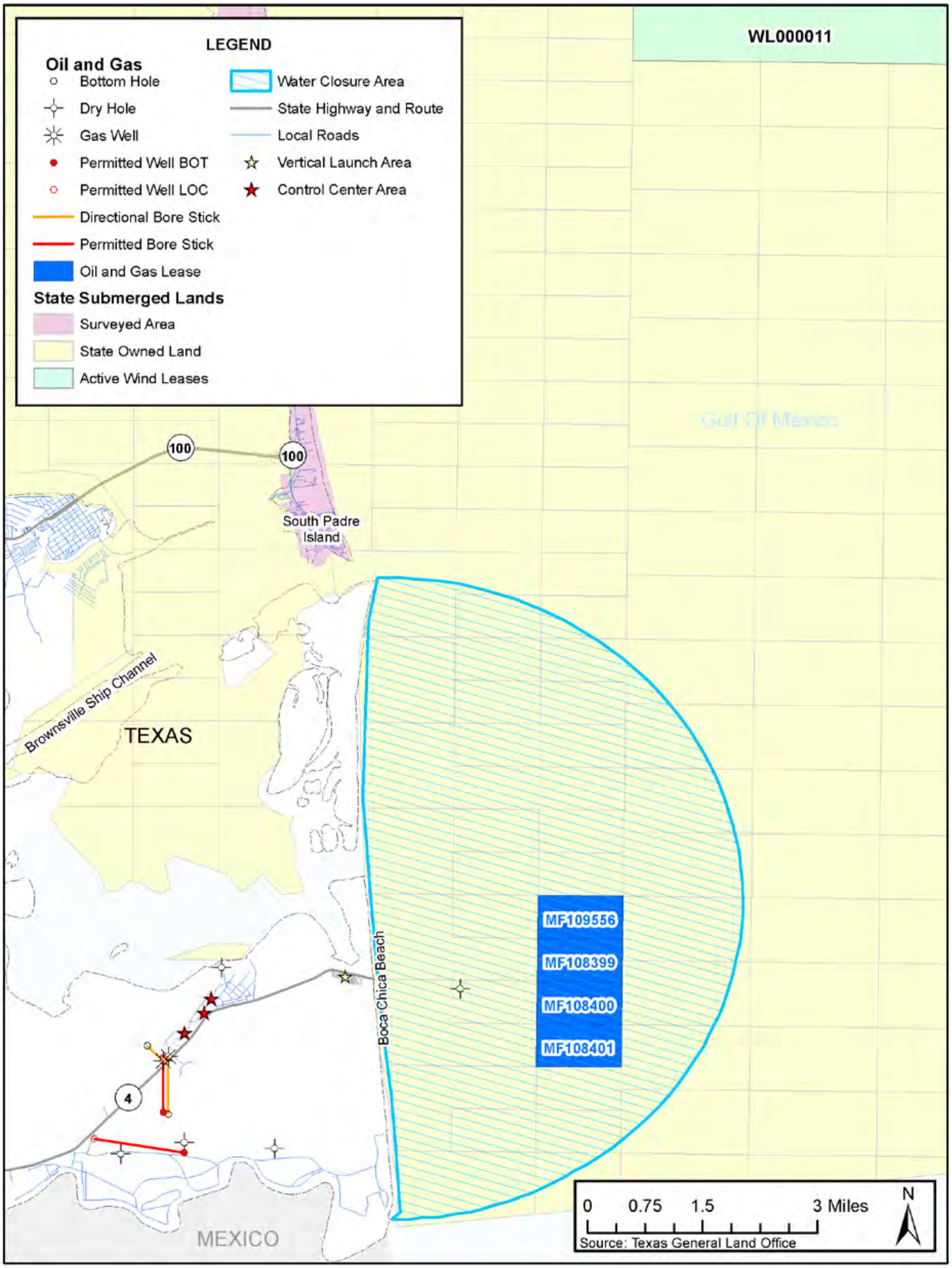


Exhibit 3.1-2. TGLO Managed Land within the Vicinity of the ROI

3.2 SECTION 4(F) PROPERTIES

3.2.1 Definition and Description

Section 4(f) properties include any publicly owned parks, recreation areas, and wildlife or waterfowl refuges, or any publicly or privately owned historic site listed or eligible for listing on the NRHP. When private institutions, organizations, or individuals own parks, recreational areas, or wildlife and waterfowl refuges, Section 4(f) does not apply to these properties, even if such areas are open to the public. However, a privately owned property may be protected under Section 4(f) when it is located on long-term leased public land or a public easement. For historic sites, Section 4(f) applies to any type of architectural or archaeological resource that is on or is eligible for listing on the NRHP. In addition, an archaeological site must also warrant preservation in place in order for Section 4(f) to apply.

3.2.2 Regulatory Setting

Established by the Department of Transportation Act of 1966, Section 4(f), which applies only to agencies within the DOT, was designed to protect publicly owned parks, recreational areas, wildlife and waterfowl refuges, and public and private historical sites. Any project that receives funding from or requires the approval of the DOT, including the FAA, must be analyzed for compliance with Section 4(f). To comply with Section 4(f), it must first be determined if there are any Section 4(f) properties within the ROI. If a Section 4(f) property is present, then it must be determined whether the Proposed Action "uses" the Section 4(f) property. "Use" within the meaning of the statute (49 U.S.C. § 303(c)) includes taking permanent ownership of or applying a permanent easement to land from a Section 4(f) property for transportation purposes.

A Section 4(f) use also occurs when there is a temporary occupancy of land of a Section 4(f) property or when there is a constructive use of land of a Section 4(f) property. As defined in the implementing regulations for Section 4(f) (23 CFR 774.13(d)), a temporary occupancy of a Section 4(f) property constitutes a use when all of the following conditions are satisfied: 1) duration is greater than the time needed to construct the project and there is a change in ownership of the land; 2) the scope of work is major in terms of the nature and magnitude of changes to the Section 4(f) property; 3) there would be permanent adverse physical impacts or either temporary or permanent interference with the protected activities, features, or attributes of the property; 4) the land being used would not be returned to as good as a condition as existed prior to the project; and 5) there is no documented agreement with the official(s) having jurisdiction over the Section 4(f) property regarding the above conditions. A constructive use involves no physical use through incorporating the land into the project, but occurs when the proximity (indirect) impacts result in substantial impairment to the property's activities, features, or attributes that qualify the property for protection under Section 4(f).

FAA Order 1050.1E outlines the policies and procedures for assessing environmental impacts resulting from FAA projects. The Order places responsibility of determining impacts on Section 4(f) properties with the FAA and defines a use as either direct (actual physical taking of lands) or constructive (indirect impacts). If there would be a constructive use, the FAA must determine if the impacts would substantially impair the Section 4(f) property. Substantial impairment occurs when the activities, features, or attributes of the property that contribute to its significance or enjoyment are substantially diminished.

The FAA is required to identify a feasible and prudent avoidance alternative if the Proposed Action is determined to have a greater than *de minimis* impact to a Section 4(f) property. A *de minimis* impact determination may be made with respect to a physical use of a Section 4(f) property if, after taking into account any measures to minimize harm, the result is either:

- A determination that the project would not adversely affect the activities, features, or attributes qualifying a park, recreation area, or wildlife or waterfowl refuge for protection under Section 4(f); or
- A Section 106 finding of no adverse effect or no historic properties affected.
- The DOT cannot approve the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites unless the following conditions apply:
    - There is no feasible and prudent alternative to the use of the land
    - The action includes all possible planning to minimize harm to the property resulting from use

Mitigation measures that eliminate or reduce the effects of a physical or constructive use are considered when evaluating impacts. The FAA consults with all appropriate Federal, State, and local officials having jurisdiction over affected Section 4(f) properties when determining the potential impact on the properties.

3.2.3 Region of Influence

The ROI for publicly owned parks, recreation areas, and wildlife or waterfowl refuges protected under Section 4(f) encompasses the launch-day closure areas (refer to Exhibit 2.1-1), as the closures would prevent the public from using the parks and wildlife refuges.

For NRHP-listed or eligible historic resources that are protected under Section 4(f), the ROI is identical to the Area of Potential Effects (APE) defined for cultural resources under Section 106 of the National Historic Preservation Act (NHPA). The FAA defined an APE for direct effects and an APE for indirect effects in consultation with the THC (the Texas State Historic Preservation Office). The APE for direct effects was defined as the boundaries of the sites for the proposed vertical launch and control center areas. The APE for indirect effects was defined as a 5-mile radius centered upon the proposed vertical launch area (Exhibit 3.2-1). The THC concurred with these APEs on June 27, 2012 (see Appendix C).

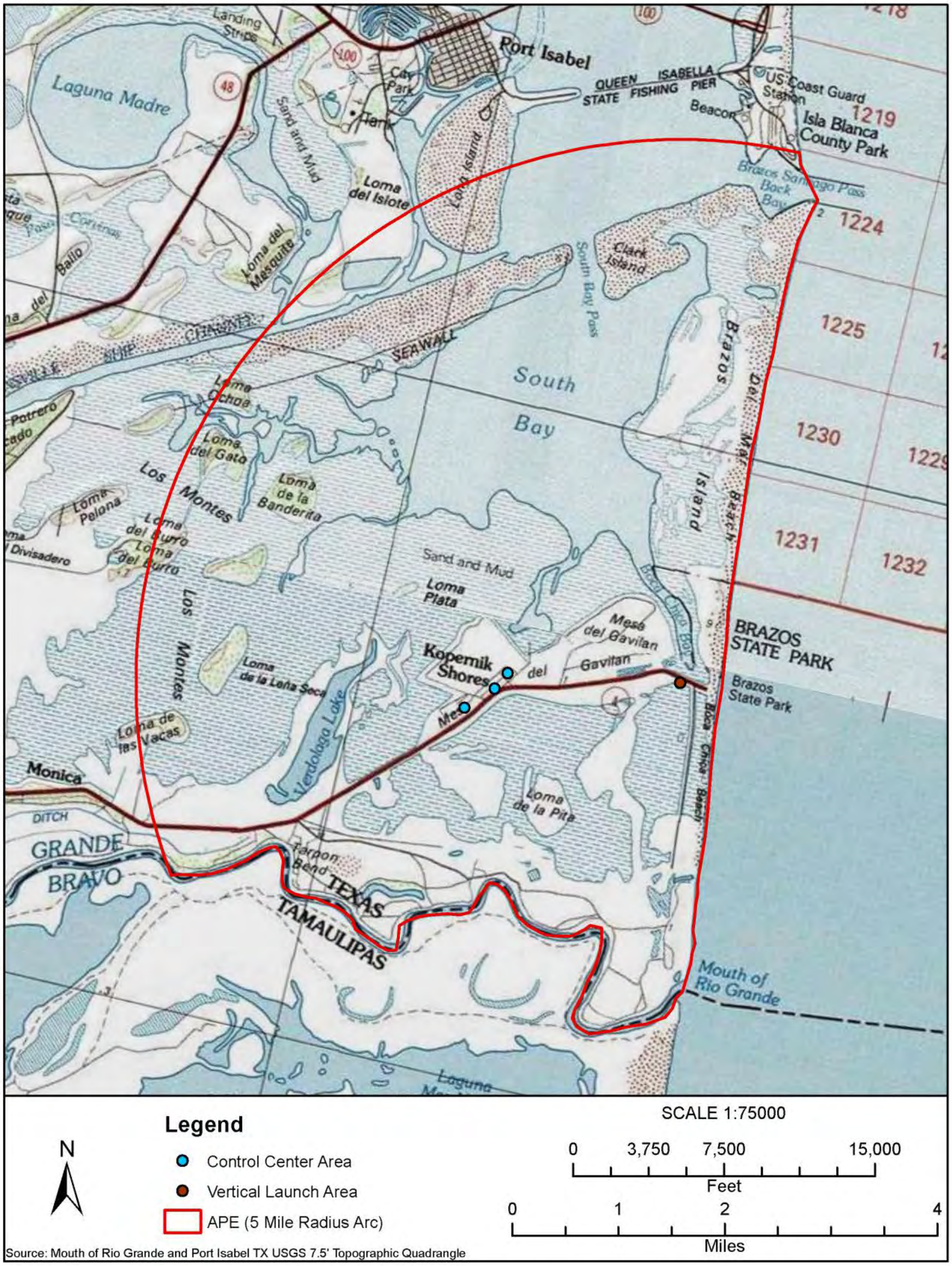


Exhibit 3.2-1. APE for Indirect Effects

3.2.4 Existing Conditions

3.2.4.1 Public Parks, Recreation Areas, and Refuges

Two state parks, a tract of an NWR, and a coastal preserve that are considered Section 4(f) lands are within the ROI: Boca Chica State Park, Brazos Island State Park, the Lower Rio Grande Valley NWR (Boca Chica Tract), and the South Bay Coastal Preserve. Nearest to the proposed vertical launch area are Boca Chica State Park (surrounding it on the east, south, and west) and Brazos Island State Park (directly north). State parks are managed by the TPWD. Under the Open Beaches Act, Boca Chica and Brazos Island State Parks are considered public land up to the high tide line or the line of vegetation. Boca Chica State Park encompasses 1,000 undeveloped acres that border the south shore of South Bay. Although the park has no visitor facilities, it is open for swimming, snorkeling, surfing, fishing, bird watching, and kite surfing (City-Data 2012). Established in 1957, Brazos Island State Park provides 217 acres on the north side of State Highway 4 for swimming, surfing, ocean fishing, camping, and nature study (Texas State Historical Association 2012).

The NWR includes lands managed by private landowners, non-profit organizations, and the State of Texas along the last 275 miles of the Rio Grande; the refuge itself is managed by the USFWS (USFWS 2012a). Lands within the NWR System are set aside for the conservation of fish, plants, and wildlife. More than 40,000 acres of the NWR are open to the public for watching or photographing wildlife, walking nature trails, hunting, and special organized events (USFWS 2012b).

Northwest of the proposed vertical launch area is the South Bay Coastal Preserve. The Preserve was established in 1984 and includes 3,500 surface acres west of Brazos Island between the Brownsville Ship Channel and the Rio Grande River. Managed by the TPWD, the South Bay Coastal Preserve provides occasional and seasonal recreational use for fishing and waterfowl hunting and considerable commercial oyster landings. Its emergent and submergent vegetation and algal tidal flats provide breeding and forage areas for numerous species of finfish, shellfish, and birds, and a winter habitat for migratory birds (TPWD 2012a).

3.2.4.2 Historic Sites

The APE includes 11 properties that are listed on the NRHP or are potentially eligible for listing on the NRHP. Of these, seven are archaeological sites that are important chiefly for data recovery and do not warrant preservation in place. These seven sites include a prehistoric site, four historic sites, and two historic shipwreck sites. These sites have been evaluated as eligible for the NRHP because they have the potential to answer important research questions. None of the sites contain intact structural remains that would warrant them being considered eligible for the NRHP under any other criteria. They are important chiefly because of the information they could provide, and not because they contain any structural remains that would be worthy of preservation in place. As such, Section 4(f) does not apply to these sites. Therefore, of the 11 historic sites being considered under Section 106 of the NHPA, only four of the historic sites are protected under Section 4(f) (Table 3.2-1).

In proximity to the vertical launch area are Cypress Pilings associated with an 1846 floating bridge for a railroad crossing of Boca Chica Bay during the Mexican War, Palmetto Pilings associated with a bridge for a railroad crossing of Boca Chica Bay during the last two years of the Civil War, and the 1936 Texas Centennial Marker for the Palmetto Pilings. Both sets of pilings and the historical marker have not been formally evaluated for the NRHP, but are considered to be eligible.

Also, the eastern boundary of the 5,991-acre Palmito Ranch Battlefield NHL, an NRHP-listed site, is approximately 3 miles west of the vertical launch area and 1 mile west of the proposed control center area. The Palmito Ranch Battlefield NHL is managed by the NPS. Refer to Section 3.5, *Historical, Architectural, Archaeological, and Cultural Resources* for further discussion of all these sites.

Table 3.2-1. Section 4(f) Historic Sites in the APE

Site Number	Site Name	Site Type	NRHP Eligibility
41CF93	Palmito Ranch Battlefield NHL	Civil War battlefield	Listed
41CF117.1	Cypress Pilings	1846 floating bridge pilings	Potentially Eligible
N/A	Palmetto Pilings	1865 railroad pilings	Potentially Eligible
N/A	Palmetto Pilings Historical Marker	1936 granite marker	Determined Eligible

N/A = Not Applicable

3.3 NOISE

3.3.1 Definition and Description

Noise is considered unwanted or annoying sound that interferes with or disrupts normal human activities. Although exposure to very high noise levels can cause hearing loss, the principal human response to noise is annoyance. The response of different individuals to similar noise events is diverse and is influenced by the type of noise, perceived importance of the noise, its appropriateness in the setting, time of day, type of activity during which the noise occurs, and sensitivity of the individual.

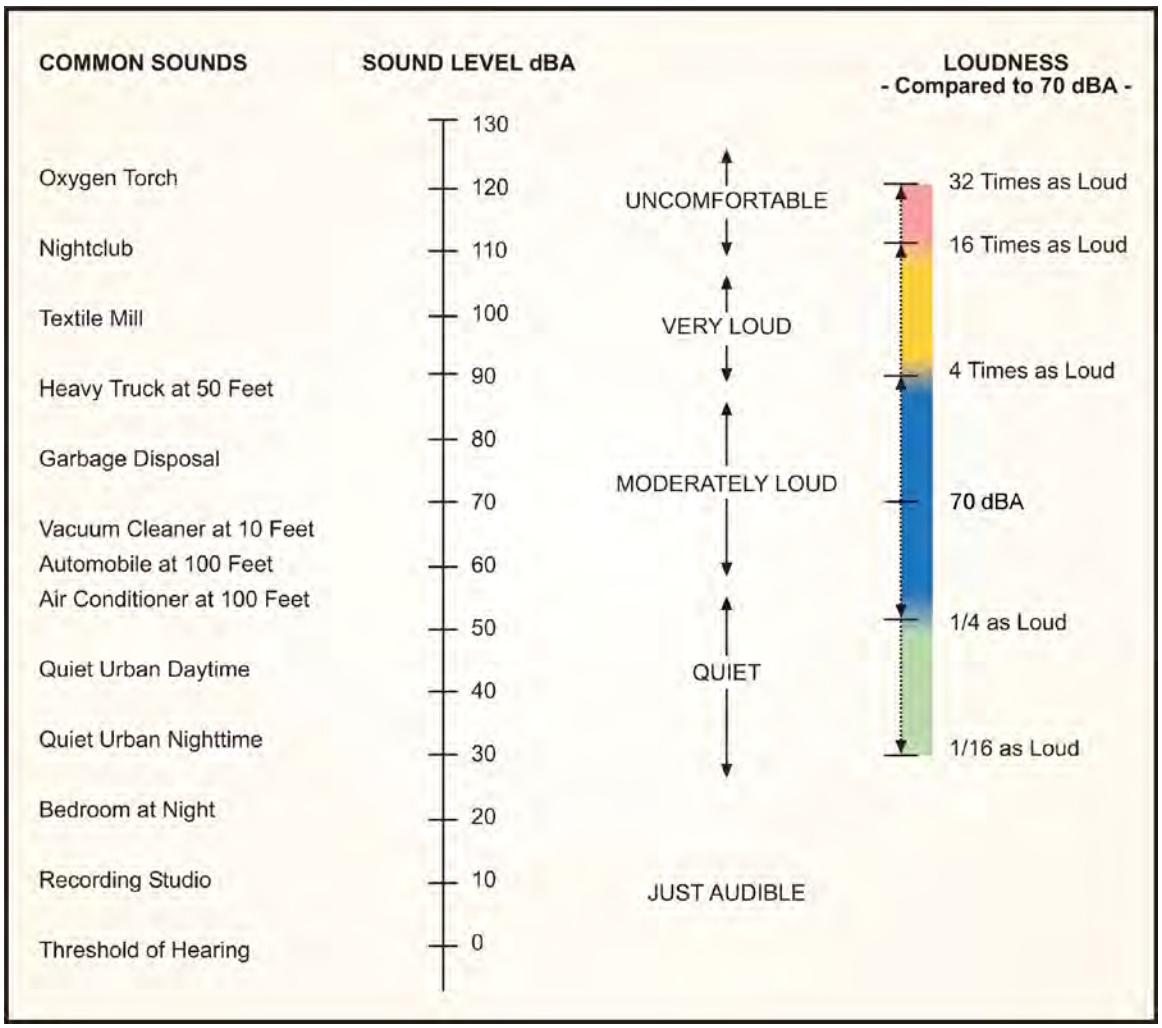
Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and are sensed by the human ear. Sound is all around us. The perception and evaluation of sound involves three basic physical characteristics:

- Duration—the length of time the sound can be detected
- Magnitude—the acoustic energy, which is expressed in terms of sound pressure, in decibels (dB)
- Frequency—the number of cycles per second the air vibrates, in Hertz (Hz)

The duration of a noise source can be continuous (constant), transient (short-duration), or impulsive (typically less than 1 second) (U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM] 2005). Launch noise and sonic booms (i.e., shock waves created from supersonic flight when a launch vehicle travels faster than the speed of sound) are classified as transient noise events (Appendix D). A transient noise event has a beginning and an end where the sound temporarily rises above the background and then fades back into it. Transient sounds are typically associated with a sound source that moves such an aircraft overflight (USACHPPM 2005).

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. This vast range means that using a linear scale to represent sound level is not feasible. The dB is a logarithmic unit used to represent the magnitude of a sound, also referred to as the sound level.

All sounds have a spectral content, which means their magnitude or level changes with frequency, where frequency is measured in cycles per second or Hz. To mimic the human ear's non-linear sensitivity and perception of different frequencies of sound, the spectral content is weighted. For example, environmental noise measurements are usually on an "A-weighted" scale that filters out very low and very high frequencies in order to replicate human sensitivity. It is common to add the "A" to the measurement unit (dB) in order to identify that the measurement has been made with this filtering process (dBA). Exhibit 3.3-1 provides a chart of A-weighted sound levels from typical noise sources. Some noise sources (e.g., air conditioner, vacuum cleaner) are continuous sounds that maintain a constant sound level for some period of time. Other sources (e.g., automobile, heavy truck) are the maximum sound produced during an event like a vehicle pass-by. Other sounds (e.g., urban daytime, urban nighttime) are averages taken over extended periods of time.



Note: dBA = A-weighted decibel

Sources: Derived from Harris (1979) and Federal Interagency Committee on Aviation Noise (FICAN) (1997).

Exhibit 3.3-1. A-Weighted Sound Levels from Typical Sources

A metric is a system for measuring or quantifying a particular characteristic of a subject. Since noise is a complex physical phenomenon, different noise metrics help to quantify the noise environment and describe impacts from noise. The selection of particular metrics for noise analysis is based on the nature of the noise event and who or what is affected by the sound. For example, different noise metrics are used to evaluate the highest sound level occurring during a single event than those used for evaluating long-term average sound levels.

The overall sound pressure level (OASPL) provides a measure of the sound level at any given time. The maximum OASPL (L_{max}) indicates the highest OASPL over the duration of the noise event (Appendix D). The L_{max} is a single-event metric that is useful for analyzing short-term responses to noise exposure (Federal Interagency Committee on Noise [FICON] 1992). OASPL can be presented as either unweighted or A-weighted. The maximum unweighted OASPL (L_{max}) is used for the analysis of noise impacts to structures.

The $L_{A,max}$ represents the maximum A-weighted OASPL from the period modeled (Appendix D). A-weighting approximates the natural range and sensitivity of human hearing (USACHPPM 2005). The $L_{A,max}$ is used for the analysis of noise impacts to humans and wildlife.

Sound Exposure Level (SEL) represents both the magnitude of a sound and its duration. SEL provides a measure of the cumulative noise exposure of the entire acoustic event, but it does not directly represent the sound level heard at any given time. Mathematically, it represents the sound level of a constant sound that would, in 1 second, generate the same acoustic energy as the actual time-varying noise event. For sound generated by rocket launches, which last more than 1 second, the SEL is greater than the L_{max} because an individual launch can take minutes and the L_{max} occurs instantaneously. Noise contour maps of these metrics are comprised of lines of equal noise level or exposure, and they serve as visual aids for assessing the impact of noise on a community.

The most common long-term metric is the Day-Night Average Sound Level (DNL) which presents an average sound level over the course of an average annual day. In order to account for increased human sensitivity to noise at night, a 10-dB penalty is applied to nighttime events (occurring between the hours of 10:00 p.m. and 7:00 a.m.).

3.3.2 Regulatory Setting

Noise criteria have been developed in order to protect the public health and welfare of surrounding communities. The following noise criteria address human annoyance, hearing conservation, and structural damage. The noise metrics used in this EIS are described in summary format below and in a more detailed manner in Appendix D.

Human Annoyance

FAA Order 1050.1E, Change 1, guidance on noise indicates that a significant noise impact would occur if analysis shows that the Proposed Action would cause noise sensitive areas to experience an increase in noise of DNL 1.5 dBA or more at or above DNL 65 dBA noise exposure when compared to the no action alternative during the same time frame. DNL has been found to correlate well with adverse community impacts for regularly occurring events including aircraft, rail, and road noise (Schultz 1978; Finegold et al. 1994). DNL is based on long-term consistent noise exposure. However, the Proposed Action is for up to twelve total launches per year. Thus, it is acknowledged that the suitability of DNL for infrequent noise events is uncertain with respect to current research and dose response studies. The DNL contours are provided to estimate the potential annoyance in compliance with FAA requirements.

Hearing Conservation

Multiple federal government agencies have provided guidelines on permissible noise exposure limits. These documented guidelines are in place to protect human hearing from long-term continuous daily exposures to high noise levels and aid in the prevention of noise-induced hearing loss (NIHL). The National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA) have standardized employee noise exposure requirements based on level and duration allowed during an 8-hour workday (NIOSH 1998; OSHA 1910.95, Appendix A). For the entire American public at all times rather than the American worker during his workday, the U.S. Environmental Protection Agency (EPA) has recommended noise exposure levels with a margin of safety based on level and duration over 24 hours (EPA 1974). The recommendations are designed such that over a 40-year lifetime exposure, the excess risk of developing occupational NIHL is minimized (EPA 1974).

In terms of upper limits on the noise levels, NIOSH set the maximum exposure at 140 dBA, and OSHA set it at 115 dBA. The EPA does not state a maximum level for non-impulsive noise. Therefore, a maximum noise level of 115 dBA is used to identify potential locations where hearing protection should be considered for a rocket launch. This level is conservative for NIHL since rocket launches would occur at a rate of up to once a month. At this level, the different guidelines provide a range of exposure times from 15 minutes (OSHA) to 28 seconds (NIOSH and EPA).

The Department of Defense Occupational Hearing Conservation Program (Department of Defense Instruction 6055.12) states that the maximum allowable exposure to steady-state noise is 130 dBA. Thus, in the event the sound levels were greater than the predicted values, there would be 15 dBA margin of safety before a threat of hearing damage for a short-term continuous level of 130 dBA.

Structural Damage

A NASA technical memo found a relationship between structural damage claims and overall sound pressure level, where “the probability of structural damage [was] proportional to the intensity of the low frequency sound” (Guest and Sloane 1972). Structural components most sensitive to launch noise include windows, and less frequently plastered walls and ceilings. Studies based on ground testing of rocket systems indicate that the relationship between damage claims and noise levels may provide criteria regarding structural damage from rocket noise, even though the duration for ground testing is much greater than the exposure duration expected for proposed launch events (Appendix D). Guest and Sloane (1972) concluded that 1 damage claim in 1,000 households exposed is expected at an average continuous level of 111 dB, and 1 in 100 households at 119 dB. It is important to highlight the difference between the static ground tests in which the probability of structural damage is based on, and the launch events of concern for the noise analysis in this EIS. The ground tests occurred for durations much greater than the exposure duration expected for the proposed launch events. Additionally, during ground tests, the engine remains in one position which results in longer exposure duration to continuous levels as opposed to the transient noise occurring from the moving vehicle during a launch event.

3.3.3 Region of Influence

The ROI for noise includes those areas where construction activities would occur at the vertical launch and control center areas, as well as the vertical launch area and nearby areas that would be exposed to noise from launch activities.

The FAA is aware that noise generated from launches may be audible beyond the U.S./Mexico border. Therefore, the FAA has included Mexico in the ROI for noise.

3.3.4 Existing Conditions

Ambient sound or background noise may be described as the collection of both natural and man-made sounds that is always present (FICON 1992). The proposed vertical launch area is located in a sparsely populated coastal area off the Gulf of Mexico comprised mostly of sand and mud flats. The ambient sounds along the coastline typically include waves from the ocean, wind-generated sounds from vegetation, and bioacoustics sounds from animals and birds. However, the proposed vertical launch area is also adjacent to State Highway 4, which provides the only access to Boca Chica Beach. Beach visitors frequent this area where vehicles can drive onto the beach. Consequently, the area is also subject to traffic noise. The proposed control center area is in a rural residential environment, which typically has low ambient noise levels of approximately 40 dBA (EPA 1978).

The land surrounding the proposed vertical launch and control center areas is primarily used for recreational purposes and includes Boca Chica State Park, the Lower Rio Grande Valley NWR, the South Bay Coastal Preserve, Brazos Island State Park, Isla Blanca Park, and the Palmito Ranch Battlefield NHL. For a National Historic Park and a NHL, the typical A-weighted daytime and nighttime sound levels are estimated as 43 dBA and 37 dBA, respectively (American National Standards Institute 12.9 Part 3 [1993]). These levels represent very quiet suburban and rural residential settings with a population density of approximately 200 people per square kilometer.

Aerial imagery south of the U.S./Mexico border has been reviewed and the area was found to be unpopulated and undeveloped.

3.4 VISUAL RESOURCES AND LIGHT EMISSIONS

3.4.1 Definition and Description

Visual resources consist of the natural and cultural features that make up the visible landscape. They include land, water, vegetation, buildings, structures, and other cultural features within the viewshed of an observer. Potential visual impacts are determined by estimating the degree of change in the visual resources of a viewshed that would result from implementing the Proposed Action.

Light emissions include any source of light that emanates from a light source into the surrounding environment and illuminates that area. Sources of light emissions include launch site lighting, employee/customer parking lighting, airborne and ground-based aircraft operations, and roadway lighting. Glare is a type of light emission being redirected off of a reflective surface, such as window glass in a facility.

3.4.2 Regulatory Setting

Federal

The visual resource assessment process is rooted in several Federal laws including NEPA and the NHPA. Section 106 of the NHPA requires that Federal agencies take into account the effects of Federal undertakings on NRHP-listed or eligible historical and archaeological resources, including "the introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting."

The FAA considers the extent to which any lighting associated with an action creates an annoyance among people in the vicinity or interferes with their normal activities. Visual, or aesthetic, impacts are inherently more difficult to define because of the subjectivity involved. Aesthetic impacts deal more broadly with the extent that the development contrasts with the existing environment and whether the jurisdictional agency considers this contrast objectionable.

FAA Order 1050.1E outlines the concepts for evaluating light emissions and visual impacts. The order states that annoyance from lighting and measures to minimize the effects should be documented in the EIS. Additionally, a discussion of the application of design, art, architecture, and landscape architecture should be considered in mitigating adverse visual impact.

State

There are no state regulations that govern visual resources and light emissions.

Local

There are no local regulations that govern visual resources and light emissions.

3.4.3 Region of Influence

The ROI is defined as a casual observer's the viewshed for the proposed vertical launch area and control center area. A basic principal of visual analysis is the closer an object is to an observer, the more details of that object become visible. Using this principle, a landscape can be divided into three distance zones based on relative visibility of an object for a casual observer from travel routes and/or observation points. These distance zones are: 1) Foreground/Middleground (objects 0 to 5 miles away), 2) Background (objects 5 to 15 miles away), and 3) Seldom Seen (objects more than 15 miles away). For the current analysis, an ROI of 15 miles was used, because the facilities would have only intermittent visibility at distances beyond that to the casual observer along the State Highway 4, which is the primary travel route in the project area. The ROI of 15 miles extends into Mexico to the south, approximately 15 miles out into the Gulf of Mexico to the east, and onto South Padre Island to the north.

3.4.4 Existing Conditions

The analysis of visual resources is largely subjective and depends upon the sensitivity, training, and experience of the viewer as well as a variety of other environmental factors (angle of observation, time of day, etc.). Because the FAA does not provide detailed visual impact analysis guidance, this document relies on principles established by the U.S. Bureau of Land Management (BLM) Visual Contrast Rating (VCR) system, which employs a systematic process to analyze potential visual impacts of proposed projects and activities. The basic principle of the process is that the degree to which an activity affects the landscape depends upon the visual contrast created between a proposed project and the existing landscape (BLM 1986). In the analysis, the degree of contrast is measured by comparing the project features with the major features in the existing landscape. The basic design elements of form, line, color and texture are used to make the comparison and to describe the visual contrast created by the project (BLM 1986). Descriptions of the existing character of the landscape as viewed from the proposed vertical launch and control center areas follow.

The landscape of the proposed vertical launch area is analyzed from State Highway 4, because that is the vantage point from where most observers would view it from. The landscape from this location is panoramic in nature with broad expansive views and few visual intrusions. Views to the north include the tall, rectangular, blocky forms and straight lines of the buildings on South Padre Island and the undulating lines of the dunes in the background. Cylindrical forms and straight lines of the historic Palmetto Pilings and the gently undulating lines of Boca Chica Bay are visible in the middle ground. In the foreground, the irregular forms of the vegetation (palm trees and low shrubs) and straight lines of a concrete house foundation are present. Colors present in the spring include various shades of greens and grays of the vegetation, tans of the sand and concrete foundation, and blues of the water in the bay. The texture of the vegetation is coarse with smooth patches in the open tidal areas (Exhibit 3.4-1).

Views to the south are similar to those of other views: broad and open with few to no forms present on the landscape other than irregularly shaped palm trees and low shrubs. Lines are horizontal and straight and formed largely by the horizon. Colors include greens and grays of the vegetation, and the tans of the sand in the open areas. The texture of the vegetation is coarse.

Views to the west include the low, rectangular forms of the houses, the triangular and domed forms of the trees at Boca Chica Village, the linear forms of a few scattered tall towers in the background, and the cylindrical forms of the Palmetto Pilings in the middle ground. The lines present include the curved lines of State Highway 4 around the edges of the lomas (or clay dunes) on the tidal flats, and along the edge of the pullout. Colors include the whites, browns, yellows, and blues of the structures, and the greens, grays, and browns of the vegetation. The texture of the vegetation is coarse (Exhibit 3.4-2).

Views to the east include the triangular and trapezoidal forms of the dunes and the diamond shape of the road signs (Exhibit 3.4-3). The lines present include straight lines of State Highway 4 and highway signs, and the curved lines around the tidal areas. Colors include the greens and yellows of the vegetation, the tan colors of the sand in the tidal areas, and the grays of the pavement on State Highway 4, the pilings, and the pullout. The texture of the vegetation is coarse with smooth patches in the open tidal areas.

Exhibit 3.4-1. View to north from 1960s house foundation across State Highway 4 from the Vertical Launch Area; hotels on South Padre Island visible in center

Exhibit 3.4-2. View to west from Palmetto Pilings Historical Marker adjacent to Vertical Launch Area

Exhibit 3.4-3. View to east from State Highway 4 at Vertical Launch Area

The landscape at the proposed control center area is analyzed from Eichorn Boulevard, which extends between Parcels 2 and 3 within Boca Chica Village, because that is the vantage point from where most viewers would observe the landscape for the longest period of time. The landscape at the control center area is similar to that of the vertical launch area. The landscape is generally expansive and panoramic in nature with few visual intrusions.

The views to the north include the irregular forms of the vegetation and a single vertical, linear form of a communications tower. Few lines are present. The sky and the vegetation create a horizontal, straight line in the background. The vegetation and the edge of the road disturbance create a curved line in the foreground. Colors are primarily the greens, browns, and yellows of the vegetation, and the texture of the vegetation is coarse (Exhibit 3.4-4).

Views to the south display a greater variety of forms and lines. Forms present include sequential trapezoids of the vegetation and the blocky, square building in the background; the trapezoids of the entrance signs; and the irregular forms of the palm trees in the middle ground. Lines created by Eichorn Boulevard in the foreground are straight and horizontal. Colors include the greens and yellows of the vegetation, reds and whites of the buildings, and the light gray of the roadway. The texture of the vegetation is coarse (Exhibit 3.4-5).

Exhibit 3.4-4. View to north from Eichorn Boulevard between control center area Parcels 2 and 3 at Boca Chica Village

Exhibit 3.4-5. View to south from Eichorn Boulevard between control center area Parcels 2 and 3 at Boca Chica Village

Views to the west are dominated by the rectangular, blocky forms of the houses in Boca Chica Village and the dome forms and irregular forms of the trees (Exhibit 3.4-6). Straight lines are created by the buildings and by the edges of Eichorn Boulevard. A variety of colors are present including blues, yellows, browns, reds, grays, and whites of the buildings and roads, and the greens and yellows of the vegetation. Views to the east are similar to those of other views, and include the square, blocky form of the service station/bait shop, and the vertical, linear form of the telephone poles. Eichorn Boulevard and State Highway 4 create sharp, straight lines. Colors present include the whites, reds, and browns of the buildings and roads, and the greens, grays, and browns of the vegetation. The texture of the vegetation is coarse

Exhibit 3.4-6. View to west/southwest from Eichorn Boulevard between Parcels 2 and 3 at the Boca Chica Village

Currently, light emissions at the proposed vertical launch area are minimal and of low intensity. The sources of light emissions are from South Padre Island to the north, drilling platforms in the Gulf of Mexico to the east, and Boca Chica Village to the west. The low intensity emissions are due to the low wattage and great distances of the area from the source. Greater light emissions are present at the proposed control center area, but are also of low intensity. Light sources in this area are primarily from the residences in Boca Chica Village. Other sources of light are the Port of Brownsville to the north and South Padre Island to the northeast.

3.5 HISTORICAL, ARCHITECTURAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

3.5.1 Definition and Description

Historical, architectural, archaeological, and cultural resources are individual subsets of resources that relate to history and culture. They convey information about the past experience of human beings. Historical resources gain their significance from their relationship with historical events or people. Architectural resources are generally categorized as tangible aboveground resources that are of historic or aesthetic significance. Archaeological resources are generally found below the surface of the ground and yield information about both prehistoric and historic human activity. The term cultural resource can encompass historical, architectural, and archaeological resources but also applies to natural features, objects, and even vegetation that are of importance to a culture, subculture, or community. Traditional cultural properties, a subset of cultural resources, gain their significance from a relationship with a traditional practice, belief, or way of life.

3.5.2 Regulatory Setting

Federal

Several statutes, EOs, and other regulations protect cultural resources, including the NHPA. Under NEPA, the FAA is responsible for analyzing the impacts of an action to historical, architectural, archaeological, and cultural resources as part of a broader review of the entire environment. Section 106 of the NHPA is the foremost piece of Federal legislation for the protection of significant archaeological, architectural, and cultural resources. Under Section 106, the FAA is responsible for taking into account the effects of its actions (referred to as undertakings) on historic properties and affording the Advisory Council on Historic Preservation (ACHP) the opportunity to comment on such undertakings. Undertakings refer to any federal actions requiring the issuance of federal permit or federal funding. Historic properties refer to any cultural resource that is listed in, or eligible for listing in, the NRHP. Under most circumstances, cultural resources must be at least 50 years old to be considered eligible for listing. Under certain specific criteria (termed Criteria Considerations), they can also be found eligible even if they have not reached the threshold for historic properties of 50 years old.

Section 106 does not require preservation of historic properties or cultural resources, but does require that impacts to these resources be an important part of the decision-making process of a proposed Federal action. Along the same lines, Section 101(b)(4) of NEPA requires that impacts to cultural resources be considered in federal actions and that all adverse impacts be mitigated to reduce or eliminate the impact.

The ACHP has created a set of regulations (36 CFR Part 800) outlining the process for identifying and evaluating cultural resources, assessing the impacts of Federal action on historic properties, and determining possible mitigation for these impacts. Under the implementing regulations, all historic properties within an APE are identified, and the effects of the proposed undertaking on the identified historic properties within the defined APE are then analyzed and management recommendations formulated. The effects of an undertaking on a historic property are evaluated in terms of impacts on seven aspects of integrity of the property: location, workmanship, design, materials, setting, feeling, and association. The impacts on a historic property can vary depending upon the type of property it is (district, building/structure, archaeological site, or object), and the criteria for which the historic property (Criteria for Evaluation to the NRHP, 36 CFR 60.4) is eligible under. Impacts that negatively affect the eligibility of a historic property for inclusion on the NRHP are considered to have an adverse effect. Impacts that do not adversely affect the eligibility of the historic property are considered to have no adverse effect.

State

In addition to Federal laws and statutes, the State of Texas has its own set of statutes and regulations governing cultural resources. Among these is the Texas Natural Resources Code, Title 9, Chapter 191, which protects archaeological and historic sites on state and local public land. The code establishes a system of permitting whereby any contractor breaking ground on publicly owned land must obtain a permit to do so. Texas Administrative Code Title 13, Part 2, Chapter 26 establishes the rules and procedures for the implementation of the Antiquities Code of Texas by the THC, including the issuance of archaeological and historic structures permits.

Local

There are no applicable local statutes or regulations.

3.5.3 Region of Influence

The ROI for cultural resources is the APE of the Proposed Action. Under 36 CFR 800.4, the Federal agency, in consultation with the State Historic Preservation Officer, determines an APE for the undertaking. An APE is defined as:

> "…the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The [APE] is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking" (36 CFR 800.16[d]).

Direct impacts are those impacts that would have an immediate effect on the physical character of a property. These types of impacts are primarily those associated with construction activities. Indirect impacts are those impacts that occur over a longer period of time, and effect more aesthetic aspects of a property. These types of impacts generally affect the setting of historic properties (visual/auditory).

In consultation with the THC (concurrence received on June 27, 2012; see Appendix C), the FAA defined a direct impacts APE for the vertical launch area and the control center area. The direct impacts APE for the vertical launch area was defined as the entire 56.5-acre site, and the direct impacts APE for the control center area was defined as the limits of all three parcels on which development would occur totaling approximately 12.4 acres. Also in consultation with the THC, a 5-mile radius area around the proposed vertical launch area was defined as the indirect impacts APE (see Exhibit 3.2-1) The indirect impacts APE extends from the proposed vertical launch area north to Brazos Santiago Pass, south to the U.S./Mexico border and the mouth of the Rio Grande, and west to a point near the Camp Belknap historical marker.

The most notable historic property within the APE for indirect effects is the Palmito Ranch Battlefield NHL. The Palmito Ranch Battlefield NHL is located on lands owned by the Lower Rio Grande Valley NWR but is managed by the NPS. As manager of the NHL, the NPS accepted the FAA's invitation to be a consulting party. Under 36 CFR 800.10, there are special requirements for the protection of NHLs. One such requirement is that the Federal agency (in this case, the FAA) notify the Secretary of the Interior of any consultation that involves an NHL, and invite the Secretary to participate in the consultation where there may be an adverse effect to the NHL. The Secretary of the Interior appointed the NPS to be its representative in the process.

3.5.4 Historic Context

Prehistory

The Project Area is located within the coastal region of the Texas coast, which is typically divided into the upper, central, and lower coastal regions. The Project Area is located within the lower coast region, which extends from Baffin Bay to the Rio Grande delta. For an in-depth discussion of the Project's prehistoric context, the reader is directed to *The Prehistory of the Texas Coastal Zone: 10,000 Years of Changing Environment and Culture* (Ricklis 2009).

The prehistoric cultural stages represented in the region include the Paleoindian Stage (circa [ca.] 11,000–7,000 B.C.), the Archaic Stage (ca. 7,000 B.C.–A.D. 800), and the Late Prehistoric Stage (ca. A.D. 800–1500). These are followed by the Protohistoric Period (ca. A.D. 1500–1800), and the Historic Period (ca. 1800–1962) (Ricklis 2009). Table 3.5-1 shows the prehistoric cultural stages, period, and date range.

Table3.5-1. Prehistoric Chronology of the Texas Lower Coast (from Ricklis 2009)

Stage	Period	Date Range
Paleoindian		11,000 –7,000 B.C.
Archaic		7,000 B.C.–A.D. 800
	Early Archaic	7,000 –4,000 B.C.
	Middle Archaic	4,000 –2,000 B.C.
	Coastal Occupation Hiatus	2,000 –1,000 B.C.
	Late Archaic	1,000 B.C.–A.D. 800
Late Prehistoric		A.D. 800 –1500
Protohistoric		A.D. 1500 –1800

The Paleoindian stage on the Texas coast is represented by a variety of phases, including Clovis, Folsom, Golondina, St. Mary's Hall, Wilson, and Scottsbluff. The existing data from the archaeological record is not indicative of Paleoindian coastal occupation of the Texas coast however, due to the rise in sea levels that have occurred over the past 10,000 years and the subsequent inundation of ancient shorelines and coastal areas that may have been utilized by Paleoindian populations (Ricklis 2009).

The Archaic stage (7,000 B.C.–A.D. 800) is divided into three periods based on changes in material culture. These consist of the Early Archaic period (7,000–4,000 B.C.), the Middle Archaic (4,000–2,000 B.C.) and the Late Archaic period (1,000 B.C.–A.D. 800), broken by a coastal occupation hiatus (2,000–1,000 B.C.) (Ricklis 2009).

The archaeological record of the Early Archaic period (7,000–4,000 B.C.) is characterized by sites consisting of shell middens, most of which have been recorded along the central coast, and appear to be indicative of short-term resource procurement, rather than long-term habitation of the area. Resource exploitation in the Early Archaic period likely also included limited fishing, hunting, and gathering (Ricklis 2009).

The Middle Archaic period (4,000–2,000 B.C.) was characterized by increased occupation of coastal areas, and is represented in the archaeological record by camp sites and sites indicative of a resource base which included some fishing on the north shore of Baffin Bay on the lower coast. Additionally, some long-distance trade may have been taking place, as evidenced by the presence of obsidian artifacts at some Middle Archaic sites on the Texas coast (Ricklis 2009).

The period between the Middle Archaic and Late Archaic is distinguished by a coastal occupation hiatus (2,000–1,000 B.C.); it is theorized that this gap in the archaeological record is indicative of a rapid rise in sea level during this time, resulting in a reduction of resources within bay shallows, which would have rendered coastal areas economically unviable to groups that had previously exploited these areas (Ricklis 2009).

Following the coastal occupation hiatus, the Late Archaic period (1,000 B.C.–A.D. 800) becomes apparent within the archaeological record. By this time, sea levels had stabilized, and the barrier islands just off the coast were forming. The stabilization of the marine environment led to an increase in resources, which in turn led to more intensive occupation of coastal areas, and marine resources like fish were exploited to a greater degree than in earlier periods, resulting in larger sites within the archaeological record. Along the lower coast, fish may have been even more intensively exploited due to a lack of shellfish resulting from hypersaline water conditions, apparent from the lack of shell middens found on the lower coast, although it should be noted that shell ornaments have been recorded at sites in the region (Ricklis 2009).

In the Late Prehistoric stage (A.D. 800– 1500), the bow and arrow and ceramics start to show up in the archaeological record, although no indigenous ceramics have been found on the lower coast of Texas. Rather, evidence of trade is present along the lower coast in the form of Post-Classic Huastecan ceramics, which were traded between lower coastal groups and Mesoamerican Huastecan groups. Despite the dominance of subsistence economies, populations began to increase, and the Brownsville Complex, the Rockport Phase/Karankawa, Akokisa, and other groups were present up and down the coast of Texas (Ricklis 2009).

In the Protohistoric stage (A.D. 1500–1800), European contact with Native Americans occurred and written accounts of native cultures appear, beginning with the arrival of explorers and colonists from Europe and ending around the time of the establishment of Spanish missions.

History

Cameron County is the southernmost county in the state of Texas. It lies between the Nueces and Rio Grande Rivers. The area became a point of contention between Texas and Mexico during the Texas Revolution (Hildebrand 1950). The area had been a part of Tamaulipas, Mexico, but with the signing of the Treaties of Velasco, the land was given to the Republic of Texas. At that time it was included in San Patrico County (Garza and Long 2012b).

Cameron County was officially established on February 12, 1848, 10 days after the Treaty of Guadalupe Hildago was signed, ending the Mexican War. It was named for Ewen Cameron, a Scottish immigrant who arrived in Texas in 1837. Cameron was a member of the last raiding expedition from Texas into Mexico during the Texas Revolution (Garza and Long 2012a; Hildebrand 1950). The county was sparsely populated and consisted of only three towns: Port Isabel, Brownsville, and Santa Maria (Hildebrand 1950).

The Mexican War (1846–1848) began as a result of Mexico's refusals to settle the boundary of Texas at the Rio Grande and to sell northern California to the United States. After assuming the presidency, James Polk began a campaign of increasing political pressure on Mexico to settle these boundary disputes. When the Mexican government would not agree to his terms, President Polk ordered General Zachary Taylor, who was stationed with his troops at Corpus Christi, to advance to the Rio Grande (Bauer 2012).

In early 1846, General Zachary Taylor set up a foothold in the area directly across from Matamoros, Mexico and began construction of a fort. The fort was originally known as Fort Texas, but was renamed Fort Brown in honor of Major Jacob Brown, who died in a Mexican attack on the area. The Mexican government viewed Taylor's advance to present-day Brownsville and his construction of a fort as an act of war. In April 1846, Mexican troops stationed at Matamoros crossed the Rio Grande and ambushed an American patrol. President Polk used this incident as an opportunity to obtain a declaration of war from Congress, which he achieved on May 13, 1846. Prior to the official declaration of war, General Taylor's 2,200-man army defeated 3,700 Mexican soldiers under General Mariano Arista at the battles of Palo Alto and Resaca de la Palma (Bauer 2012).

After the declaration of war, Congress authorized General Taylor to organize 50,000 volunteer soldiers to supplement his army. With no facilities available for the troops at Brazos Santiago, they were placed in a temporary encampment located southwest of Verdolaga Lake. Camp Belknap was approximately 2 miles long and 0.5-mile wide at its widest point, and is thought to be the largest encampment of volunteer soldiers; it housed 7,000 to 8,000 soldiers.

By September 1846, General Taylor had captured Monterrey and negotiated an armistice with General Arista. President Polk did not agree with the terms of the armistice and ordered Taylor to advance further into Mexico, continuing the war. General Taylor's troops worked in conjunction with other troops under the orders of Generals John E. Wool and Stephen W. Kearny to seize strategic areas in Mexico, New Mexico, and northern California. After a few months, the Mexican government refused to meet the requirements of President Polk in negotiations. The war continued and an additional army under General Winfield Scott was raised to march to Mexico City (Bauer 2012).

In March 1847, a naval squadron under Commodore David Conner put General Scott's 10,000-man army ashore near Veracruz, completing America's first large-scale amphibious assault. The troops continued to push farther into Mexico; simultaneously, the Navy seized Mexico's chief port, Mazatlan. After successful battles in eastern Mexico, General Scott led his army to Mexico City. American troops were successful in their assaults on the city, taking over control of the capital in September 1847. The loss of the port and the inability to prevent troops from occupying cities in central and eastern Mexico forced an end to the war in late 1847. By that time, the Mexican government had fallen. Peace negotiations were postponed until February 1848, when a new government was formed. With the signing of the

Treaty of Guadalupe Hidalgo, the United States was granted California, Arizona, New Mexico, portions of Utah, Nevada, and Colorado, and the Rio Grande boundary for Texas (Bauer 2012).

With the area north of the Rio Grande officially a part of the state of Texas, Charles Stillman purchased 4,676 acres northwest of Matamoros, and formed the Brownsville Town Company with two partners, Samuel Belden and Simon Mussina. A portion of this land was within an original land grant given to the Garza family from the Spaniards in the seventeenth century. The Brownsville Town Company began selling lots for as much as $1,500 (Garza and Long 2012a).

Over the next year, the population began to increase, partly from Mexican refugees coming to Brownsville from Matamoros and partly as a result of the 1849 Gold Rush, which routed travelers through Brownsville on the Gila Route. Brownsville was named the county seat in 1849 (Garza and Long 2012b). By 1850, the first newspaper was started and by 1854, the first Catholic Church, Oblates of Mary Immaculate, was founded. The city was incorporated in 1853 (Garza and Long 2012a).

Port Isabel was the second largest town in Cameron County. Official claim to the land encompassing the present day Port Isabel was made in 1823, when the land was granted to Rafael Garcia. By the 1830s a small community had developed in the area. A post office was established under the name of Point Isabel in 1845. Its name was changed to Brazos Santiago in 1849, when the Oblates of Mary Immaculate came to the community and created its first church, Our Lady by the Sea Church. In the 1850s, the town developed into a major exporter of cotton (Garza 2012b).

On February 1, 1861, Texas seceded from the Union, the seventh state to do so. Brownsville, Port Isabel, and the land between the two towns saw action throughout the duration of the Civil War. The Brownsville area was a stronghold for the Confederate Army. Port Isabel's natural port was utilized by blockade runners for the Confederacy until May 30, 1863, when the Union attacked the port and destroyed or captured all of the ships in the harbor. The entryway is known as the Brazos Santiago. Afterwards, Port Isabel was under the control of the Union (Garza 2012b; Garza and Long 2012b; Hildebrand 1950; THC 2012c).

Once Port Isabel was under the control of Union forces, cotton began to be smuggled through Brownsville to Mexico and shipped to European markets through the neutral port of Bagdad, Mexico. Although cotton was technically supposed to be sold to the Confederate government, states west of the Mississippi were not officially obligated to sell to the Confederacy and so could sell cotton in European markets for a higher price and money backed by gold. These factors made Brownsville a boomtown during the Civil War (THC 2012b). The price of everything and wages increased in Brownsville (Hildebrand 1950).

In November 1863, Union forces, with the expressed purpose of interrupting the trade through Mexico, moved on Brownsville. Knowing they were outmaneuvered, the Confederate Army abandoned Fort Brown and destroyed it using 8,000 pounds of explosives. The Union held Brownsville for eight months. The Confederates, led by General John S. Ford, reoccupied the area around Fort Brown on July 30, 1864.

By the spring of 1865, the Confederacy as a whole was fairly weak. In April 1865, General Robert E. Lee surrendered to General Ulysses S. Grant at Appomattox Court House, which is recognized as the official end of the Civil War. However, each department of the Confederate Army had to officially surrender on its own as well. The states west of the Mississippi (the Trans-Mississippi Department of the Confederate Army) had a steady supply of money coming from their export of cotton through Mexico and some members of the Texas army had threatened to continue to fight, despite Lee's surrender (Haecker 2003).

Recognizing that the Trans-Mississippi Department would be one of the hardest departments to convince to surrender, General Grant had sent General Lew Wallace to negotiate a peace agreement in February 1865. Both sides had settled on an agreement whereby Texas would agree to peace if none of their military personnel were prosecuted for their part in the war. Although an agreement was in place, both sides had not formally accepted. By early May 1865, the other states in the Trans-Mississippi Department had formally surrendered; Texas had not (NPS 1993).

The formal agreement was sent to the Confederates on May 11, 1865. On the same day, Union Colonel Theodore H. Barrett, who was in control of troops stationed at Brazos Santiago, ordered his troops to move on the Confederate troops stationed in Brownsville. His reason for doing so is only speculated. The troops skirmished for the following two days. On May 13, 1865, Confederate troops, led by Colonel John S. Ford launched a counterattack and drove the Union troops back to Brazos Santiago. This was later known as the Battle of Palmito Ranch and it was the last battle of the Civil War (NPS 1993; Haecker 2003).

The Texas troops of the Confederacy officially surrender on May 26, 1865, and the entire Trans-Mississippi Department surrendered on June 2, 1865 (NPS 1993). Brownsville and its surrounding areas were then occupied by Union troops. The town was rebuilt within a few months, but the economy was slow to recover (Garza and Long 2012b). The Rio Grande Valley Railroad, the first railway in the region, was constructed from Port Isabel to Brownsville in 1872, but it was not until the middle of the 1870s that the economy of Brownsville fully recovered (Garza 2012b; Garza and Long 2012a).

In 1904 the St. Louis, Brownsville and Mexico Railroad was completed to Brownsville. This railroad opened the area to northern farmers who began to come to the area at the turn of the twentieth century. They cleared the land, built irrigation systems and roads, and introduced large-scale truck farming and citrus farming. The new farming endeavors began a new period of prosperity around Brownsville. Improvements such as water and sewer lines were completed for the city at this time. Port Isabel, however, remained a small coastal town with a population of less than 200 (Garza 2012b; Garza and Long 2012b; Hildebrand 1950).

The availability of cheap land in the area created a strong interest in land speculation. Special trains were dispatched to bring land speculators to the area and by the early 1920s as many as 200 people a day were coming to see the land (Garza and Long 2012b; Hildebrand 1950).

One of the more notable land speculation ventures was the construction of the Del Mar Resort on Boca Chica Beach. Advertised as being on the same latitude as Miami, the resort was built in the 1920s by Colonel Sam Robinson, who moved to the Rio Grande Valley in 1917. The resort had 20 day-cabins available for rent, a bathhouse, and a ballroom. It was quite successful resort until 1933, when a hurricane destroyed most of the buildings. The remaining buildings were turned into a base for the

Coast Guard during World War II. As a result of the Great Depression and the hurricane damage, the owners of the property were not able to reopen the resort after the end of the war (Garcia 2003).

The 1933 hurricane spurred the Works Progress Administration to take part in the dredging and construction of the port of Brownsville, a venture that the city had been trying to complete since 1928. The port was officially opened in 1936. The completion of the port made Brownsville the shipping center for the lower Rio Grande Valley and Mexico. This helped the economy of the town weather the Great Depression and by the beginning of World War II Brownsville was poised for another boom (Garza and Long 2012b).

Shrimpers moved to the region from Louisiana and other parts of Texas in the 1940s and the town began exporting large amounts of shrimp. Additionally, cotton developed into a large-scale export crop to the area in the late 1940s. In 1949, the Gulf Intracoastal Waterway was extended to Brownsville, increasing its shipping capabilities. Brownsville became the leading exporter of cotton in the 1950s after the demand for cotton increased. The boom continued into the 1960s. The population in Brownsville increased by 12,000 people from the 1950s to the 1960s (Garza and Long 2012b).

In Port Isabel the Intracoastal Waterway had increased trade. A bridge connecting the town to Padre Island was constructed in 1954, helping to make the small town a tourist destination. By this time the population of Port Isabel has increased to 5,300 (Garza 2012b).

In the early 1960s, John A. Caputa, a radio personality turned real estate developer from Chicago, decided to build a retirement community for Polish immigrants 22 miles east of Brownsville. One of his three business partners already owned 3,250 acres of land inland from the site of the former Del Mar Resort. Together, they created the Rio Grande Beach Corporation to develop the community, with Caputa in charge of marketing the house lots (Kelly ca. 1979). Using radio and print ads, Caputa marketed the retirement community to the working-class Polish community in Chicago, Illinois as the Fort Lauderdale of the west (Heaton 2008; Kelly ca. 1979). He had the property landscaped and brought trains full of Polish immigrants to the site (Chapman 1992).

Caputa named the retirement community Kennedy Shores after President Kennedy, whom he greatly admired. Lots were sold for $1,200 and houses for $12,500. Within a few years, Kennedy Shores consisted of 30 residences, a restaurant, and a hotel. The community had its own water treatment plant and sewer and electrical services (Garza 2012a). However, in 1967 Hurricane Beulah destroyed the restaurant and utilities and washed away large parts of the property. As a result of the storm, the corporation experienced financial difficulties and 1,000 acres of the original tract were sold at a sheriff's sale (Kelly ca. 1979).

Seeing the sheriff's sale as an opportunity to break from the corporation and continue in his own venture, Caputa purchased the 1,000-acre tract in 1968 and subdivided it into 5,000 lots, which he aimed to sell for $5,000 each. He had electricity restored to the area (but no other utilities) and completed other improvements to the property worth an estimated $250,000. While completing the improvements, Caputa's former partners began a legal dispute with him over the sheriff's sale, miring Caputa in legal fees and stalling construction of the village (Kelly ca. 1979).

Desperate for financing, Caputa took to the radio airwaves again and asked his audience to lend him money towards constructing the retirement village, with the promise that he would repay them with 12 percent interest after a year. Unfortunately, Caputa's financial and legal problems persisted and he was only able to construct about 35–45 houses, a hotel, a restaurant (demolished, but concrete foundation remains), and a swimming pool, between the late 1960s and mid-1970s (Chapman 1992; Kelly ca. 1992). People from Chicago's Polish community did, however, move to the village, and in 1975, renamed it Kopernik Shores, after Polish astronomer Nikolai Kopernik (Garcia 2003; Garza 2012a). In 1978, the population of Kopernik Shores was 26 (Garza 2012a). Currently, this development is referred to as Boca Chica Village.

Since the 1970s, the population in Brownsville and its surrounding area has continued to increase and new industries have been introduced because of the Border Industrialization Program instituted by the Mexican government to increase business ventures and attract laborers to the border areas. Since the program's start in 1966, 100 industries have moved to the area. By the 1990s these included petrochemical companies, frozen food, and fruit and vegetable canning, along with many others (Garza and Long 2012a).

3.5.5 Existing Conditions

3.5.5.1 Architectural Resources

An intensive-level field survey was undertaken within and adjacent to the sites of the vertical launch area and control center parcels. A reconnaissance-level survey was conducted throughout the rest of the APE given that the area is largely undeveloped and few architectural resources were anticipated.

There are no aboveground resources in the vertical launch area. Within the defined 5-mile APE for indirect impacts, a total of nine architectural resources were identified. The architectural resources include: 1) the Palmetto Pilings Historical Marker; 2) the Boca Chica Village development adjacent to the proposed control center area; 3) the Spanish Dagger subdivision; 4) single residence and garage along Boca Chica Boulevard; 5) ranch along Boca Chica Boulevard; 6) cabins along Boca Chica Boulevard; 7) the Sanchez Oil and Gas Corporation tank battery; 8) the drainage channel at Tarpon Bend; and 9) the jetties at the Brazos Santiago Pass.

Across from the northwest corner of the vertical launch area is the historical marker for the Palmetto Pilings. The granite marker, which stands at the edge of a dirt and gravel pullout, is a 1936 Texas Centennial Marker erected to identify the pilings from a nearby historic railroad crossing.

No other architectural resources were found in the area between the vertical launch area and the control center area. Boca Chica Village is adjacent to all three parcels of the control center area, and elements of the community are within the northernmost parcel of the control center area.

Continuing west on State Highway 4, just west of Boca Chica Village, is a property that includes a one-story building, perhaps a residence, and a one-story prefabricated garage and storage building. Both buildings post-date 1970.

Two new residences located within the Spanish Dagger Subdivision are on the north side of State Highway 4 about 0.5 miles west of Boca Chica Village. These one-and-half-story A-frame buildings, the only ones within the subdivision, appear to be seasonal residences. Less than a tenth of a mile west of these residences are gas tanks, meters, and wells of the Sanchez Oil and Gas Corporation. These utility structures, which were installed within the past five years, stand on a large concrete pad lined by a chain-link fence.

Additional identified buildings include a ranch house and a couple of wood-frame cabins at Tarpon Bend. The Ranch-style house is next to the Rio Grande River on Rio Grande Drive. The house is less than 50 years old, as its location is not shown on the 1970 photorevised Mouth of Rio Grande quadrangle (U.S. Geological Survey topographic map). Approximately 700 ft east of the ranch house are recreational vehicles and a couple of small wood-frame cabins. Both cabins post-date 1970.

Between the Rio Grande and State Highway 4 is a shallow drainage channel. The east-west aligned channel extends from west of Tarpon Bend to an unnamed bend in the river east of Palmito Ranch, a distance of roughly 4.5 miles. This channel was constructed sometime between 1970 and 1983, as the east half of the channel is not shown on the 1970 photorevised Mouth of Rio Grande quadrangle, but the west half is indicated on the 1983 photorevised Palmito Hill quadrangle (U.S. Geological Survey topographic maps).

At the north end of the APE is the dual-jetty entrance channel through the Brazos Santiago Pass, the water passage between Brazos and Padre Islands from the Gulf of Mexico to Port Isabel and Brownsville. Spanish explorers used the natural harbor at Brazos Santiago Pass as early as 1523. Three hundred years later, in 1820, Spain established Brazos Santiago as a port, and the harbor has been an important transshipment point ever since (USACE 1977). During the Civil War, the pass was an important harbor entry for Confederate trade. In the early 1930s, construction began on a deep-draft ship channel through the pass to Port Isabel and Brownsville, 17 miles inland. The project was completed using Public Works Administration funds after the area was hit by a major hurricane in 1933 (Garza and Long 2012a). Since completion of the navigation project in 1936, the ship channel has been a critical economic stimulus to agriculture, industry, and commerce in the Rio Grande Valley Region, and to international trade with Mexico (USACE 1977). The current jetty entrance of the channel through Brazos Santiago Pass was constructed sometime after 1977.

Except for the historical marker, all the other architectural resources in the APE are less than 50 years old and do not meet any of the eligibility criteria for the NRHP. The Boca Chica Village was constructed between 1967 and 1974. The other residences and ranches in the APE were constructed between 1970 and 1977. The Spanish Dagger subdivision and the Sanchez oil and gas tank battery are of recent construction (2005 and 2009 respectively). As these architectural resources are less than 50 years old and do not meet the exceptional significance criterion for resources that are less than 50 years old, they are not eligible for the NRHP. As well, they do not qualify as Texas Historical Landmarks (see Appendix C).

The marker was recommended as eligible for the NRHP. In a letter dated November 16, 2012, the THC concurred that the marker is eligible for inclusion in the NRHP (Appendix C).

3.5.5.2 Archaeological Resources

An intensive archaeological inventory of the designated direct effects APE was accomplished through intensive pedestrian survey, subsurface testing, and systematic metal detection survey. An inventory of previously recorded sites within the indirect effects APE was undertaken by searching the Texas Historic Sites and Texas Archaeological Sites databases.

Direct Effects APE

A total area of 68.9 acres was inventoried for archaeological resources within the direct effects APE. Survey methods consisted of an intensive pedestrian survey, subsurface testing, and systematic metal detection survey (as requested by the THC for control center area Parcels 1, 2, and 3). Prior to this effort, no previous surveys had been conducted on the vertical launch area or the control center area, and no previously recorded cultural resources are present within their boundaries.

Special attention was given to areas of enhanced subsurface visibility such as erosional areas and animal burrow backdirt piles. When archaeological resources were discovered, a thorough investigation of the immediately surrounding area was completed in order to delineate the boundaries of the occurrence. In the case of positive shovel tests, radials were excavated at 5-meter intervals oriented along cardinal directions. Sites were mapped using a Trimble Geoexplorer XT GPS unit with an error margin of less than 5 meters. A digital camera was used to take photographs of all archaeological resources, including overviews of sites, and details of features and diagnostic artifacts. Artifacts recovered from shovel probes were collected, and will be returned to the landowner or curated at the Texas Archaeological Research Laboratory in Austin.

The intensive archaeological resources survey of the vertical launch area and the control center area parcels resulted in the identification of one historic site and 19 isolated finds.

Historic Sites

The single historic site (41CF217) is located within the boundaries of the vertical launch area. The historic site consists of a scatter of historic artifacts on an open tidal flat, extending into an adjacent sand dune to the east. The artifacts present on the site suggest a late 19th or early 20th century occupation. The site failed to meet any of the criteria for eligibility to the NRHP and was evaluated as not eligible. The THC concurred with the recommendation that Site 41CF217 is not eligible for the NRHP (Appendix C).

Isolated Finds

The six isolated finds identified in the vertical launch area consist of two prehistoric artifacts and four modern artifacts. The remaining 13 isolated finds are located on control center area Parcels 1 and 3. One of the isolated finds in the control center parcels is historic, and the remaining 12 consist of modern artifacts. All the isolated finds were evaluated as not eligible for the NRHP. The THC concurred that the 19 isolated finds are ineligible for listing on the NRHP (Appendix C).

The proposed utility corridor between the vertical launch area and the control center area would be located within the ROW on the south side of Boca Chica Boulevard. The ROW was surveyed for archaeological sites by the TxDOT in 1999. No sites were found within the surveyed corridor (THC 2012a).

Indirect Effects APE (5 Mile Radius)

One National Historic Landmark (Palmito Ranch Battlefield [41CF93]), 14 archaeological sites, and one historic linear site have been previously recorded within the 5 mile indirect effects APE of the vertical launch area (41CF4, 41CF5, 41CF6, 41CF7, 41CF19, 41CF117.1, 41CF117.2, 41CF118, 41CF119, 41CF120, 41CF121, 41CF124, 41CF125, 41CF127, and 41CF184). One unrecorded historic linear site is also within indirect effects APE (Palmetto Pilings). Three of the sites (41CF117.1, 41CF117.2, and Palmetto Pilings) are in close proximity to the vertical launch area, and one is in close proximity to the control center parcels (41CF124). The 17 archaeological resources in the 5-mile indirect effects APE are summarized in Table 3.5-2.

Table 3.5-2. Summary of Cultural Resources within the 5-mile Indirect Effects APE

Resource No.	Resource Name	Temporal Affiliation	Resource Type	NRHP Eligibility	State Archaeological Landmark Eligibility
41CF93	Palmito Ranch Battlefield NHL	Historic	Civil War Battlefield	Listed/Official	Not Eligible/Field
41CF4	Brazos Santiago Depot	Historic	1840-1870 Military depot and camp	Listed/Official	Not Eligible/Field
41CF5	None	Historic	Shipwreck	Unknown	Unknown
41CF6	White's Ranch	Historic	Civil War camp	Eligible/Field	Eligible/Field
41CF7	Clarksville	Historic	1847-1874 Townsite	Eligible/Field	Eligible/Field
41CF19	None	Prehistoric	Campsite	Unevaluated	Unevaluated
41CF117.1	Cypress Pilings	Historic	1846 Floating bridge pilings	Eligible/Field	Eligible/Field
41CF117.2	Pilings Site	Historic	Historic campsite	Eligible/Field	Eligible/Field
41CF118	Loma del Burro West	Prehistoric	Campsite	Not Eligible/Field	Not Eligible/Field
41CF119	Loma del Burro: Northeast	Prehistoric	Campsite	Not Eligible/Field	Not Eligible/Field
41CF120	Anderson No. 2	Prehistoric	Campsite	Not Eligible/Field	Not Eligible/Field
41CF121	Loma Silvan 01.0	Prehistoric	Campsite	Not Eligible/Field	Not Eligible/Field
41CF124	Polish Village Site No. 1	Historic	Open military (Union) campsite	Not Eligible/Field	Not Eligible/Field
41CF125	Boca Chica Beach Wreck	Historic	Shipwreck	Eligible/Field	Designated/ Official
41CF127	Del Mar	Historic	1929-1933 Resort community	Not Eligible/Field	Not Eligible/Field
41CF184	Boca Chica #2	Historic	Shipwreck	Unevaluated	Designated/ Official
N/A	Palmetto Pilings	Historic	1865 Railroad Pilings	Unevaluated	Unevaluated

N/A = Not Applicable

The identified sites are both prehistoric and historic sites. The historic sites are largely associated with Mexican War and Civil War activities in the area. Of the 15 previously recorded archaeological sites, one is officially listed in the NRHP (the Brazos Santiago Depot); five have been recommended as eligible for inclusion in the NRHP by the previous investigators (41CF6, 41CF7, 41CF117.1, 41CF117.2, and 41CF125); six have been recommended by previous investigators as not eligible for inclusion in the NRHP (41CF118, 41CF119, 41CF120, 41CF121, 41CF124, and 41CF127); two are undetermined for NRHP-eligibility (41CF19 and 41CF184); and one is of unknown eligibility (41CF5). Additionally, two archaeological sites have been officially designated as State Archaeological Landmarks (41CF125 and 41CF184); four sites have been recommended by the previous investigators as eligible for nomination as State Archaeological Landmarks (41CF6, 41CF7, 41CF117.1, and 41CF117.2); eight sites have been recommended by the previous investigators as not eligible for nomination as State Archaeological Landmarks (41CF93, 41CF4, 41CF118, 41CF119, 41CF120, 41CF121, 41CF124, and 41CF127); one is unevaluated (41CF19), and one is of unknown status (41CF5).

Two linear historic sites consisting of Cypress Pilings from a Mexican War-era (1846) floating bridge (41CF117.1) and Palmetto Pilings from a Civil War-era (1865) railroad crossing (no site number) are located on the north side of State Highway 4 approximately 1,200 and 200 ft (respectively) from the vertical launch area (Exhibit 3.5-1). The 1846 Cypress Pilings (41CF117.1) have been previously recorded and recommended by the previous investigators as eligible for the NRHP and as a State Archaeological Landmark. The 1865 Palmetto Pilings have not been formally recorded or evaluated for eligibility to the NRHP nor as a State Archaeological Landmark. The 1865 Palmetto Pilings are treated here as eligible for both the NRHP and as a State Archaeological Landmark.

The foundation for a house destroyed by Hurricane Beulah in 1967 is present just across State Highway 4 from the vertical launch area (Lof 2012) (Exhibit 3.5-1). The construction date of the foundation is unknown but likely dates to the mid-1960s.

Additionally, there is the potential for historic archaeological resources within the hard closure and water closure areas for launches, which are shown on Exhibit 2.1-1. Historic archaeological resources in these areas comprise submerged shipwrecks or formerly submerged shipwrecks that are now buried in sand and sediment. Two databases were consulted to identify reported shipwreck sites in the hard closure and water closure areas. They include the Texas Archeological Research Laboratory's Archeological Sites Atlas and the NOAA Office of Coast Survey's Automated Wreck and Obstruction Information System, which is a catalogue of reported submerged shipwrecks and obstructions in U.S. coastal waters. The Archaeological Sites Atlas indicates approximately 50 shipwrecks are in the hard closure and water closure areas (Texas Archeological Research Lab 2012). The NOAA database indicates 10 reported shipwrecks and obstructions in these closure areas (NOAA 2012b). The majority of the sites are along the shoreline, at the mouth of the Rio Grande, and at the mouth of the Brownsville Ship Channel.

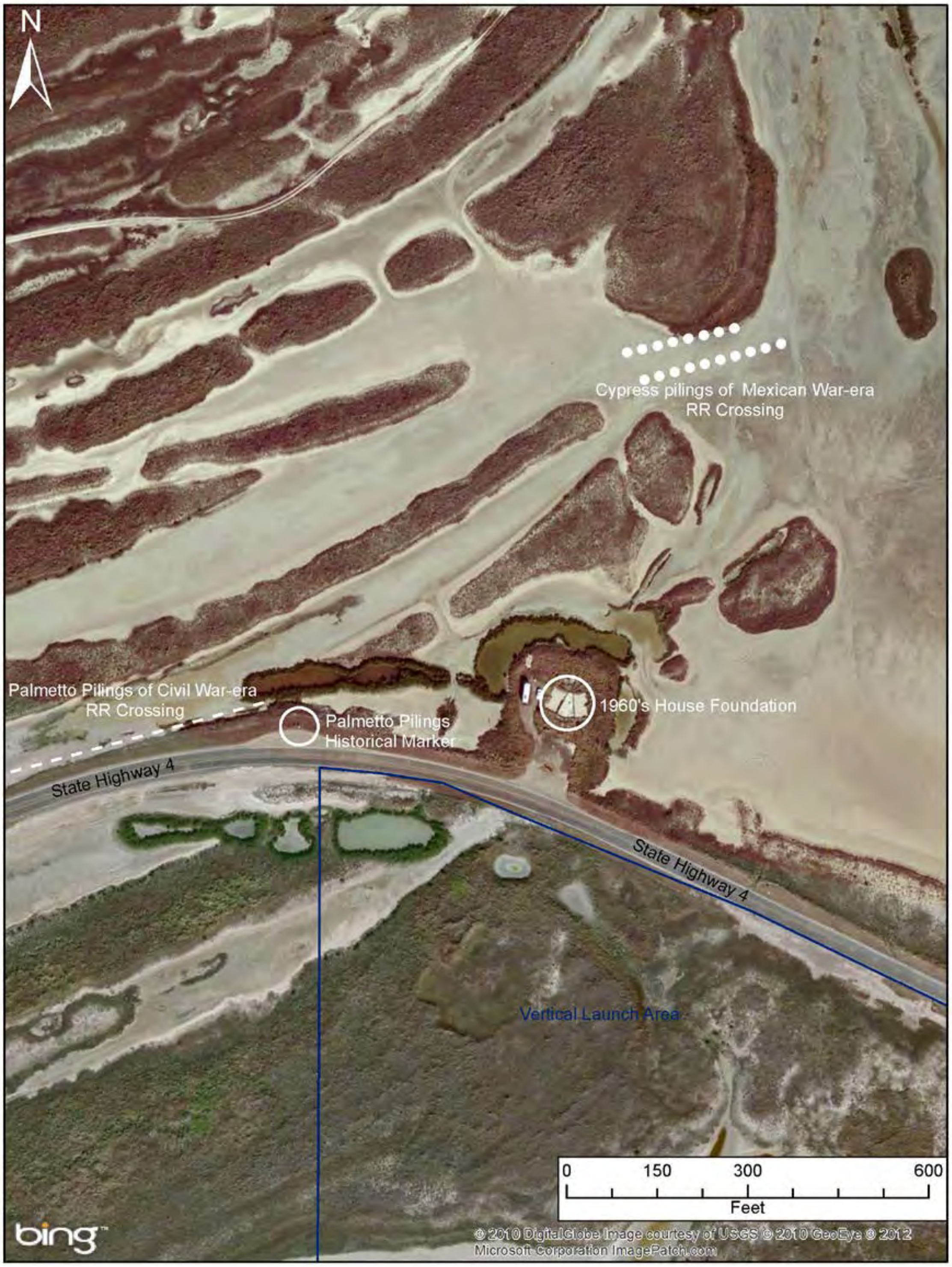


Exhibit 3.5-1. Archaeological Sites Adjacent to the Vertical Launch Area

3.5.5.3 Palmito Ranch Battlefield NHL

The Civil War period Palmito Ranch Battlefield NHL is located within the 5-mile APE of the proposed vertical launch area and within 2 miles of the control center area (Exhibit 3.5-2). The Palmito Ranch Battlefield was listed on the NRHP in 1993 and was designated an NHL in 1997. The Palmito Ranch Battlefield NHL is a roughly 5-mile long stretch of land that is the site of the final battle of the Civil War fought on May 12-13, 1865, approximately 1 month after the signing of the peace treaty at Appomattox Courthouse, Virginia. The core battlefield (assigned Smithsonian Number 41CF93) area is located at Palmito Ranch in the approximate center of the NHL. Also within the boundaries of the NHL are a number of Civil War-era ranches including Tulosa Ranch, Palmito Ranch, White's Ranch, and Cobb's Ranch. These ranches are considered noncontributing resources until further research is completed (NPS 1997). A Civil War Union railroad camp located near Cobb's Ranch is considered a contributing resource. The southern boundary of the NHL is the Rio Grande and the northern boundary is State Highway 4. The western boundary of the NHL is a line extending southward to the Rio Grande from Loma Del Muerto. The eastern boundary of the NHL is a line extending southward to the Rio Grande from the westernmost tip of Vertolaga Lake (NPS 1997). The eastern boundary of the NHL lies approximately 3 miles west of the proposed vertical launch area and 1.25 miles west of the control center area. The setting of the Palmito Ranch Battlefield is little changed from what was present in 1865 with virtually no development occurring in the ensuing years. It is considered to still retain its integrity of setting, feeling, and association (NPS 1997). The Palmito Ranch Battlefield NHL is listed on the NRHP under Criteria A and D of the NRHP Criteria for Evaluation (36 CFR 60.4).

3.5.5.4 Tribal Consultation

Native American consultation with potentially affected tribes resulted in no Traditional Cultural Properties or areas of Native American concern being identified. Consultation letters were sent by the FAA to the Apache, Comanche, Kiowa, Mescalero Apache, and Tonkawa on May 2, 2012. No responses have been received to date regarding any known Traditional Cultural Properties or areas of Native American concern.

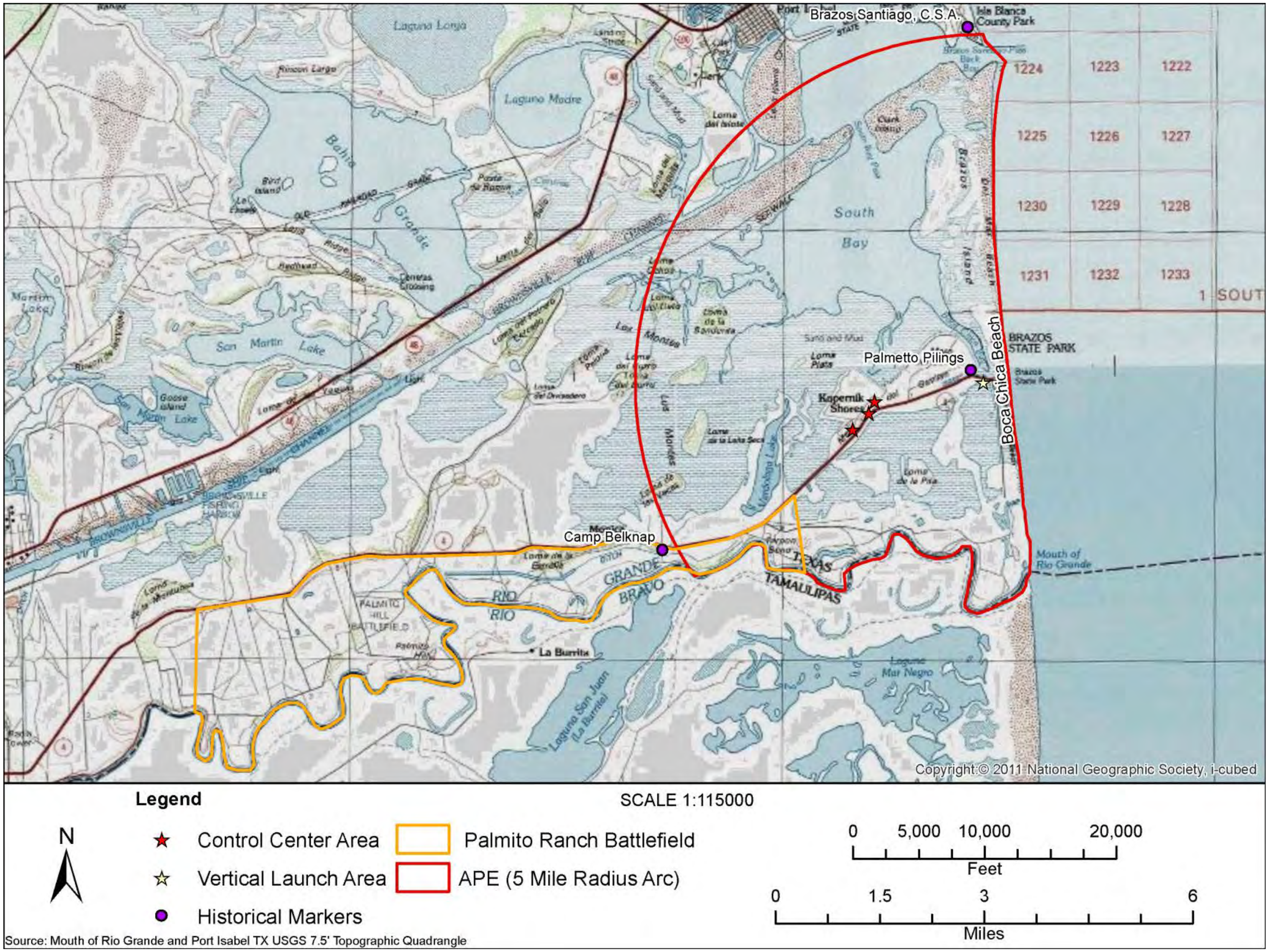


Exhibit 3.5-2. Historic Sites within 5 Miles of the Vertical Launch Area including the Palmito Ranch Battlefield

3.6 AIR QUALITY

3.6.1 Definition and Description

The Earth's atmosphere consists of four main layers: the troposphere, stratosphere, mesosphere, and ionosphere. For the purposes of this EIS, the discussion of air quality within the lower troposphere is defined as at or below 3,000 ft above ground level (AGL), which the EPA accepts as the nominal height of the atmosphere mixing layer in assessing contributions of emissions to ground-level ambient air quality under the CAA (EPA 1992). Although launch vehicle emissions from operations at or above 3,000 ft above ground surface would occur, these emissions would not result in appreciable ground-level concentrations. The mixing layer (sometimes referred to as the boundary layer) is the layer of air directly above the Earth that is relatively well mixed. This layer extends to a height referred to as the mixing height, above which the free troposphere extends up to the tropopause. Typically, temperature and density decrease with altitude in the atmosphere up to the mixing height. However, at the mixing height, the temperature begins to increase with altitude and creates an inversion which prevents a parcel of air from spontaneously rising past the mixing height (Visconti 2001). For more information, see Appendix E.

3.6.2 Regulatory Setting

3.6.2.1 Criteria Pollutants

Air quality is defined by ambient air concentrations of specific pollutants determined by the EPA to be of concern related to the health and welfare of the general public and the environment. Widespread across the U.S., the primary pollutants of concern are called "criteria pollutants" and include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), suspended particulate matter less than or equal to 10 microns in diameter (PM_{10}), fine particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead. Under the CAA, the EPA has established National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50.1-50.17) for these pollutants. These standards represent the maximum allowable atmospheric concentrations that may occur while ensuring protection of public health and welfare, with a reasonable margin of safety. Short-term standards (1-, 8-, and 24-hour periods) are established for pollutants contributing to acute health effects, while long-term standards (quarterly and annual averages) are established for pollutants contributing to chronic health effects. The TCEQ, Office of Air has adopted the NAAQS, which are presented in Table 3.6-1. It should be noted that airborne emissions of lead are not addressed in this EIS, because there are no significant lead emission sources associated with the Proposed Action.

Table 3.6-1. National Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standards	Secondary Standards
CO	8-hr	9 ppm	None
	1-hr	35 ppm	
Lead	Rolling 3-Month Average	0.15 μg/m^3	Same as Primary

Table 3.6-1. National Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standards	Secondary Standards
NO_2	Annual (arithmetic average)	53 ppb	Same as Primary
	1-hr	100 ppb	None
PM_{10}	24-hr	150 µg/m^3	Same as Primary
$PM_{2.5}$	Annual (arithmetic average)	12.0 µg/m^3	15.0 µg/m^3
	24-hr	35 µg/m^3	Same as Primary
O_3	8-hr	0.075 ppm	Same as Primary
SO_2	3-hr	None	0.5 ppm
	1-hr	75 ppb	None

Notes: ppb = parts per billion; ppm = parts per million; mg/m^3 = milligrams per cubic meter; µg/m^3 = micrograms per cubic meter; CO = carbon monoxide; NO_2 = nitrogen dioxide; PM_{10} = particulate matter less than or equal to 10 microns in diameter; $PM_{2.5}$ = fine particulate matter 2.5 microns or less in diameter; O_3 = ozone; SO_2 = sulfur dioxide

Source: EPA 2012a.

3.6.2.2 Hazardous Air Pollutants (HAPs)

In addition to the ambient air quality standards for criteria pollutants, national standards exist for HAPs which are regulated under Section 112(b) of the 1990 CAA Amendments. The National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulate HAP emissions from stationary sources (40 CFR Parts 61 and 63). HAPs emitted from mobile sources are called Mobile Source Air Toxics (MSATs) and include acetaldehyde, acrolein, benzene, 1,3-butadiene, diesel particulate matter, formaldehyde, naphthalene, and polycyclic organic matter. These compounds are emitted from highway vehicles and non-road equipment and are known or suspected to cause serious health and environmental effects. In 2001, the EPA issued its first MSAT Rule, which identified 21 compounds as being HAPs that required regulation. In February 2007, the EPA issued a second MSAT Rule which generally supported the findings in the first rule and provided additional recommendations of compounds having the greatest impact on health. The rule also identified several engine emission certification standards that must be implemented.

Unlike the criteria pollutants, there are no NAAQS for HAPs. The primary control methodologies instituted by Federal regulation for MSATs involve technological improvements for reducing their content in fuel and altering engine operating characteristics to reduce the volume of pollutants generated during combustion. MSATs would be the primary HAPs emitted by mobile sources during construction and operations. The equipment used during construction would likely vary in age and have a range of pollution reduction effectiveness. Construction equipment, however, would be operated intermittently over a large area and would produce negligible ambient HAPs in a localized area. Operational equipment, including vehicles driven by commuters, is anticipated to be primarily newer equipment (post-2010 model year) that generate lower emissions and would also produce negligible ambient HAPs. Therefore, MSAT emissions are not considered further in this analysis.

3.6.2.3 New Source Review (NSR)

The NSR permitting program requires proposed sources of air pollutant emissions to demonstrate their potential to emit will not result in an exceedance of an NAAQS or contribute to a violation of an NAAQS. The NSR program is implemented in the State of Texas by TCEQ and the regulations that address the program can be found in Title 30 of TAC, Chapter 116. TCEQ manages the NSR program for sources located in Texas, including Prevention of Significant Deterioration (PSD) reviews, with the exception of greenhouse gas reviews.

Significant emissions rates are defined for federal PSD regulations under 40 CFR 52.21 (b)(23)(i), and have been established for both criteria and non-criteria pollutants. HAPs are now exempt from PSD applicability, because HAPS are specifically regulated under Title III of the CAA Amendments.

PSD requirements apply to major stationary sources. The CAA specifies 28 categories of stationary sources which are considered major sources if they emit or have potential to emit 100 tons per year or more of any pollutant subject to CAA regulation. Any other stationary source that emits or has the potential to emit 250 tons per year or more of any air pollutant subject to regulation under CAA is considered a major source and is subject to PSD requirements. As indicated in Section 2.0, *Proposed Action and Alternatives*, the proposed vertical launch area and control center area do not include any major stationary sources, so the PSD requirements would not apply to the Proposed Action.

3.6.2.4 Greenhouse Gases (GHGs)

GHGs are gas emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities. The climate change associated with this global warming is expected to produce negative economic and social consequences across the globe.

Although not required by FAA Order 1050.1E, the FAA has developed interim guidance for considering greenhouse gases and climate under NEPA, in a memorandum dated January 12, 2012 (FAA Order 1050.1E, Change 1, Guidance Memo #3). Additionally, in February 2010, the CEQ issued draft NEPA guidance for considering the effects of climate change and GHG emissions.

Research has shown there is a direct correlation between fuel combustion and GHG emissions. In terms of U.S. contributions, the Government Accountability Office (GAO) reports that "domestic aviation contributes about three percent of total CO_2 emissions, according to EPA data," compared with other industrial sources including the remainder of the transportation sector (20 percent) and power generation (41 percent) (GAO 2009). The International Civil Aviation Organization estimates that GHG emissions from aircraft account for roughly 3 percent of all anthropogenic GHG emissions globally (Melrose 2010). Climate change due to GHG emissions is a global phenomenon, so the affected environment is the global climate (EPA 2009a). Discussion of the estimated GHG emissions associated with the Proposed Action and the impact analysis can be found in cumulative impact analysis in Section 5.2.6, *Air Quality*.

3.6.3 Region of Influence

The ROI for the air quality analysis is the Brownsville-Laredo Intrastate Air Quality Control Region (40 CFR 81.135), which includes the Texas counties of Cameron, Hidalgo, Jim Hogg, Starr, Webb, Willacy, and Zapata. The air quality analysis focuses on the local environs surrounding the proposed vertical launch area and control center, which are located in Cameron County.

3.6.4 Existing Conditions

The proposed vertical launch and control center areas are located in Cameron County, Texas, approximately 6.5 miles south of Port Isabel and 18 miles east of Brownsville along the Gulf of Mexico coastline. Areas that are and historically have been in compliance with the NAAQS are designated by EPA as better than national standards or unclassifiable/attainment. Cameron County, which includes the proposed vertical launch area and control center area, maintains these designations for all criteria pollutants (40 CFR 81.310). The designation of attainment for any NAAQS is based on the evaluation of ambient air quality monitoring data collected through Federal, State and/or local monitoring networks. There are two ambient air monitoring stations located in Cameron County. One is located in Brownsville and collects data on O_3, CO, PM_{10} and $PM_{2.5}$, Semi-volatile organic compounds (SVOCs), select volatile organic compounds (VOCs), and meteorological parameters (TCEQ 2009-2010; TCEQ 2009-2011). The second monitoring station is located in Isla Blanca Park and collects meteorological data only. CO data for the 3-year period 2009-2011 indicate that ambient levels are quite low, averaging 0.1 parts per million (ppm). The annual maximum hourly value ranged from 1.7 to 1.9 ppm. Ozone values for the same period averaged 26-27 parts per billion (ppb). There were no exceedances of the O_3 NAAQS for the 3-year period. PM_{10} typically ranged on average from 20.11 to 24.36 μg/m^3, though maximum hourly values reached as high as 280.94 μg/m^3 for a single hour period in 2009. There were no exceedances of the PM_{10} NAAQS for the 3-year period. $PM_{2.5}$ typically ranged on average from 10.10 to 11.04 μg/m^3 for any given hour, though there were occasions in each of the 3 years when the 24-hour NAAQS was violated due to extended periods of maximums that were as high as 55 to 70 μg/m^3. Although there have been instances of exceedance above the 24-hour NAAQS for $PM_{2.5}$, the area has not established a pattern of exceedance that would require designation as nonattainment. In December 2012, the primary standard for 24-hour $PM_{2.5}$ was reduced to 12 μg/m^3. Ambient air monitoring data will now be reviewed against the new standard. All areas surrounding the proposed vertical launch area and control center area are in attainment for criteria pollutants. Because the region is in attainment, the CAA General Conformity Rule (40 CFR Parts 51 and 93) does not apply and is not addressed in this EIS.

The climate of the region is characterized by an extended summer season and a mild fall and winter, generally with high humidity. Data from the South Padre Island meteorological station near Port Isabel from 1992 through 2010 shows the average daily temperatures range from lows of 48.3 °F (February) to 81.8 °F (August) to highs of 61.8 °F (January) to 92.6 °F (August) (National Climate Data Center [NCDC] 2012).

Average annual precipitation in the region is about 23.5 inches, with the highest annual precipitation total of 37.4 inches recorded in 2010 and the lowest total of 13.2 inches recorded in 2006 during the period from 1992 through 2010. Most of this precipitation is received during the hurricane months of

July, August, and September. Rainfall totals for the other 9 months of the year are generally less than 2 inches (NCDC 2012).

Wind speeds in the region are usually moderate, although extremely strong winds accompany hurricanes that strike the region. Wind speeds are fairly consistent in the coastal area where the proposed vertical launch area would be located. Wind speed data collected during 2009 and 2010 at the Isla Blanca Park monitoring station indicates a somewhat greater tendency for increased wind speed during the late fall, winter, and early spring time frame. Based on the monitoring data, the summer months are more likely to have a larger number of low wind speed days (TCEQ 2009-2010).

The Gulf Coast of Texas is subject to hurricanes and tropical storms from May through November, with the largest storms and the heaviest amount of rainfall concentrated during the months of July through September (Roth 2010).

3.7 WATER RESOURCES (INCLUDING SURFACE WATERS, GROUNDWATER, WETLANDS, FLOODPLAINS, AND WILD AND SCENIC RIVERS)

3.7.1 Definition and Description

Water resources include surface waters, groundwater, wetlands, floodplains, and Wild and Scenic Rivers. There are several Federal and State laws and regulations that address water resources, including the CWA; Safe Drinking Water Act; Fish and Wildlife Coordination Act; Rivers and Harbors Act; Wild and Scenic Rivers Act; EO 11990, *Protection of Wetlands*; and EO 11988, *Floodplain Management*.

Surface waters include streams, rivers, lakes, ponds, estuaries and oceans. Groundwater is subsurface water that occupies the space between sand, clay, and rock formations. Groundwater, an essential resource in many areas, is used for water consumption, agricultural irrigation, and industrial applications. Groundwater properties are often described in terms of depth to aquifer, aquifer or well capacity, water quality, and surrounding geologic composition. The term aquifer is used to describe the geologic layers that store or transmit groundwater, to wells, springs, and other water sources. Aquifers are areas of mostly high porosity soil where water can be stored between soil particles and within soil pore spaces.

Wetlands are lowland areas covered with shallow and sometimes temporary or intermittent waters. These areas include, but are not limited to, swamps, marshes, bogs, sloughs, potholes, wet meadows, river overflows, tidal overflows, estuarine areas, and shallow lakes and ponds with vegetation that is present for most of the growing season. Wetlands provide many benefits to the human, biological, and hydrological environment, including habitat for fish and wildlife, water quality improvement, flood storage, and opportunities for recreation.

Floodplains are lowland areas located adjacent to bodies of water in which the ordinary high water level fluctuates on an annual basis. Along rivers, the ordinary high water level may fluctuate as a result of a precipitation event. Tidally influenced waters may fluctuate due to spring tides or as a result of a large storm event (e.g., storm surge). When one of these events is large enough, it causes the water level to exceed the ordinary high water mark and enter the adjacent floodplain. As a result, functioning floodplains provide critical protection for surrounding communities because of their ability to dissipate energy and water from flooding. Any fill to floodplains results in the decrease of the effectiveness of a floodplain to mitigate flooding. Floodplains are often discussed in terms of the 100-year flood. The 100-year flood is a flood having a 1 percent chance of occurring in any given year. The 100-year flood is also known as the base flood. Floodplains are valued for their natural flood and erosion control, enhancement of biological productivity, and socioeconomic benefits and functions.

Wild and Scenic Rivers are those rivers or sections of rivers that are free-flowing and have remarkable scenic, recreational, geologic, fish, wildlife, historic, or cultural values as defined by the Wild and Scenic Rivers Act. Wild and Scenic Rivers are designated by Congress, and in some cases the Department of Interior.

3.7.2 Regulatory Setting

Federal

The Federal CWA has established regulations for discharges to surface water and is the primary law regulating water pollution and surface water quality. Under CWA Section 402, the EPA has authority to issue pollution control programs and to regulate water pollution discharge through the National Pollutant Discharge Elimination System (NPDES) permit program (EPA 2009b). The CWA limits any discharge of pollutants to a level sufficient to assure compliance with the state water quality standards. Discharges of dredged or fill materials are regulated under Section 404 of the CWA. The USACE regulates the dredging and filling of waters of the U.S., including wetlands. In addition to the USACE, the EPA and the states regulate dredge and fill operations and dredge material disposal. Section 303(d) of the CWA requires states, territories, and authorized tribes to develop a list of impaired waters. Waters are considered impaired when they do not meet water quality standards that the state, territories, and authorized tribes have set. States, territories, and authorized tribes are required to create a priority ranking system for these waters, as well as the development of total maximum daily loads for these waters. Section 303(d) is an important component of the CWA for protecting and restoring water quality.

The Safe Drinking Water Act (SDWA) was established by Congress in 1974 and was enacted to protect public health through the regulation of the nation's public drinking water supply. SDWA also protects the sources of public drinking water including rivers, lakes, reservoirs, springs, and groundwater wells (it does not cover private wells). Under the SDWA, the EPA sets national standards for both naturally occurring and man-made pollutants that can be present within public drinking water. EPA also requires Federal agencies to coordinate with the EPA on impacts to Sole Source Aquifers. Federal actions should be evaluated to ensure they do not contribute pollutants that would cause a threat to the nation's public drinking water supply.

The Fish and Wildlife Coordination Act (FWCA) provides the USFWS with the authority to be involved in proposed water resource development projects for the purposes of evaluating impacts to fish and wildlife. FWCA also requires Federal agencies to consult with the USFWS when they construct, license, or permit water resource development projects. The FWCA requires that fish and wildlife resources are given equal consideration to other resources and project features.

The Rivers and Harbors Act was established to prevent the discharge of refuse matter of any type into a navigable water or a tributary of the U.S. without a permit. This includes activities that require excavation, fill, alteration of a water course, condition or capacity of a port, harbor, channel, or other areas covered by the Act. Additionally, under the Rivers and Harbors Act navigable streams cannot be dammed without a permit. The majority of the activities included in the Rivers and Harbors Act are regulated under the CWA.

The Wild and Scenic Rivers Act (16 U.S.C. 1271-1287) establishes a National Wild and Scenic Rivers System and prescribes the methods and standards through which additional rivers may be identified and added to the system. This Act authorizes the Secretary of the Interior and the Secretary of Agriculture to study areas and submit proposals to the President and Congress for additions to the system, and to describe procedures and limitations for control of lands. Federal agencies proposing projects in proximity to a designated Wild and Scenic River or a river listed on the Nationwide River Inventory (NRI) would be required to coordinate with the agency administering the river or river segment to ensure the protection of the values which led to the designation as a Wild and Scenic River or to listing on the NRI.

EO 11990, *Protection of Wetlands*, states federal actions must "... avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative." EO 11990 states that agencies shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands. Agencies are also responsible for preserving and enhancing the natural and beneficial values of wetlands.

DOT has implemented EO 11990 through policies and procedures documented in DOT Order 5660.1A, Preservation of the Nation's Wetlands. DOT Order 5660.1A requires that transportation facilities and projects should be planned, constructed, and operated to assure the protection, preservation, and enhancement of the nation's wetlands to the fullest extent practicable, and establishes procedures for implementation of the policy.

EO 11988, *Floodplain Management,* addresses floodplain management and establishes requirements to ensure Federal agencies avoid directly and indirectly supporting the development of floodplains when alternatives are feasible. In addition, it prohibits impacts to floodplains from short-term and long-term occupancy and modification of floodplains when alternatives exist. Agencies are required to document that there is no practicable alternative prior to taking action that would encroach on a 100-year floodplain. Additionally, if avoidance of the floodplain location is not practicable, agencies are required to minimize harm to the floodplain.

DOT has implemented EO 11988 through policies and procedures documented in DOT Order 5650.2, Floodplain Management and Protection. DOT Order 5650.2 defines the natural and beneficial values provided by floodplains to include "natural moderation of floods, water quality maintenance, groundwater recharge, fish, wildlife, plants, open space, natural beauty, scientific study, outdoor recreation, agriculture, aquaculture, and forestry." Based on DOT Order 5650.2, if an action includes development within a floodplain, the analysis shall indicate if the encroachment would be a "significant encroachment," that is, whether it would cause one or more of the following to occur:

- The action would have a considerable probability of loss of human life
- The action would likely have substantial, encroachment-associated costs or damage, including interrupting aircraft service or loss of a vital transportation facility (e.g., flooding of a runway or taxiway, important navigational aid out of service due to flooding, etc.)
- The action would cause notable adverse impact on natural and beneficial floodplain values

FAA Order 1050.1E also stresses that impacts to floodplains due to development are to be avoided and minimized by all means practicable. Whenever a proposed action is determined to result in a significant encroachment, the FAA/AST must (1) find that the proposed significant encroachment is the only practicable alternative and that the action conforms to applicable state and/or local flood protection standards; (2) include in the EIS a sufficient discussion to permit an initial review of methods proposed to minimize harm; and (3) make reference to the floodplain location in any public hearing notices or other notices offering an opportunity for public comment on the Proposed Action.

State

Under Title 30, Chapter 307 of the TAC, water quality standards were written by the TCEQ to comply with CWA. TCEQ regulates wetlands and water quality through the state's water quality certification (CWA 401) and Federal consistency with the TCMP (Environmental Law Institute [ELI] 2008). TCEQ's jurisdiction extends only to wetlands found in coastal areas; however, the Commission's authority to issue water quality certifications is not limited to coastal areas (ELI 2008). The EPA has delegated responsibility for implementation of CWA 401 certification reviews to TCEQ for any 404 USACE permit applications that would require discharge of dredged or fill material to waters of the U.S., including wetlands (ELI 2008). Unless a permit is obtained, it is unlawful to discharge any pollutant from a point source into waters of the U.S. Certification from the TCEQ through the USACE permitting process would demonstrate compliance with state water quality standards.

TCEQ is also responsible for administering the program and has created the Texas Pollutant Discharge Elimination System (TPDES) to regulate discharges of pollutants (TCEQ 2012). On September 14, 1998 the state assumed the authority to administer the NPDES program. TCEQ now has the Federal regulatory authority over discharges of pollutants to surface water. Exceptions to the TPDES regulation are discharges associated with oil, gas, and geothermal exploration which are regulated by the Railroad Commission of Texas.

Local

The location of the Proposed Action is within Cameron County, Texas where municipal water resource related regulations impacting water quality have been implemented locally. The USDA NRCS local work group for Cameron County has identified water quality and water quantity as the highest priorities of concern within the county, enabling funding assistance to agricultural producers in implementing conservation practices that would be beneficial to water resources throughout Cameron County (NRCS 2012b). Cameron County has initiated a stormwater management program to control polluted stormwater runoff, through the Cameron County Stormwater Management Plan (SWMP). Implementation of SWMP includes Best Management Practices (BMPs) to improve water quality. Under the Cameron County's SWMP, BMPs are implemented to achieve the regulatory standard of reducing pollutants to the Maximum Extent Practicable. Any projects that occur within a floodplain are required to comply with floodplain ordinances based on the FEMA National Flood Insurance Program requirements. Cameron County has participated in the NFIP since June 15, 1979 (FEMA 2012a).

3.7.3 Region of Influence

The ROI for water resources for this EIS is defined as surface water, groundwater, and wetlands within or adjacent to the proposed vertical launch and control center areas (Exhibit 3.7-1). Surface waters included in the ROI are those within South Bay, Laguna Madre, the Rio Grande, and waters of the Gulf of Mexico. In addition, there is a large wetland area between the Rio Grande River and the proposed vertical launch area.

3.7.4 Existing Conditions

3.7.4.1 Surface Waters

There are no surface waters (non-wetland surface waters) within the boundaries or footprints of the control center area or the vertical launch area. The location of the proposed vertical launch and control center areas are within South Laguna Madre watershed, which is within the Bahia-Grande Brownsville Ship Channel watershed, a 363-square mile subwatershed to the Southwestern Texas Coastal Basin (EPA 2012b). South Bay is an inland bay along the Gulf of Mexico located within the Laguna Madre hypersaline lagoon system and is the southernmost bay in Texas (TPWD 2012b). South Bay is separated from the Gulf of Mexico by Brazos Island. On the northern boundary of South Bay is an inlet where water flows freely from South Bay into the Brownsville Shipping Channel, which connects the Port of Brownsville to the Gulf of Mexico. On the southern end of South Bay, approximately 0.5 miles north of the proposed vertical launch area, is Boca Chica Bay where Boca Chica State Park is located. Boca Chica Bay, located approximately 0.03 miles from the vertical launch area, is a subdelta of the Rio Grande. South Bay water quality results were last posted in March 2005, and although they indicated the presence of fecal coliform, these levels were below EPA standards (EPA 2012b).

To the east of the proposed vertical launch area is the Gulf of Mexico. Waters of the Gulf of Mexico have been deemed impaired waters by EPA. Causes of impairment include the presence of mercury in fish tissue (TCEQ 2011a). Water quality is regularly sampled at Boca Chica State Park Station #3, which is located near where State Highway 4 meets the Gulf of Mexico. The results of the last sampling event conducted in April 2012 indicated that *Enterococcus* bacteria were below maximum concentration in April 2012 (EPA 2012b). *Enterococcus* is the Federal standard for water quality at public salt water beaches.

The Rio Grande is located approximately 2 miles south of the proposed vertical launch and control center areas and is located outside of the watershed. Portions of the Rio Grande are deemed Wild and Scenic. However, these portions are located over 400 miles away from the proposed vertical launch and control center areas. In addition, as per the NRI, no rivers or river segments within Cameron County are currently listed.

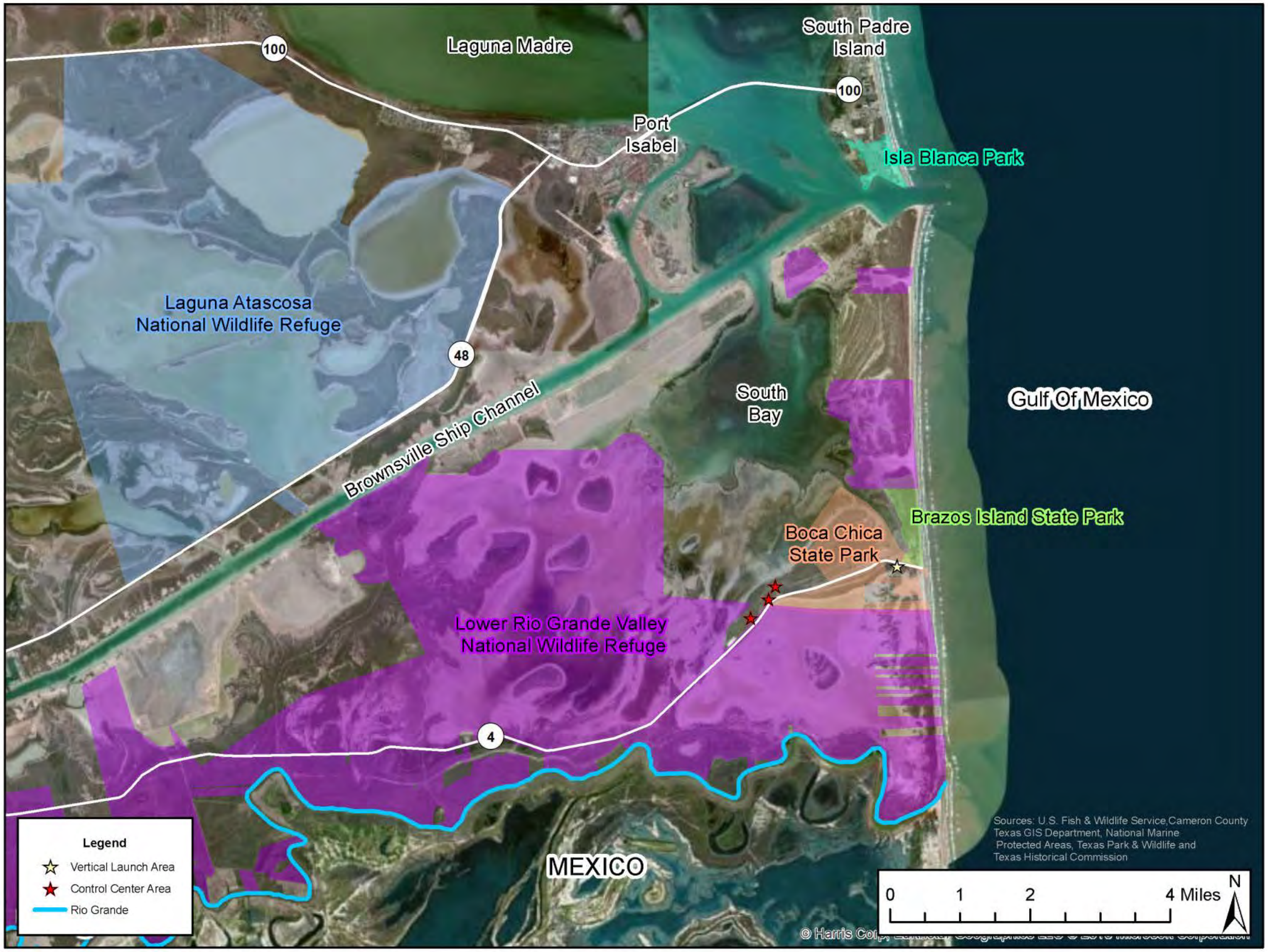


Exhibit 3.7-1. ROI for Water resources

3.7.4.2 Groundwater

Hydrostratigraphy

Available groundwater in the vicinity of the vertical launch and control center areas is primarily within the Gulf Coast Aquifer, which is found along the Gulf Coast of Texas, Louisiana, Mississippi, Alabama, and western Florida. Baker (1979) divided the Gulf Coast Aquifer in South Texas into five hydrostratigraphic units: (1) the Catahoula Confining System, (2) the Jasper Aquifer, (3) the Burkeville Confining System, (4) the Evangeline Aquifer, and (5) the Chicot Aquifer (Exhibit 3.7-2).

As shown in Exhibit 3.7-3, sediment thickness increases from west to east toward the Gulf of Mexico. Thickness maps for the aquifers and the confining unit indicate a maximum sediment thickness of up to 1,200 ft for the Chicot Aquifer, 2,800 ft for the Evangeline Aquifer, 1,600 ft for the Burkeville Confining System, and 3,200 ft for the Jasper Aquifer. The aquifers and confining unit thicken downdip toward the Gulf of Mexico. However, the aquifers show less variation in thicknesses along the north-south direction (Baker 1979), perhaps indicating that sediment source areas have not changed considerably during sediment deposition (Choudhury and Mace 2007).

The EPA has not designated any Sole Source Aquifers within the vicinity of the vertical launch and control center areas (EPA 2012c). As discussed in Section 3.7.2, *Regulatory Settings,* Sole Source Aquifer designations are applied by the EPA to protect drinking water supplies in areas with few or no alternative sources to the groundwater resource.

Review of the Texas Water Development Board (TWDB) groundwater database report system indicates that there are no registered groundwater wells in the vicinity of the vertical launch and control center areas. The only water well within 5 miles of the project area is state well 8907301, located approximately 2 miles to the south of the vertical launch and control center areas (TWDB 2012a). The Edwards Aquifer, the nearest designated Sole Source Aquifer, is located over 250 miles away, just north of San Antonio, Texas.

Jasper Aquifer

The configuration of the Jasper Aquifer in the subsurface is geometrically irregular as the delineation was based on the aquifer being treated as a rock stratigraphic unit (Baker 1979). The lower boundary of the aquifer coincides with the stratigraphic lower boundary of the Oakville or the Fleming formations, or it may be contained within or coincide with the base of the Catahoula Formation (Exhibit 3.7-3). The top of the aquifer lies locally within the Fleming Formation or coincides with the top of the Oakville Formation (Choudhury and Mace 2007).

Burkeville Confining System

The Burkeville Confining System separates the Jasper and Evangeline aquifers. It is predominantly composed of silt and clay but may occasionally contain isolated sand lenses locally containing fresh water. It occurs as clayey sediments in the upper part of the Oakville Sandstone and the middle part of the Fleming Formation. Given the predominance of silt and clay in the Burkeville Confining System, it primarily acts as a confining unit (Ryder 1988). The Burkeville Confining System pinches out in the subsurface in western Starr, Jim Hogg, and part of Duval counties (Choudhury and Mace 2007).

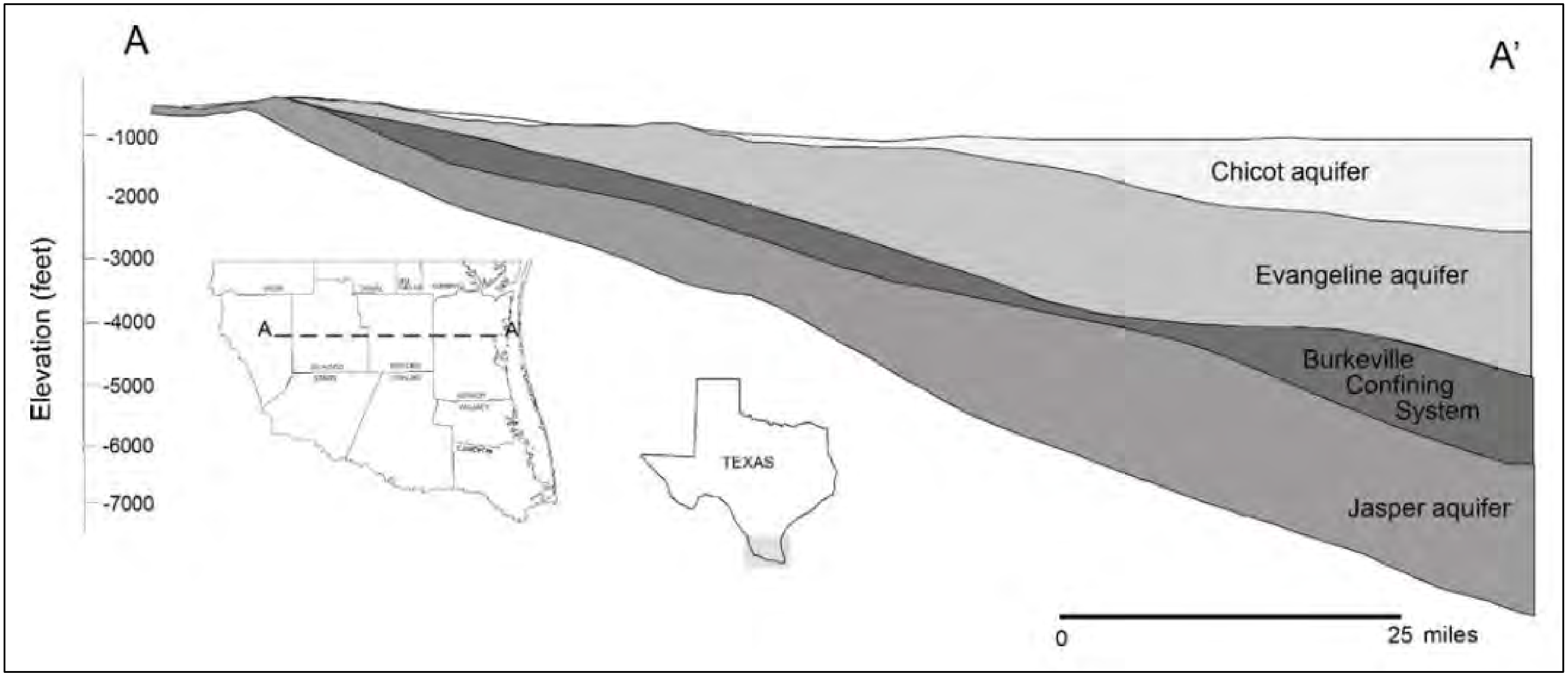


Exhibit 3.7-2. East-West Cross Section Showing Geometry and Stratigraphic Distribution of the Aquifers in the Lower Rio Grande Valley of Texas (Choudhury and Mace 2007)

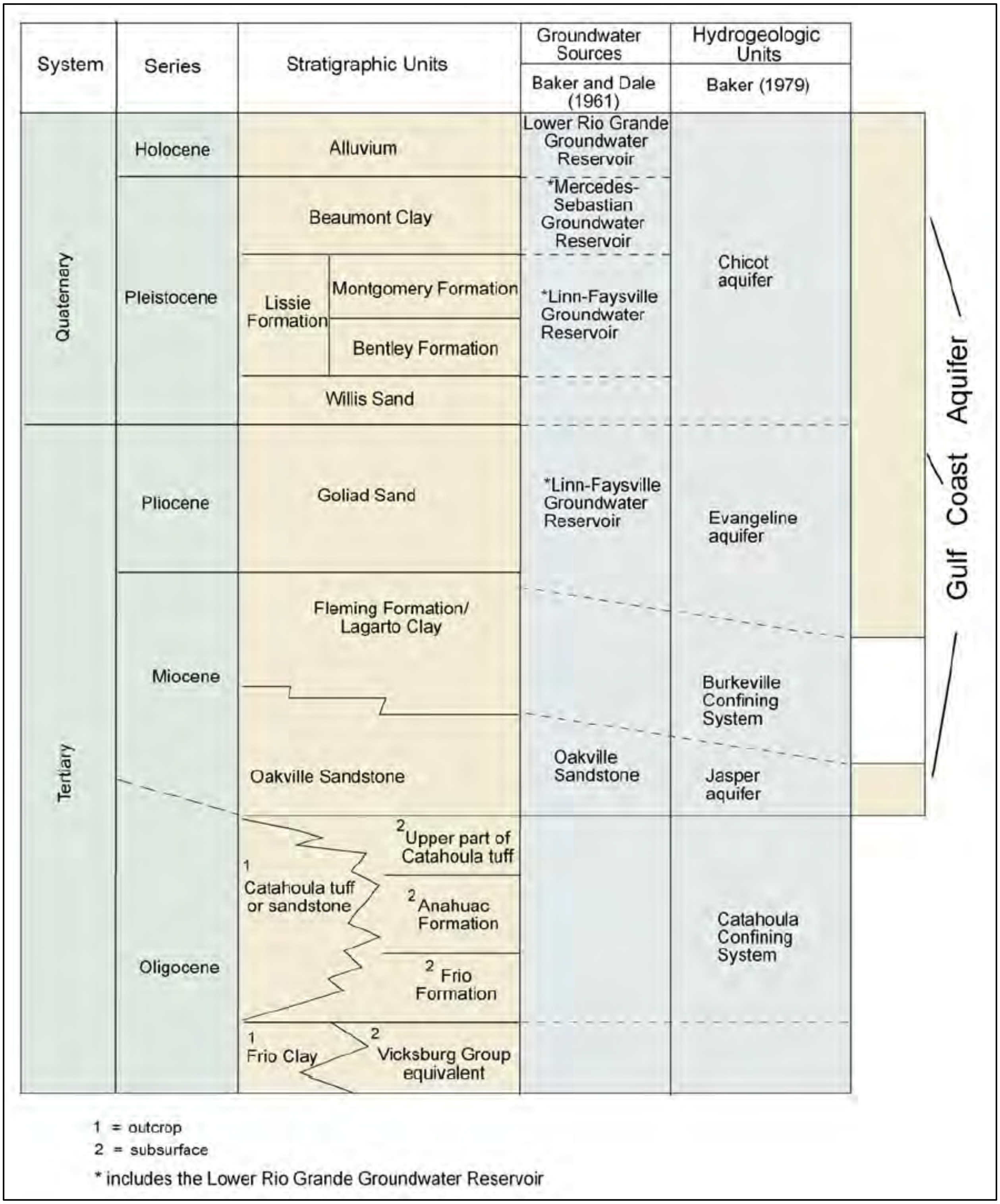


Exhibit 3.7-3. Stratigraphic and Hydrostratigraphic Classification of the Gulf Coast Aquifer in South Texas (Choudhury and Mace 2003)

Evangeline Aquifer

The Evangeline Aquifer consists of the Goliad Sand and may include sections of sand and clay of the Fleming Formation. The aquifer is wedge shaped and contains mostly sand with individual sand beds that are tens of feet thick. The Evangeline Aquifer is underlain by the Burkeville Confining System near the Gulf of Mexico but directly overlies the Jasper Aquifer inland to the west where the Burkeville Confining System has pinched out (Choudhury and Mace 2007).

Chicot Aquifer

The Chicot Aquifer includes the Montgomery Formation, Lissie Formation, Beaumont Formation, and the overlying alluvial/sand plain deposits, including the Rio Grande Alluvium. The Pleistocene/Upper Pliocene forms the base of the Chicot Aquifer. The Chicot Aquifer consists of discontinuous sand and clay beds of nearly equal thickness for most of the coastal areas. Although the Chicot Aquifer generally has a higher sand-clay ratio than the underlying Evangeline Aquifer (McCoy 1990), the two aquifers are difficult to distinguish from each other using geophysical logs. Cross-formational flow is a significant component of the total flow for each aquifer, with deeper groundwater from the Evangeline Aquifer flowing upward near the coast and resulting in greater salinity in the overlying Chicot Aquifer (Choudhury and Mace 2007).

In Cameron County, pumping tests on wells completed in the Chicot Aquifer near the Rio Grande showed an average coefficient of transmissibility of 49,500 gal per day per foot (gpd/ft) and an average yield of 1,200 gal per minute (gpm) (Myers 1969). Discharges as high as 2,900 gpm have also been reported for wells completed in the Chicot aquifer in Cameron County (Baker and Dale 1961).

In western Cameron County, the water-bearing sediments of the Goliad Sand, Lissie Formation, Beaumont Formation, and the alluvium, though locally separated by clay layers, are hydraulically connected and acts as a hydraulic unit. The Beaumont Formation also hosts considerable groundwater in Cameron County (Baker and Dale 1961). These permeable deposits probably represent a relict channel of the former course of the Rio Grande (Choudhury and Mace 2007).

Rio Grande Alluvium

The Rio Grande Alluvium consists of gravel, sand, silt, and clay that underlie most of the Rio Grande delta (Rose 1954). Thickness of the deposit ranges from 50 to 300 ft with the thickest sections occurring adjacent to the present course of the Rio Grande. In the lower part of the alluvium, a zone of water-bearing material extends from the vicinity of Rio Grande City to Brownsville. The extent of the aquifer can also be defined by a string of irrigation wells that were installed around the fringes of the aquifer. The permeable zones in the alluvium are in hydraulic connection with the adjacent and underlying beds of the Goliad Sand, Lissie Formation, and Beaumont Formation (Baker and Dale 1961).

<u>Groundwater Recharge</u>

In general, recharge to the aquifers in the study area is by precipitation on the land surface. Water that does not run off, and is not lost through evapotranspiration, percolates into the subsurface. The degree of subsurface infiltration is determined by the permeability of the soil stratum and underlying beds. The soils of the Lower Rio Grande Valley are characterized by many different types varying in permeability from low, less than 0.06 inch per hour, to high, 6.0 inches per hour (McCoy 1990).

Recharge can also occur in irrigated areas by infiltration of excess irrigation water. Along the Rio Grande and the numerous unlined flood ways and irrigation canals in Cameron County, southern Hidalgo County, and Willacy County, water percolates into the subsurface when the local water table is lower than the streambed (McCoy 1990).

Collectively, the entire suite of geologic strata in the study area form a large, leaky artesian system in which recharge can occur across formational boundaries where permeable sands are in contact (Muller and Price 1979). Additionally, uncemented and improperly cased wells can allow ground-water communication between different zones within a well bore (McCoy 1990). However, the recharge to these aquifers generally occurs inland to the west, and the discharge of these aquifers occurs along the Gulf Coast.

<u>Groundwater Demands</u>

The Chicot and the Evangeline aquifers show considerable variations in well yields over a short distance primarily due to the diversity of its composition. For example, ancient river courses containing narrow sand and gravel deposits produce high yields, but floodplain deposits on the banks containing silt and mud may produce no water at all (Choudhury and Mace 2007).

Although the Gulf Coast Aquifer has been extensively pumped, it is difficult to predict yield from the aquifer. This uncertainty in estimating yield is due to the unpredictability in determining the distribution of sand-shale content, pore-fill cements, and compaction from the overlying sediments. Transmissivity (rate of water flow) ranges from 3,000 to 18,000 ft^2 per day and 3,000 to 15,000 ft^2 per day in the Chicot and Evangeline aquifers, respectively (Choudhury and Mace 2007).

The TWDB previously completed several predictive groundwater availability model simulations of the Gulf Coast Aquifer to assist in developing a desired future condition of the groundwater in the Lower Rio Grande Valley. Simulations of groundwater pumping stresses on the Gulf Coast aquifer in the Lower Rio Grande Valley yielded estimates on the available groundwater in Cameron County. The available groundwater in the Nueces-Rio Grande Basin in Cameron County totaled 48,576 acre-feet per year (afy), and simulations of pumping this volume resulted in a simulated average drawdown of 52 ft through 2060 (Hassan 2011).

A summary of historical water use by groundwater and surface water in Cameron County is presented in Table 3.7-1. The total water use per year between the years 2000 and 2004 averaged 223,457 afy, of which an average of 7,858 afy was pumped from groundwater. Approximately 3.5 percent of the total water use and 5.1 percent of the municipal water use in Cameron County was obtained from groundwater between the years 2000 and 2004 (TWDB 2012b).

Table 3.7-1. Summary of Historical Water Use (acre feet) by Groundwater and Surface Water (2000-2004)

Year	Source	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total	% Total
2000	GW	1,503	80	0	6,673	8	31	8,295	3.73
2000	SW	66,567	3,350	1,498	142,451	0	277	214,143	96.27
	Total	**68,070**	**3,430**	**1,498**	**149,124**	**8**	**308**	**222,438**	
2001	GW	2,688	16	0	9,409	8	28	12,149	4.93
2001	SW	41,960	1,599	2,393	188,186	0	287	234,425	95.07
	Total	**44,648**	**1,615**	**2,393**	**197,595**	**8**	**315**	**246,574**	
2002	GW	3,097	9	0	8,749	8	23	11,886	5.16
2002	SW	48,334	941	2,899	166,245	0	226	218,645	94.84
	Total	**51,431**	**950**	**2,899**	**174,994**	**8**	**249**	**230,531**	
2003	GW	3,408	11	0	0	8	32	3,459	1.68
2003	SW	53,183	1,074	2,090	145,850	0	319	202,516	98.32
	Total	**56,591**	**1,085**	**2,090**	**145,850**	**8**	**351**	**205,975**	
2004	GW	3,451	14	0	0	8	30	3,503	1.65
2004	SW	53,855	1,350	3,709	149,048	0	303	208,265	98.35
	Total	**57,306**	**1,364**	**3,709**	**149,048**	**8**	**333**	**211,768**	
	GW	2,829	26	0	4,966	8	29	7,858	3.52
	SW	52,780	1,663	2,518	158,356	0	282	215,599	96.48
2000-2004 AVG		55,609	1,689	2,518	163,322	8	311	223,457	

Notes: GW = Groundwater; SW = Surface Water;
Source: TWDB 2012b.

The TWDB prepared a regional water plan in 2011 to project the municipal water demand from 2010 and 2060, by decade. Table 3.7-2 shows the projected water demands for Cameron County for the next 50 years, ranging from 462,975 afy in 2010 to 507,573 afy in 2060 (TWDB 2012c). Assuming that the groundwater pumping remains at 3.5 percent of the total water use and at 5.1 percent of the municipal water use, the total groundwater pumping demand in Cameron County is estimated to be 16,200 afy in 2020, and 17,900 afy in 2060. Of the projected groundwater pumping demand in Cameron County, the municipal groundwater demand is projected to be 4,500 afy in 2010, 5,300 afy in 2020, and 8,700 afy in 2060.

Table 3.7-2. Cameron County Water Demand Projections for 2010-2060 (acre feet)

Year	2010	2020	2030	2040	2050	2060
Mining	6	6	6	6	6	6
Manufacturing	4,156	4,590	4,983	5,372	5,709	6,165
Steam Electric	1,616	1,523	1,780	2,094	2,477	2,944
Irrigation	367,404	347,771	325,144	325,144	325,144	325,144
Livestock	1,103	1,103	1,103	1,103	1,103	1,103
Municipal	88,690	104,850	121,342	138,190	155,290	172,211
Cameron County Total	462,975	459,843	454,358	471,909	489,729	507,573

Source: TWDB 2012c.

Groundwater Quality

Although significant quantities of groundwater occur in the Gulf Coast Aquifer in sections where sands are dominant, much of this groundwater resource is not directly usable due to its moderate to high salinity. Groundwater is generally fresh in most of the outcrop but increases in salinity at depth and along flow paths toward the Gulf Coast.

The groundwater of the Lower Rio Grande Valley is characterized by its generally poor quality in relation to the waters of the Rio Grande. Surface water from the Rio Grande usually has total dissolved solids (TDS) content of from 400 to 750 milligrams per liter (mg/L) and is classified as fresh in quality. Groundwater from all the aquifers in Cameron County generally exceeds 1,000 mg/L TDS (slightly saline) and often exceeds 3,000 mg/L (moderately saline) (McCoy 1990), which is greater than the National Secondary Drinking Water Regulations standard of 500 mg/L.

Additionally, constituents such as chloride and sulfate often exceed the Texas Department of Health recommended drinking water standards. TDS concentrations in groundwater in the Lower Rio Grande Valley increases to concentrations greater than 3,000 mg/L in the southeast portions of Cameron County. The TDS concentrations in the Chicot and Evangeline aquifers in south central Cameron County has the highest TDS values, with concentrations greater than 10,000 mg/L (Choudhury and Mace 2007). The groundwater in the vicinity of the vertical launch and control center areas is likely brine, with TDS greater than the Texas Department of Health recommended drinking water standards.

3.7.4.3 Wetlands

The proposed vertical launch and control center areas contain estuarine emergent and scrub/shrub wetlands. The wetlands within the proposed vertical launch and control center areas were delineated using the 1987 USACE Wetland Delineation Manual (USACE 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain (USACE 2010). The wetland delineation was conducted by Cardno TEC from May 14-17, 2012. The survey area consisted of the proposed vertical launch area, and all three parcels that comprise the proposed control center area. During the wetland delineation it was determined that only the vertical launch area and Parcel 3 of the control center area contain wetlands. A total of 25.43 acres of wetlands are present at the vertical launch area (Exhibit 3.7-4) and 0.04 acre of wetlands were identified on Parcel 3 of the control center area (Exhibit 3.7-5). As a result, only the vertical launch area and Parcel 3 of the control center area were included in the Jurisdictional Wetland Determination report dated July 3, 2012 (see Appendix F).

The wetland delineation results were field verified during a site visit on July 6, 2012 with the USACE. The preliminary Jurisdictional Determination was issued by the USACE on August 31, 2012, providing concurrence on the wetland boundaries. The jurisdictional determination confirmed the wetland boundaries and verified the wetland acreages. The Jurisdictional Wetland Determination report (Appendix F) divides the wetlands into depressional areas, high marsh areas, and unvegetated salt flats.

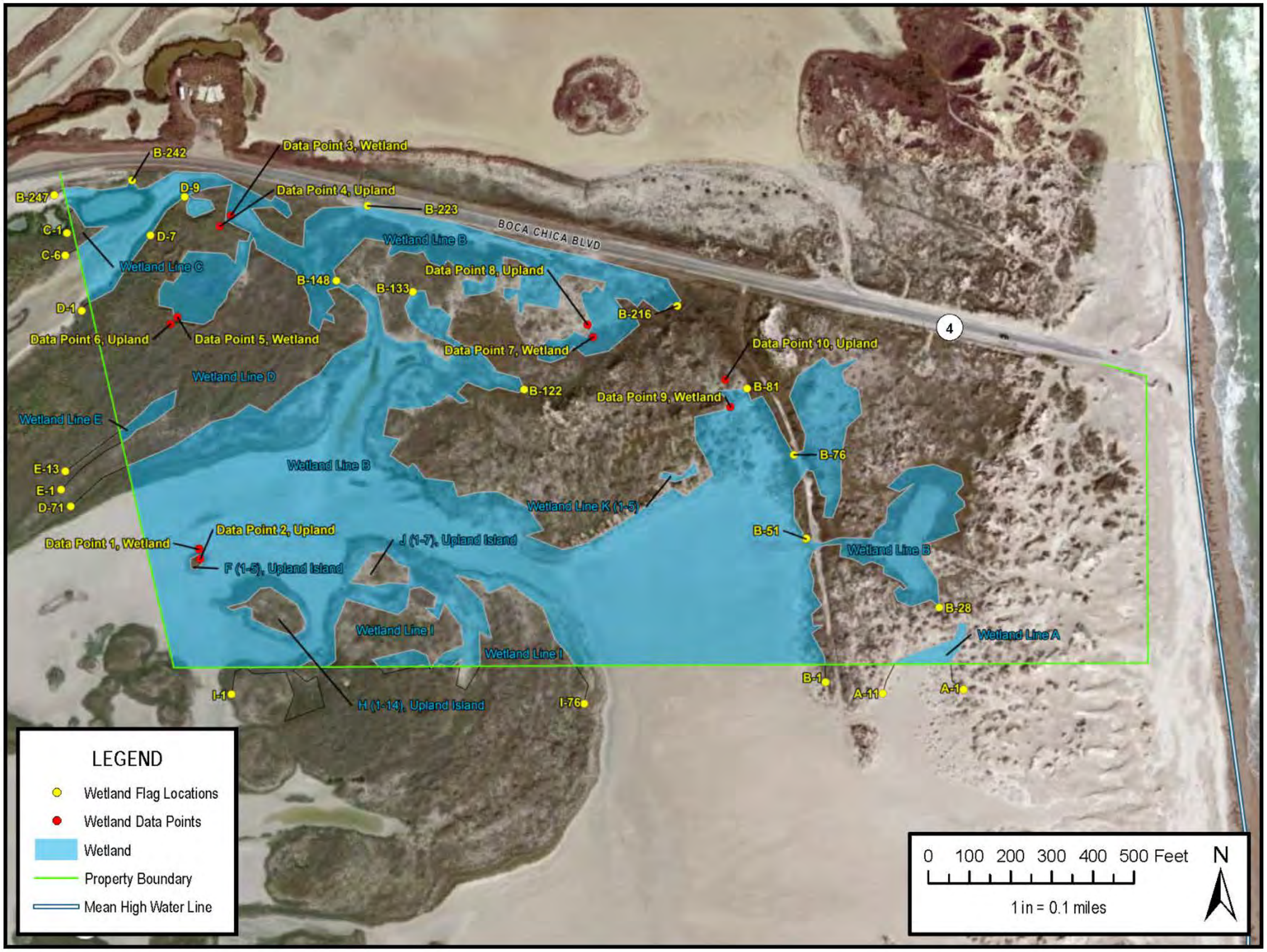


Exhibit 3.7-4. Vertical Launch Area Wetland Delineation

Exhibit 3.7-5. Control Center Area Wetland Delineation

The wetlands within the vertical launch area are part of a large system of tidal salt flat wetlands that fill from and drain to the southern portion of the site. During springs tides or exceptionally high tides, the salt flat wetlands on the vertical launch area site become inundated with water from the Gulf of Mexico.

Based on the Cowardin classification system (Cowardin et al. 1979), the unvegetated salt flats and depressional features are estuarine, intertidal, and unconsolidated shore with a sand substrate (E2US2). The emergent high marsh wetlands are estuarine, intertidal, and emergent with persistent vegetation (E2EM1). The scrub shrub high marsh wetlands are estuarine, intertidal, scrub-shrub with broad-leaved evergreen vegetation (E2SS3). As depicted in Exhibit 3.7-6, of the 25.43 acres of wetlands at the vertical launch area, 0.24 acre are composed of depressional areas, 12.15 acres are composed of high marsh areas, and 13.04 acres are composed of unvegetated salt flats. The 0.04 acre wetland located on Parcel 3 of the control center area is an emergent high marsh area, as shown in Exhibit 3.7-7. The wetland vegetation within the proposed vertical launch area is typified by saltgrass (*Distichlis spicata*), shoregrass (*Monanathocloe littoralis*), Virginia glasswort (*Salicornia virginica*), shoreline seapurslane (*Sesuvium portulacastrum*), seaside tansy (*Borrichia frutescens*), and gulf cordgrass (*Spartina spartinae*). The wetland vegetation within the control center area is typified by bushy seaside tansy, shoregrass, and saltgrass (Appendix F).

Wetlands provide many natural and beneficial values, which can vary depending on location. Examples of natural and beneficial values of the wetlands present at the proposed vertical launch and control center areas include groundwater recharge, flood mitigation, water quality maintenance, storm abatement and coastline protection, wildlife habitat, and aesthetics.

3.7.4.4 Floodplains

The vertical launch and the control center areas are located entirely within a 100-year floodplain (Exhibit 3.7-8). Zone A8 is an area subject to inundation with a 1 percent chance of a flood event occurring in any given year. However, Zone A does not have the additional hazard designation related to storm waves. C zones are areas of minimal flood hazard, usually depicted as above the 500-year flood level. Flood Zone V10 is designated within the 100-year flood zone; however, this is a classified coastal area with a 1 percent chance of a flood occurring on a given year and having an additional hazard associated with storm waves. The control center area is located within a 100-year flood zone designated A8 but is also combined with C-designated flood zones. These areas are not distinctive to one another in this area for the most part. Rather, they are a smooth transition of flood zones not easily bounded.

The FEMA maps available for this area use an older format of flood designation with the letter “V” and a number. Newer versions available for other areas now include a letter, such as “V” followed by a letter. However, in either case, flood zone designations of VE or V1-V30 would be those areas within the 100-year floodplain and have an additional velocity hazard due to wave action. A coastal high hazard area is an area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources (FEMA 2007). “Primary frontal dune” is defined as “a continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to

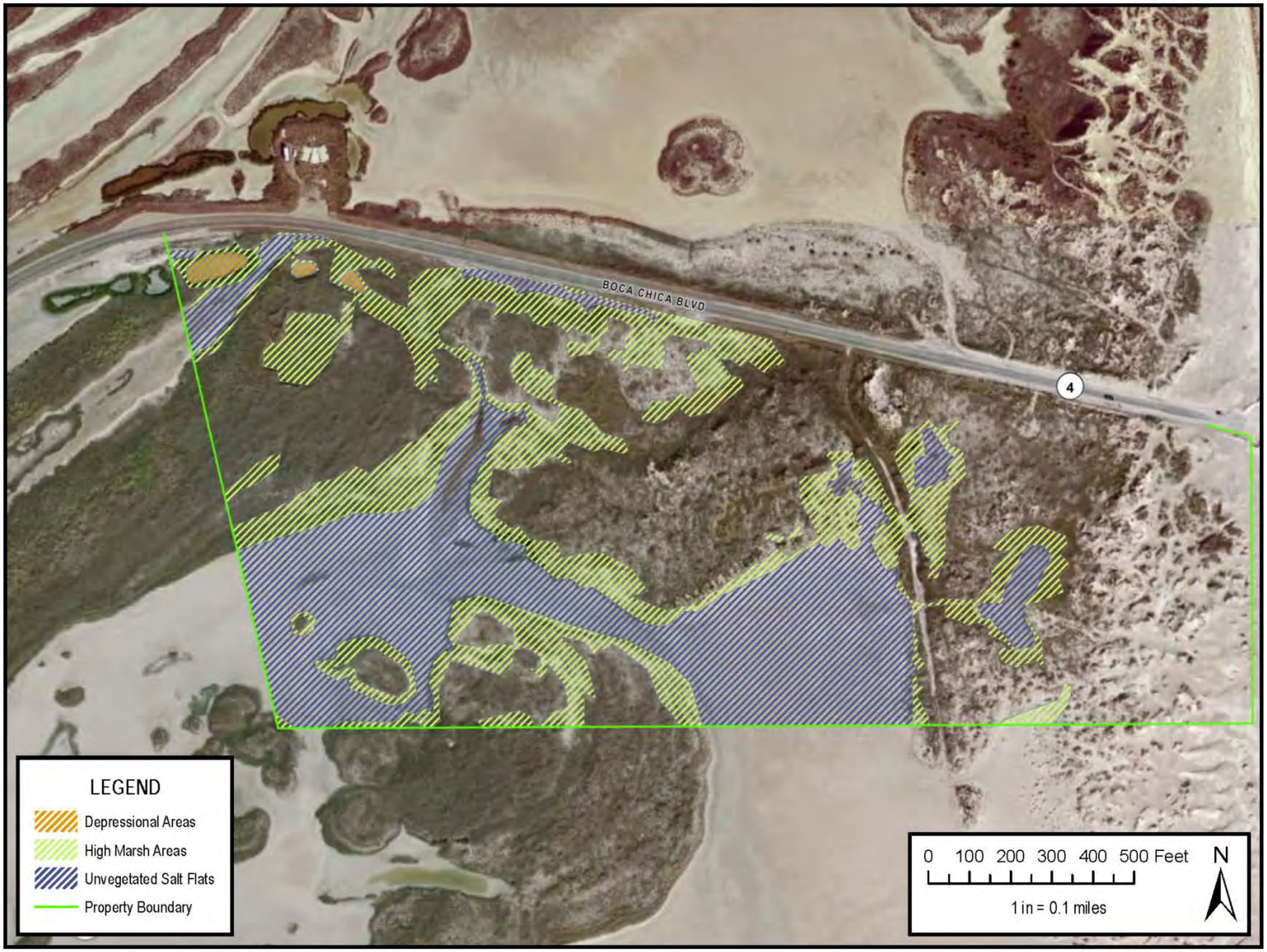


Exhibit 3.7-6. Vertical Launch Area Wetland Vegetation Communities

Exhibit 3.7-7. Control Center Area Wetland Vegetation Communities

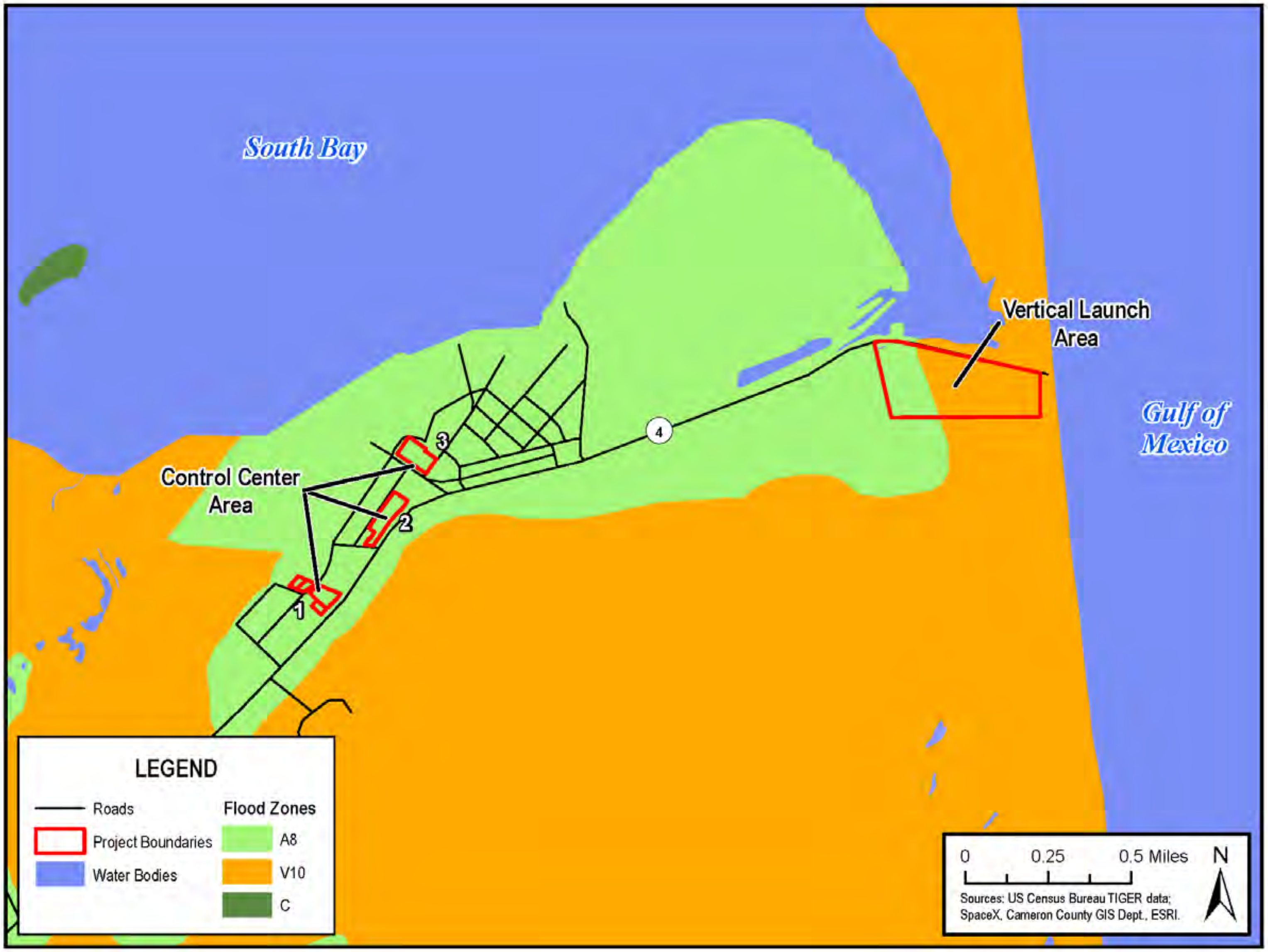


Exhibit 3.7-8. Floodplains within the Vertical Launch and Control Center Areas

the beach and subject to erosion and overtopping from high tides and waves during major coastal storms" (FEMA 2007).

The break between A8 and V10 flood zones does not strongly correlate with elevation. As depicted on Google Earth elevations, the break between the two zones comes between the 3 and 5 ft above sea level mark. The slightly elevated western portion of the proposed vertical launch area is residing within the 100-year floodplain designated A8, and the slightly lower eastern portion located within flood Zone V10. The proposed vertical launch area Hangar, western security gate and guard shack, storage/ground support equipment, parts, local office, machine/weld/workshop, roads and parking and pad access road would all fall within Zone A8. The remaining components of the vertical launch area would fall within Zone V10 (FEMA 2012b).

Similar to wetlands, floodplains provide many natural and beneficial values. Examples of these values provided by the project's coastal floodplain include natural moderation of floods, water quality maintenance, groundwater recharge, plant and animal habitat, open space, natural beauty, and outdoor recreation.

3.7.4.5 Wild and Scenic Rivers

The Rio Grande deemed Wild and Scenic is over 400 miles west of the vertical launch and control center areas.

3.8 BIOLOGICAL RESOURCES (FISH, WILDLIFE, AND PLANTS)

3.8.1 Definition and Description

Biological resources include plant and animal species and the habitats where they occur. Plant associations are referred to as vegetation and animal species are referred to as wildlife. Habitat can be defined as the resources and conditions present in an area that supports the existence of a plant or animal (Hall et al. 1997). Although the existence and preservation of biological resources are intrinsically valuable, these resources also provide aesthetic, recreational, and socioeconomic values to society. This analysis focuses on species or vegetation types that are important to the function of the ecosystem, of special societal importance, or are protected under Federal or state law or statute. For the purposes of this EIS, these resources are divided into three major categories: vegetation, wildlife, and special-status species.

Vegetation includes terrestrial plant communities and the analysis focuses on vegetation types that are important to the function of the ecosystem or are protected under Federal or State law.

Wildlife includes all common animal species, with the exception of those identified as special-status species (see below). The wildlife category includes invertebrates, fish, amphibians, reptiles, mammals, and birds, including native bird species protected under the Migratory Bird Treaty Act (MBTA).

Special-status species includes plant and animal species that are listed or proposed for listing by USFWS as threatened or endangered under the ESA, or are candidate species for listing under the Endangered Species Act (ESA). Candidate species are plant or animal species for which USFWS has sufficient information on file regarding biological vulnerability and threats to support a proposal that would list them as endangered or threatened under the ESA, based on the most recent candidate review, but have yet to be listed (USFWS 2012c). Candidate species are provided no statutory protection under the ESA. In addition, designated critical habitat (and habitat proposed for designation) for ESA-listed species is also included in this EIS, as appropriate. Critical habitat is a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but is needed for its recovery. This section also addresses species that are listed by the State of Texas as threatened or endangered.

For this project, marine species are those occurring in areas of the Gulf of Mexico that would be under the flight path of launch vehicles (see Exhibit 2.1-2). Impacts to marine species are expected to be discountable. After launch, the first stage of the Falcon 9 would land in the Gulf of Mexico, approximately 550 miles downrange, and would potentially be recovered by a salvage ship. The salvage ship would be able to locate the first stage through telemetry signals from the stage. The recovered first stage would be returned to SpaceX facilities in Hawthorne, California. If the expended first stage could not be located, it would likely be due to damage. It would subsequently sink, and therefore, it would not be recovered. There would be no significant impacts to marine wildlife given the relatively low density of species within the surface waters of these open ocean areas. In addition, due to the properties of water, noise during a launch would not readily pass the air-water interface and therefore the short-term increase in the in-air noise environment would not result in impacts to marine species beneath the surface. No impacts to marine mammals are expected; therefore, these species are not addressed in detail in this EIS. An email was received from NOAA’s Office of Protected Resources (Headquarters, Program Office of the National Marine Fisheries Service [NMFS]) on May 9, 2012, stating that there are no anticipated impacts on marine mammals with implementation of the Proposed Action (NMFS 2012; Appendix G). Therefore, impacts to special-status marine species are expected to be discountable, and therefore these species are not addressed in detail in this EIS. In addition, based upon informal consultation with NMFS under Section 7 of the ESA, NMFS concurred with FAA’s findings that the Proposed Action would have insignificant or discountable effects on federally listed sea turtles in the marine environment and sperm whales (NMFS 2013; Appendix G). These species are not discussed further in this chapter.

3.8.2 Regulatory Setting

Federal

The ESA (16 U.S.C. 1531 et seq.) establishes measures for the protection of plant and animal species that are federally listed as threatened or endangered, and for the conservation of habitats that are critical to the continued existence of those species. ‘Endangered’ means a species is in danger of extinction throughout all or a significant portion of its range. ‘Threatened’ means a species is likely to become endangered within the foreseeable future. For ESA-listed species, Federal agencies are required to ensure that their actions do not jeopardize the continued existence of an endangered or threatened species or its critical habitat, if designated. In accordance with Section 7 of the ESA, a Biological Assessment (BA) has been prepared by the FAA to analyze the potential impacts of the Proposed Action on ESA-listed species and critical habitat under the jurisdiction of USFWS (see Appendix G). The BA has been submitted to the USFWS for review. The Biological Opinion (BO) that is issued by USFWS after their review of the BA and consultation as part of the ESA Section 7 consultation process, will be the final determination of impacts to ESA-listed species that are being evaluated in this EIS. The BO may also specify Conservation Recommendations, which are discretionary action agency activities that are intended to minimize or avoid adverse effects of a Proposed Action on federally listed species or critical habitat, to help implement recovery plans, or to develop information. Action agencies may or may not choose to implement the suggested Conservations Recommendations.

Under the MBTA (16 U.S.C. 703 et seq.), the taking, killing or possessing of migratory birds (including their eggs, nests, and feathers) is unlawful. The MBTA was designed to protect migratory birds. An activity has a significant adverse effect if, over a reasonable period of time, it diminishes the capacity of a population of a migratory bird species to maintain genetic diversity, to reproduce, and to function effectively in its native ecosystem. Assessment of a project's effects on migratory birds places an emphasis on "Species of Concern" as defined by EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*. This EO directs Federal agencies to take action to further implement the MBTA.

EO 13112, *Invasive Species,* was issued to prevent the introduction of invasive species; provide for their control; and minimize the economic, ecological, and human health impacts that invasive species cause.

State

Texas laws and regulations pertaining to state endangered or threatened animal species are contained in TPWD Code, Chapters 67 and 68 and TAC Sections 65.171-65.176 of Title 31. Laws and regulations pertaining to endangered or threatened plant species are contained in Chapter 88 of the TPWD Code and Sections 69.01-69.9 of the TAC. These regulations prohibit the taking, possession, transportation, or sale of any of the animal species designated by state law as endangered or threatened without the issuance of a permit.

Local

There are no local statutes or regulations applicable to biological resources.

3.8.3 Region of Influence

For the purposes of this EIS, the ROI for biological resources includes those areas that would be impacted by 1) construction activities at the proposed vertical launch and control center areas; 2) noise from proposed launch operations; and 3) the launch day land and water closure areas (Exhibit 3.8-1). This ROI is the same as the action area defined in the BA for addressing potential impacts to federally listed species.

3.8.4 Existing Conditions

3.8.4.1 Vegetation

The USFWS currently recognizes 11 biotic communities in the Lower Rio Grande Valley region. The vertical launch and control center areas are located within the clay loma/wind tidal flats biotic community. This community is characterized by a matrix of clay dunes interspersed within saline flats, marshes, and shallow bays that are periodically inundated by water from the Gulf of Mexico. Lomas are formed from silt or clay particles deposited by wind on tidal flats. Dunes often form around the tidal flats. Typical plants found in loma/tidal flats include sea ox-eye (*Borrichia frutescens*), saltwort (*Batis maritima*), and glasswort (*Salicornia virginica*) on vegetated portions of the flats, and gulf cordgrass

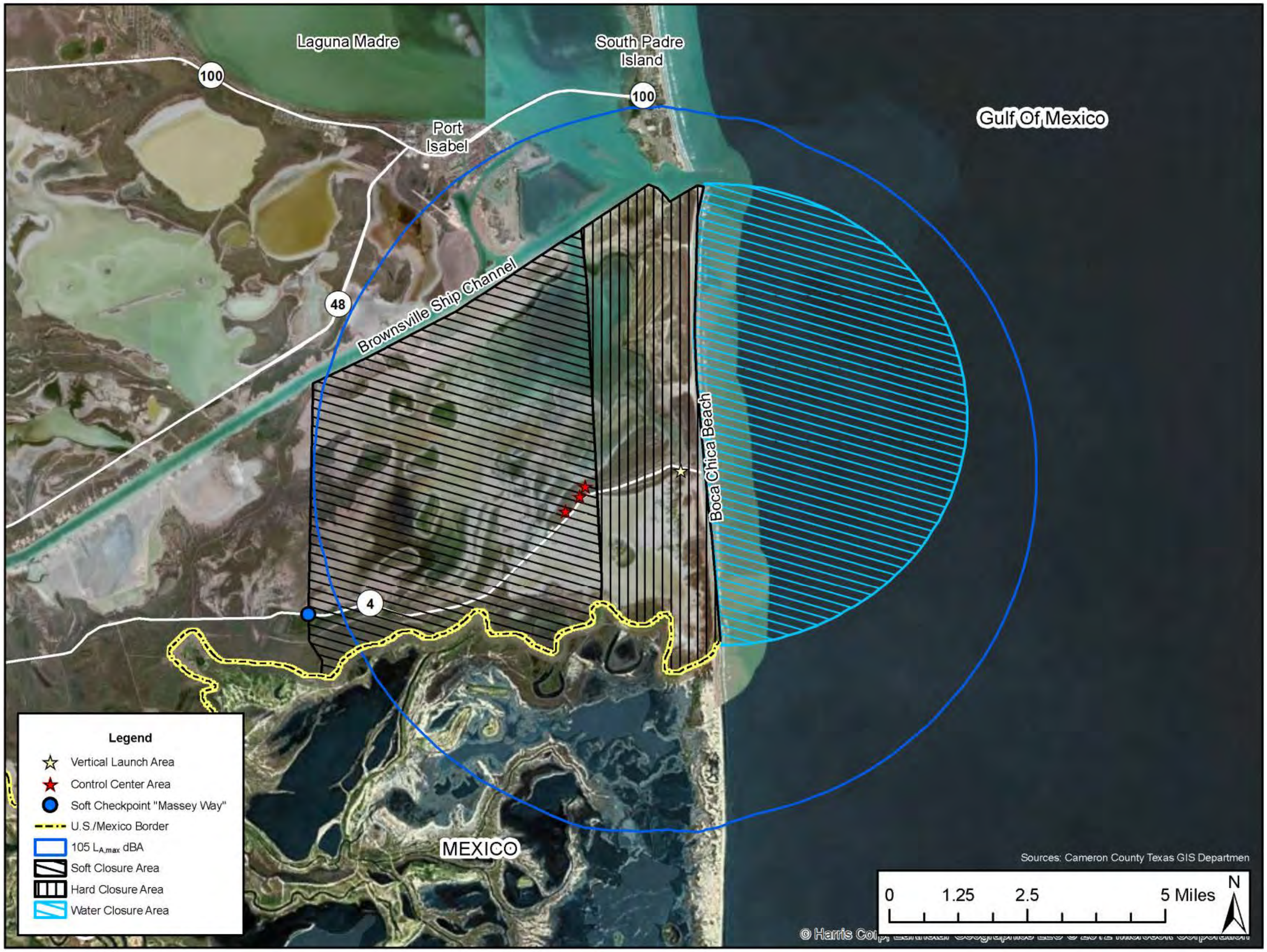


Exhibit 3.8-1. ROI for Biological Resources

(*Spartina spartinae*), Berlandier's fiddlewood (*Citharexlyum berlandieri*), texas ebony (*Pithecellobium ebano*) and yucca (*Yucca treculeana*) on higher lomas (Jahrsdoerfer and Leslie 1988; USFWS 1997).

Vegetation communities in Texas were first mapped in detail by McMahan et al. (1984). The vertical launch and control center areas are located within the Gulf Prairies and Marshes Ecoregion. Prior to European settlement, this ecoregion consisted of a mosaic of tallgrass coastal prairie, riparian bottomland hardwood forests, ephemeral freshwater wetlands, canebrake swamps, extensive coastal forests, chenier woodlands, freshwater tidal wetlands, brush mottes and corridors, barrier islands, estuaries, saltwater marshes, hypersaline lagoons, lomas, and associated Tamaulipan thornscrub habitats (The Nature Conservancy [TNC] 2002).

The majority of the proposed vertical launch and control center areas are located within marsh/barrier islands subtype 3 (smooth cordgrass-marsh saltgrass-sea ox-eye marsh) which is generally dominated by sea ox-eye, black rush (*Juncus roemerianus*), saltwort, black mangrove (*Avicennia germinanus*), glasswort, seashore paspalum (*Paspalum vaginatum*), and shoalgrass (*Halodule beaudettei*). In the eastern portion of the proposed vertical launch area, from the high tide mark to leeward marshes, is an area of sand dunes that is characterized by marsh/barrier island subtype 4 (seaoats-seacoast bluestem grassland). This vegetation type is generally dominated by beach croton (*Croton punctatus*), single-spike paspalum (*Paspalum monostachyum*), Pan American balsamscale (*Elionurus tripsacoides*), flat sedge (*Cyperus* spp.), seapurslane (*Sesuvium portulacastrum)*, bulrush (*Scirpus* spp.), beach morning glory (*Ipomoea imperati*), goatfoot morning glory (*Ipomoea pes-caprae*), sea rocket (*Cakile edentula*), and lime pricklyash (*Zanthoxylum fagara*) (McMahan et al. 1984).

Site visits were conducted on May 14-17 and May 30-June 1, 2012 to delineate wetlands and to collect site-specific habitat and wildlife information within the proposed vertical launch and control center areas. The proposed vertical launch area is composed of approximately 56.5 acres, of which 25.4 acres are jurisdictional wetlands and 31.1 acres are uplands (FAA 2012b) (see Appendix F–Jurisdictional Wetland Determination and see Exhibit 3.7-5). The uplands located within the vertical launch area are largely comprised of sporadically vegetated sand dunes in the eastern portion of the property and moderately to densely vegetated uplands in the western portion of the property. Additional upland islands are located in the unvegetated salt flats. The wetlands on-site are comprised of scrub shrub and emergent wetlands, both of which are categorized as high marsh areas, and unvegetated salt flats. Additionally, three small unvegetated depressional features were identified in the northwestern portion of the site. Upland vegetation is typified by Texas pricklypear (*Opuntia engelmannii*), honey mesquite (*Prosopis glandulosa*), little bluestem (*Schizachyrium scoparium*), gush bluestem (*Andropogon glomeratus*), giant reed (*Arundo donax*), cuman ragweed (*Ambrosia cumanensis*) and golden tickseed (*Coreopsis tinctoria*). Wetland vegetation is primarily comprised of saltgrass (*Distichlis spicata*), shoregrass (*Monanathocloe littoralis*), glasswort, shoreline seapurslane, sea ox-eye, and gulf cordgrass (*Spartina spartinae*). Other species observed include black mangrove and turtleweed. Vegetation observed in the sand dunes included beach croton, sea purslane, and beach morning glory (FAA 2012b).

The proposed 12.4-acre control center area is comprised of three parcels located north of Boca Chica Boulevard, and range from approximately 1.5 to 1.9 miles west of the proposed vertical launch area (see Exhibits 2-2a and 2-2b). The control center area acreages for Parcels 1, 2, and 3 are approximately 4.0 acres, 4.4 acres, and 4.0 acres, respectively. All three parcels consist of upland vegetation dominated by little bluestem (*Schizachyrium scoparium*), honey mesquite, cuman ragweed, and yucca. Parcel 3 contains one small 0.04-acre jurisdictional wetland. This wetland is considered an emergent high marsh area dominated by bushy seaside tansy, shoregrass, and saltgrass. As of May 2012, a large portion of Parcel 1 had been recently burned (FAA 2012b).

3.8.4.2 Wildlife

The vertical launch and control center areas are located in the loma/tidal flats biotic community in the Lower Rio Grande Valley region, which supports a diverse array of wildlife. The vertical launch and control center areas are located on private property in between several wildlife refuges that make up the South Texas Refuges Complex. This complex is made up of Santa Ana NWR, Laguna Atascosa NWR, and Lower Rio Grande Valley NWR. These NWRs, as well as the native habitat between them, represent a wide north-south coastal corridor on the eastern boundary of the Rio Grande delta that supports a matrix of native rangeland wetlands and upland communities that provide a corridor for wildlife movement (USFWS 2004). The Rio Grande Valley Wildlife Corridor initiative is a project consisting of private landowners, TPWD, USFWS, nonprofit conservation organizations (e.g., Audubon Society, TNC, and Valley Land Fund) and Mexican, State, Federal, and non-governmental natural resource agencies (e.g., La Secretaria de Medio Ambiente y Recursos Naturales [SEMARNAT], La Secretaria de Desarollo Urbano y Ecologia [SEDUE] of the Tamaulipas state government, and Pronatura Noreste) to preserve land within this wildlife corridor in the Lower Rio Grande Valley of the U.S. and Mexico (USFWS et al. 2007; TPWD 2012c).

Common wildlife found within the beach and sand dunes areas just east of the vertical launch and control center areas include mammal species, such as spotted ground squirrel (*Spermophilus silosoma*), kangaroo rats (*Dipodomys* spp.), and grasshopper mice (*Onychomys* spp.) (USFWS 1993). Other common mammals that are found in the Lower Rio Grande Valley and have the potential to occur within the vicinity of the proposed vertical launch and control center areas include the eastern cottontail (*Sylvilagus floridanus*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), and raccoon (*Procyon lotor*) (Jahrsdoerfer and Leslie 1988; USFWS 1993). Invertebrates such as coquina clams (*Donax variabilis*) and mole crabs (*Emerita* spp.) are found near the water, while ghost crabs (*Ocypode* spp.) and keeled earless lizards (*Holbrookia propinqua*) are found in the upper beach and foredunes. The proposed vertical launch and control center areas are located within the Central Flyway, a migratory bird route used by more than 500 species annually. The vertical launch and control center areas are located within the Lower Rio Grande Valley which is the southernmost range for numerous raptors and shorebirds that winter in south Texas, as well as the northernmost range for many species of neotropical migrants. As a result, the South Texas area has become a popular birding spot for viewing species of interest, such as the white-tailed hawk (*Buteo albicaudatus*), crested caracara (*Caracara cheriway*), roseate spoonbill (*Ajaia ajaja*), green jay (*Cyanocorax yncas*), groove-billed ani (*Crotophaga sulcirostris*), and northern aplomado falcon (*Falco femoralis septentrionalis*). Numerous ground-nesting birds use the shoreline and the upland areas within the project area (TPWD 2012d). Examples of these species include Wilson's phalarope (*Phalaropus tricolor*), sanderling (*Calidris alba*), ruddy turnstone (*Arenaria interpres*), royal tern (*Thalasseus maximus*), Forster's tern (*Sterna forsteri*), and laughing gull (*Leucophaeus atricilla*). During site visits in May and June of 2012, the following birds were observed: barn swallow (*Hirundo rustica*), black-bellied plover (*Pluvialis squatarola*), Brewer's blackbird (*Euphagus cyanocephalus*), brown pelican (*Pelecanus occidentalis*), laughing gull, least tern (*Sterna antillarum*), long-billed dowitcher (*Limnodromus scolopaceus*), northern bobwhite (*Colinus virginianus*), semipalmated sandpiper (C*alidris pusilla*), snowy plover (*Charadrius alexandrinus*), turkey vulture (*Cathartes sura*), willet (*Tringa semipalmata),* and Wilson's phalarope.

3.8.4.3 Special-Status Species

The FAA coordinated with the USFWS on special-status species. Based on the correspondence received from the USFWS Corpus Christi Ecological Services Field Office on May 4, 2012 (USFWS 2012d) regarding the list of species and critical habitat in the action area potentially affected by the Proposed Action (per 50 CFR 402.12 (c)), this EIS addresses the potential effects associated with the Proposed Action on 10 ESA-listed species, critical habitat for 1 species, and 3 candidate species in Cameron County. In addition, 43 state-listed species (some of which are also federally listed) have the potential to occur within Cameron County; 17 of these species have been observed or have the potential to occur in the ROI due to presence of suitable habitat (Table 3.8-1). In accordance with ESA Section 7, a BA was completed and formal consultation with the USFWS is ongoing.

Of the 46 species listed in Table 3.8-1, 10 ESA-listed species, 1 Federal candidate species, and 7 State-listed species have the potential to occur in the proposed vertical launch and control center areas due to presence of suitable habitat within the ROI. The following sections provide a brief description of the federally listed species that have been observed or have the potential to occur within the ROI.

Table 3.8-1. Federally and State-Listed Species Known to Occur or Potentially Occurring in Cameron County, Texas

Group	Common Name (Scientific Name)	Status*	Habitat	Within ROI*
Birds	Piping plover *(Charadrius melodus)*	FT & CH ST	Beaches and bayside mid or salt flats	O
	Northern aplomado falcon *(Falco femoralis septentrionalis)*	FE, SE	Savanna and open woodlands; grassy plains and valleys with scattered mesquite, yucca, and cactus	O
	Red-crowned parrot *(Amazona viridigenalis)*	FC	Urban areas	U
	Sprague's pipit (*Anthus spragueii*)	FC	Winter migrant; coastal grasslands and upland prairie	U
	Red knot (*Calidris canutus roselaari*)	FC	Winter migrant; coastal habitats, sandy intertidal flats, tidal inlets or mouths of bays and estuaries	O
	Peregrine falcon (*Falco peregrinus*)	ST	Nests in tall cliff eyries, wide range of habitats during winter including urban, coastal areas and barrier islands	O
	Gray hawk (*Asturina nitida*)	ST	Mature riparian woodlands and nearby mesquite and scrub grasslands	U
	Reddish egret (*Egretta rufescens*)	ST	Brackish marshes and shallow salt ponds and tidal flats	O
	Texas Botteri's sparrow (*Aimophila botterii texana*)	ST	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca	U
	White-tailed hawk (*Buteo albicaudatus*)	ST	Near coast on prairies, cordgrass flats, and scrub-live oak	O
	Wood stork (*Mycteria americana*)	ST[1]	Prairies ponds, flooded pastures or fields, ditches, mudflats	P
	Zone-tailed hawk (*Buteo albonotatus*)	ST	Arid open country, deciduous or pine-oak woodland, tree-lined rivers and wooded canyons	U
	Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)	ST	Riparian trees, brush, and mesquite thickets; roosts in small cavities	U
	Common black-hawk (*Buteogallus anthracinus*)	ST	Cotton-lined rivers and streams	U
	Northern beardless-tyrannulet (*Camptostoma imberbe*)	ST	Mesquite woodlands	U
	Rose-throated becard (*Pachyramphus aglaiae*)	ST	Riparian trees, woodlands, open forest, scrub, and mangroves	U
	Tropical parula (*Parula pitiayumi*)	ST	Dense or open woods, undergrowth, brush, and trees along edges of rivers	U
	White-faced ibis (*Plegadis chihi*)	ST	Freshwater marshes, sloughs; can be found in brackish and saltwater habitats	P
	Texas Botteri's sparrow (*Aimophila botterii texana*)	ST	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca	U
	Sooty tern (*Sterna fuscata*)	ST	Pelagic waters, spoil islands, and coastal beaches	P
Mammals	Gulf Coast Jaguarundi *(Herpailurus yaguarondi cacomitli)*	FE, SE	Thick brushlands	P (transient)
	Ocelot *(Leopardus pardalis)*	FE, SE	Mesquite-thorn scrub and live oak thickets	P (transient)
	West Indian manatee *(Trichechus manatus)*	FE, SE	Gulf and bay system	P
	Southern yellow bat (*Lasiurus ega*)	ST	Associated with trees, such as palm trees	U

Table 3.8-1. Federally and State-Listed Species Known to Occur or Potentially Occurring in Cameron County, Texas

Group	Common Name (Scientific Name)	Status*	Habitat	Within ROI*
	Coues' rice rat (*Oryzomys couesi*)	ST	Cattail-bulrush marsh with shallower zone of aquatic grasses near the shoreline; shade trees important	U
	White-nosed coati (*Nasua narica*)	ST	Woodlands, riparian corridors and canyons	U
Reptiles and Amphibians	Atlantic hawksbill sea turtle *(Eretmochelys imbricata)* [-2]	FE, SE	Gulf and bay systems, warm shallow waters	P
	Green sea turtle *(Chelonia mydas)* [-2]	FT, SE	Gulf and bay systems; shallow water seagrass beds	P
	Kemp's ridley sea turtle *(Lepidochelys kempii)* [-2]	FE, SE	Gulf and bay systems, shallow waters	O
	Leatherback sea turtle *(Dermochelys coriacea)* [-2]	FE, SE	Gulf and bay systems, widest ranging open water reptile	P
	Loggerhead sea turtle *(Caretta caretta)* [-2]	FT, ST	Gulf and bay systems	P
	Sheep frog (*Hypopachus variolosus*)	ST	Grasslands and savannahs; moist sites in arid areas	U
	Black-striped snake (*Coniophanes imperialis*)	ST	Semi-arid coastal plain	P
	Northern cat-eyed snake (*Leptodeira septentrionalis septentrionalis*)	ST	Thorn brush woodland, dense thickets bordering ponds and streams	U
	Speckled racer (*Drymobius margaritiferus*)	ST	Dense thickets near water, riparian woodlands, palm groves	U
	Texas horned lizard (*Phrynosoma cornutum*)	ST	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees	U
	Texas indigo snake (*Drymarchon melanurus erebennus*)	ST	Thornbush-chaparral woodlands, dense riparian corridors	U
	Texas tortoise (*Gopherus berlandieri*)	ST	Open brush with grass understory	U
	Black-spotted newt (*Notophthalmus meridionalis*)	ST	Freshwater wet areas such as arroyos, canals, ditches, or shallow depressions	U
	Mexican treefrog (*Smilisca baudinii*)	ST	Subtropical region of extreme southern Texas; lays eggs in temporary rain pools	U
	South Texas siren (Siren sp. 1)	ST	Freshwater wet areas such as arroyos, canals, ditches, or shallow depressions	U
	White-lipped frog (*Leptodactylus fragilis*)	ST	Grasslands, cultivated fields, roadside ditches	U
	Texas scarlet snake (*Cemophora coccinea lineri*)	ST	Mixed hardwood scrub on sandy soils	U
Plants	South Texas ambrosia *(Ambrosia cheiranthifolia)*	FE, SE	Grasslands and mesquite-dominated shrublands	U
	Texas ayenia *(Ayenia limitaris)*	FE, SE	Subtropical thorn woodland or tall shrublands on loamy soils	U
	Star cactus (*Astrophytum asterias*)	FE, SE	Sparsely vegetated openings between shrub thickets within mesquite grasslands or mesquite-blackbrush thorn shrublands	U

Notes: *CH = designated critical habitat; FC = federal candidate; FE = federally endangered; FT = federally threatened; ST = state threatened; O = observed; P = potential; U = unlikely

[(1)]The wood storks found in south Texas are from the Mexican breeding population and therefore are not federally endangered.

[(2)]Sea turtles are under joint jurisdiction between the USFWS (nesting stage) and NMFS (marine stage). This EIS only addresses the terrestrial nesting stage because NMFS concurred with FAA's findings that the Proposed Action would have insignificant or discountable effects on sea turtles in the marine environment.

Sources: TPWD 2012c, d, e; USFWS 2012d.

Piping Plover

Piping plovers on migration and in wintering areas are federally listed as threatened (USFWS 1996). The piping plover is also listed by the state as threatened. In July 2001, the USFWS designated 137 areas totaling 165,211 acres along the east and Gulf coasts as critical habitat for the wintering population of the piping plover (USFWS 2001a). The proposed vertical launch and control center areas are located within piping plover designated critical habitat (Exhibit 3.8-2). The Proposed Action is located within critical habitat Unit TX-1. The critical habitat description within Unit TX-1 specifically states that it does not include densely vegetated habitat within those boundaries. The majority of the ROI is densely vegetated, and therefore not considered critical habitat for the piping plover. However, unvegetated flats and depressional wetlands that occur within the Unit TX-1 are considered critical habitat. Approximately 0.7 acre of unvegetated flats and depressional wetlands occur within the vertical launch area.

Piping plovers are migratory shorebirds that spend approximately 3-4 months a year on breeding grounds along the Atlantic Coast from Canada to North Carolina, in the Great Lakes, and in the northern Great Plains.

Piping plovers winter primarily along Gulf Coast beaches from Florida to Mexico, along the Atlantic Coast from North Carolina to Florida, and in the Caribbean islands. Piping plovers usually begin arriving on the Texas coast in July, with some late-nesting birds arriving in September. Sightings on the wintering grounds are rare in May, June, and July, but a few individuals can be found throughout the year (USFWS 2001a). Wintering plovers in Texas prefer unvegetated or very sparsely vegetated tidal mudflats, sand flats or algal flats. These areas are periodically covered with water and then exposed by tides or wind. A mosaic of sites throughout the landscape is important for wintering plovers due to the dynamic weather and tidal conditions within their wintering habitat (USFWS 2003; TPWD 2012f).

In 2009, migratory (September 4–October 9) and wintering (November 17–December 14) surveys for piping plovers were conducted within the Lower Laguna Madre region in South Texas. During the migratory surveys, 801 piping plovers were observed, while 881 were documented during the wintering surveys. During the migratory survey, 2 piping plovers were on Boca Chica Beach and 5 were observed on Boca Chica flats, located within the proposed vertical launch area. During the wintering surveys, no piping plovers were observed on Boca Chica Beach, while 11 were observed on Boca Chica Flats (Zdravkovic and Durkin 2011). In 2009, surveys in the Boca Chica Beach and South Bay area documented approximately 305 piping plovers. In 2012, USFWS staff sighted approximately 150 piping plovers in the area (USFWS 2013).

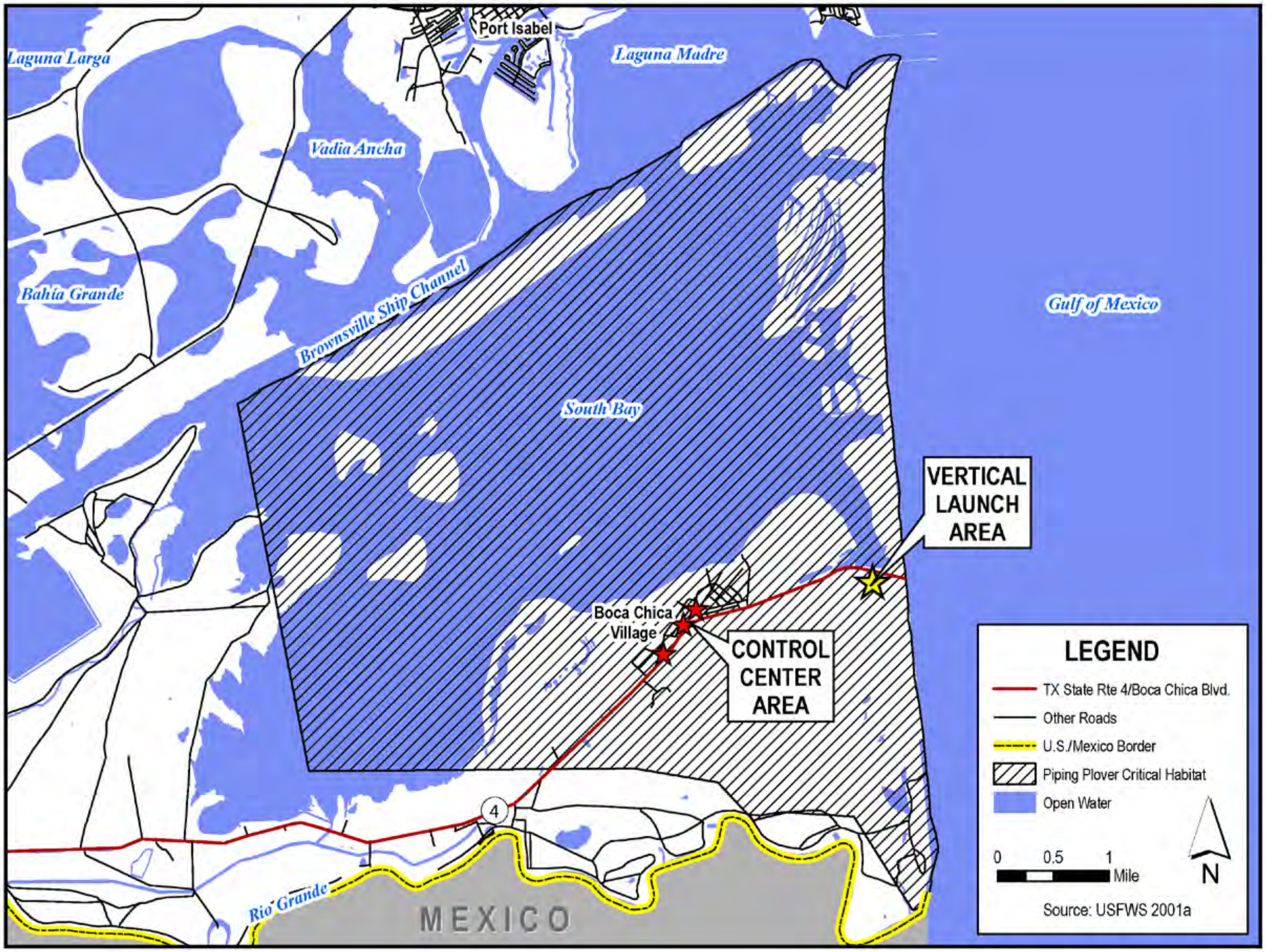


Exhibit 3.8-2. Piping Plover Critical Habitat within the ROI

Northern Aplomado Falcon

The northern aplomado falcon is a federally and state endangered species with no designated critical habitat. Northern aplomado falcon habitat in the U.S. primarily consists of yucca-covered sand ridges in coastal prairies, riparian woodlands in open grasslands, and desert grassland with scattered mesquite and yucca. Northern aplomado falcons use stick nests of other birds in desert or sub-tropical localities. They primarily feed on small birds, insects, rodents, and reptiles (USFWS 1990, 2007).

In southern Texas, the northern aplomado falcon is primarily found at Laguna Atascosa NWR in Cameron County and Matagorda Island NWR in Calhoun County. Aplomado surveys were conducted on USFWS lands within the vicinity of the Port of Brownsville from 1993 to 2003. Aplomado falcons were observed foraging and nesting within this area. In 1999, 2001, and 2003, no aplomado falcon nests were observed in this area; however, several aplomado falcons were observed. In 1996, 1997, 1998, 2000, and 2002, one aplomado falcon nest was observed (Blanton & Associates 2001, 2002, 2003). Currently there are 23 artificial nest platforms that have been constructed within this survey area. The two closest platforms are approximately 4.5 miles to the northwest (Boca Chica East platform) and 9.3 miles west (Boca Chica West platform) of the proposed control center location (USFWS 2012e). No aplomado falcon nests or individuals were observed on these nest platforms during the surveys. Aplomado surveys in 2010 and 2011 were conducted in the Laguna Atascosa NWR in Cameron County, and Matagorda Island NWR in Calhoun County. In 2010, 82 falcons were observed in 32 of 40 known territories (Laguna Atascosa NWR–18/24; Matagorda Island NWR–14/16) (Peregrine Fund 2010). In 2011, 79 falcons were observed occupying 34 of 44 known territories (Laguna Atascosa NWR–20/26; Matagorda Island NWR–14/18) (Peregrine Fund 2011). USFWS biologists observed two aplomado falcon nestlings in the Boca Chica East platform nest and three nestlings in the State Highway 4 nest (approximately 1 mile west of the Boca Chica West platform and 10 miles west of the control center area) in June 2011 (USFWS 2013).

Potential foraging habitat for the northern aplomado falcon exists within the ROI. Limited perching and nesting sites (trees, yuccas, and power poles) occur within the vicinity of the proposed control center area, but outside the project footprints; however, no nesting or perching sites occur within the vicinity of the proposed vertical launch area. Aplomado falcons may pass through the area while moving to other areas of suitable habitat to the north and south of the project areas; however, these movements would be infrequent and transitory.

Ocelot

The ocelot is a federally and state endangered species with no designated critical habitat. In south Texas, the ocelot prefers Tamaulipan brushland communities that consist of dense thornscrub with greater than 75 percent canopy cover and 95 percent shrub cover. Laguna Atascosa NWR, approximately 15 miles north of the project areas, supports the largest known U.S. population of ocelots, with an estimated 10-25 ocelots on and adjacent to the Laguna Atascosa Unit of the Refuge (USFWS 2010). There have also been reportings in the Lower Rio Grande Valley NWR (USFWS 1997, 2004). In 1998, one ocelot was trapped and observed traveling along State Highway 4 within the action area, approximately 3.5 miles west (by road) of the proposed control center area parcel 1 (Blanton & Associates 1998). The action area does not contain quality habitat for the ocelot. However, the proposed vertical launch and control center areas are located within the proposed Rio Grande Valley Wildlife Corridor which comprises a north-south coastal corridor on the eastern boundary of the Rio

Grande delta that supports a matrix of native rangeland, wetland, and upland communities that may be suitable for ocelot movement (USFWS 2004).

Gulf Coast Jaguarundi

The Gulf Coast jaguarundi (hereafter jaguarundi) is a federally and state endangered species with no designated critical habitat. Little is known about jaguarundi habitat in Texas; however, their habitat is thought to be very similar to the ocelot and consists of thick, dense thorny brushlands. The last known record of a jaguarundi in the U.S. was a road kill in 1986 along State Highway 4, just east of Brownsville. Unconfirmed jaguarundi sightings within the vicinity of the ROI include those observed in Lower Rio Grande Valley NWR and Laguna Atascosa NWR (USFWS 2004). The ROI has very little shrub cover, and therefore does not contain quality habitat for the jaguarundi. However, the ROI is located within the center of the South Texas Refuges Complex made up of Santa Ana NWR, Laguna Atascosa NWR, and Lower Rio Grande Valley NWR. These NWRs, as well as the habitat between them, represents a wide north-south coastal corridor on the eastern boundary of the Rio Grande delta that supports a matrix of native rangeland wetlands and upland communities that may be suitable for jaguarundi movement (USFWS 2004; TPWD 2012g).

West Indian Manatee

The West Indian manatee is a federally and state endangered species with no designated critical habitat in the ROI. Historically, manatees were found along the entire coast of the Gulf of Mexico from the Suwannee River in Florida to the Bay of Campeche, Mexico, and considered common in south Texas (Gunter 1941; Powell and Rathbun 1984; Lefebvre et al. 2001). Manatees occurring west of Florida and to the north of Mexico generally are considered to be strays originating from populations in either Florida or Mexico. Manatees are typically found in large slow-moving rivers, river mouths, and shallow low-energy coastal areas such as estuaries, coves, and bays where the water is calm and aquatic vegetation is available. Access to warm water, freshwater, and food is required by manatees. Temperature is the overriding factor in determining the geographic extent of suitable habitat to manatees (Fertl et al. 2005).

Seagrasses are a main component of a manatee's diet in coastal areas (USFWS 2001b). While seagrasses are prevalent in Laguna Madre, seagrass meadows are increasing in upper Laguna Madre and decreasing in lower Laguna Madre (Onuf 1995). Exhibit 3.8-3 depicts the current extent of seagrass beds within and in the vicinity of the ROI, primarily in South Bay within the ROI and to the north of the Brownsville Ship Channel in the Lower Laguna Madre.

Of the 69 records of manatees from Texas since 1912, only 9 have been within the action area and all of them are from 1912-1919 near the mouth of the Rio Grande (Gunter 1941; Fertl et al. 2005). Since that time, there have been no sightings of manatees within the ROI, although a single manatee was seen in 1992 and 1994 in the Lower Laguna Madre near Port Isabel approximately 4 miles north of the ROI.

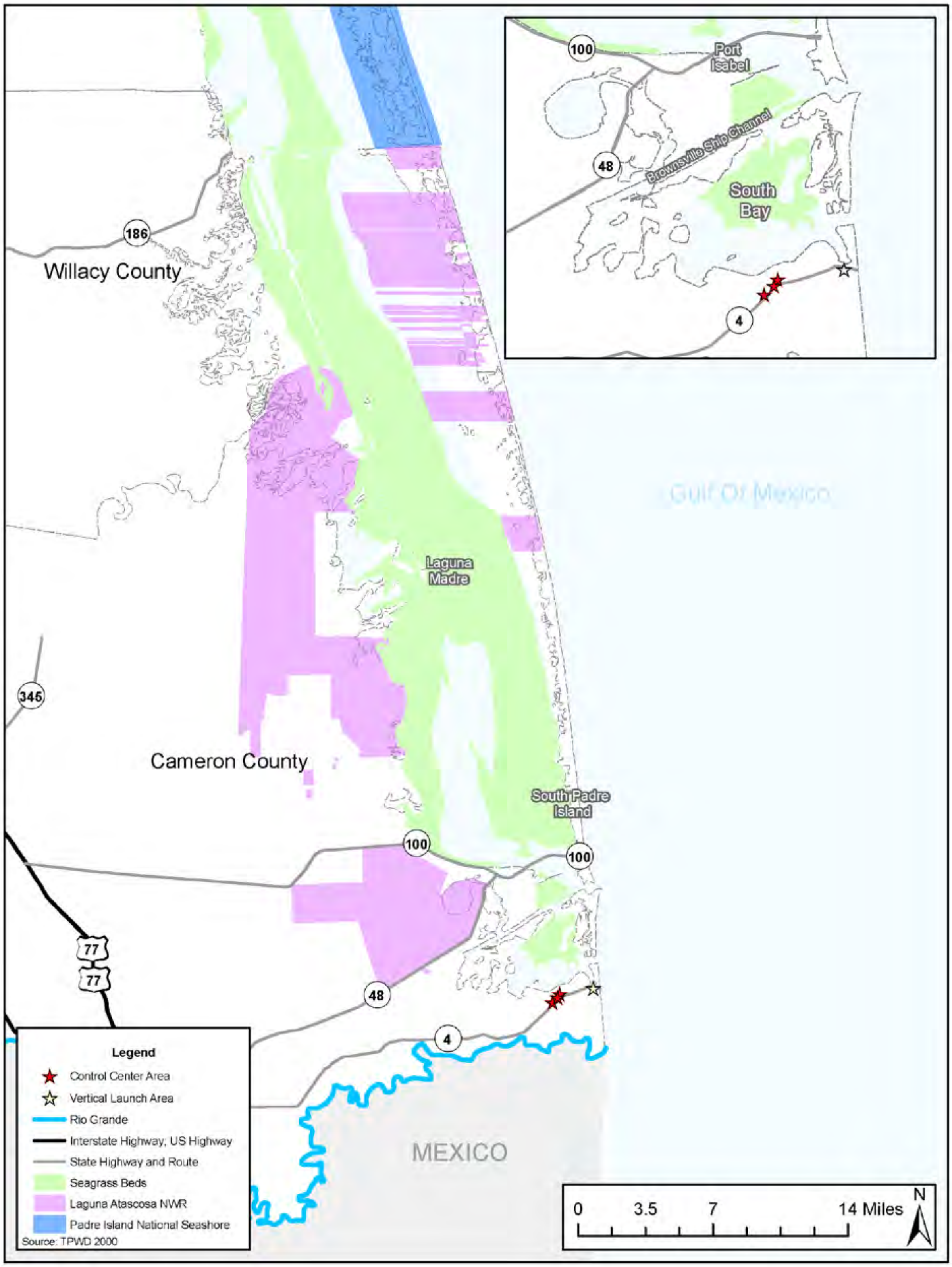


Exhibit 3.8-3. Occurrence of Seagrass Beds within and in the Vicinity of the ROI

Hawksbill Sea Turtle

The Hawksbill sea turtle is a federally and state endangered species with no designated critical habitat in the ROI. The only hawksbill nest documented on the Texas Coast was in 1998 at Padre Island National Seashore (NPS 2012b). None of the proposed construction and operation areas are located in any potential sea turtle nesting areas. The eastern boundary of the perimeter fence for the vertical launch area is over 500 feet west of potential sea turtle nesting areas and is separated by sand dunes.

Green Sea Turtle

The green sea turtle is a federally threatened and state endangered species with no designated critical habitat in the ROI. Padre Island National Seashore and South Padre Island are the only locations on the Texas coast where green turtle nesting has been documented (NPS 2012a). Over the past 5 years, 25 green sea turtles have nested on either Padre Island National Seashore or South Padre Island (eight in 2012, six in 2011, five in 2010, one in 2009, and five in 2008) (Shaver 2009, 2010, 2011; NPS 2012c, d). None of the proposed construction and operation areas are located in any potential sea turtle nesting areas. The eastern boundary of the perimeter fence for the vertical launch area is over 500 ft west of potential nesting areas and is separated by sand dunes.

Kemp’s Ridley Sea Turtle

The Kemp’s ridley sea turtle is a federally and state endangered species with no designated critical habitat. Kemp’s ridley sea turtles nest primarily from April through July, predominantly during daylight hours. Nesting occurs in synchronized emergences which are thought to be triggered by high wind speeds and changes in barometric pressure (NMFS et al. 2011; Sea Turtle Inc. 2012). Over the last 5 years, there have been 38 Kemp’s ridley nests found on Boca Chica Beach (10 in 2012, three in 2011, four in 2010, nine in 2009, and 12 in 2008) (Shaver 2009, 2010, 2011; NPS 2012c, d). None of the proposed construction and operation areas are located in any potential sea turtle nesting areas. The eastern boundary of the perimeter fence for the vertical launch area is over 500 ft west of potential nesting areas and is separated by sand dunes.

Leatherback Sea Turtle

The leatherback sea turtle is a federally and state endangered species with no designated critical habitat in the ROI. No leatherback sea turtles have been recorded nesting on Boca Chica Beach. In 2008, the first leatherback nest confirmed on the Texas coast since the 1930s was found on Padre Island National Seashore (Shaver 2009). None of the proposed construction and operation areas are located in any potential sea turtle nesting areas. The eastern boundary of the perimeter fence for the vertical launch area is over 500 ft west of potential nesting areas and is separated by sand dunes.

Loggerhead Sea Turtle

The loggerhead sea turtle is a federally and state threatened species with no designated critical habitat. Over the past 5 years, 17 loggerhead sea turtles have nested on the Texas Coast (three in 2008 on Padre Island National Seashore, Mustang Island, and Bolivar Peninsula; nine in 2010 and zero in 2011 on Padre Island National Seashore; and five in 2012 at Quintana Beach, north Padre Island, Padre Island National Seashore, and South Padre Island) (Shaver 2009, 2010, 2011; NPS 2012c, d). None of the proposed construction and operation areas are located in any potential sea turtle nesting areas. The eastern boundary of the perimeter fence for the vertical launch area is over 500 feet west of potential nesting areas and is separated by sand dunes.

Red Knot

The red knot is a federal candidate species and has been observed in Cameron County as a winter migrant. In Texas, the red knot occurs along sandy beaches primarily on Mustang Island along Corpus Christi Bay and other outer beaches and tidal mudflats and salt marshes on Bolivar Flats along Galveston Bay (Niles et al. 2007). Although most red knots are found during winter months, individuals of this species are known to remain on the lower Texas coast year-round. Records indicate that the red knot has been observed prior to 1996 on Boca Chica Beach (Skagen et al. 1999). Over 30 red knots were sited within the ROI in May 2012. Several hundred migrate through the area, and some have been known to stay throughout most of the year (USFWS 2013; Appendix G). In addition, the red knot has been observed at Laguna Atascosa NWR (Skagen et al. 1999; USFWS 2010) and on Padre Island (Audubon Society 2009; Niles et al. 2009 as cited in USFWS 2011). During migratory and wintering surveys conducted in 2009 at Boca Chica Beach and Laguna Atascosa NWR, the red knot was not observed, although it was observed on South Padre Island and Mansfield Channel spoil islands (Zdarvkovic and Durkin 2011). During migrating stopovers and in wintering areas, red knots are found primarily in coastal habitats, particularly in areas with extensive sandy intertidal flats or near tidal inlets or mouths of bays and estuaries (USFWS 2005). Along the Texas coast, red knots forage on beaches, oyster reefs, and exposed bay bottoms, and roost on high sand flats, reefs, and other sites protected from high tides (USFWS 2011).

Peregrine Falcon

The peregrine falcon is a state-listed threatened species and has been observed as a migrant species in Cameron County. Peregrine falcons nest in tall cliff eyries in west Texas and are found in a wide range of habitats during winter along the coast including urban and coastal areas (TPWD 2003). Potential foraging habitat does occur within the ROI.

Reddish Egret

The reddish egret is a state-listed threatened species that has been observed in Cameron County. They are found primarily in salt and brackish water wetlands along the Gulf Coast of Texas. In Texas, reddish egrets nest on the ground near a bush or prickly pear cactus or on oyster shell beaches (TPWD 2012h). Potential habitat does occur within ROI.

Sooty Tern

The sooty tern is a state-listed threatened species that has been observed in Cameron County. It is found primarily over pelagic waters, outlying islets and rocks, and coastal beaches (NatureServe 2012a). Potential habitat does occur within the ROI.

White-tailed Hawk

The white-tailed hawk is a state-listed threatened species that has been observed in Cameron County and within the ROI. In Texas, it is found near the coast on prairies, cordgrass flats, and scrub-live oak. They nest in low trees, large shrubs, and crowns of yucca (NatureServe 2012b).

White-faced Ibis

The white-faced ibis is a state-listed threatened species that has been observed in Cameron County. It is found breeding and wintering along the Gulf Coast primarily in marshes, swamps, ponds and rivers (TPWD 2012i). Potential habitat does occur within the ROI.

Wood Stork

The wood stork is a state-listed threatened species and has been observed in Cameron County as an uncommon migrant. It prefers habitats such as coastal marshes, bays, prairies, and lakes (Arnold 2001). Potential habitat does occur within the ROI.

Black-striped Snake

The black-striped snake is a state-listed threatened species that has been observed in Cameron County. It inhabits the semiarid coastal plains of Texas and is found in forests, savannas, agricultural landscapes, and edges of wet or marshy areas (NatureServe 2012c). Potential habitat does occur within the project area.

3.9 HAZARDOUS MATERIALS, POLLUTION PREVENTION, AND SOLID WASTE

3.9.1 Definition and Description

Analysis of the presence, handling, storage, and disposal of hazardous materials, solid waste, and hazardous waste includes an evaluation of the following:

- Waste streams that would be generated by the project, the potential for the wastes to impact environmental resources, and the impacts on waste handling and disposal facilities that would likely receive the wastes
- Potential to encounter existing hazardous materials during the construction and operation phases of the project
- Potential to interfere with any ongoing remediation of existing contaminated sites at the proposed project site or in the immediate vicinity
- Potential hazardous materials that could be transported and used during construction and operation of the proposed facilities, and applicable pollution prevention strategies and procedures

The terms *hazardous materials, hazardous waste, and hazardous substances* are often used interchangeably when used informally to refer to contaminants, industrial wastes, dangerous goods, and petroleum products. Each of these terms, however, has a specific technical meaning based on the relevant regulations.

Hazardous material is defined by the DOT as any substance or material that has been determined to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce. In the context of transportation, the term hazardous materials includes hazardous wastes and hazardous substances, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table (49 CFR 172.101), and materials that meet the defining criteria for hazard classes and divisions in 49 CFR 173.

Hazardous substance is a more broadly defined term under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to include the following:

- Any element, compound, mixture, solution, or substance designated as hazardous under Section 102 of CERCLA
- Any hazardous substance designated under Section 311(b)(2)(a) or any toxic pollutant listed under Section 307(a) of the CWA
- Any hazardous waste under Section 3001 of the Resource Conservation and Recovery Act (RCRA)
- Any hazardous air pollutant listed under Section 112 of the CAA
- Any imminently hazardous chemical substance or mixture which the EPA Administrator has "taken action under" Section 7 of the Toxic Substances Control Act (TSCA)

Hazardous waste is a type of solid waste defined under RCRA as a solid waste that possesses at least one of the following four characteristics: ignitibility, corrosivity, reactivity, or toxicity. Management and disposal of hazardous waste has much more stringent requirements compared to those for non-hazardous wastes.

Pollution prevention describes methods used to avoid, prevent, or reduce waste generation and pollutant discharges or emissions through strategies such as using fewer toxic inputs, redesigning products, altering manufacturing and maintenance processes, and conserving water and energy.

Solid waste is defined by the EPA as any discarded item, garbage or refuse; sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility; and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. Municipal solid waste is commonly known as trash or garbage. Industrial solid waste is made up of a wide variety of non-hazardous materials that result from the production of goods and products.

3.9.2 Regulatory Setting

Federal

Several primary Federal statutes govern the handling and disposal of hazardous materials, chemicals, substances, and wastes. The two statutes of most importance to the FAA are RCRA and CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the Community Environmental Response Facilitation Act of 1992. RCRA governs the generation, treatment, storage, and disposal (TSD) of hazardous wastes. CERCLA provides for consultation with natural resources trustees and cleanup of any release of a hazardous substance (excluding petroleum) into the environment.

The Federal Hazardous Materials Regulations are contained in 49 CFR parts 171 through 180.

State

The TCEQ enforces state laws and rules pertaining to hazardous, industrial, and solid wastes. Texas regulations pertaining to municipal solid waste and industrial and hazardous wastes are located in Title 30 of the Texas Administrative Code (30 TAC), Chapter 330 and Chapter 335, respectively.

Local

The Cameron County Department of Health and Human Services is responsible for enforcing state and county guidelines dealing with general sanitation issues.

3.9.3 Region of Influence

The ROI is the surrounding area that could be affected by construction and operation of the proposed vertical launch and control center areas. The ROI for hazardous materials includes local area and national markets; the ROI is dependent on whether the cost or value of the commodity makes it economical to transport over long distances or not. The hazardous materials used in construction and operations are available in local and national markets. The ROI includes waste transporters and TSD facilities as well as the suppliers of hazardous materials used in construction and operation of the facility. The extent of the ROI varies by material and waste type. The ROI for solid waste disposal facilities is within Brownsville, Texas and Cameron County. The ROI for hazardous waste TSD facilities includes western and northern Texas.

3.9.4 Existing Conditions

3.9.4.1 Hazardous Materials

The proposed vertical launch area is located in an undeveloped area. No hazardous materials are known to be in storage or in use in this area. An Environmental Data Report (EDR) was obtained for the vertical launch area. The information contained within the data report was sufficient to satisfy the requirements of ASTM E1527-05 and the EPA's All Appropriate Inquiry rule. According to the EDR, no contaminated sites or releases, users, or generators of hazardous materials are located within in the vicinity of the proposed vertical launch area (EDR 2012; Appendix H). The nearest documented sites identified at the time the report was completed were the Laguna Madre Water District Isla Blanca Wastewater Treatment Plant, located approximately 5 miles north of the vertical launch area, and the Brownsville Navigation District borrow area, located approximately 6 miles north of the vertical launch area. A review of CERCLA, RCRA, Toxic Release Inventory (TRI), TSCA, and brownfields databases did not identify any hazardous materials use, release, or disposal sites in the vicinity of the proposed vertical launch area (EPA 2012b).

The proposed control center area is located adjacent to Boca Chica Village, a small residential community. A review of CERCLA, RCRA, TRI, TSCA, and brownfields databases did not identify any hazardous materials use, release, or disposal sites in the vicinity of the proposed control center area (EPA 2012b).

3.9.4.2 Hazardous Substances

A review of historical aerial photos of the proposed vertical launch area from 1950 to present did not indicate any history of development (Google Earth 2012). In addition, the EDR report obtained for the vertical launch area did not indicate any history of known releases, users, or generators of hazardous substances in the vicinity of the proposed vertical launch area (EDR 2012; Appendix H). Therefore, hazardous substances are not anticipated to be present in the proposed vertical launch area.

The proposed control center area is located adjacent to Boca Chica Village. According to local real estate records, many of the homes were built in the late 1960s. A review of historical aerial photos of the proposed control center area location from 1950 to present (Google Earth 2012) and a field survey conducted on May 16–17, 2012, for this project did not indicate any history of commercial or industrial development at the proposed control center area. A trailer home is situated at the east corner of the parcel, and a small, prefabricated metal shed is at the opposite corner. No hazardous substances are known to occur within the parcels that comprise the proposed control center area.

3.9.4.3 Hazardous Waste

Hazardous wastes are not anticipated to be present within the proposed vertical launch and control center areas. In addition, the EDR did not identify hazardous waste generators or TSD facilities in the vicinity of the proposed vertical launch area (EDR 2012; Appendix H). Several hazardous waste TSD facilities are located in the State of Texas and could be used for the transport and disposal of hazardous wastes from the Proposed Action. The nearest TSD facility to the proposed vertical launch and control center areas is the Safety-Kleen Systems Inc. (Handler ID: TXD083145656), located approximately 54 miles away in McAllen, Texas. The facility is permitted to handle only organic and inorganic liquids (Environmental Compliance Assistance Platform 2012).

3.9.4.4 Pollution Prevention

Cameron County is classified as a small municipal separate storm sewer system (small MS4) operator. As such, the county has developed the Cameron County SWMP to implement programs and practices to control polluted stormwater runoff through the TCEQ TPDES permit program and in accordance with the requirements of TPDES General Permit TXR040000 (Cameron County 2008). The scope of the SWMP includes an inventory of BMPs for six Minimum Control Measures that will be implemented over a 5-year period to reduce pollutants and protect water quality. The six Minimum Control Measures are as follows:

- Public Education and Outreach on Stormwater Impacts;
- Public Involvement/Participation;
- Illicit Discharge Detection and Elimination;
- Pollution Prevention/Good Housekeeping for Municipal Operations;
- Construction Site Stormwater Runoff Control; and
- Post-Construction Stormwater Management in New Development/Re-development (Cameron County 2008).

3.9.4.5 Solid Waste

The Lower Rio Grande Valley Development Council (LRGVDC) is the state-designated agency for solid waste management issues in the region. The Solid Waste Management Program, funded by TCEQ, includes the development of the Regional Solid Waste Management Plan, carried out under the guidance of the Solid Waste Advisory Committee (SWAC). The main focus of the Solid Waste Department is to assist local governments and communities with solid waste management issues important to the region. According to the LRGVDC, one landfill is currently operating in Cameron

County—the Brownsville Municipal Solid Waste Landfill (LRGVDC 2012). This landfill has an estimated life expectancy of 38 years. This landfill is permitted to accept household/residential waste (i.e., normal household waste, yard waste, white goods with refrigerant free certification if applicable, furniture, and bedding); construction waste (i.e., wood, concrete, brick, insulation, sheet rock); and some special wastes (dead animals, oil contaminated soil, grease trap waste) (Brownsville Public Works 2012). There is also one transfer station located in the City of Harlingen (TCEQ 2011b). The proposed location of the vertical launch area is currently undeveloped and no solid waste is generated on the property. The proposed location of the control center area contains a small road network and a few residential dwellings. Municipal solid waste is currently generated in this community.

Incidental amounts of debris and litter may be present on the proposed vertical launch and control center areas as items may have been directly discarded by site visitors or deposited from other areas due to wind and water run-off during storm events. No visible evidence of dumping or burial of solid waste was observed during a field survey on May 16–17, 2012.

3.10 SOCIOECONOMICS, ENVIRONMENTAL JUSTICE, AND CHILDREN'S ENVIRONMENTAL HEALTH RISKS AND SAFETY RISKS

3.10.1 Definition and Description

This section describes the existing socioeconomic, environmental justice, and children's environmental health and safety characteristics of the region in the vicinity of the Proposed Action.

Socioeconomics describes the basic attributes and resources associated with the human environment, particularly population, employment, income, housing, and community services. The environmental justice discussion presents data on minority and low-income populations. The presence of children is also identified in order to evaluate potential risks to their environmental health and safety.

3.10.2 Regulatory Setting

SpaceX, to the fullest extent possible, must observe all local and State laws, regulations, and ordinances concerning economic development, housing, zoning, transportation, etc. when planning, assessing, or implementing the Proposed Action.

Issued in 1994, EO 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*, focuses the attention of federal agencies on human health and environmental conditions in minority and low-income populations, including Indian tribes. This EO was also established to ensure that, if there were disproportionately high and adverse human health or environmental effects of federal actions on these populations, those effects would be identified and addressed. DOT Order 5610.2, *Environmental Justice in Minority and Low-Income Populations*, requires the FAA to provide for meaningful public involvement by minority and low-income populations and to conduct analysis that identifies and addresses potential impacts on these populations that may be disproportionately high and adverse. Environmental justice is achieved if minority and low income communities are not subjected to disproportionately high or adverse environmental effects.

EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks,* was issued in 1997 to identify and address issues that affect the protection of children. Children may suffer disproportionately more environmental health and safety risks than adults because of various factors, such as children's neurological, digestive, immunological, and other bodily systems are still developing; children eat more food, drink more fluids, and breath more air in proportion to their body weight than adults; children's behavior patterns may make them more susceptible to accidents, because they are less able to protect themselves; and children's size and weight may diminish their protection from standard safety features.

3.10.3 Region of Influence

The ROI for the Proposed Action is defined as the area in which the majority of direct and secondary or indirect effects on socioeconomic variables arising from the Proposed Action's construction and operation are likely to occur. For the Proposed Action, the ROI includes Cameron and Willacy counties (Exhibit 3.10-1) which compose the Brownsville-Harlingen-Raymondville, TX Combined Statistical Area.[2] The State of Texas and the U.S. serve as the geographic region for comparative analysis.

The ROI for environmental justice and children's environmental health risks and safety risks includes Cameron and Willacy counties and the Census Tract that encompasses the vertical launch and control center areas. Census Tract 127 is assessed because it represents the area most likely to experience any potential impacts caused by the construction and operation of the Proposed Action. Boca Chica Village is also included as it is the closest residential area to the vertical launch and control center areas. The State of Texas serves as the geographic region for comparative analysis.

3.10.4 Existing Conditions

3.10.4.1 Population

The 2010 U.S. Census reports a total population of 428,315 persons within the ROI of the Proposed Action (U.S. Census Bureau [USCB] 2012a). Cameron County has 456 persons per square mile, while Willacy County has 37.5 persons per square mile. Table 3.10-1 presents the population and population density figures from the 2010 Census.

Table 3.10-1. Population and Population Density, 2010

Jurisdiction/Region	Population	Population Density (persons per square mile)
United States	308,745,538	87.4
Texas	25,145,561	96.3
ROI		
Cameron County	406,220	456.0
Willacy County	22,095	37.5
ROI Total	428,315	-

Source: USCB 2012a.

[2] Combined Statistical Areas can be characterized as representing larger regions that reflect broader social and economic interactions, such as wholesaling, commodity distribution, and weekend recreation activities (Office of Management and Budget 2009).

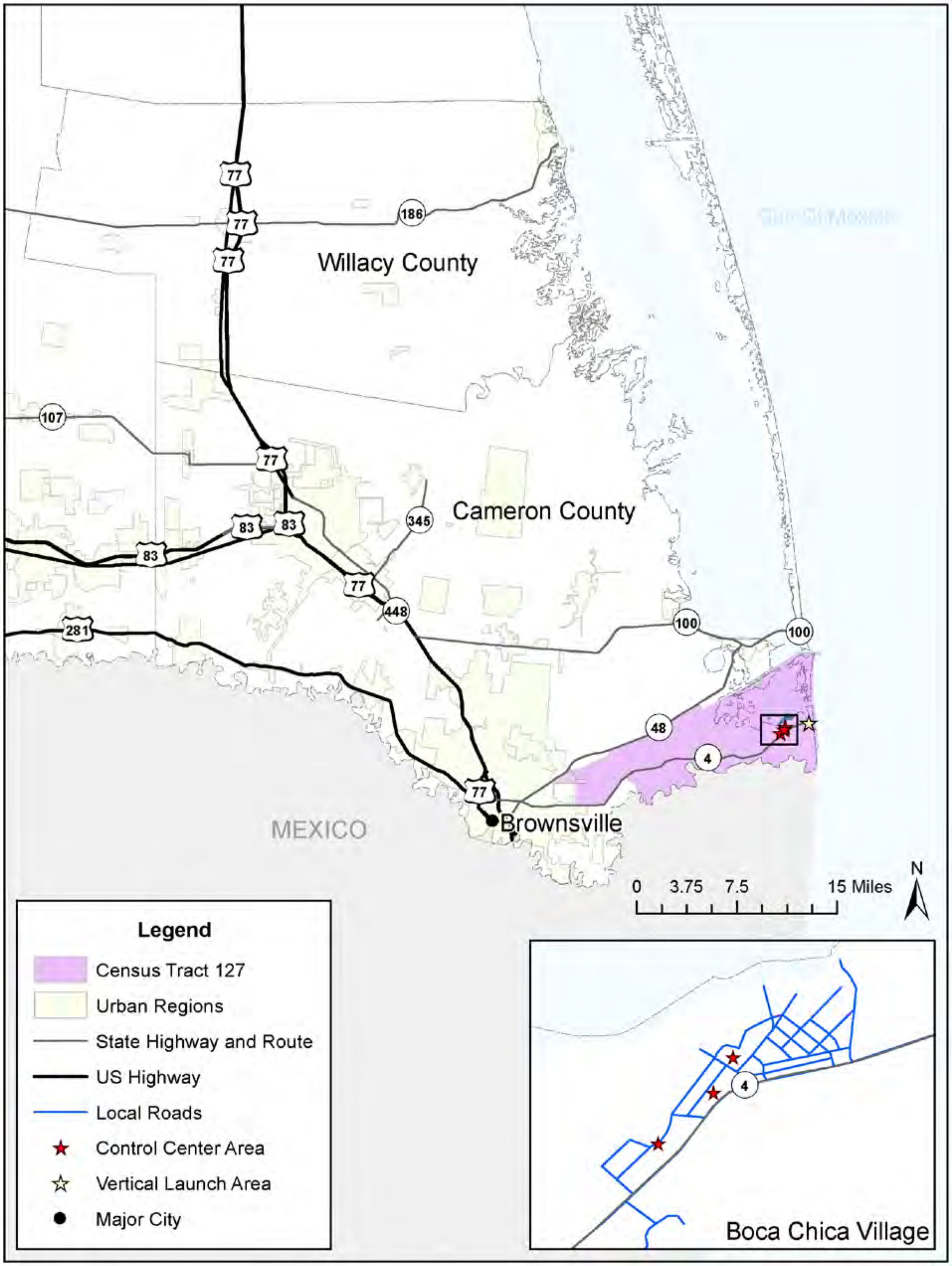


Exhibit 3.10-1. Socioeconomics and Environmental Justice Region of Influence

Table 3.10-2 shows the 2010 population and the population growth rates for the U.S., the State of Texas, and for both counties within the ROI (USCB 2012a). The USCB estimates that the population growth rate in the ROI was 20.5 percent from 2000 to 2010 (an annual growth rate of approximately 1.9 percent). This rate is about the same as the population growth rate for Texas and considerably greater than the growth rate for the U.S. Among the two counties in the ROI, Cameron County is estimated to have gained 70,993 residents, and Willacy County is estimated to have gained 2,013 residents between 2000 and 2010.

Table 3.10-2. Population Growth Rates, 2000–2010

Jurisdiction/Region	2000 Population	2010 Population	Percent (%) Growth
United States	281,421,906	308,745,538	9.7
Texas	20,851,820	25,145,561	20.6
ROI			
Cameron County	335,227	406,220	21.2
Willacy County	20,082	22,095	10.0
ROI Total	355,309	428,315	20.5

Source: USCB 2012a.

3.10.4.2 Employment and Income

Table 3.10-3 summarizes the employment sectors and the percent of workers employed in those sectors from the Census American Community Survey 2006-2010 5-Year Estimates, the best consistent data for all the jurisdictions. Both Cameron and Willacy counties have a higher percentage of their civilian workforce employed in the service sector than Texas or the U.S. The total civilian labor force in the ROI is 145,043 (USCB 2012b). There are no commercial activities in the vicinity of the vertical launch and control center areas.

Table 3.10-3. Percent of Workers Employed by Occupation, 2010

Jurisdiction	Management, Business, Science, Arts	Service	Sales, Office	Natural Resources, Construction, Maintenance	Production, Transportation, Material Moving
United States	35.3	17.1	25.4	9.8	12.4
Texas	33.7	16.9	25.7	11.6	12.1
ROI					
Cameron County	26.7	24.0	26.0	11.2	12.1
Willacy County	22.6	36.6	22.5	10.6	7.8

Source: USCB 2012b.

Unemployment rates for the ROI are shown in Table 3.10-4. While the unemployment rate in Texas and the nation declined from 2010 to 2012, the rate remained the same in Cameron County and increased by 13 percent in Willacy County. Unemployment rates in Cameron and Willacy counties remain significantly higher than in Texas and the nation (Bureau of Labor Statistics [BLS] 2012).

Table 3.10-4. Unemployment Rates

Jurisdiction	Unemployment Rate 2010 (%)	Unemployment Rate 2012 (%)	Percent (%) Change in Unemployment Rate
United States	9.6	8.2	-14.6
Texas	8.2	7.0	-14.6
ROI			
Cameron County	11.3	11.3*	0.0
Willacy County	12.8	14.5*	+13.3

Note: *Not seasonally adjusted.
Source: BLS 2012.

Table 3.10-5 presents a comparison of per capita income and median household income for the U.S., Texas, and Cameron and Willacy counties. The information indicates that both Cameron and Willacy counties have a lower median household income and a lower per capita income than Texas and the U.S.

Table 3.10-5. Per Capita and Median Household Income, 2010

Jurisdiction	Per Capita Income	Median Household Income
United States	$27,334	$51,914
Texas	$24,870	$49,646
ROI		
Cameron County	$13,695	$33,770
Willacy County	$10,800	$22,881

Source: USCB 2012a.

3.10.4.3 Housing

The number of housing units in the ROI totaled approximately 149,000 in 2010 as shown in Table 3.10-6. Homeowner vacancy rates were lower than for Texas and the U.S. The rental vacancy rate was highest in Willacy County (20.2 percent). The rental vacancy rate in Cameron County and Texas were approximately the same (10 percent), slightly higher than for the nation (9.2 percent). Due to their coastal location, both Cameron and Willacy counties have a greater percentage of their vacant housing units comprised of vacant seasonal or recreational units (7.8 percent and 4.3 percent, respectively) compared to Texas and the U.S. (2.1 percent and 3.5 percent, respectively) (USCB 2012a).

Table 3.10-6. General Housing Profile, 2010

Jurisdiction	Total Housing Units	Vacant Housing Units	Homeowner Vacancy Rate (%)	Rental Vacancy Rate (%)
United States	131,704,730	14,988,438	2.4	9.2
Texas	9,977,436	1,054,503	2.1	10.8
ROI				
Cameron County	141,924	22,293	1.8	10.3
Willacy County	7,040	1,276	1.6	20.2

Source: USCB 2012a.

3.10.4.4 Emergency Response

Emergency response services are provided by police, fire, and emergency medical technicians. Cameron and Willacy counties are both served by sheriff departments in addition to incorporated jurisdictions' police departments (Federal Bureau of Investigation 2012). The U.S. Customs and Border Protection currently operates a checkpoint along State Highway 4 between Brownsville and the proposed vertical launch area and control center area. There are 13 fire departments, including volunteer and career personnel, in Cameron and Willacy counties (U.S. Fire Administration 2012). In addition, private ambulance service is also available in the ROI. Most law enforcement and firefighting entities in the ROI share Mutual Aid Agreements that allow cross-coverage for emergencies.

3.10.4.5 Medical Facilities

The residents of Cameron County are served by the following hospitals/health centers (Healthy Texas 2010):

- Brownsville Medical Center
- Dolly Vinsant Hospital
- Rio Grande State Center
- South Texas Hospital
- Valley Baptist Hospital
- Valley Regional Medical Center

The residents of Willacy County are served by the following hospitals/health centers (Healthy Texas 2010):

- Willacy Methodist Hospital
- Su Clinica Familiar
- Planned Parenthood of Cameron and Willacy Counties

3.10.4.6 Public Schools

During the 2010-2011 school year, Cameron County served 99,940 students. Cameron County is made up of 10 school districts that are located at least partially within Cameron County. Students residing in Cameron County attend Brownsville, Harlingen Con, La Feria, Los Fresnos, Point Isabel, Rio Hondo, San Benito, Santa Maria, and Santa Rosa Independent School Districts. Brownsville Independent School District served 49,991 students during the 2010-2011 school year. Willacy County is made up of four school districts including Lasara, Lyford, Raymondsville, and San Perlita Independent School Districts. Willacy County served 4,500 students during the 2010-2011 school year (Texas Education Agency 2012). Table 3.10-7 provides a profile of the Public School Districts.

Table 3.10-7. Public School District Profile, 2010-2011 School Year (Excludes Charter Schools)

School District	Number of Schools (K-12)	Total Student Enrollment	Teacher-Student Ratio
Texas, all districts	8,044	4,778,688	1:14.7
ROI			
Cameron County	169	99,940	1:13.4
Willacy County	16	4,500	1:14.7

Source: Texas Education Agency 2012.

3.10.4.7 Minority Populations

For the purpose of this evaluation, minority refers to people who identified themselves in the Census as Black or African American, Asian, or Pacific Islander, American Indian or Alaskan Native, other non-White races, or as being of Hispanic or Latino origin. Persons of Hispanic and Latino origin may be of any race (CEQ 1997). The CEQ identifies these groups as minority populations when either (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage in the affected area is meaningfully greater than the minority population percentage in the general population or appropriate unit of geographical analysis. While not defined by the CEQ, the term "meaningfully greater" has been used by FAA in previous NEPA documents to mean 20 percentage points greater than the geographic region of comparison (most often the State in which the affected area is part) (FAA 2008). The geographical unit for comparison in this analysis is the State of Texas.

Exhibit 3.10-1 shows the location of the vertical launch and control center areas within Census Tract 127. Census Tract 127 (2010 population: 5,621) is assessed because it represents the area most likely to experience any potential impacts caused by the construction and operation of the Proposed Action (USCB 2012a). Boca Chica Village (2010 population: 29) is also included as it is the closest residential area to the proposed vertical launch and control center areas (USCB 2012a).

Table 3.10-8 shows the percent race and ethnicity in the ROI. While the percentage of people who identified themselves as white was greater in Cameron and Willacy counties and Census Tract 127 than for Texas or the nation, the percentage of people who identified themselves as of Hispanic or Latino origin was also much greater than in Texas or the nation. Census Tract 127 has the greatest percentage of minorities (95.0 percent), followed by Willacy County (89.9 percent), and Cameron County (89.3 percent). Boca Chica Village has the lowest percentage of minority populations (37.9 percent). As defined by the CEQ and the FAA, the ROI and Census Tract 127 would be considered minority populations but Boca Chica Village would not.

Table 3.10-8. Race and Ethnicity, 2010[a]

Jurisdiction	White (%)	Black/ African American (%)	American Indian/ Alaska Native (%)	Asian (%)	Native Hawaiian/Other Pacific Islander (%)	Hispanic or Latino Origin[b] (%)	Total Minority (%)
United States	72.4	12.6	0.9	4.8	0.2	16.3	36.3
Texas	70.4	11.8	0.7	3.8	0.1	37.6	54.7
ROI							
Cameron County	87.0	0.5	0.4	0.7	0.0	88.1	89.3
Census Tract 127	85.0	0.5	0.4	0.2	0.0	94.5	95.0
Boca Chica Village	100.0	0.0	0.0	0.0	0.0	37.9	37.9
Willacy County	85.8	2.1	0.3	0.6	0.0	87.2	89.9

Notes: [a]One race. Data presented reflect most reported race and ethnicity categories; percentages may not add to 100% due to rounding. [b]Hispanic origin may be of any race.
Source: USCB 2012a.

3.10.4.8 Low Income Populations

Table 3.10-9 presents data for low-income families and individuals in the ROI whose annual income in the past 12 months was below the poverty level. Both Cameron and Willacy counties have a much higher percentage of families and individuals below the poverty level than Texas and the U.S. While still higher than the rates for Texas and the nation, Census Tract 127, which encompasses the proposed vertical launch and control center areas, has a lower rate of families and individuals below the poverty line than Cameron and Willacy counties. Comparable census data are not available for Boca Chica Village For the purposes of this EIS, the FAA considers the presence of low-income families and individuals in Cameron and Willacy counties to be meaningfully greater than in the State of Texas. The presence of low-income families and individuals in Census Tract 127 would not be considered meaningfully greater than in the State. Therefore, Cameron and Willacy counties would be considered low-income populations, but Census Tract 127 would not be considered a low-income populations.

Table 3.10-9. Families and Individuals below Poverty Level

Jurisdiction	Percent (%) Families Below Poverty Level	Percent (%) Individuals Below Poverty Level
United States	10.1	13.8
Texas	13.0	16.8
ROI		
Cameron County	30.0	34.7
Census Tract 127	25.5	27.4
Boca Chica Village	N/A	N/A
Willacy County	39.4	43.4

N/A = Data Not Available
Source: USCB 2012b.

3.10.4.9 Children's Environmental Health Risks and Safety Risks

The area surrounding the proposed vertical launch area is bordered by the Gulf of Mexico on the east. To the north, west, and south is mostly open land with little human population. The nearest residential area is Boca Chica Village which is located approximately 2 miles from the vertical launch area and which abuts the control center area. The nearest public school to the proposed vertical launch area, Port Isabel Junior High, is over 6 miles away in Port Isabel. Table 3.10-10 summarizes the distribution of population by age for the ROI. The data in Table 3.10-10 indicate that the population under 18 years in Cameron County is greater than in Texas and the nation. Willacy County closely aligns with Texas and the U.S. across all populations. Census Tract 127 has the greatest percentage of population under 18 years (38.6 percent), and under 5 years (9.6 percent). There are no children under the age of 18 in Boca Chica Village. Cameron and Willacy counties, Census Tract 127, and Boca Chica Village do not have populations of children less than 5 years that are significantly greater than the State of Texas.

Table 3.10-10. Percent Distribution of Population by Age, 2010

Region	Percent (%) Under 5 Years	Percent (%) Under 18 Years	Percent (%) 65 and Older
United States	6.5	24.0	13.0
Texas	7.7	27.3	10.3
ROI			
Cameron County	8.8	33.0	11.1
Census Tract 127	9.6	38.6	5.8
Boca Chica Village	0.0	0.0	48.3
Willacy County	7.1	26.8	11.7

Source: USCB 2012a.

3.11 NATURAL RESOURCES AND ENERGY SUPPLY

3.11.1 Definition and Description

As an impact category, energy supply and natural resources provides an evaluation of a project's consumption of natural resources (such as water, asphalt, aggregate, wood, etc.) and use of energy supplies (such as coal for electricity; natural gas for heating; and fuel for aircraft, commercial space launch vehicles, or other ground vehicles). The project's consumption of natural resources and use of energy supplies would result from proposed construction and operational activities.

3.11.2 Regulatory Setting

Federal

FAA Order 1050.1E establishes policies and procedures for compliance with NEPA. Whereas FAA Order 1050.1E acknowledges that there are no specific Federal requirements in place to regulate the use of natural resources and energy supply, it also emphasizes that it is the policy of the FAA to encourage the development of facilities that exemplify the highest standards of design including principles of sustainability. Additionally, the following EOs provide guidance to Federal agencies regarding the use of natural resources and energy supply:

- EO 13123, *Greening the Government through Efficient Energy Management*
- EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*
- EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*

The Safe Drinking Water Act was established to protect the quality of drinking water of the U.S. The Act focuses on all waters actually or potentially designed for drinking use, whether from above ground or underground. The EPA is responsible for establishing minimum standards to protect tap water and requires all owners or operators of public water systems to comply with these standards.

State

Under TAC Title 30, Chapter 307, water quality standards were written by TCEQ to comply with CWA. The Texas Legislature has authorized the TCEQ, TWDB, and TPWD to study, identify, and delineate priority groundwater management areas, and initiate the creation of Groundwater Conservation Districts (GCDs) within those areas, for the purpose of managing the State's groundwater resources in areas where critical groundwater problems exist or may exist in the future. The primary management of groundwater in Texas is found at the local level through GCDs. The Proposed Action in Cameron County does not fall within any specific GCDs.

Local

The location of the proposed vertical launch and control center areas is within Cameron County, Texas which has municipal water resource-related regulations addressing potential impacts to local water quality. The USDA NRCS local work group for Cameron County has identified water quality and water quantity as the highest priorities of concern within the county, enabling funding assistance to agricultural producers in implementing conservation practices that would be beneficial to water resources throughout Cameron County (NRCS 2012b).

3.11.3 Region of Influence

Supply of the water and electricity required to construct and support the proposed vertical launch and control center areas would be focused in southern Texas, within Cameron County. Resources such as building materials and fuel supplies that would be transported to the proposed vertical launch and control center areas would be provided by suppliers within the broader southern Texas region. Groundwater included in the ROI are those within the Gulf of Mexico aquifers designated as underground sources of drinking water (see Section 3.7, *Water Resources*).

3.11.4 Existing Conditions

3.11.4.1 Energy Supply

Resources required for the supply of energy include electricity and fuels. Electricity, in the vicinity of the proposed control center area, is currently provided by the Magic Valley Electric Cooperative (MVEC). The MVEC service area includes the entire State Highway 4 corridor between the City of Brownsville and the Boca Chica Village area. Power supply for MVEC is provided by the South Texas Electric Cooperative (STEC). MVEC is one of eight distribution cooperatives that is served by STEC (MVEC 2012a). STEC's power is generated utilizing a variety of fuels, including lignite, natural gas, and diesel.

The existing single phase distribution facilities serve Boca Chica Village and there are currently 35 existing accounts (MVEC 2012b). The maximum capacity of the distribution line is between 350-500 kW and Boca Chica Village is currently operating below that capacity (MVEC 2012b). There is no infrastructure between the Boca Chica Village and the proposed vertical launch area.

3.11.4.2 Natural Resources

The natural resources required for the construction of the vertical launch area include a water source for potable use, as well as for the deluge water system during launch activities.

There is currently no potable water supply associated with the vertical launch area or the control center area. The nearest municipal water supply is the City of Brownsville, with the closest connections approximately 15-20 miles west of the vertical launch and control center areas. Based on the TWDB projected municipal water use in Brownsville from 2010 through 2060, the actual municipal water use in

2010 and the projected water use in 2020 is 45,312 and 54,105 afy, respectively (TWDB 2012c). The total municipal capacity from the Rio Grande is 47.5 MGD (53,242 afy). The 2010 municipal water usage was at 85 percent of the current treatment facilities' capacity. Expansions to Southmost Regional Water Authority Regional Desalination Plant are expected to increase the available water capacity to 55 MGD (61,648 afy) by 2020. The 2020 projection would be at 88 percent of the expanded treatment facilities' capacity. As presented in Section 3.7.4.2, *Groundwater,* the projected municipal groundwater demand for Cameron County in the year 2010 is 4,500 afy (1,470 million gallons per year [MGY]), and in the year 2020 is 5,300 afy (1,730 MGY).

3.11.4.3 Aggregate Supply

There are currently a number of suppliers of construction material within the Brownsville vicinity. Large amounts of sand and gravel would be needed for the amount of concrete that would be required for the construction of the Proposed Action. Suppliers of these types of materials in the vicinity of Brownsville include, but are not limited to, the following:

- Samson Sandpit & Materials—26254 Altas Palmas Rd., Harlingen, Texas 70552
- Materiales Triple AAA Inc.—7165 Padre Island Hwy., Brownsville, Texas 78521
- P D American Limestone Products—9805 State Highway 48, Brownsville, Texas 78521
- Triple A Materials—6521 Paredes Line Rd., Brownsville, Texas 78526
- Cerda Caliche Sand and Gravel—1163 E. Expressway 83, San Benito, Texas 78586

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4.0 ENVIRONMENTAL CONSEQUENCES

This chapter presents an analysis of the potential impacts upon various components of the environment that could result from implementation of the Proposed Action. To evaluate potential impacts, the analyses presented in this chapter overlays the components of the Proposed Action described in Chapter 2 onto baseline conditions within the ROI for each environmental resource area presented in Chapter 3. Both direct and indirect impacts are considered in the EIS. Direct impacts are those caused by the Proposed Action or the No Action Alternative that occur at the same time and place (or immediately thereafter). Direct impacts could result from construction (e.g., placing fill in wetlands and floodplains or disturbance of wildlife) or operations (e.g., air emissions or noise). Indirect impacts are those caused by the project, but occur later in time or are farther removed in distance than direct impacts. Indirect impacts could include the effect of loss of habitat on species viability over time or changes in wetland functions due to stormwater runoff.

The terms below are used to describe the intensity of effects and to assess significance. Significance was determined according to NEPA implementing regulations at 40 CFR 1508.27, which requires considerations of both context and intensity as follows.

- **Context**—the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.
- **Intensity**—the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:
    - Impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial.
    - The degree to which the proposed action affects public health or safety.
    - Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
    - The degree to which the effects on the quality of the human environment are likely to be highly controversial.
    - The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.
    - The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
    - Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

- The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the NRHP or may cause loss or destruction of significant scientific, cultural, or historical resources.
- The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the ESA.
- Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.

The analysis in this chapter also considered FAA's guidance on the analysis of environmental impact categories, found in Appendix A of FAA Order 1050.1E, which includes a description of how to analyze significance of impacts, and describes the FAA's significance thresholds.

4.1 COMPATIBLE LAND USE (INCLUDING FARMLANDS AND COASTAL RESOURCES)

4.1.1 Proposed Action

Potential impacts to land use are assessed by comparing the existing land uses with the changes that would occur from implementation of the Proposed Action, including induced effects. Impacts to land use are evaluated for significance by determining the degree to which proposed development and uses conflict with existing land use and local plans and policies. The analysis addresses development at the vertical launch area and control center area, change in noise conditions from operations at the vertical launch area and the control center area, and secondary impacts to land use from growth induced effects.

Under the Proposed Action, potential short-term and long-term impacts to land use would occur from construction of the vertical launch and control center areas.

Growth induced impacts to land use could result from spending wages and salaries by direct and indirect employees on items such as food, housing, transportation, and medical services. This spending creates induced employment in nearly all sectors of the economy, especially service sectors (see Section 4.10, *Socioeconomics, Environmental Justice, and Children's Environmental Health Risks and Safety Risks*).

4.1.1.1 Construction

Under the Proposed Action, SpaceX plans to construct new facilities, structures, and utility connections in two areas in order to support the launch of the Falcon 9 and Falcon Heavy launch vehicles. The proposed schedule for construction activities would be a 24-month period. Construction activities are described in Section 2.1.2, *Construction Activities*.

<u>Land Use</u>

The proposed vertical launch area would change from vacant, undeveloped, open space, to a mixed-use facility. Of the approximate 56.5-acre vertical launch area, only 20 acres would be physically disturbed by proposed construction (see Exhibit 2.1-3). The proposed 12.4-acre control center area would change from vacant, residential lots to a mixed-use facility (see Exhibits 2.1-4a and 2.1-4b). Since Cameron County does not have a land use plan or zoning in unincorporated areas, changes from undeveloped, private land to mixed-use private land does not violate local land use ordinances.

Utilities would be installed underground in the ROW along State Highway 4. SpaceX would coordinate with TxDOT to obtain the appropriate utility permits in accordance with the Utility Accommodation Policy found in the TAC. The installation of underground utilities in the ROW would not adversely affect land use along State Highway 4 (TxDOT 2012).

Overall, land use on 32.4 acres would change due to the construction of the vertical launch and control center areas. There would be no impacts to the oil and gas leases or the existing gas wells, as no construction is taking place in the vicinity of existing TGLO oil and gas leases and wells.

Growth induced effects to land use from construction could occur in nearby areas. Local construction expenditures, including construction wages, during the 24-month period would have a beneficial impact on the ROI economy through direct spending and would generate economic activity that could lead to indirect job creation in areas such as the accommodation and food services and retail trade sectors. However, under a maximum scenario, construction workers and their families would represent 0.04 percent of the ROI population. Land uses in Willacy and Cameron Counties would not be expected to change in order to accommodate growth induced effects from construction activities (for a more detailed discussion on growth due to construction, see Section 4.10, *Socioeconomics, Environmental Justice, and Children's Environmental Health Risks and Safety Risks*).

<u>Coastal Resources</u>

A Federal Consistency Review is being prepared, in coordination with TGLO, to assess compliance of the Proposed Action with the TCMP (see *Appendix B*). The following summarizes the findings of the Federal Consistency Determination.

Coastal Barriers. The Proposed Action is not subject to Federal funding, and is therefore not subject to restrictions under the CBRA. A letter was sent from the FAA to USFWS on June 18, 2012, requesting concurrence that the CBRA does not apply to this Proposed Action. A response letter from USFWS dated August 14, 2012, concurred that the Proposed Action is exempt from CBRA under Section 3(3)(C) which states that "assistance for environmental studies, planning, and assessments that are required incident to the issuance of permits or other authorizations under Federal law" are not considered financial assistance and therefore CBRA provisions would not apply. If NASA were to adopt the EIS, the agency would need to coordinate with the USFWS to determine if expenditures on payloads launched from the proposed site would comply with the provisions of the CBRA.

Coastal Historic Areas. No coastal historic areas would be physically altered or removed as a result of the Proposed Action.

Coastal Preserves. The proposed vertical launch and control center areas are outside of the boundaries of coastal preserves. However, impacts to wildlife resources within coastal preserves and Boca Chica Beach would be primarily limited to short-term disturbances associated with increased vehicular traffic, human presence, and noise from construction and launch activities (for more information regarding impacts to habitat and wildlife, see Section 4.8, *Biological Resources*).

Coastal Shore Areas. Proposed construction areas are located outside of the defined coastal shore. The Proposed Action would not physically impact coastal shore areas.

Coastal Wetlands. The construction of the vertical launch area and the control center area would result in the permanent impact to 6.19 acres of wetlands: approximately 3.34 acres of direct impacts and 2.85 acres of indirect impacts. SpaceX would submit an individual permit to the USACE for proposed wetlands impacts, which would require compensatory mitigation for those wetland impacts. SpaceX would comply with the conditions of the wetland permit. For more information regarding impacts to wetlands, see Section 4.7, *Water Resources*).

Critical Dune Areas. Although the property boundary for the proposed vertical launch area may abut critical dune areas, all construction is proposed inland of the dunes. Therefore, construction of the vertical launch and control center areas are not expected to compromise dune structure or impact dune vegetation. Launch activities would have minimal impacts to vegetation from fire.

Critical Erosion Areas. The proposed vertical launch area and control center area are not within a critical erosion area designated by the TGLO in the Texas Coastwide Erosion Response Plan (2009) (TGLO 2009). Therefore, implementation of the Proposed Action would not impact critical erosion areas.

Gulf Beaches. The Proposed Action would not occur in the marine environment. There would be no construction impacts to hard substrate reefs, oyster reefs, submerged lands, submerged aquatic vegetation, or open waters of the Gulf of Mexico.

Hard Substrate Reefs. The Proposed Action would not occur in the marine environment; therefore, there would be no construction impacts to hard substrate reefs.

Oyster Reefs. The Proposed Action would not occur in the marine environment; therefore, there would be no construction impacts to oyster reefs.

Submerged Lands. The Proposed Action would not occur in the marine environment; therefore, there would be no construction impacts to submerged lands.

Special Hazard Area. The proposed vertical launch and control center areas are located within Zone A8 and Zone V10 of the Flood Insurance Rate Map for Cameron County, Texas, which is designated as a special hazard area according to 31 TAC §501.3 of the TCMP (see Section 4.7, *Water Resources*).

Submerged Aquatic Vegetation. The Proposed Action would not occur in the marine environment; therefore, there would be no construction impacts to submerged aquatic vegetation (see Section 4.8., *Biological Resources*).

Tidal Sand or Mud Flats. The proposed vertical launch area includes 13.0 acres of unvegetated tidal sand flats. No mud flats are located in the vertical launch area or control center area. The construction of the vertical launch area and the control center area would result in the permanent impact of 6.19 acres of wetlands. Within the total acres of wetlands to be impacted, a total of 0.62 acre of tidal sand flats would be removed during project construction at the vertical launch area. In addition, the construction of the vertical launch area would effectively cut off the tidal influence to 2.85 acres of wetland through the construction of buildings and roads. These indirect wetland impacts are comprised of 2.54 acres of high marsh vegetated wetlands and 0.31 acre of unvegetated wetland salt flats. As discussed previously, SpaceX would submit a wetland permit application to the USACE and would comply with all permit conditions and mitigation requirements.

Water of the Open Gulf of Mexico. The Proposed Action would not occur in the marine environment; therefore, there would be no construction impacts to open waters of the Gulf of Mexico.

Water under Tidal Influence. Tidal wetlands and sand flats are present at the proposed vertical launch area, as described above. For construction of the proposed vertical launch area, 3.30 acres of tidally influenced wetlands would be impacted. No tidal wetlands are located at the proposed control center area. SpaceX would coordinate with USACE for wetland permitting and mitigation.

4.1.1.2 Operation

Land Use

Once the vertical launch and control center areas are constructed, SpaceX would conduct launches of the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of reusable suborbital launch vehicles. Operational activities are described in Section 2.1.1.

Impacts to land use from operations conducted at the control center would result from routine day-to-day activities, as well as pre-launch and launch day activities. Day-to-day, approximately 30 full-time personnel would be on-site year round, increasing over a 10-year period up to approximately 150 full-time workers in 2022 (see Table 2.1-2, Personnel for Proposed SpaceX Texas Launch Site Operations). The presence of an additional 30 to 150 people year round would change the noise environment, visual viewshed, nighttime light emissions, traffic, and number of people in the vicinity of the control center area. Launch operations would result in an increase of an additional 100 personnel intermittently. Impacts to land use at the control center area and adjacent areas are considered significant because of the change from an undisturbed area to an active facility with personnel working on-site, increased traffic, and increase noise that would occur from proposed operational activities.

Proposed operations would involve limited public access to Boca Chica State Park during launches, as closure of the nearby Boca Chica Beach and State Highway 4 would be necessary for safety and security reasons (see Section 2.1.1.6, *Launch Day Activities*, for additional details). Although the Open Beaches Act provides for unrestricted access to public beaches, SpaceX is working closely with the TGLO, the Cameron County Commissioners Court, the Cameron County Dunes Committee, the State Senator, and the State Representative to ensure that a temporary closure of a public beach and beach access would be allowable under Texas law. As of March 28, 2013, proposed legislation had been filed by State Senator Eddie Lucio, Jr. and State Representative Rene Oliveira that would amend the Texas Natural Resources Code Chapter 61 to allow for the TGLO and/or the Cameron County Commissioners Court to temporarily close a public beach and beach access for space flight activities, including launches. However, if the primary launch date falls on the major summer holidays of Memorial Day, Fourth of July, Labor Day, and/or summer weekends between Memorial Day and Labor Day weekends, additional approval from the TGLO would be required. The proposed legislation would also allow for a MOA between the TGLO and Cameron County to further define specific requirements for beach and access closure requests, approvals, and related public notices. Mitigation for these temporary closures is discussed further in Section 6.1, *Mitigation*). Due to the short duration and limited number of launches, direct impacts to nearby recreational land use are not considered to be significant.

Changes in noise conditions are an important aspect of determining land use compatibility. As described in FAA Order 1050.1E, land use compatibility is evaluated for noise sensitive areas such residential, educational, health, and religious structures and sites, and parks, recreational areas (including areas with wilderness characteristics), wildlife refuges, and cultural and historical sites. The impacts on compatible land use from noise would be most pronounced in Boca Chica Village, a nearby residential area. Adjacent public lands described in Section 3.1, *Compatible Land Use (Including Farmlands and Coastal Resources),* would also be impacted by noise from launch events, which have the potential to disrupt the general visitor experience. Impacts to land use from noise would vary depending on the launch vehicle, as the Falcon 9 would result in lower noise levels than the Falcon Heavy.

To assess land use compatibility in residential areas, consideration was given to the noise impact analysis and the DNL 65 dBA FAA standard which encompasses the area of concern. Three operational scenarios along with the baseline conditions are outlined in Table 4.1-1. DNL 65 dBA noise contours are shown in Exhibit 4.1-1.

Table 4.1-1. Annual Operations Scenarios for DNL Noise Contours

Scenario	Falcon 9 Annual Operations		Falcon Heavy Annual Operations		Total Operations	DNL 65 dBA Contour Radius (miles)	Number of Households Affected[1]
	Daytime	Nighttime	Daytime	Nighttime			
Baseline	-	-	-	-	-	-	-
A	10	-	2	-	12	1.5	-
B	9	1	2	-	12	2.0	13
C	10	-	1	1	12	2.8	35

Notes: [1]The total number of households in Boca Chica Village, is 35, which is based off of the total number of known MVEC accounts as described in Section 3.11.4.1, *Energy Supply*.

Existing ambient noise conditions in the project areas are estimated at 40 dB. Boca Chica Village would be within the DNL 65 dBA contour for Scenario B and C (Exhibit 4.1-1). Both scenarios involve a nighttime launch: one nighttime launch of the Falcon 9 (Scenario B), and one nighttime launch of the Falcon Heavy (Scenario C). In order to account for increased human sensitivity to noise at night, a 10 dB penalty is applied to nighttime events (occurring between the hours of 10:00 p.m. and 7:00 a.m.) (see Section 3.3.1, *Noise*). Under Scenario B, 13 households would be affected. Under Scenario C, 35 households would be affected. The probability of a noise induced structural vibration damage claim at Boca Chica Village would be greater than 1 in 100. Sonic booms associated with launch events would not impact residential areas, because sonic booms would occur

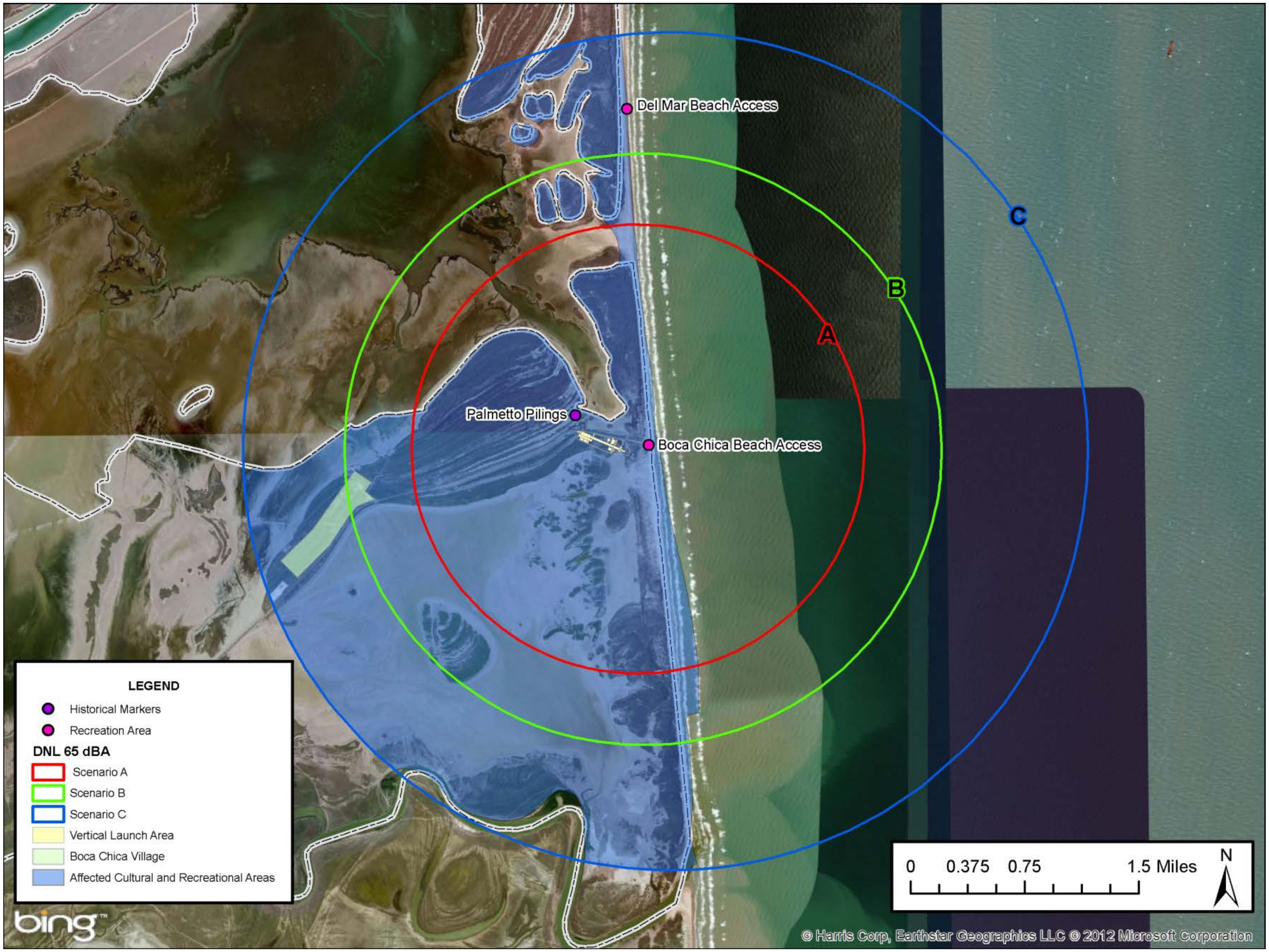

Exhibit 4.1-1 DNL 65 dBA Noise Contours for the Three Annual Operations Scenarios

more than 40 miles off the coast over the Gulf of Mexico. Although the launch noise would be short in duration (only a few minutes), would attenuate rapidly, and would occur infrequently, the increase in noise compared to current conditions is not considered compatible with nearby residential land use. Therefore, noise impacts to residential land use in the areas adjacent to the vertical launch area are expected to be significant because of the proposed significant increase of ambient noise conditions.

To assess land use compatibility in public lands, particularly those lands used for recreation, consideration was again given to the noise impact analysis and the DNL 65 dBA FAA standard, which encompasses the area of concern. Boca Chica State Park, Del Mar Beach, portions of Brazos Island State Park, the Lower Rio Grande Valley NWR, and the Palmetto Pilings and its associated historical marker, all fall within the area of concern (greater than DNL 65 dBA). FAA Order 1050.1E establishes that noise sensitive areas, such as parks, recreational areas (including areas with wilderness characteristics), wildlife refuges and cultural and historical sites, are incompatible with noise annoyances greater than DNL 65 dBA. Therefore, impacts to public land use in the areas adjacent to the vertical launch area are expected to be significant because of the proposed significant increase of ambient noise conditions.

The ROI for noise does not extend to the areas discussed in the Comprehensive Plans for the cities of Brownsville, Port Isabel, and South Padre Island. Although noise impacts from the proposed launch events may be heard in these communities, proposed noise levels would not be much higher than ambient levels (e.g., traffic along a busy street) and impacts would be temporary and infrequent, occurring a maximum of 12 times per year. The Proposed Action would not violate the goals in these Comprehensive Plans. Therefore, land use impacts to Brownsville, Port Isabel, and South Padre Island as a result of noise would not be considered significant. However, growth induced impacts to land use in Brownsville, Port Isabel and South Padre Island could result from the generation of additional indirect jobs and income in areas such as lodging and food services, and retail trade sectors, which are expected to benefit from the Proposed Action. Some food services and lodging may be built along State Highway 4 to accommodate the increased demand of laborers, personnel, and spectators for the launches. Although there is no commercial zoning in this portion of Cameron County, appropriate permitting through Cameron County would be required prior to the construction or operation of such projects.

The Brownsville Comprehensive Plan supports a growing economy and the establishment of new firms attracted by geographical opportunities, emphasizing that a successful plan for Brownsville would create conditions that promote custom opportunities in development and investment environments (City of Brownsville 2009). One land use goal of the City of Port Isabel Comprehensive Plan is to “promote the development of urban land in a manner consistent with attracting residents, visitors, and desirable commercial investments (City of Port Isabel 2005). The South Padre Island Comprehensive Plan has the development of a year-round economy with increased residents, tourists and businesses as its primary goals (South Padre Island 2008). Although Cameron and Willacy Counties could experience growth induced impacts to land use, these impacts are generally regarded as positive and in accordance with local policies and land use management plans (for a more detailed discussion on growth due to operations, see Section 4.10.1.2).

With the expiration of three and the pending expiration of one, off-shore oil and gas leases and the general lack of drilling that is currently being performed in the Gulf of Mexico, it is unlikely there would be off-shore drilling in the vicinity of the Proposed Action. Similarly, with only one low-yielding gas well, and another gas well that is no longer producing, located in the vicinity of the control center area, it is unlikely there would be additional drilling in the vicinity of the control center area. With no increase in oil and gas production in the vicinity of the proposed vertical launch area and control center areas, there would be no significant impacts to the oil and gas land use.

Active wind lease areas are not within the proposed water closure area and are not in the path of the proposed launch trajectory. Therefore, no impacts to the wind lease areas are anticipated as a result of the Proposed Action. In addition, the TGLO would not be excluded from leasing state-owned submerged lands within the water closure area; thus, the Proposed Action would not cause a loss of revenue to the PSF. However, as discussed in Section 2.1.1.6, *Launch Day Activities*, SpaceX must implement a plan that defines the process for ensuring that any unauthorized persons, ships, trains, aircraft or other vehicles are not within the hazard area during a launch event. Therefore, the Proposed Action would temporarily limit public use of state-owned submerged land during a launch event.

In summary, construction and operation of the proposed vertical launch and control center areas would change land uses from rural residential and recreational to developed, mixed use. The noise impacts associated with a typical launch would be limited to a few minutes and would occur a maximum of twelve times a year. The noise levels would exceed the FAA standard of DNL 65dBA. Impacts to land use compatibility from the construction of the facilities and from noise generated during operations, are considered to be significant.

<u>Coastal Resources</u>

The following summarizes the findings of the Federal Consistency Determination (see *Appendix B*).

Coastal Barriers. Operation of the vertical launch area and control center would not result in impacts to coastal barriers.

Coastal Historic Areas. Potential impacts could consist of visual and auditory effects on the setting of historic properties in the APE from the presence of proposed permanent structures at the vertical launch and control center areas and auditory effects from proposed launches. However, all architectural resources at the site are less than 50 years old and are not considered eligible under NRHP criteria (for more information regarding impacts to historical, architectural, archaeological and cultural resources, see Section 4.5).

Coastal Preserves. The proposed vertical launch and control center areas are outside the boundaries of coastal preserves and Boca Chica State Park. However, the disturbance from launch operations may result in short-term visual and noise impacts to individuals visiting and wildlife within the coastal preserves and the beach. Additionally, public access to Brazos Island State Park, the Lower Rio Grande Valley NWR (Boca Chica Tract), and Boca Chica State Park would be restricted during days when launches are scheduled and temporary beach closures are implemented. Impacts to wildlife resources within coastal preserves would be primarily limited to short-term disturbance associated with increased vehicular traffic, human presence, and noise from launch activities (for more information regarding impacts to habitat and wildlife, see Section 4.8 *Biological Resources*).

Coastal Shore Areas. Operation of the vertical launch area and control center would not result in impacts to coastal shore areas.

Coastal Wetlands. Operation of the vertical launch area and control center would not result in impacts to coastal wetlands.

Critical Dune Areas. Launch activities would have minimal impacts to vegetation in critical dune areas from fire. Fires are unlikely since launch activities would occur over concrete pads with no surrounding vegetation. Very little particulate deposition is expected since the Falcon 9 and Falcon Heavy vehicles utilize liquid fuels (LOX and RP-1).

Critical Erosion Areas. Operation of the vertical launch area and control center would not result in impacts to critical erosion areas.

Gulf Beaches. Access to Boca Chica Beach would be temporarily restricted during days when launches are scheduled and beach closures are implemented.

Hard Substrate Reefs. Operations would not occur in the marine environment; therefore, there would be no operation impacts to hard substrate reefs.

Oyster Reefs. Operations would not occur in the marine environment; therefore, there would be no operation impacts to oyster reefs.

Submerged Land. The Proposed Action would not occur in the marine environment. However, state-owned submerged lands are included in the water closure area for launch day activities (see Exhibit 3.1-2). The TGLO would not be excluded from leasing submerged lands within the water closure area and exploration and production of mineral resources within those areas would not be prevented by the Proposed Action. Therefore, the Proposed Action would not cause a loss of revenue to the PSF. However, as discussed in Section 2.1.1.6, *Launch Day Activities*, SpaceX must implement a plan that defines the process for ensuring that any unauthorized persons, ships, trains, aircraft or other vehicles are not within the hazard area up to 15 hours during a launch event. Therefore, the Proposed Action would limit public use of state-owned submerged land during a launch event.

Special Hazard Area. Operation of the vertical launch area and control center area would not result in impacts to special hazard areas.

Submerged Aquatic Vegetation. Due to the desire of the public to view a launch, there is the potential for increased boat traffic outside the water closure area during launch days. Elevated boating activity could increase disturbance to submerged aquatic vegetation from rotor wash. However, the majority of areas of known seagrass beds are not used by recreational boat traffic. Any disturbance to submerged aquatic vegetation as a result of boating activity associated with operations would occur a maximum of 12 times per year.

Tidal Sand or Mud Flats. Operation of the vertical launch area and control center would not result in impacts to tidal sand or mud flats.

Water of the Open Gulf of Mexico. Operation of the vertical launch area and control center would not result in impacts to waters of the Gulf of Mexico. Although the trajectory of orbital and sub-orbital vehicles would be over the Gulf, no impacts are anticipated.

Water under Tidal Influence. Operation of the vertical launch area and control center would not result in impacts to waters under tidal influence.

In summary, impacts to CNRAs as defined in the TCMP would include noise impacts associated with proposed construction and operation activities.

4.1.2 No Action Alternative

Under the No Action Alternative, the FAA/AST would not issue launch licenses and/or experimental permits that would allow SpaceX to launch the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of suborbital launch vehicles. The vertical launch area and control center area would not be constructed. No impacts to land use or coastal resources would occur under the No Action Alternative because land use would not change.

4.2 SECTION 4(F) PROPERTIES

4.2.1 Proposed Action

4.2.1.1 Construction

Construction of facilities for the Proposed Action would not involve a physical use (actual taking of lands) or temporary occupancy of Section 4(f) properties. The land that would be acquired for construction of the vertical launch and control center areas is privately owned. No lands from public parks, recreation areas, refuges, or historic sites would be purchased or placed under a permanent easement, and no public lands would be temporarily occupied during construction of the launch facilities.

The proposed construction of the vertical launch and control center areas was analyzed to determine whether construction activities would constitute a constructive use of Section 4(f) properties (i.e., whether construction would result in adverse indirect impacts that would substantially impair Section 4(f) properties). A Section 4(f) property is substantially impaired when the activities, features, or attributes of the property that contribute to its significance or enjoyment are substantially diminished. The sections below provide this assessment for public parks, recreation areas, and refuges, and historic sites.

<u>Public Parks, Recreation Areas, and Refuges</u>

Impacts from construction activities on public parks and wildlife refuges within the ROI would be temporary in nature. Construction would occur over a period of 24 months. During this time, vehicular access to Boca Chica State Park, Brazos Island State Park, and South Bay Coastal Preserve may be slowed or delayed when construction vehicles are traveling to and from the proposed vertical launch and control center areas. Vehicular access to the Lower Rio Grande Valley NWR during this time would not be restricted. There would be no permanent, long-term access restrictions to any of these Section 4(f) properties. Construction activities would result in increased noise levels, particularly during pile driving activities at the vertical launch and control center areas, but it would be short-term and temporary. The noise would not substantially limit the use or diminish the quality of any of the Section 4(f) properties, such that their value is impaired. Therefore, the FAA determined construction activities would not constitute a constructive use of these Section 4(f) properties.

Historic Sites

The analysis of impacts on historic sites protected under Section 4(f) was determined in accordance with Section 106 regulations (36 CFR Part 800). As described in Section 4.5, *Historical, Architectural, Archaeological, and Cultural Resources*, construction of the launch site would have an adverse effect on the qualities that make the Palmito Ranch Battlefield NHL eligible for the NRHP, and that make it an NHL. The setting of this site is of primary importance to its significance, and thus, to its listing on the NRHP and designation as an NHL. Indirect visual effects to the setting of the battlefield would result from the construction of the vertical launch and control center areas. Little development has occurred in this area, and what has been developed largely comprises one-story residences. The 250-ft tall water tower and the up to 200-ft tall lightning protection towers would be visible from much of the battlefield area. However, the water tower and lightning protection towers would have a small profile on the horizon due to the relative distance of the vertical launch area from the NHL (approximately 3 miles from the eastern end of the NHL). To minimize the visibility of these towers in the landscape, SpaceX would paint the towers a non-reflective, light color that blends in with the surrounding. Additional measures to minimize harm may be developed in consultation with the THC, NPS, and other consulting parties during the Section 106 process. Taking this into account, the FAA determined construction of the proposed vertical launch and control center areas would not constitute a constructive use of the NHL.

The FAA is consulting with the officials having jurisdiction over all of the Section 4(f) properties to determine whether the officials concur with FAA's determination that construction of the proposed vertical launch and control center areas would not constitute a constructive use of the properties (see Appendix C). The results of this consultation will be provided in the Final EIS.

4.2.1.2 Operation

Public Parks, Recreation Areas, and Refuges

Operation of the proposed vertical launch and control center areas would have temporary, intermittent impacts on the use of the parks and wildlife refuges and management areas identified as Section 4(f) properties in Section 3.2.1, *Definition and Description*. During launches, public access to Boca Chica State Park, Brazos Island State Park, the South Bay Coastal Preserve, major portions of the Lower Rio Grande Valley NWR, and a portion of the Palmito Ranch Battlefield NHL would be closed for safety and security reasons (refer to Exhibit 2.1-1). The closures would occur on an intermittent basis, up to 12 times per year, and would be temporary (up to 15 hours for each launch; a maximum of 180 hours a year). Therefore, closures under the Proposed Action would not substantially reduce the use or enjoyment of the parks, preserve, and wildlife refuge within the ROI because impacts from closures during launches would be intermittent and temporary.

A quiet setting is an important attribute of the Section 4(f) properties in the ROI. Therefore, in addition to closures, the FAA modeled noise levels from the vertical launch of the Falcon 9 and Falcon Heavy vehicles under the Proposed Action (see Section 4.3) to determine whether there would be significant noise increases such that the value of public land or a historic site, in terms of their purpose and quality, would be substantially impaired, thus constituting a constructive use of a Section 4(f) property. The assessment used the DNL 65 dBA standard defined by FAA Order 1050.1E for three scenarios (see Table 4.1-1). The noise modeling demonstrates that all of Boca Chica State Park and Brazos Island State Park, and portions of the South Bay Coastal Preserve and NWR, would be within the DNL 65 dBA noise contour for the three launch event scenarios. The proposed launches would produce short-term high levels of noise that would last approximately 3 to 5 minutes for each launch, and there would be no more than 12 launches per year. At all other times, the quiet setting of the Section 4(f) properties would persist. Because of the short-term and intermittent nature of the impacts from noise during launches, the FAA determined that noise from launches would not substantially diminish the attributes (i.e., quiet setting) that contribute to the enjoyment or quality of the Section 4(f) properties. Therefore, the FAA determined that operational activities would not constitute a constructive use of these Section 4(f) properties.

<u>Historic Sites</u>

During launches, public access to the eastern third of the NHL would be closed for safety and security reasons. The closures would occur on an intermittent basis, up to 12 times per year, and would be temporary (up to 15 hours for each launch; a maximum of 180 hours per year). Public notification of launches would be published in advance of all launches. The western two-thirds of the NHL, which comprises the core area of the battlefield, would be accessible to and open for use by the public during launches. Therefore, the closures would not substantially reduce the use or enjoyment of the NHL because impacts from closures during launches would be intermittent and temporary.

The FAA reviewed modeled noise levels from the vertical launch of the Falcon 9 and Falcon Heavy vehicles to determine whether there would be significant noise increases such that the value of the NHL, 1846 Cypress Pilings, 1865 Palmetto Pilings, and the Palmetto Pilings Texas Centennial Historical Marker, in terms of their respective significance, would be substantially impaired, thus constituting a constructive use of these four properties. The noise modeling demonstrates that both sets of pilings and the Palmetto Pilings Historical Marker, but not the NHL, would be within the DNL 65 dBA noise contour for the three launch event scenarios (see Section 4.3, *Noise*). The proposed launches would produce short-term high levels of noise that would last approximately 3 to 5 minutes for each launch, and there would be no more than 12 launches per year. When launches are not occurring (i.e., approximately 97 percent of the year), the normal quiet setting of the properties would persist. Because of the short-term and intermittent nature of the noise generated from launches, the FAA determined operations would not substantially diminish any of the attributes that contribute to the significance of the Section 4(f) properties. Therefore, the FAA determined the noise generated by the launches would not constitute a constructive use of the four Section 4(f) properties.

FAA Order 1050.1E indicates additional factors should be considered when determining the significance of noise impacts on noise sensitive areas within national parks. Although the NHL is outside of the DNL

65 dBA noise contours for the three modeled launch event scenarios, supplemental noise metrics were modeled at the east and west borders of the NHL (approximately 3.5 and 12.1 miles, respectively, from the vertical launch area) to determine the sound levels from a single launch event of the Falcon 9 and Falcon Heavy (see Section 4.3.1.2, *Operations*). One of the modeled noise metrics includes the A-weighted $L_{A,max}$ to examine the impact based on the 115 dBA OSHA hearing conservation guidelines discussed in Section 3.3.2, *Regulatory Setting*. The results indicate that the 115 dBA OSHA hearing conservation guideline would not be exceeded at either location of the battlefield (refer to Table 4.3-3).

Another supplemental metric modeled the potential speech interference of a launch event (see Section 4.3.1.2, *Operations*). Outdoor speech interference can be expressed as a percentage of sentence intelligibility between two people standing at approximately one meter (3.28 ft) apart and speaking in a normal voice, with 95 percent speech intelligibility as the threshold for reliable communication. The model results indicate that speech intelligibility at either location in the NHL would drop below 95 percent for a period of less than 3 to 5 minutes per launch (refer to Table 4.3-3). To account for outdoor interpretive programs where the communication distance may be greater than 3.28 feet, time above an overall sound pressure of 52 dBA was used to estimate potential speech interference between two people standing 16.4 feet (5 meters) apart with normal voice levels, or 32.8 feet (10 meters) apart with raised voice levels. The results of this model indicate that speech intelligibility at either location in the NHL would drop below 95 percent for a period of up to 6 to 8 minutes per launch.

According to the unweighted L_{max} levels modeled for the Proposed Action, the probability of noise-induced structural vibration damage to buildings or structures is 1 in 100 within areas exposed to unweighted noise levels of 119 dB or greater, which is 3.4 miles from the launch pad in the vertical launch area for the Falcon 9 and 6.4 miles for the Falcon Heavy. Of the four historic sites identified as Section 4(f) properties in Section 3.2, the Cypress Pilings, Palmetto Pilings, and Palmetto Pilings Historical Marker would be susceptible to noise-induced vibrations from launches. All three properties are northwest of the vertical launch area, within 2,000 ft of where the launch pad and associated flame duct would be positioned. Physical damage from vibrations caused by high noise levels, such as displacement or breakage of the structural features of the pilings, cracking of the marker's foundation, or the marker toppling over, would adversely impact these historic sites. The FAA would develop measures to minimize harm to the three properties in consultation with the THC and consulting parties, in accordance with the Section 106 process. In conclusion, the FAA determined operations would not cause a substantial impairment to the historical integrity of the Cypress Pilings, Palmetto Pilings, or Palmetto Pilings Historical Marker, and thus, would not constitute a constructive use of any of these properties.

In accordance with FAA Order 1050.1E, the FAA is consulting with the officials having jurisdiction over these Section 4(f) properties to determine whether the officials concur with FAA's determination that operation of the proposed vertical launch and control center areas would not constitute a constructive use of the properties (see Appendix C).

4.2.2 No Action Alternative

Under the No Action Alternative, the FAA/AST would not issue launch licenses and/or experimental permits that would allow SpaceX to launch the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of suborbital launch vehicles. The vertical launch area and control center area would not be constructed. There would be no impacts to Section 4(f) properties.

4.3 NOISE

4.3.1 Proposed Action

This section addresses noise from proposed construction activities and operational activities. Proposed construction at the vertical launch and control center areas would occur over a 24-month period as described in Section 2.1.2, *Construction Activities*. Proposed operations would consist of up to 12 launches per year of the Falcon 9, Falcon Heavy, and a variety of reusable suborbital launch vehicles as described in Section 2.1.1, *Operational Activities.* Noise impacts are assessed for noise exposure, occupational noise, and the potential for structural damage.

4.3.1.1 Construction

Intermittent construction noise would occur from proposed construction activities over 24 months at the vertical launch and control center areas. Construction would typically occur during normal working hours between 8:00 a.m. and 5:00 p.m., Monday through Friday. The control center area is immediately adjacent to Boca Chica Village; the vertical launch area is approximately 1.8 miles from the nearest residence in Boca Chica Village.

Construction activities that would impact community noise levels include noise from construction equipment operating at the sites and construction/delivery vehicles traveling to and from the sites. Residences within Boca Chica Village would experience increased noise levels primarily from construction activities and construction/delivery vehicles at the control center area, and from construction/delivery vehicles traveling to and from the vertical launch area. Construction would result in increased noise levels, particularly during pile driving activities at the vertical launch area. Construction activities, including impact pile driver hammering, could potentially create multiple, individual noise sources that range from L_{max} 73 to 101 dBA at 50 ft from the activities (DOT 2006). Traffic noise from a diesel truck traveling 50 miles per hour is approximately 85 dBA at 50 ft (California Department of Transportation 1998). As the distance doubles between the noise source and receiver, there is typically a reduction in the noise level of approximately 3 dB from a linear source such as a busy roadway and 6 dB from a point source like construction operations at the site.

Noise levels at a given receptor would depend on the type and number of pieces of construction equipment being operated and receptor’s distance from the construction site. Small increases in noise levels along truck routes would be expected as a result of the operation of delivery trucks and other construction vehicles. Noise impacts would vary widely, depending upon the phase of construction and specific task being undertaken. Phases of construction that would generate noise include land clearing and excavating, foundation and capping, erection of structural steel, construction of exterior walls, and construction of roads and utilities. Increased noise levels would typically be greatest during the early stages of each construction phase, although these periods would be of relatively short duration. Therefore, significant impacts to community noise levels from proposed construction related activities are not anticipated.

Occupational noise exposure prevention procedures, such as hearing protection, would be required at the construction sites to comply with all applicable OSHA occupational noise exposure regulations. Therefore, significant impacts to workers at the construction sites from proposed construction related activities are not anticipated.

4.3.1.2 Operation

Small increases in noise levels along State Highway 4 would be expected as a result of the operation of delivery trucks and other personnel vehicles. Increased noise levels would typically be greatest during commuting hours, although these periods would be of relatively short duration. Operation of the facilities at the vertical launch and control center areas would typically occur during normal working hours between 8:00 a.m. and 5:00 p.m., Monday through Friday. Noise impacts would vary widely, depending upon the specific task being undertaken. For the control center area, primary noise sources would be similar to those found at a general industrial site, including nonroad equipment (i.e., forklifts), truck traffic, employee vehicles, generators, and other on-site equipment. Primary payload processing activities, including payload checkout, spacecraft propellant loading, and payload encapsulation, would take place at the control center area. These activities are further described in Section 2.1.2, *Construction Activities*. It is expected there would be minimal noise from these activities as they would take place inside an enclosed Hangar. In addition, other activities at the control center area consist of typical office work, which would also be confined to inside the buildings. Non-launch operations at the vertical launch area would not be expected to generate a significant amount of noise as first and second stage integration would take place inside an enclosed Hangar. During pre-launch periods, activity at the control center area would increase with a commensurate increase in vehicular traffic, nonroad equipment usage, and generator usage. These activities would resume to routine levels post-launch. Therefore, significant impacts to community noise levels from proposed non-launch, operations-related activities are not anticipated.

Transient noise events would occur under the Proposed Action, including up to 12 launches per year, which includes a maximum of two Falcon Heavy launches. Noise levels from the launch vehicles would occur at the vertical launch area and in the surrounding area. As launch vehicles in flight gain altitude, their noise contributions drop to lower levels, eventually becoming indistinguishable from background or ambient noise. At subsonic speeds the noise generated by rocket launches is primarily from the combustion of propellants and the engine exhaust interacting with the atmosphere.

As discussed in Section 3.3, *Noise*, DNL is typically used for the evaluation of community annoyance. DNL is a composite metric that accounts for the SEL of all noise events in a 24-hour period. Typically DNL levels are expressed as the level over a 24-hour annual average day. In order to account for increased human sensitivity to noise at night, a 10-dB penalty is applied to nighttime events (occurring between the hours of 10:00 p.m. and 7:00 a.m.). Therefore, the DNL is dependent on the number of annual daytime and nighttime events. The Proposed Action includes up to 12 launches per year, which equates to 0.033 average daily events.

Three scenarios are outlined in Table 4.1-1 and their respective DNL 65 dBA noise contours are shown in Exhibit 4.1-1. FAA Order 1050.1E, Change 1, states a significant noise impact would occur if analysis shows that the Proposed Action would cause a noise sensitive area to experience an increase in noise of DNL 1.5 dBA or more at or above the DNL 65 dBA noise exposure level when compared to existing ambient noise conditions, estimated at 40 dBA. Boca Chica Village falls within the DNL 65 dBA contour for Scenarios B and C (see Exhibit 4.1-1). Both scenarios involve a nighttime launch: one nighttime launch of the Falcon 9 (Scenario B), and one nighttime launch of the Falcon Heavy (Scenario C). Under Scenario B, 13 households would be affected. Under Scenario C, 35 households would be affected. Therefore, noise impacts to Boca Chica Village would be considered significant during a nighttime launch of the Falcon 9 and Falcon Heavy only.

Noise from a single launch event was modeled to examine the impact based on the 115 dBA hearing conservation guidelines discussed in Section 3.3.2, *Regulatory Setting*. Exhibit 4.3-1 shows the proposed noise contours from the launch of the Falcon 9 launch vehicle represented by the Maximum A-Weighted OASPL ($L_{A,max}$). Exhibit 4.3-2 shows the proposed noise contours from the launch of the Falcon Heavy launch vehicle represented by the $L_{A,max}$. The nearest house to the vertical launch area is marked with a black diamond in each exhibit.

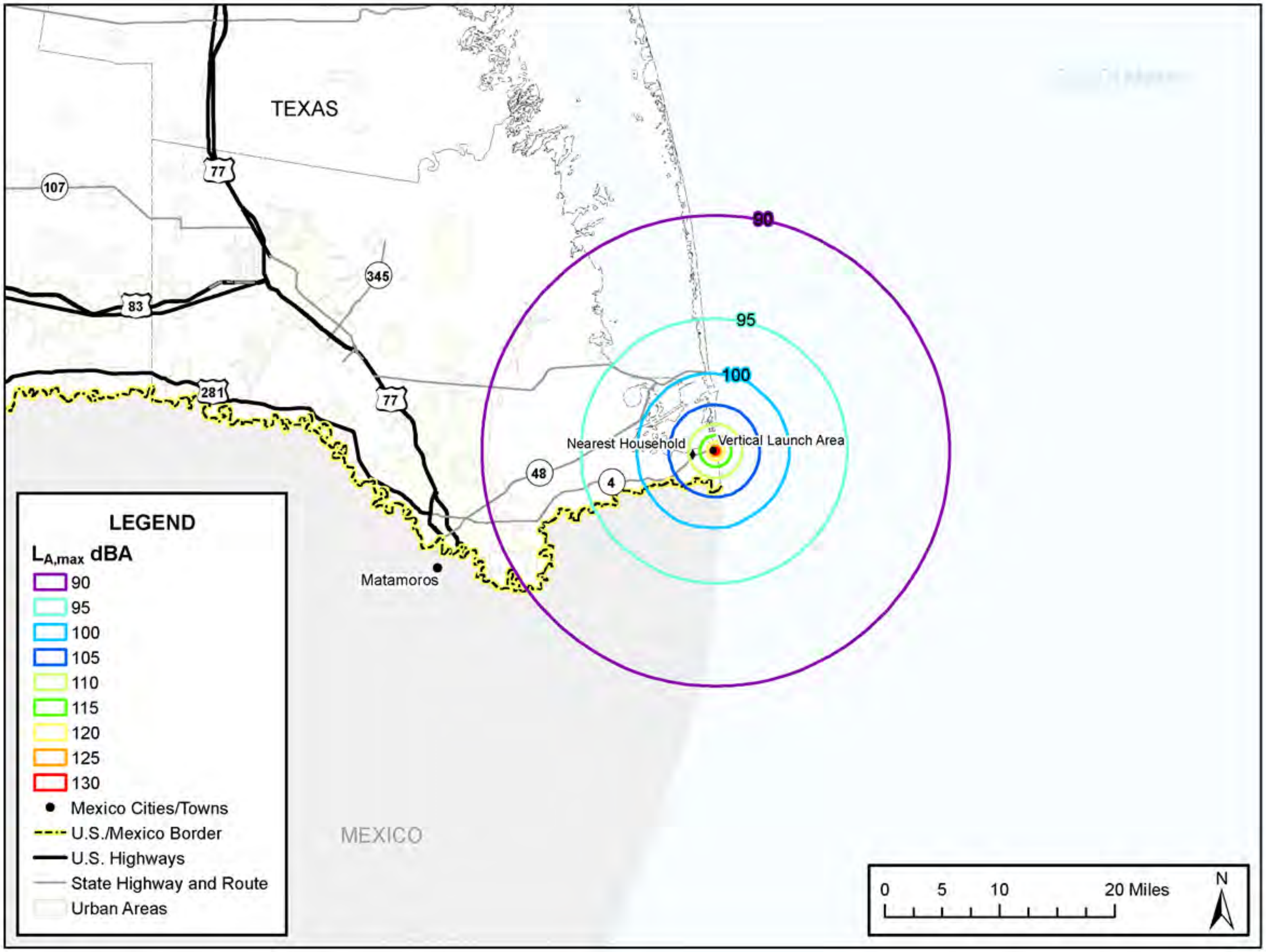

Exhibit 4.3-1. Modeled OASPL Noise Contours for a Falcon 9 Launch (A-weighted $L_{A,max}$)

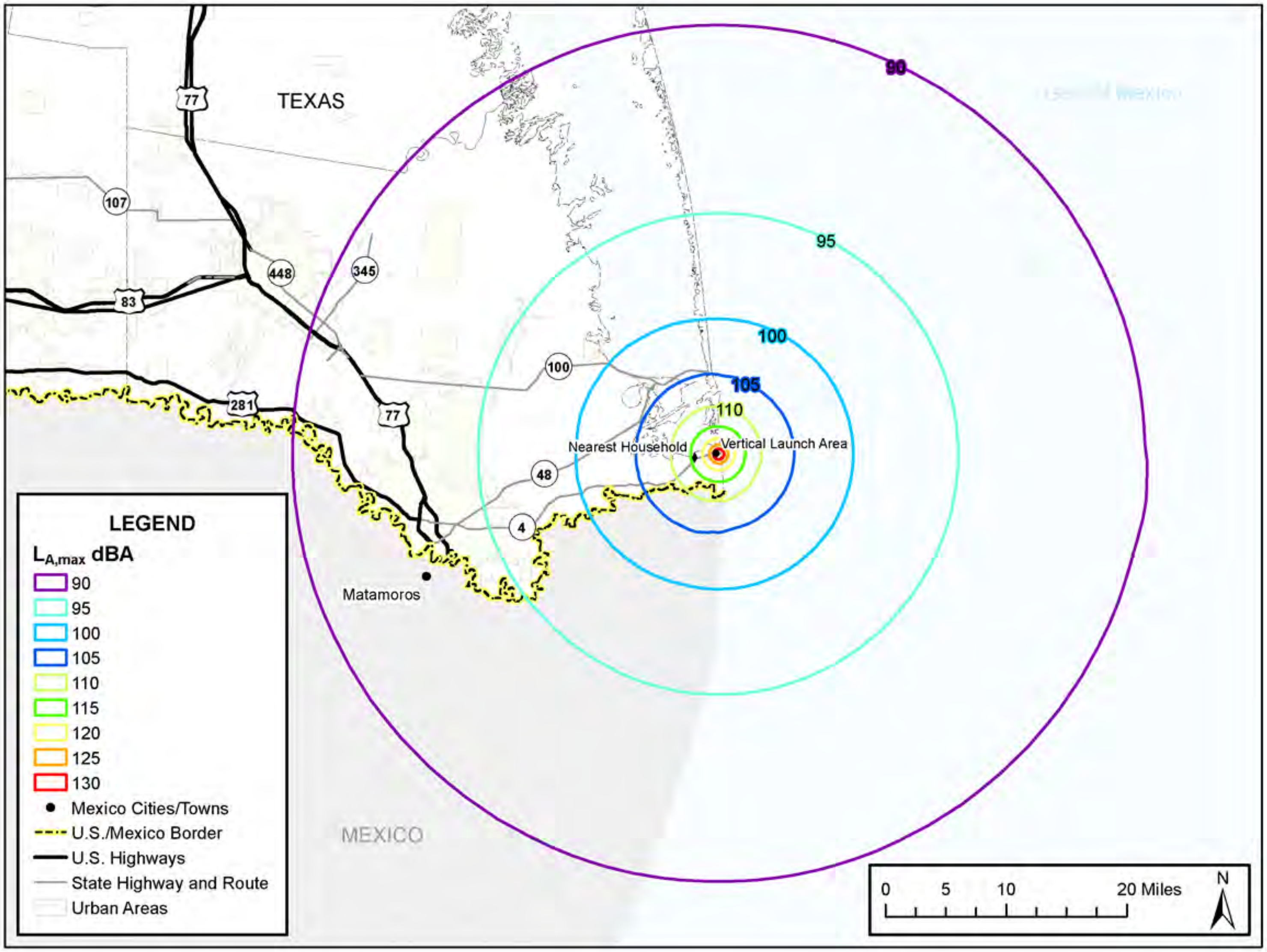

Exhibit 4.3-2. Modeled OASPL Noise Contours for Falcon Heavy Launch Vehicle (A-weighted $L_{A,max}$)

Table 4.3-1 provides the maximum predicted $L_{A,max}$ versus distance values (at any given heading from the pad) for the Falcon 9 and Falcon Heavy launch vehicle.

Table 4.3-1. Falcon 9 and Falcon Heavy Maximum Predicted $L_{A,max}$ by distance (Maximum A-Weighted OASPL)

	$L_{A,max}$ (dBA)	
Distance (miles)	**Falcon 9**	**Falcon Heavy**
0.2	130	135
0.3	128	133
0.4	125	130
0.5	123	128
0.6	122	126
0.7	120	125
0.8	119	123
0.9	118	123
1.0	117	122
1.5	113	118
2.0	111	115
3.0	107	112
4.0	104	109
5.0	102	107
6.0	100	105
7.0	99	104
8.0	98	103
9.0	96	101
10.0	95	100
12.0	94	99
15.0	92	97
17.0	91	95
20.0	89	94

Notes: $L_{A,max}$ = A-weighted maximum sound level; OASPL = overall sound pressure level; dBA =A-weighted decibel

The nearest house location, located 1.8 miles from the proposed vertical launch area, was modeled as a specific point of interest to determine the sound levels from a single launch event of a Falcon 9 and Falcon Heavy. The model predicted a maximum OASPL of 114 dBA for the Falcon 9 and 119 dBA for the Falcon Heavy at the nearest house location. Although the nearest house may experience noise levels above the 115 dBA hearing conservation guideline from a Falcon Heavy launch, the noise levels above 115 dBA would only last approximately 45 seconds, and proposed launches of the Falcon Heavy would only occur a maximum of two times per year (Appendix D). The results of the noise study conclude that noise levels may exceed the 115 dBA guideline within distances up to approximately 1.2 miles for the Falcon 9 and 2.1 miles for the Falcon Heavy (Appendix D). For a launch of the Falcon 9, the short-term impacts based on the hearing conservation guideline are not anticipated to be adverse as there are no housing developments within 1.2 miles of the proposed vertical launch area. However, the short-term impacts based on the hearing conservation guideline within 2.1 miles from the proposed launch of the Falcon Heavy are anticipated to be adverse, as the 115 dBA guideline is exceeded at these distances, albeit for less than 1 minute.

Hearing protection measures would be implemented to ensure the health and safety of Boca Chica Village residents during launch activities. For example, the residents would be notified of each scheduled launch event and potential noise hazards well in advance of the launch day (see Section 2.1.1.5, *Pre-Launch Activities*). Residents would be encouraged to remain indoors during a launch event, which can reduce noise exposure. SpaceX may also make hearing protection devices available to residents to reduce noise levels below 115 dBA at distances up to approximately 1.2 miles for the Falcon 9 and 2.1 miles for the Falcon Heavy.

During a launch, workers would normally be at the control center area, which is approximately 2 miles from the vertical launch area. Any workers potentially exposed to noise greater than OSHA standards at the control center area would be required to wear adequate hearing protection to comply with all applicable OSHA occupational noise exposure regulations. Therefore, adverse impacts to workers at the control center area during launches are not anticipated.

Analyzing noise impacts to structures considers the unweighted dB level. Exhibit 4.3-3 shows the modeled unweighted OASPL (L_{max}) noise contours from the launch of the Falcon 9 launch vehicle. Exhibit 4.3-4 shows the modeled L_{max} noise contours from the launch of the Falcon Heavy launch vehicle. The nearest house to the vertical launch area is marked with a black diamond in each exhibit. Table 4.3-2 provides the maximum modeled L_{max} versus distance values (at any given heading from the pad) for the Falcon 9 and Falcon Heavy.

Table 4.3-2. Falcon 9 and Falcon Heavy Maximum Predicted L_{max} by distance (Maximum Unweighted OASPL)

	L_{max} (dB)	
Distance (miles)	**Falcon 9**	**Falcon Heavy**
0.2	141	146
0.3	139	144
0.4	137	142
0.5	135	140
0.6	133	138
0.7	132	137
0.8	130	135
0.9	130	135
1.0	129	134
1.5	126	130
2.0	123	128
3.0	120	125
4.0	117	122
5.0	116	121
6.0	114	119
7.0	113	118
8.0	112	117
9.0	111	116
10.0	110	115
12.0	109	114
15.0	107	112
17.0	106	111
20.0	105	111

Notes: L_{max} = maximum sound level; OASPL = overall sound pressure level; dB =decibel

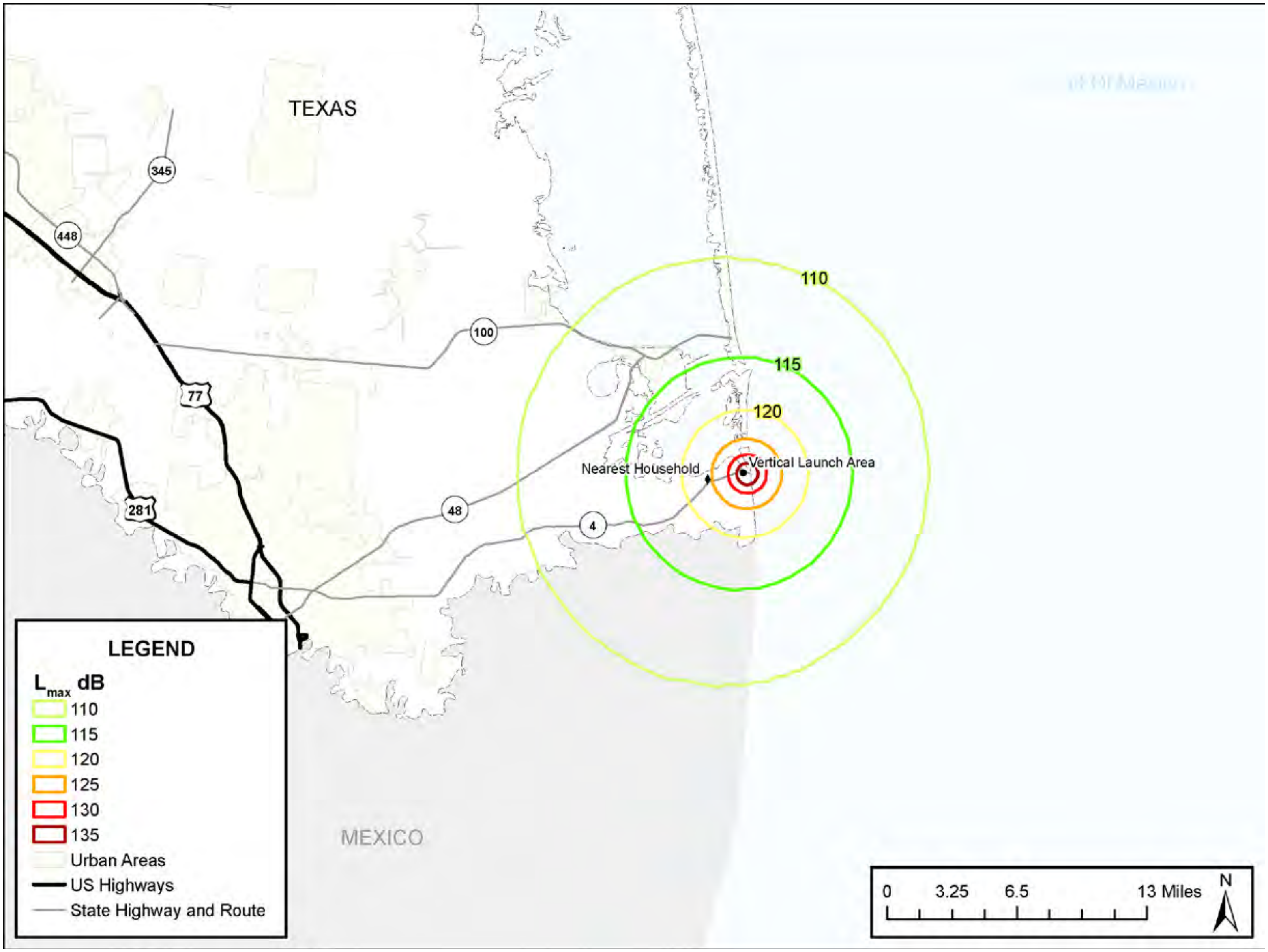

Exhibit 4.3-3. Modeled OASPL Noise Contours for Falcon 9 Launch Vehicle (Unweighted L_{max})

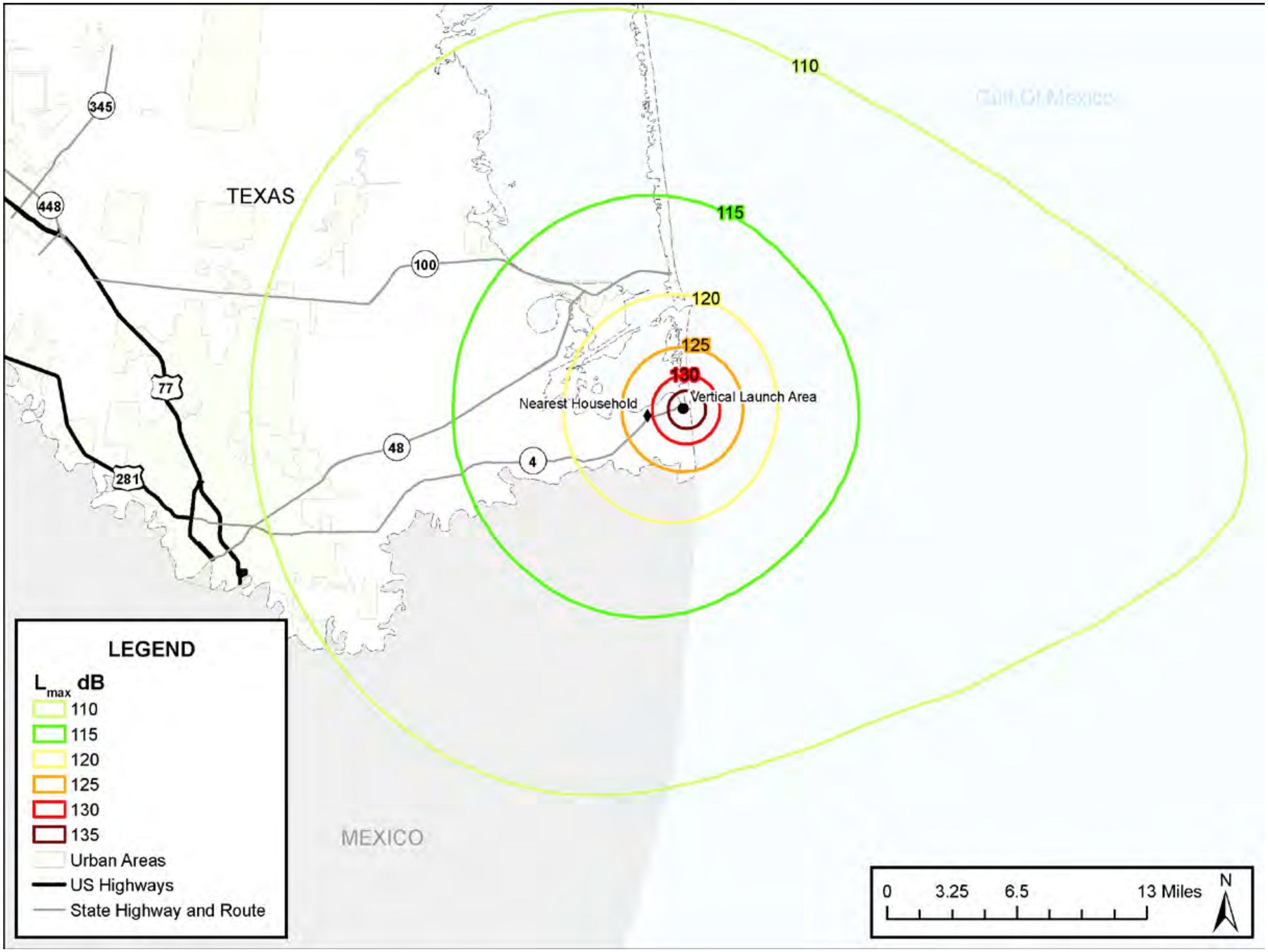

Exhibit 4.3-4. Modeled Noise Contours for Falcon Heavy Launch Vehicle (Unweighted L_{max})

Studies based on ground testing of rocket systems indicate an expectation of 1 damage claim in 1,000 households exposed to an average continuous noise level of 111 dB, and 1 in 100 households at 119 dB. Accordingly, the unweighted noise levels of 111 dB and 119 dB are used as a general guideline for assessing potential risk for structural damage claims (Appendix D).

The area exposed to levels of 119 dB or greater is included within 3.4 miles of the vertical launch area for the Falcon 9 and within 6.4 miles of the vertical launch area for the Falcon Heavy. The area exposed to unweighted noise levels of 111 dB or greater is included within 9.1 miles of the vertical launch area for the Falcon 9 and within 17.3 miles of the vertical launch area for the Falcon Heavy. The unweighted noise levels at the nearest house, which is 1.8 miles from the vertical launch area, suggest the probability of a noise induced structural vibration damage claim would be greater than 1 in 100 (Appendix D).

Areas exposed to unweighted noise levels of 111 dB or greater would extend to South Padre Island and into Mexico. Because FAA is required to analyze transboundary impacts, areas in Mexico are also considered in the analysis. The FAA/AST sent a letter, dated February 27, 2013, to the Mexico Secretary of Communications and Transportation to request comments on the Proposed Action. The unweighted L_{max} levels indicate the probability of a noise induced structural vibration damage claim at South Padre Island would be less than 1 in a 100 for a Falcon 9 launch and greater than 1 in a 100 for a Falcon Heavy launch. Sound levels indicate the maximum A-weighted OASPL levels on the island would be less than 115 dBA hearing conservation guidelines. South Padre Island lies outside the DNL 65 dBA contours.

The unweighted L_{max} levels at what appears to be the closest population center in Mexico (25.858550° N, 97.268427° W) to the vertical launch area indicate the probability of a noise induced structural vibration damage claim would be less than 1 in 1,000 for a Falcon 9 launch and slightly greater than 1 in 1,000 for a Falcon Heavy launch. The maximum A-weighted OASPL levels in this area of Mexico would be less than 115 dBA hearing conservation guidelines (see Exhibit 4.3-1 and 4.3-2). Mexico lies outside the DNL 65 dBA contour levels for Scenarios A and B with a small area located inside the DNL 65 dBA for Scenario C, which includes one nighttime Falcon Heavy launch (refer to Exhibit 4.1-1). As discussed in Section 3.3.4. *Existing Conditions*, aerial imagery south of the U.S./Mexico border has been reviewed and the area was found to be unpopulated and undeveloped.

Palmito Ranch Battlefield NHL and Palo Alto Battlefield National Historic Park were modeled as specific points of interest to determine the sound levels due to a single launch event of the Falcon 9 and Falcon Heavy. The specific points modeled are located on the Palmito Ranch Battlefield eastern and western borders and Palo Alto Battlefield, and are located approximately 3.5, 12.1, and 19.4 miles, respectively, from the vertical launch area. Assessment methods included an evaluation of the maximum A-weighted and unweighted OASPL, along with SEL and time above supplemental noise metrics, as presented in Table 4.3-3.

Table 4.3-3. Supplemental Noise Metrics for Palmito Ranch Battlefield and Palo Alto Battlefield (Maximum A-weighted and Unweighted OASPL, SEL, and Time Above)

Acoustic Metrics	Palmito Ranch Battlefield (Eastern Border)		Palmito Ranch Battlefield (Western Border)		Palo Alto Battlefield	
	Falcon 9	Falcon Heavy	Falcon 9	Falcon Heavy	Falcon 9	Falcon Heavy
L_{max} (dBA)	105	110	94	99	89	94
L_{max} (dB)	119	124	109	114	105	110
SEL (dBA)	121	126	112	116	108	112
Time Above (66 dBA)	<3 min	<5 min	<3 min	<4 min	<3 min	<3 min
Time Above (52 dBA)	<7 min	<8 min	<6 min	<8 min	<5 min	<7 min

The A-weighted $L_{A,max}$ results indicate that the 115 dBA hearing conservation guideline would not be exceeded at any of the battlefield locations. The unweighted L_{max} results at the eastern border of Palmito Ranch indicate the probability of a noise induced structural vibration damage claim would be greater than 1 in a 100 for a Falcon 9 or Falcon Heavy launch. The unweighted L_{max} results at the western border of Palmito Ranch indicate the probability of a noise induced structural vibration damage claim would be less than 1 in a 1,000 for a Falcon 9 launch and less than 1 in a 100 for a Falcon Heavy launch. The unweighted L_{max} results at the Palo Alto indicate the probability of a noise induced structural vibration damage claim would be less than 1 in a 1,000 for a Falcon 9 or Falcon Heavy launch. The SEL is provided as a supplemental metric, which represents the noise exposure of the entire acoustic event. Note, both Palmito Ranch and Palo Alto Battlefields are located outside of the DNL 65 dBA contours.

Time above OASPL 66 dBA is an additional supplemental metric that can be used to estimate potential speech interference. Outdoor speech interference can be expressed as a percentage of sentence intelligibility among two people speaking in a normal voice at approximately 1 meter (3.28 ft) apart. The model results indicate that speech intelligibility would drop below 95 percent for a time period of up to 3 to 5 minutes per launch as shown in Table 4.3-3. Ninety-five percent speech intelligibility usually permits reliable communication because of the redundancy in normal conservation.

<u>Sonic Booms</u>

In addition to the launch noise, a launch vehicle can create a sonic boom as a result of the shock waves created from supersonic flight, when the vehicle travels faster than the speed of sound. The perception of a sonic boom depends on the distance from the vehicle to the observer as well as the physical characteristics of the vehicle and the atmospheric conditions. The noise is perceived as a deep double boom, with most of its energy concentrated in the low frequency range. Although sonic booms generally last less than 1 second, their potential for impact is considerable (Appendix D).

Advanced acoustic models were used to generate noise contours for assessing the noise levels and noise exposure in the area surrounding the proposed vertical launch area (Appendix D). Several aspects of the launch vehicles were considered in the acoustic models including engine characteristics, ascent trajectory, and the vehicle dimensions. The models used to predict the launch noise and sonic boom impact (PCBOOM4) considered the launch vehicle model, trajectory path, atmospheric conditions, and the ground surface height (Appendix D).

The ground overpressure due to sonic booms was modeled to determine the noise impact generated by a launch event. The sonic boom overpressure is measured in pounds per square foot. The sonic booms modeled for the Falcon 9 and Falcon Heavy would intercept the surface more than 40 miles off the coast over the Gulf of Mexico with a maximum sonic boom overpressure of 5.25 pounds per square foot (Appendix D, and would not be heard on land. Sonic boom impacts to marine life are discussed in Section 4.8.1.2, *Operation*. There would not be a significant impact from noise as a result of sonic booms.

4.3.2 No Action Alternative

Under the No Action Alternative, the FAA would not issue launch licenses and/or experimental permits to SpaceX for launch operations from the private site in Cameron County, Texas. Ambient noise conditions in and around the proposed vertical launch area and control center areas would remain as they are today and no significant impacts would occur.

4.4 VISUAL RESOURCES AND LIGHT EMISSIONS

4.4.1 Proposed Action

4.4.1.1 Construction

Construction activities at the vertical launch and control center areas would occur over a 24-month period. The construction would typically occur between the hours of 8:00 am and 5:00 pm, Monday through Friday. During the construction phase, the presence of stockpiled materials, excavated soils stockpiles, scaffolding, and large pieces of equipment including cranes would be highly visible on the flat landscape to the casual observer. Two sets of casual observers would be impacted by construction activities at both areas. The residents of Boca Chica Village would be impacted by the high visibility of construction equipment at both areas for extended periods of time. Visibility to travelers on State Highway 4 would be intermittent and for short periods of time. Impacts to both sets of casual observers from construction activities would be temporary, lasting only as long as construction activities would occur. Overall, construction is expected to last 24 months, but the exact nature of the materials that would be visible (e.g., excavated soil or construction equipment) would vary over this time period.

Implementation of the VCR system analysis for the proposed vertical launch area indicates a moderate to weak overall contrast between the current landscape and that of the landscape following the clearing and grading to level the land with regards to the features (land/water and vegetation) and the elements (form, line, color, and texture) present. The level, horizontal forms created by the cutting and filling of the land at the vertical launch area would have no contrast with the flat, horizontal form of the present landscape and adjacent Gulf of Mexico. However, the straight, sharp lines created by clearing the land would contrast strongly with the gently undulating lines of the landscape, including that found on Boca Chica Beach, and the surface of the water in the Gulf of Mexico. The removal of the natural vegetation would expose the tan sandy soils underneath, which would have a strong contrast with the green/blue colors of the water in the Gulf of Mexico but no contrast with the tan colors in tidal areas on the landscape. The smooth texture of the exposed areas would have a weak contrast with the smooth texture of the landscape and that of the water in the Gulf of Mexico. As the vegetation remaining over a large portion of the vertical launch area would be the same as that in the surrounding landscape, there would be no contrast in form, line, color, or texture.

Implementation of the VCR system analysis at the proposed control center area indicates a weak overall contrast between the current landscape and that of the landscape following the clearing and grading to level the land with regards to the features (land/water and vegetation) and the elements (form, line, color, and texture) present. The level, horizontal forms created by cutting and filling the land would have no contrast with the level, horizontal form of the existing landscape. The sharp, distinct lines created by the clearing of the vegetation on the landscape would contrast sharply with the soft, indistinct lines of the landscape. The removal of vegetation would expose the brown and tan soils, creating no contrast with the underlying soils of the surrounding landscape. The texture of the exposed areas would also have a weak contrast with the smooth texture of the surrounding land. As the vegetation remaining over a large portion of the control center area would be the same as that in the surrounding landscape, there would be no contrast in form, line, color, or texture.

As all construction activities would occur during daylight hours, no additional lighting is expected to be necessary. Consequently, there would be no impacts from light emissions during construction phases of the project.

4.4.1.2 Operation

Presence of the Vertical Launch and Control Center Areas

Implementation of the VCR system analysis at the proposed vertical launch area indicates a strong contrast between the current landscape and that of the landscape following construction of the facilities with regards to the features (buildings and structures) and the elements (form, line, color, and texture) present. The flat launch pad and ramp would contrast weakly with the dominant horizontal, flat form of the landscape including the waters of the Gulf of Mexico. The blocky, rectangular buildings and tall, linear water tower and lightning towers at the vertical launch area would have a strong contrast with the triangular and trapezoidal forms of the dunes and the dominant flat, horizontal landscape. Contrasts with the buildings and structures on South Padre Island in the background to the north would be weak. However, the view of casual observers along State Highway 4 is to the east and west and not to the north and south, negating the weaker contrast. Contrasts with buildings and structures of Boca Chica Village in the background would also be weak. However, the distance (1.8 miles) between the vertical launch area and Boca Chica Village would largely negate the weaker contrast. Additionally, the contrast would be reduced only to some degree for westbound travelers. The straight, sharp lines created by the construction of the launch pad, ramp, parking areas, and roads would contrast strongly with the gently undulating lines of the landscape. The bold, straight, vertical lines of the buildings and structures would have a high degree of contrast with the gently undulating, horizontal lines on the landscape. Final colors of the proposed buildings and structures at the vertical launch area would be coordinated with NPS to minimize visibility of the structures from the Palmito Ranch Battlefield NHL. Therefore, color contrasts cannot be analyzed at this time. Lastly, the smooth texture of the buildings and structures would contrast strongly with the coarse texture of the vegetation.

Implementation of the VCR system analysis at the proposed control center area indicates a strong contrast between the current landscape and that of the landscape following the construction of the facilities with regards to the features (buildings and structures) and the elements (form, line, color, and texture) present. The blocky, rectangular buildings, antennas, and circular water tanks at the control center area would have a strong contrast with the horizontal, flat landscape. Contrasts with the surrounding buildings of Boca Chica Village would be weak to moderate. The vertical, sharp lines of buildings and structures would contrast strongly with the indistinct, horizontal lines of the landscape. Colors of the proposed buildings and structures at the control center area are unknown at this time so contrasts cannot be analyzed. Lastly, the smooth texture of the buildings and structures would contrast strongly with the coarse texture of the vegetation.

A viewshed analysis conducted for the proposed vertical launch area to the west towards Brownsville indicates the vertical launch area would be visible to a casual observer standing 5 ft 7 inches tall along State Highway 4 at distances in excess of 15 miles. Also, a visual simulation of the vertical launch area from a point along State Highway 4 at the eastern end of the Palmito Ranch Battlefield NHL indicates a moderate to high degree of contrast with the current setting (see Exhibit 4.4-1). A weak to moderate contrast is indicated between the buildings and structures of the control center and the existing buildings and structures of Boca Chica Village that surrounds it.

Once constructed, the structures associated with the proposed vertical launch and control center areas would likely have a significant impact on the visual resources of the ROI. Possible mitigation measures for the significant impact are listed in Chapter 6.

<u>Daily and Launch Operations</u>

For safety and security purposes after construction, the entire vertical launch area and some of the interior facilities would be lighted between dusk and dawn after the construction phases are completed. The entire vertical launch area would be lit by high pressure sodium (HPS) fixtures mounted on poles. HPS light fixtures mounted on poles would also be used at the launch pad. The exact number and placement of the poles for the vertical launch area lighting is currently uncertain, but would be determined during the site engineering design process. During each annual night launch, bright metal halide spotlights would be used for a short duration (1-2 days maximum) to illuminate the launch vehicle. The number of spotlights would be finalized during the site engineering design process. The guard buildings at the two entry gates at the vertical launch area would have exterior lights for security purposes. The exterior lighting at the guard buildings would consist of 135W low pressure sodium "full cutoff" wall mounted fixtures and vapor proof, F32, T8, amber sleeved, fluorescent tube fixtures mounted on the ceilings underneath overhangs.

Exhibit 4.4-1. Visual Simulation of the Vertical Launch Area from a Point Along State Highway 4 at the Eastern End of the Palmito Ranch Battlefield NHL

The daytime operations at the vertical launch area would have no impact on the light emissions in the area during the daylight hours. Nighttime lighting would result in greater levels of light emissions of greater intensity at the vertical launch area. The lighting of the vertical launch area and the interior facilities during the nighttime hours (dusk to dawn) would be designed so as to not be visible from areas seaward of the dunes on Boca Chica Beach in order not to impact wildlife. The lighting at the facility would be visible to residents of Boca Chica Village located 1.8 miles away to the west. However, at this distance, the lighting would be only minimally visible during the hours between dusk and dawn when the residents of the housing development are primarily sleeping. Nighttime launch activities would result in particularly intense light emissions; however, the Proposed Action includes only one nighttime launch per year. Although only for a short duration, light emissions during nighttime launches would be dramatically higher than current conditions. As discussed in Section 2.1.2.1, *Vertical Launch Area*, SpaceX would prepare a Lighting Management Plan in coordination with the USFWS and NPS prior to construction and use of the vertical launch area. Therefore, the light emissions at the vertical launch area at night would have a moderate impact on the current low intensity and limited emissions that are currently present.

In addition to daily operations, launches of the Falcon 9, Falcon Heavy, and smaller reusable launch vehicles would be visible for several miles around the vertical launch area up to 12 times a year. The launch vehicles would leave a contrail (i.e., a white exhaust plume of smoke and steam and a flame) as a result of the fuel mixture being combusted. Launches would have the potential to be seen by residents of nearby villages, towns, and cities (e.g., Boca Chica Village, Brownsville, Port Isabel, etc.). Visual impacts from launches would be short-term and infrequent, because the launches would be visible for only a few minutes, and there would be a maximum of 12 launches per year. A nighttime launch would have the greatest impact due to the low light emissions in the area.

The daytime operations at the control center area would have no impact on the light emission in the area during the daylight hours. Nighttime launch operations would result in somewhat greater levels of light emissions than that currently present from Boca Chica Village. The slightly greater light emissions would have a negligible impact on the current levels present.

4.4.2 No Action Alternative

Under the No Action Alternative, the FAA/AST would not issue launch licenses and/or experimental permits to SpaceX for launch operations from the private site in Cameron County, Texas. The vertical launch and control center areas would not be constructed. The area would remain the same as it is today. Therefore, no impacts would occur to visual resources and light emissions.

4.5 HISTORICAL, ARCHITECTURAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

4.5.1 Proposed Action

The Proposed Action has the potential to indirectly impact a total of 11 historic properties. Table 4.5-1 lists these properties. Potential indirect impacts could result from visual or auditory effects or from ground vibrations. Other potential indirect impacts would consist of secondary (induced) impacts. Secondary impacts consist of impacts resulting from the increased visitation and use of the area due to the presence of the launch site (refer to Section 4.12 for the *Secondary [Induced] Impacts* analysis). The indirect impacts to five of the historic properties are considered to be an adverse effect because the impacts could diminish their integrity, which is one of the criteria for listing on the NRHP, as described below. The adversely affected properties include the Palmito Ranch Battlefield NHL (41CF93), the 1846 Cypress Pilings (41CF117.1), the associated Pilings Site (41CF117.2), the 1865 Palmetto Pilings (no number), and the Palmetto Pilings Historical Marker (no number).

Table 4.5-1. NRHP-Listed and Eligible Cultural Resources Affected by the Proposed Action

Resource No.	Resource Name	Resource Type	NRHP Status	Effect
41CF4	Brazos Santiago Depot	1840-1870 military depot and camp	Listed	No Adverse Effect
41CF6	White's Ranch	Civil War camp	Potentially eligible	No Adverse Effect
41CF7	Clarksville	1847-1874 town site	Potentially eligible	No Adverse Effect
41CF19	--	Prehistoric campsite	Potentially eligible	No Adverse Effect
41CF93	Palmito Ranch Battlefield	Civil War battlefield	Listed; NHL	Adverse Effect
41CF117.1	Cypress Pilings	1846 floating bridge pilings	Potentially eligible	Adverse Effect
41CF117.2	Pilings Site	Historic campsite	Potentially eligible	Adverse Effect*
41CF125	Boca Chica Beach Wreck	Historic shipwreck	Potentially eligible	No Adverse Effect
41CF184	Boca Chica #2	Historic shipwreck	Potentially eligible	No Adverse Effect
N/A	Palmetto Pilings	1865 railroad pilings	Potentially eligible	Adverse Effect
N/A	Palmetto Pilings Historical Marker	1936 granite marker	Determined eligible	Adverse Effect

N/A = Not Applicable
*Secondary (Induced) impact; refer to Section 4.12.

4.5.1.1 Construction

Construction of the proposed vertical launch and control center areas would not directly (physically) impact any historic property. No significant archaeological resources were found during the pedestrian survey and shovel probing of the direct impacts APE. One archaeological site and six isolated finds were found during survey of the vertical launch area. An intensive pedestrian survey, metal detection survey, and shovel testing of the three parcels at the control center area resulted in the identification of 13 isolated finds. The single site and all 19 of the isolated finds have been evaluated as not eligible for the NRHP, as they meet none of the eligibility criteria set forth in 36 CFR 60.4. As such, the Proposed Action would have no effect on them.

Construction of the vertical launch and control center areas would indirectly affect the Palmito Ranch Battlefield NHL. The setting of the battlefield is considered an important aspect of its integrity. The existing landscape is largely undeveloped and little changed from its period of significance. The construction of the vertical launch area and the control center area facilities would add new elements to the existing landscape and change the integrity of historic setting of the battlefield.

A viewshed analysis for the vertical launch area indicates that the facilities at the launch site would be visible to the casual observer from most areas within the NHL. The primary areas of observation would be from State Highway 4 for eastbound travelers (see Exhibit 4.4-1). Vegetation might screen some or all of the vertical launch area facilities from view for short periods of time for eastbound travelers on the Highway. A viewshed analysis also shows that the planned 250-foot tall water tower would be especially visible on the flat horizontal landscape of the project area including from most areas within the Palmito Ranch Battlefield NHL. The addition of the vertical launch area facilities and the control center facilities would add several new elements to the existing landscape and forever change the integrity of the historic setting. The setting of the Palmito Ranch Battlefield NHL contributes to its historic integrity and significance and any change to such would adversely affect the NHL.

Construction of the proposed utilities in the ROW of State Highway 4 between the vertical launch area and the control center area would have no impact on any known historic properties. No sites were found during inventory of the ROW corridor by TxDOT in 1999 (THC 2012a).

4.5.1.2 Operation

The launches of the Falcon Program launch vehicles and a variety of reusable suborbital launch vehicles would produce a short-term, indirect impact on the historic sites within the 5-mile APE that are listed, eligible for listing, or potentially eligible for listing on the NRHP (see Section 3.5.4, *Historic Context*). The high levels of noise produced during each launch would occur only during actual launch events (no more than 12 launches per year) and for a few minutes for each launch, and thus, would be temporary. At all other times (approximately 97 percent of the year), the quiet setting of the historic properties would persist. Therefore, there would be no adverse effects to the historic properties from launch operations.

FAA Order 1050.1E indicates additional factors should be considered when determining the significance of noise impacts on noise sensitive areas within national parks. The Palmito Ranch Battlefield NHL is outside of the DNL 65 dBA noise contours (the standard defined by FAA Order 1050.1E for assessing noise impacts) for the three modeled launch event scenarios described in Section 4.3.1, *Proposed Action*, and shown in Exhibit 4.1-1. Nonetheless, supplemental noise metrics were modeled at the east and west borders of the NHL (approximately 3.5 and 12.1 miles, respectively, from the vertical launch area) to determine the sound levels from a single launch event of the Falcon 9 and Falcon Heavy. One of the modeled noise metrics included the A-weighted $L_{A,max}$ to examine the impact based on the 115 dBA hearing conservation guidelines discussed in Section 3.3.2, *Regulatory Setting*. The results indicate that the 115 dBA hearing conservation guideline would not be exceeded at either location of the battlefield (refer to Table 4.3-3). Another supplemental metric modeled the potential speech interference of a launch event. Outdoor speech interference can be expressed as a percentage of sentence intelligibility between two people standing at approximately one meter (3.28 ft) apart and speaking in a normal voice, with 95 percent speech intelligibility as the threshold for reliable communication. The model results indicate that speech intelligibility at either location in the NHL would drop below 95 percent for a period of less than 3 to 5 minutes per launch (refer to Table 4.3-3).

Vibration caused by the launch operations under the Proposed Action may adversely affect the historic sites within the APE for indirect effects. According to the noise modeling conducted for the Proposed Action, the probability of noise-induced structural vibration damage to structures is 1 in 100 within areas exposed to unweighted noise levels of 119 dB or greater, which for the Falcon 9 is within 3.4 miles of the vertical launch area and 6.4 miles for the Falcon Heavy (please refer to Section 4.3.1, *Proposed Action*). All the historic sites listed in Table 4.5-1 are within the area that would be exposed to unweighted noise levels of 119 dB or greater for the Falcon Heavy, and all but White's Ranch (41CF6) and a prehistoric campsite (41CF19) are within the area that would be exposed to unweighted noise levels of 119 dB or greater for the Falcon 9. However, unlike the other historic sites, only the Cypress Pilings (41CF117.1), the Palmetto Pilings (no number), and the Palmetto Pilings Historical Marker have structural features that would be susceptible to noise-induced vibrations from launches. These sites are within 2,000 ft of the launch pad. Potential damage could include displacement or breakage of the structural features of the pilings, and cracking of the marker's foundation or the marker toppling over. Thus, these historic sites may be physically damaged from vibrations caused by high noise levels, an adverse effect to the historic properties. The extent and severity of these impacts are unknown, as they would vary by distance, materials, and soil substrate.

Section 106 consulting parties have concurred on FAA's finding of adverse effect for the five historic properties listed in Table 4.5-1. Section 106 consultation with THC and NPS on potential mitigation measures is ongoing (see Appendix C). The FAA is in the process of developing a MOA with the Section 106 consulting parties to mitigate the adverse effects on historic properties should the Proposed Action be implemented.

4.5.2 No Action Alternative

Under the No Action Alternative, the FAA/AST would not issue launch licenses and/or experimental permits to SpaceX for launch operations from the private site in Cameron County, Texas. The vertical launch area and the control center area would not be constructed. No impacts would occur to any of the historic properties in the APE.

4.6 AIR QUALITY

4.6.1 Proposed Action

Potential impacts to air quality could result from the proposed construction and operation of the new facilities within the vertical launch area and control center area and from conducting up to 12 launches per year (which includes up to two-Falcon Heavy launches). Determining potential impacts involves estimating emissions generated from the proposed activities and assessing their impacts on air quality. Potential impacts were evaluated based on calculated direct and indirect emissions associated with implementation of the Proposed Action and the No Action Alternative. Significant air quality impacts would occur if implementation of any of the alternatives would directly or indirectly result in the exceedance of one or more of the NAAQS for any of the time frames analyzed. For criteria pollutant emissions, the emissions associated with the Proposed Action were compared to the 2008 National Emission Inventory (NEI) data for Cameron County (EPA 2008) to assess how large of a percentage contribution to the regional air emissions the operational activities would represent.

4.6.1.1 Construction

Specific construction requirements at the vertical launch area and control center area are not accurately known at this time given that the project is in the design phase; however, emissions have been estimated based on data available. Where data are limited, the analysis has reviewed what would constitute the most conservative scenario with respect to construction activities, construction vehicles, and associated emissions.

Construction of infrastructure and support facilities is described in Section 2.1.2, *Construction Activities*. For the purposes of the EIS analysis, it is assumed the construction would take place in a 24-month period between January 2014 and December 2015. Estimated construction costs were not available at the time of this document preparation; however, given the final build-out size of the project and the 24-month timeframe, it was estimated that 47 workers would be on-site at any one time. The construction worker population would be drawn from the local environs, with many expected to live in the Brownsville area.

Emission factors for construction equipment calculations throughout the period 2014–2015 are from the EPA's NONROAD model (EPA 2009c). These emission factors, along with productivity data obtained from National Estimator (Craftsman Book Company 2012) were used to estimate construction activities and associated emissions from heavy duty diesel equipment. Emission rates for fugitive dust were estimated using guidelines outlined in the Western Regional Air Partnership (WRAP) Fugitive Dust Handbook (Western Governors' Association 2006) and AP-42, Volume 1, Section 13.2.2, Unpaved Roads (EPA 2006). The methodology used in the WRAP Handbook assumes standard dust mitigation best practices activities of 50 percent from wetting. The WRAP Handbook offers several options for selecting factors for PM_{10} (coarse particulate matter) depending on what information is known.

After PM_{10} is estimated, the fraction of fugitive dust emitted as $PM_{2.5}$ is estimated. The most recent WRAP study (Midwest Research Institute 2005) recommends the use of a fractional factor of 0.10 to estimate the $PM_{2.5}$ portion of the PM_{10}. The WRAP factors were used to estimate fugitive dust emissions from land disturbance activities.

For site preparation activities, the emission factor was obtained from Table 3-2 of the WRAP Fugitive Dust Handbook. The areas of disturbance and approximate durations were used, resulting in the selection of the first factor with worst-case conditions for use in the analysis.

The emission of any air pollutants as a result of ground disturbance, use of equipment, coatings application, or other construction activities would be controlled by incorporating BMPs, to include minimal idling of engines, watering of soils to be disturbed, use of low volatility coatings and other recognized controls.

Emissions from construction workers commuting and on-road construction vehicles were calculated using EPA's Motor Vehicle Emissions Simulator (MOVES) (EPA 2010a). The construction workers and construction trucks were assumed to be driving from the Brownsville area. Emissions from construction workers driving from the Brownsville area to the proposed vertical launch and control center areas and back have been estimated for 47 workers during the years January 2014–December 2015. Construction equipment emissions during the period would be intermittent and short-term for various time frames during the construction years. Table 4.6-1 presents the estimated annual construction emissions for a total construction period of 24 months.

Table 4.6-1. Estimated Annual Construction Emissions (January 2014–December 2015)

Year	Tons/Year					
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$
2014	0.89	11.59	9.13	0.11	18.09	2.23
2015	0.89	11.59	9.13	0.11	12.01	1.62
Cameron County Regional Emissions	30,097	62,183	11,307	361	32,617	4,773
Percent (%) of County Emissions	0.003	0.02	0.08	0.03	0.06	0.05

Note: CO = carbon monoxide; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 and greater than 2.5 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; VOCs = volatile organic compounds

Detailed operation emission calculations and all assumptions used in the calculations are provided in Appendix E.

The estimated emissions from construction of the vertical launch and control enter areas represent extremely small percentages of the Cameron County regional emissions and would not cause an exceedance of any NAAQS. In conclusion, the construction impacts on air quality would not be significant. GHG emissions, as with criteria pollutants, would be minimal and the source of emissions would be temporary, occurring only during the period of construction.

Prior to beginning any of the construction work, all requisite forms or permits for air emission sources would be completed and submitted to the TCEQ. Section 382.0518(a) of the Texas CAA (relating to preconstruction authorization) states: "Before work is begun on the construction of a new facility or a modification of an existing facility that may emit air contaminants, the person planning the construction or modification must obtain a permit from the Commission."

4.6.1.2 Operation

Air quality impacts for operations were assessed by comparing the total annual operation emissions to Cameron County regional emissions. The operational emissions evaluated include:

- Ten Falcon 9 and two Falcon Heavy launches from the vertical launch area through surrounding airspace environs under the 3,000 ft AGL mixing height
- Generator operations
- Commuting employees that would work at the vertical launch and control center areas, including permanently assigned staff and transient staff that would work on-site during the launch campaigns
- Delivery trucks that would routinely visit the vertical launch and control center areas to provide supplies, such as, but not limited to, RP-1 refueling

Data used to calculate emissions from launch operations were obtained from SpaceX personnel. Commute vehicle and delivery truck emissions were calculated using MOVES (EPA 2010a). Generator emissions were calculated using data from AP-42, Section 3.4, Large Stationary Diesel and All Stationary Dual-Fuel Engines (EPA 1996).

Operational emissions are presented for the end state conditions when staffing and flight operations would be at a maximum, which is projected to occur in 2019.

Generator operations are expected to be used as emergency power sources that could be required at any time due to a power outage, and as supplemental power for use during the final stages of the launch schedule. It is anticipated that the generators could be used continuously for the final 48-hours prior to launch.

Other operational emissions include vehicle trips to the vertical launch and control center areas made by workers required to support launch activities, and heavy duty truck trips associated with delivery of components, fuel, and propellants. It is estimated that when the vertical launch area and control center areas are fully operational, it would ultimately be staffed by a total of 150 full-time SpaceX employees/contractors. During the two week launch event periods, an additional maximum of 100 local or transient workers would also be employed.

Emissions were not calculated for tank transfers of RP-1 because of the low volatility of kerosene. The remaining on-site storage tanks would contain LOX, helium, and nitrogen, none of which pose an air quality issue.

Potential emissions from the vertical launch area Hangar were also not analyzed because the Hangar would be equipped with a scrubber system to minimize emissions to the environment in the event of a payload fuel spill inside the integrated processing facility.

<u>Annual Vertical Launch and Control Center Area Operations</u>

Table 4.6-2 presents a summary of projected operational emissions associated with the vertical launch and control center areas. Emissions from the SpaceX Merlin 1D engines have been previously characterized as comprising CO_2, CO, water vapor, nitrogen oxide (NO_x), and carbon particulates (U.S. Air Force [USAF] 2007). Most CO emitted by the liquid fuel engines is oxidized to CO_2 during afterburning in the exhaust plume. Thus, CO_2, a GHG, is the primary emission from the actual launch vehicles, and these emissions are presented in Section 5.0, *Cumulative Impacts*. Other pollutants could be emitted during launch operations, including CO that is not oxidized to CO_2. Only a small proportion of the emissions associated with each launch would have the potential to affect ambient air quality, which is defined as the area below the mixing height, and which is typically defined as 3,000 ft AGL. The launch of both the Falcon 9 and the Falcon Heavy would be expected to reach the mixing height within a few seconds. The amount of CO released per launch of a Falcon vehicle has been identified in the *SpaceX Falcon Program Environmental Assessment* (U.S. Army Space and Missile Defense Command 2007). To estimate the amount of CO that would be released below the mixing height, an estimate of 20 percent of total emissions was used. Further, it was assumed that none of the CO was oxidized to CO_2. Based on this assumption, a total of approximately 2,752 tons per year would be released below the mixing height, which is the equivalent of 4.4 percent of the total CO emissions from sources located in Cameron County. This percentage is not enough to result in an exceedance of the NAAQS for CO. Additionally, it is estimated, based on the assumptions presented, that 11,009 tons per year of CO would be released above the mixing height. Small quantities of other pollutants, such as NO_x, would primarily occur above 3,000 ft and would disperse quickly after launch and therefore were not quantified for the analysis.

Table 4.6-2 presents the projected air emissions for annual operations of the vertical launch area and control enter area.

Table 4.6-2. Projected Annual Operational Air Emissions (Tons per Year)

	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$
Falcon 9 (ten launches)	0	1,714.3	0	0	0	0
Falcon Heavy (two launches)	0	1,028.6	0	0	0	0
Generator Operations	1.82	4.85	22.50	-	1.60	1.60
Staff Commutes	1.45	42.57	5.97	0.02	0.24	0.22
Supply Deliveries	0.004	0.023	0.103	0.00	0004	0.004
Total	**3.28**	**2,752.37**	**28.57**	**0.02**	**1.84**	**1.82**
Cameron County Regional Emissions	30,097	62,183	11,307	361.22	32,617	4,773
Percent (%) of County Emissions	0.01	4.43	0.25	0.01	0.01	0.04

Note: CO = carbon monoxide; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 and greater than 2.5 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; VOCs = volatile organic compounds
Detailed operational emission calculations and all assumptions used in the calculations are provided in Appendix E.

The operational emissions for the proposed vertical launch and the control center areas represent small percentages of the Cameron County regional emissions and would not cause an exceedance of any NAAQS. This area is in attainment, and therefore the General Conformity Rule does not apply. In conclusion, the operational impacts from the Proposed Action on air quality would not be significant. The impacts from GHG emissions associated with operations would be both long-term and global in context and therefore are discussed in the cumulative impact analysis in Section 5.2.6, *Air Quality*.

Sources of air emissions, such as the generators and the payload fueling systems are regulated by the TCEQ under TAC Title 30. Applicable regulations would likely include the following regulations under 30 TAC Chapter 106:

- Subchapter A, General Requirements for Permitting by Rule, §106.4.
- Subchapter I, Manufacturing, Soldering, Brazing, Welding, §106.227. Brazing, soldering, or welding equipment, except those which emit 0.6 ton per year or more of lead, are permitted by rule.
- Subchapter P, Plant Operations, Industrial Gases, §106.372. Air separation, or other industrial gas production, storage, or packaging facility is permitted by rule. Industrial gases, for purposes of this section, include only oxygen, nitrogen, helium, neon, argon, krypton, and xenon.
- Subchapter T, Surface Preparation §§106.451-106.454. Cleaning operations using abrasive materials and solvents that meet the requirements of this section are permitted by rule.

- Subchapter U, Tanks, Storage and Loading, §106.472. Tanks containing kerosene are permitted by rule.
- Subchapter W, Turbines and Engines, §106.511. Internal combustion engine and gas turbine driven compressors, electric generator sets, and water pumps, used only for portable, emergency, and/or standby services are permitted by rule, provided that the maximum annual operating hours shall not exceed 10 percent of the normal annual operating schedule of the primary equipment; and all electric motors. Standby means to be used as a "substitute for" and not "in addition to" other equipment.
- Subchapter W. Stationary Engines and Turbines, §106.512. Gas or liquid fuel-fired stationary internal combustion reciprocating engines or gas turbines that would operate in compliance with this subsection are permitted by rule.

All applicable air pollution control regulations would be adhered to and that appropriate registrations and permits would be obtained prior to beginning operations.

<u>Launch Failure</u>

Although unlikely, a launch could fail. A launch failure could occur on the launch pad or after the launch vehicle has traveled several miles into the atmosphere. Other scenarios could occur including the entire launch vehicle, with onboard propellants, being consumed in a destruct action (refer to Section 2.1.1.8, *Launch Failures*, for discussion of flight termination system) during flight. In this case, the launch vehicle is largely consumed in the destruct action, but residual propellant escapes and vaporizes into an airborne cloud. As discussed further in Section 4.9, *Hazardous Materials, Pollution Prevention, and Solid Waste*, other propellants such as UDMH (also known as 1,1-dimethyl hydrazine), MMH and NTO may also be released into the environment as a result of a launch failure. UDMH is highly reactive and degrades readily in environmental media and it is not likely to produce significant exposure impacts to humans or the environment. Both MMH and NTO are toxic to humans and pose environmental hazards if released in sufficient quantity to the environment. MMH is highly reactive as well, and is listed by the International Agency for Research on Cancer as a possible human carcinogen. Because of these potential hazards, all reasonable and feasible measures would be taken by SpaceX operators and the FAA to minimize accidents and to protect human health and the environment. To minimize the risk of accidents, SpaceX would fully comply with safety requirements set forth in 14 CFR Parts 400-450, for both ground safety and flight safety, and any other applicable regulations or guidance from the FAA. In addition, SpaceX would prepare and implement a HMERP to ensure that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to and followed by all personnel.

4.6.2 No Action Alternative

Under the No Action Alternative, the FAA/AST would not issue launch licenses and/or experimental permits that would allow SpaceX to launch the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of suborbital launch vehicles. The vertical launch area and control center area would not be constructed. The No Action Alternative would not result in the emission of any air pollutants. Therefore, there would be no impact to regional air quality.

4.7 WATER RESOURCES (INCLUDING SURFACE WATERS, GROUNDWATER, WETLANDS, FLOODPLAINS, AND WILD AND SCENIC RIVERS)

4.7.1 Proposed Action

4.7.1.1 Construction

Surface Waters

Construction and demolition associated with construction activities would involve clearing, grading, filling, and excavation that would result in disturbance to the ground surface. Such disturbance would have the potential to cause soil erosion and transport of sediment into waterways via stormwater. Sediment entering waterways has the potential to cause increased turbidity and suspended solids and carry pollutants contained in the sediment into the surrounding waterways, as described in Section 3.7.4.1, *Surface Waters*. This may smother fish eggs, aquatic insects, and oxygen producing plants resulting in decreased oxygen levels. A Stormwater Pollution Prevention Plan (SWPPP) would be prepared in order to obtain a TPDES permit, the state equivalent of a NPDES permit. The SWPPP would implement the use of BMPs during construction of the Proposed Action, which would prevent indirect impacts from erosion and sedimentation to nearby water bodies. BMPs have been defined by the Cameron County SWMPs and contain minimum measures for managing construction area runoff to reduce indirect impacts associated with increased stormwater runoff due to land disturbance (Cameron County 2008). Any impacts to surface waters associated with an increase of stormwater runoff due to construction activities would be minimized by implementation of SWPPP and BMPs. Therefore, construction of the proposed facilities would not have significant adverse impacts to surrounding surface waters.

Other potential impacts to surface water quality during construction include contamination from spills or leaks from construction vehicles and machinery. As discussed in Section 4.9, *Hazardous Materials, Pollution Prevention, and Solid Waste*, a Spill Prevention, Control, and Countermeasures Plan (SPCCP) and a Hazardous Materials Management Plan (HMMP) would be implemented to minimize the potential for accidental releases of polluting substances from construction equipment. Adherence to the SPCCP and HMMP would reduce the potential for adverse impacts to surface waters to less than significant levels.

Groundwater Resources

The construction of the vertical launch area and control center area would not require significant quantities of groundwater. The water usage is anticipated to be less than that of operation, and because the water balance analysis and aquifer drawdown analysis (refer to Section 4.11.1.2, *Operation*) do not result in significant impacts on groundwater availability, it is unlikely that the construction groundwater use would result in a significant impact in the region. Because the recharge of surface water to groundwater occurs primarily inland to the west, the new impervious surfaces such as buildings, roads, and parking areas would have no impact to the recharge of surface waters to groundwater. There could be small off-site water quantity (drawdown) effects in the immediate vicinity of the vertical launch and control center areas, but no changes in off-site water use are anticipated as a result of the Proposed Action.

The driving of piles to support heavy load buildings at the vertical launch area is not anticipated to impact groundwater resources. Pile installation would not exceed the limits of the overlying sediments associated with Rio Grande Alluvium. The thickness of this deposit ranges from 50 to 300 ft and the water bearing portion of this deposit is located over 10 miles west of the vertical launch area between the City of Brownsville and Rio Grande City. Therefore, the installation of support piles would not breach confining layers to any underlying drinking water aquifers and no drinking water sources within the Rio Grande Alluvium would be affected.

<u>Groundwater Quality</u>

Potential impacts to groundwater quality during construction include contamination from spills or leaks from construction vehicles and machinery. Hazardous fluids such as fuels would likely be stored and transferred on-site during all phases of the project. If such fluids were spilled on the ground, they could migrate to shallow groundwater underlying the vertical launch area. As discussed in Section 4.9, *Hazardous Materials, Pollution Prevention, and Solid Waste*, a SPCCP and a HMMP would be implemented to minimize the potential for accidental releases of polluting substances from construction equipment. It is important that all materials be carefully stored and handled, and that spills are quickly and thoroughly cleaned up. Material handling and spill response BMPs would be implemented according to the SWPPP developed for the vertical launch and control center areas. In addition, the SPCCP would outline measures to minimize hazards to human health and the environment from any unplanned sudden or non-sudden release of oil or other contaminant to the air, soil, surface water, or groundwater.

There would be impacts to groundwater recharge capabilities as a result of increases in impervious surface due to construction of the vertical launch and control center areas. Increases in impervious surface reduce the pervious surface in the area thereby reducing the volume of water that can infiltrate through the soil and recharge the groundwater. These impacts would not be significant because the primary recharge area for groundwater occurs inland to the west of the vertical launch and control center areas. In order to maximize the amount of groundwater recharge, BMPs, such as vegetated infiltration swales and bio-retention cells (rain gardens) with native plantings, can be implemented to offset the impact of increases in impervious surfaces.

<u>Wetlands</u>

Structural support for buildings at the vertical launch area would rely on a pile design. Fill material would be required to elevate various components of the vertical launch area, which is within wetlands. Fill material would be sourced from on-site whenever possible. All on-site material would come from within the 20-acre project area. If necessary, additional clean fill material would be sourced from the local region. The fill of wetlands would result in direct and indirect impacts. Direct impacts are a result of placing fill for construction directly into wetlands and waters as part of the construction of the vertical launch area. Indirect impacts are the result of fill material effectively isolating tidal wetlands from their tidal influence. These wetlands may persist through rainwater inputs and runoff from impervious surfaces, but the functional value of the wetlands would be diminished. In addition, a 30 percent increase in the direct impacts from the footprint of the proposed vertical launch area was calculated to account for future design contingencies. However, in order to avoid counting impacted wetlands twice, direct impacts that resulted in the creation of indirect impacts did not have a 30 percent increase applied.

The construction of the vertical launch and control center areas would result in the permanent impact of 6.19 acres of wetlands: approximately 3.34 acres of direct impacts to wetlands and 2.85 acres of indirect impacts to wetlands. The breakdown of these impacts is as follows. At the vertical launch area, approximately 3.30 acres of wetland impacts consisting of 0.7 acre of unvegetated depressional wetlands and unvegetated wetland salt flats (E2US2) and 2.60 acres of vegetated wetlands (E2SS3 and E2EM1) (Table 4.7-1 and Exhibit 4.7-1) would be impacted. The proposed construction of the launch vehicle processing hangar would result in permanent impacts to all 0.04 acre of vegetated wetlands within the control center area (Table 4.7-1 and Exhibit 4.7-2). In addition, the construction of buildings and roads at the vertical launch area would effectively cut off the tidal influence to 2.85 acres of wetland. These indirect wetland impacts are comprised of 2.54 acres of high marsh vegetated wetlands and 0.31 acre of unvegetated wetland salt flats (Table 4.7-1 and Exhibit 4.7-3).

Wetland impacts resulting from the proposed facilities and infrastructure would result in permanent fill of the underlying wetlands. As a result, the wetland would be turned to uplands and therefore would not retain any of the previous wetland functional values, such as groundwater recharge and flood storage. Wetland impacts would be avoided and minimized wherever feasible. Based on the proposed footprint for the vertical launch area, SpaceX would be required to obtain an individual permit from the USACE, which would require compensatory mitigation to offset wetland impacts. Additionally, in accordance with the DOT Order 5660.1A, the FAA has determined there is no practicable alternative to such construction (refer to Section 2.3, *Alternatives Considered but Not Carried Forward*), and the Proposed Action includes all practicable measures to minimize harm to wetlands which may result from construction (see Section 2.3.1, *SpaceX On-Site Alternatives*).

Table 4.7-1. Vertical Launch Area and Control Center Area Wetland Impacts (Indirect and Direct)

Project	Vegetated Wetland	Unvegetated Wetland Flats	Unvegetated Depressional Wetland	Total
Vertical Launch Area				
Perimeter Access Road	0.09	0.05	0	0.14
Launch Pad/Flame Duct	0.34	0.17	0	0.51
Hangar to Pad Access Road	0.40	0	0	0.40
Parking and Roads	0.67	0.12	0	0.79
Buildings	0.68	0.01	0.07	0.76
Lightning Tower Pads	0.01	0.01	0	0.02
Tanks	0.06	0	0	0.06
Utility Corridor*	0.05	0	0	0.05
Fences	0.30	0.26	0.01	0.57
Subtotal	**2.60**	**0.62**	**0.08**	**3.30**
Control Center Area				
Roads	0	0	0	0
Parking Areas	0	0	0	0
Buildings	0.04	0	0	0.04
Utilities	0	0	0	0
Subtotal	**0.04**	**0**	**0**	**0.04**
Total	**2.64**	**0.62**	**0.08**	**3.34**
Indirect Wetland Impacts	**2.54**	**0.31**	**0.00**	**2.85**
Total Wetland Impacts (Indirect and Direct)				**6.19**

* National Wetland Inventory wetlands were used to calculate wetland acreages impacted by the proposed utility corridor and were not verified in the field or included in the USACE Preliminary Jurisdictional Determination approval.

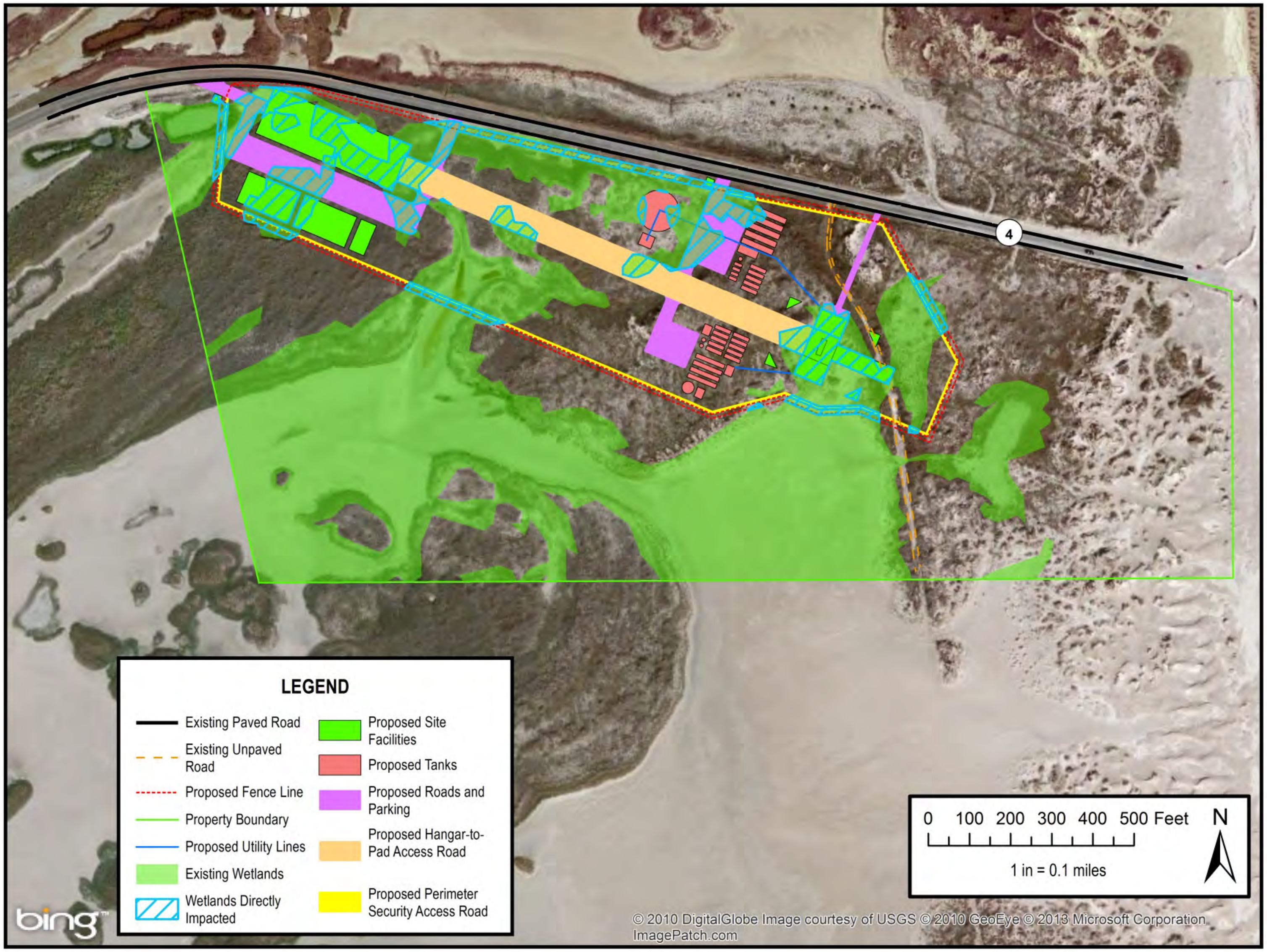

Exhibit 4.7-1. Vertical Launch Area Wetland Impacts

Exhibit 4.7-2. Control Center Area Wetland Impacts

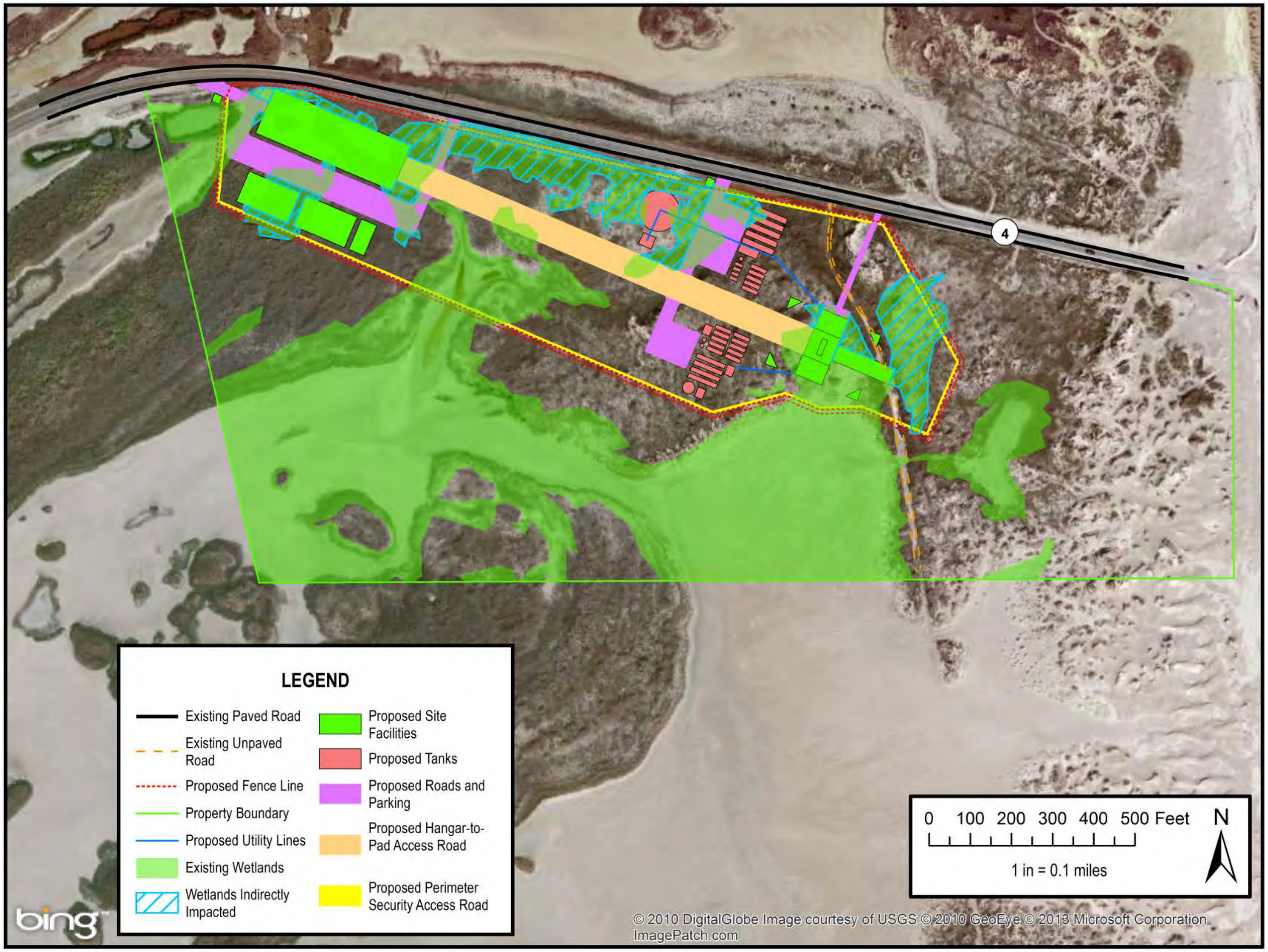

Exhibit 4.7-3. Vertical Launch Area Indirect Wetland Impacts

Floodplains

The vertical launch area would be constructed within the 100-year floodplain, Zone V and Zone A, and the control center area would be constructed within the 100-year floodplain, Zone A. Impacts to floodplains can be thought of as a displacement issue. If fill is added to a floodplain, an equal amount of capacity to hold floodwaters is removed from the floodplain. Typical potential impacts from floodplain development and the subsequent filling of floodplains include but are not limited to, the obstruction and diversion of floodwaters to other areas, increased flood levels, reduction in the storage capacity of floodwaters, and increased water velocities during flooding.

Communities in Texas that participate in the NFIP must meet the minimum floodplain development standards described by FEMA's NFIP regulations. Some participating communities develop floodplain regulations that exceed the minimum standards required by NFIP regulations if the community determines that higher standards are needed to meet their local floodplain management goals. The proposed construction would be conducted in accordance with applicable county zoning and would be coordinated with the Cameron County floodplain administrators to receive a development permit (City of Brownsville 2012). Additional coordination with Cameron County would be required to ensure the proposed construction meets the requirements of the NFIP. The NFIP permits development in the floodway if it can be demonstrated that "No-Rise" in the base flood elevation will occur. The *County of Cameron Building Regulations* outline the floodplain development standards that must be followed to comply with the NFIP and development in the floodplain.

Fill material would be required to elevate various components of the vertical launch area out of the floodplain. Fill material would be sourced from on-site whenever possible. All on-site material would come from within the 20-acre project area. If necessary, additional clean fill material would be sourced from the local region. Approximately 4.22 acres of floodplain would be filled in Zone V10 in the proposed vertical launch area and approximately 4.37 acres would be filled in Zone A8 in the western portion of the vertical launch area. The elevation increase at the vertical launch area was assumed to be 4.6 ft. A 30 percent increase in the fill required for the footprint of the vertical launch area facilities was assumed to account for possible design contingencies. The total amount of fill material for the vertical launch area would be 49,574 cubic yards (yd^3) (Table 4.7-2). Flood Zones V10 and A8 have different designations and are therefore quantified separately.

Table 4.7-2 Fill Material for the Vertical Launch and Control Center Areas by Zone A8 and Zone V10

Project	Volume (cubic yards [yd^3])		
	A8	V10	Total
Vertical Launch Area			
Perimeter Access Road	979	2,138	3,117
Launch Pad/Flame Duct	0	74	74
Hangar to Pad Access Road	1,019	12,043	13,062
Parking and Roads	5,892	5,834	11,726
Buildings	7,673	45	7,718
Lightning Tower Pads	0	371	371
Tanks	0	5,640	5,640
Fences	2,700	5,167	7,867
Subtotal	18,263	31,311	49,574

Table 4.7-2 Fill Material for the Vertical Launch and Control Center Areas by Zone A8 and Zone V10

Project	Volume (cubic yards [yd^3])		
	A8	V10	Total
Control Center Area			
Roads	11,503	0	11,503
Parking Areas	24,565	0	24,565
Buildings	14,917	0	14,917
Utilities	2,152	0	2,152
Subtotal	53,137	0	53,137
Total	71,400	31,311	102,711

According to the Brownsville, Texas Code of Ordinances in addition to 44 CFR 60.3, fill material must be placed properly, should be 95 percent of the maximum density, and have graded side slopes no steeper than 2:1 (Texas Floodplain Management Association 2008; City of Brownsville 2012). As per the requirements of 44 CFR 60.3, fill material would be used to raise the elevations for parking and open storage areas. Structural support for the Hangar, launch pad, and workshop at the vertical launch area would rely on a pile design. Upon completion of the elevation work, an Elevation Certificate (FEMA Form 81-31) verifying the "as built" elevation of the structure complies with the local floodplain ordinance and NFIP floodplain management requirements would be obtained.

Construction at the control center area would require placing fill material to level the land and construction of impervious surface. The total amount of fill material for the control center area would be approximately 53,137 yd^3 (Table 4.7-2) and would impact approximately 12.4 acres of Zone A8. Similar to the vertical launch area, an Elevation Certificate (FEMA Form 81-31) verifying the "as built" elevation of the structure complies with the local floodplain ordinance and NFIP floodplain management requirements would be obtained.

In order to comply with the local floodplain zoning required for participation in the NFIP and to obtain development permits, a hydraulic analysis of the floodplain associated with the vertical launch and control center areas would need to be conducted during the preliminary engineering design phase of the project to comply with the local county requirements. The hydraulic analysis would determine if the fill and construction of facilities within the floodplain would affect the base flood elevation. If the study determines that construction would not affect the base flood elevation, a "No-Rise" Determination would be submitted to the county. However, if the hydraulic study determined that the base flood elevation would be affected, further engineering design would need to be conducted to mitigate for the change in base flood elevation in order to comply with NFIP and Cameron County building regulations as required by the National Flood Insurance Act Title 42. The hydraulic study would also ensure that no flood storage would be lost and that the facility is adequately designed to prevent flotation, collapse, or lateral movement of the structure due to hydrodynamic and hydrostatic loads, including the effects of buoyancy. The design engineer would certify that the design elevation would withstand the depth and velocity of 100-year flood events (hydrostatic and hydrodynamic loads), any potential increase in wind load, or any other relevant load factors. Compliance with the NFIP as well as county regulations would ensure that the construction would have no significant impacts on floodplain storage and base flood elevations.

The construction activities would also be required to comply with EO 11988 through compliance with DOT Order 5650.2. To determine if construction of the proposed vertical launch and control center areas would result in a significant floodplain encroachment per DOT Order 5650.2, each of the three scenarios listed in Section 3.7.2, *Regulatory Setting*, are addressed below:

1. The action would have a considerable probability of loss of human life:

    a. Construction of the proposed vertical launch and control center areas would not result in considerable probability of loss of human life. No part of the proposed vertical launch or control center areas would be designed or constructed for human habitation or as a human dwelling. The proposed vertical launch and control center areas would not prohibit people from entering or exiting the area should a flood event occur.

2. The action would likely have substantial, encroachment-associated costs or damage, including interrupting aircraft service or loss of a vital transportation facility (e.g., flooding of a runway or taxiway, important navigational aid out of service due to flooding, etc.):

    a. The proposed vertical launch area would be constructed within a large contiguous floodplain that spans an area of approximately 5,477 acres (4.22 acres of Zone V10 and 4.37 acres of Zone A8). Construction of the vertical launch area would result in the filling of 8.59 acres of floodplain. Filling this relatively small area (less than 1 percent of the contiguous area) would not result in new areas being subject to 100-year floods, nor would it result in existing areas subject to 100-year floods becoming more prone to floods.

3. The action would cause a notable adverse impact on natural and beneficial floodplain values:

    a. Based on the analysis in Section 4.1, *Compatible Land Use (Including Farmlands and Coastal Resources)*, 4.4 *Visual Resources and Light Emissions*, and 4.8 *Biological Resources (Fish, Wildlife, and Plants)*, the FAA has determined that construction of the proposed vertical launch and control center areas would result in notable adverse impacts to some of the natural and beneficial floodplain values: land use (outdoor recreation), visual resources (open space, natural beauty), and wildlife (including federally threatened or endangered species). Therefore, based on the expected notable adverse impacts on some of the natural and beneficial floodplain values, the Proposed Action would result in significant floodplain encroachment per DOT Order 5650.2.

Based on the expected notable adverse impacts on the floodplain, the Proposed Action would result in significant floodplain encroachment per DOT Order 5650.2. Alternatives to the Proposed Action were considered and it was determined there are no non-floodplain alternative sites that would meet the requirements of the project as discussed in Section 2.3, *Alternatives Considered but Not Carried Forward*.

Wild and Scenic Rivers

There would be no impacts to wild and scenic rivers due to construction of the vertical launch or control center areas because the section of the Rio Grande deemed wild and scenic is over 400 miles west of the Proposed Action.

4.7.1.2 Operation

Surface Waters

Operation of the vertical launch area would include maintenance activities, launch vehicle preparation, and launches on impervious surfaces. The SWPPP would implement the use of BMPs during operation of the Proposed Action, which would prevent indirect impacts from erosion and sedimentation to the nearby water bodies. Any impacts associated with an increase of stormwater runoff to surface waters would be minimized by implementation of the SWPPP and BMPs and would not have significant adverse impacts to surrounding surface waters.

Potential impacts to surface water quality during operation of the vertical launch and control center areas include contamination from accidental spills or leaks from operating vehicles and machinery. As discussed in Section 4.9. *Hazardous Materials, Pollution Prevention, and Solid Waste*, an SPCCP and HMMP would be prepared and would reduce the potential for accidental spills or leaks. Therefore, contamination from accidental spills or leaks due to daily operations would not have adverse impacts to surrounding surface waters. However, in the event of a flood or storm event, SpaceX would implement flood control measures such as locating water-sensitive equipment, supplies, chemicals, etc. above flood level, and moving hazardous waste outside of the floodplain when substantial storms are imminent. The implementation of these measures would reduce the likelihood that a flood or storm event might result in loss of life, injury to persons, or damage to property or otherwise be considered a “critical action” as defined in EO 11988, *Floodplain Management*.

Surface waters near the vertical launch area could be affected by the exhaust cloud that would form near the launch pad at lift-off as a result of the exhaust plume and evaporation and subsequent condensation of deluge water. Because the Falcon 9 and Falcon Heavy launch vehicles use only LOX and RP-1 propellants, the exhaust cloud would consist of steam only and would not contain any hazardous materials (USAF 2007). As the volume of water expected to condense from the exhaust cloud is expected to be minimal, the exhaust cloud would generate less than significant impacts on surface water quality near the vertical launch area.

After a launch, the first stage of the Falcon 9 would land in the open waters of the Gulf of Mexico, approximately 550 miles downrange, and would potentially be recovered by a salvage ship. The salvage ship would be able to locate the first stage through telemetry signals from the stage. If the expended first stage could not be located, it would likely be due to damage. It would subsequently sink, and therefore, it would not be recovered. Spent first stages falling into the Gulf of Mexico are a potential source of pollution to marine environments. Depending on the vehicle, varying quantities of LOX and RP-1 would remain in the fuel tanks at the time of the splashdown. Localized temporary adverse impacts on marine waters in the immediate area surrounding this landing may occur. Long-term impacts however would be negligible due to the vast volume of the Gulf of Mexico and dissipation that would quickly occur from any contamination that could potentially be associated with this activity. For the reasons above, the Proposed Action would not have a significant adverse direct impact on surface waters.

<u>Groundwater</u>

Groundwater would be potentially used for two primary uses: the supply of the deluge water for each launch, and for personnel use at the facilities. Each of the proposed groundwater uses is discussed below.

Deluge Water System

As described in Section 2.1.2, *Construction Activities*, a deluge water system consisting of one 250,000-gal water tower would be installed at the vertical launch area for sound and vibration suppression. Up to 200,000 gal would be discharged during a launch event, and up to 12 launch events would be scheduled per year, resulting in a total deluge water system use of 2,400,000 gal per year (gpy) (7.37 afy). A well located adjacent to the water tower, and drilled into a highly transmissive (i.e., yielding relatively large water quantities) portion of the Gulf Coast Aquifer (the Chicot Aquifer) would provide all deluge water at an average well pumping rate of 4.6 gpm.

Potable Water Supply

Potable water would either be delivered by truck to a holding tank at the vertical launch area, or a well and water distribution lines would be installed to provide potable water to the area. The sewer system would consist of a mobile above ground processing unit and holding tank. This section assumes that all potable water on-site would be obtained from a single well located adjacent to the water tower. However, it is likely that the groundwater in the Gulf Coast Aquifer at the location of the vertical launch and control center areas has concentrations of TDS exceeding the Texas Department of Health recommended drinking water standards. The TDS concentrations in the Chicot and Evangeline aquifers in south central Cameron County has the highest TDS values, with concentrations greater than 10,000 mg/L (Choudhury and Mace 2007).

The operation of the vertical launch and control center areas would result in an increase of permanent and temporary personnel. The scenario resulting in the maximum number of personnel at the vertical launch and control center areas is the 2022 scenario, with 150 full-time SpaceX employees/contractors and 100 local or transient personnel working launch campaigns lasting up to 2 weeks. The TWDB *2012 Texas State Water Plan* identifies the projected per capita water demand for Cameron County as 221 gpd in the year 2020 (TWDB 2012d). With 150 full-time SpaceX employees/contractors and 100 local or transient personnel working 24 of the 52 weeks in 2022, the annual potable water usage is projected to be 15,800,000 gpy (48.6 afy). Assuming that water quality in the water well screened in the Chicot Aquifer of the Gulf Coast Aquifer system is adequate for potable use, this well would provide potable water at an average well pumping rate of 30.1 gpm.

Groundwater Supply

The combined maximum water demand for the operation of the vertical launch and control center areas is projected to be 55.9 afy in 2022. As presented in of Section 3.7.4.2, *Groundwater*, the projected municipal groundwater demand for Cameron County in the year 2010 is 4,500 afy, and in the year 2020 is 5,300 afy. The increased population and operations at the vertical launch and control center areas in 2022 would increase the demand for potable water by approximately 55.9 afy, 1.2 percent of the current municipal usage of approximately 4,500 afy in 2010, and 1.1 percent of the projected 2020 municipal usage of 5,300 afy. There would be sufficient groundwater supply to meet the estimated demand under the Proposed Action. Therefore, there would be no significant impacts to municipal groundwater availability in Cameron County.

Aquifer Drawdown

Aquifer drawdown from the operational activities was conservatively calculated assuming a transmissivity of 49,500 gpd/ft (Myers 1969), a storativity of 0.0001, and a single source well. It is estimated that the water production well screened in the discontinuous sand and clay beds of the Chicot aquifer would produce water at an average rate of approximately 34.7 gpm, based on the maximum projected water demand of 55.9 afy for potable use and for the deluge water, assuming a constant pumping rate.

Table 4.7-3 presents the drawdown at the pumping well, and at 0.5, 1, and 2 miles from the well after 10 and 20 years of aquifer withdrawal for operation. The drawdown at the source well would range up to 2.34 ft after 20 years of withdrawal for potable and deluge use. Any potential water wells within 2 miles of the pumping well would be subject to drawdown according to the amounts in Table 4.7-3. Water wells typically have water columns that exceed 20 feet in depth in order to provide adequate water volume. A difference of 2.34 ft or less would not result in a significant decrease in availability to such hypothetical wells. Impacts of this water withdrawal on other possible on-site and off-site water uses would not be significant.

Table 4.7-3. Aquifer Drawdown from Proposed Action

Years of Pumping	Distance from Withdrawal Well			
	0 mile	0.5 mile	1.0 mile	2.0 mile
	Aquifer Drawdown (ft)			
10	2.28	0.90	0.79	0.68
20	2.34	0.96	0.85	0.74

Note: Calculations completed using the Theis Equation

In addition to pumping, the creation of impervious surfaces has the potential to reduce surface recharge to groundwater. The potential drawdown of the aquifer due to new impervious surfaces such as buildings, roads, and parking areas would be minimal; the recharge of the surface water to the groundwater beneath the vertical launch area occurs primarily inland to the west. Therefore, there would be no significant impacts to groundwater recharge anticipated as a result of the Proposed Action.

Groundwater Quality

Potential impacts to groundwater quality during operation include contamination from spills or leaks from construction vehicles and machinery. Hazardous fluids such as fuels would likely be stored and transferred on-site during all phases of the project. The normal substances that would be used in the proposed facilities and vehicle maintenance (e.g., petroleum products, cleaning solvents, etc.) are currently in use at numerous businesses in Cameron County. These materials would be stored in lesser quantities at the proposed vertical launch and control center areas and used under carefully controlled conditions and in accordance with EPA and TCEQ regulations and would not impact groundwater from these sources.

There are also potential impacts to groundwater quality associated with the proposed septic system. Due to the remote location of the vertical launch area, wastewater collection would not be conveyed to an existing municipal treatment system. Therefore, septic systems are proposed at both the vertical launch and control center areas. The design of these systems would be permitted through the Department of Environmental Health at the Cameron County Department of Health and Human Services. Conformance with these permits would require the implementation of leak monitoring systems to limit impacts to the soil and groundwater associated with septic system malfunctions. If the proposed septic tanks leak into the shallow groundwater, ammonium from the septic tank effluent under aerobic conditions can convert to nitrate, contaminating groundwater and posing potential health risks to humans, particularly very young infants. Additional contaminants include fecal coliform bacteria, which could contaminate the groundwater and any water wells immediately downgradient of the septic tank, to impact human health of individuals ingesting the groundwater. There are no ecological contaminant receptors in the groundwater at the septic system. Therefore, there is no significant ecological health risk due to septic contamination of groundwater.

If hazardous fluids were spilled on the ground or released from the proposed septic system, they could migrate to shallow groundwater underlying the vertical launch area. As discussed in Section 4.9*, Hazardous Materials, Pollution Prevention, and Solid Waste*, a SPCCP plan and a HMMP would be implemented to minimize the potential for accidental releases of polluting substances from equipment. It is important that all materials be carefully stored and handled, and that spills are quickly and thoroughly cleaned up. Material handling and spill response BMPs would be implemented according to the SWPPP developed for the vertical launch area. In addition, the SPCCP would outline measures to minimize hazards to human health and the environment from any unplanned sudden or non-sudden release of oil or other contaminant to the air, soil, surface water, or groundwater.

Wetlands

Operations associated with the vertical launch and control center areas have the potential to impact wetlands. Operational impacts would be limited to a potential increase in stormwater discharges from new impervious surfaces. As discussed in Section 4.9, *Hazardous Materials, Pollution Prevention, and Solid Waste*, a SPCCP and a HMMP would be implemented to minimize the potential for accidental releases of polluting substances from construction equipment. Employees would be trained in spill response specific to the materials they use. Additionally, spill response procedures would be incorporated into regular safety meetings. Adherence to the SPCCP and HMMP would reduce the potential for adverse impacts to surface waters to less than significant levels. For the reasons above, operations associated with the Proposed Action would not have a significant impact on wetlands.

Floodplains

The vertical launch and control center areas are located within the 100-year floodplain. Operation of the vertical launch area and the control center area would not result in additional impacts to floodplains.

There would not be any significant adverse impacts to floodplain function based on the operation of the water deluge system, as the water would be collected in a retention basin under the launch pad. After the launch, the deluge water that has been collected in the retention basin would be sampled and analyzed to determine if the water contained controlled contaminants at levels that exceed TCEQ water quality standards. Water containing contaminants that exceed the water quality criteria would be removed and hauled to an approved industrial wastewater treatment facility outside of the vertical launch area. All other water not containing prohibited chemicals would be pumped back to the water tower. While the proposed launch pad is located next to an unvegetated flat, no water would reach the ground during the launch period. While there is a small potential for water vapor to reach this unvegetated area, it is not expected that the amount of water vapor from up to 12 launches per year would be enough to alter the floodplain function.

In the event of a flood or storm event, SpaceX would ensure that the storage of hazardous materials would implement flood control measures such as locating water-sensitive equipment, supplies, chemicals, etc. above flood level, and moving hazardous waste outside of the floodplain when substantial storms are imminent. The implementation of these measures would reduce the likelihood that a flood or storm event might result in loss of life, injury to persons, or damage to property or otherwise be considered a “critical action” as defined in EO 11988, *Floodplain Management*.

Wild and Scenic Rivers

No Wild and Scenic Rivers occur within the immediate vicinity of the vertical launch and control center areas; therefore, there would be no impacts to wild and scenic rivers due to the operation of the vertical launch area or the control center area.

Launch Failure

In the unlikely event of a launch failure, impacts to water resources could occur due to contamination from propellants. If propellants leaked into the Gulf of Mexico, the amount of water in comparison to the amount of propellant would allow the propellant to dilute so that impacts would be temporary and extremely localized. Dissipation into the Gulf waters would occur within hours due to a combination of wave movement, oxygen exposure, and sunlight (USAF 2007). Due to the small volume of this release into the Gulf of Mexico, impacts on water quality in the Gulf of Mexico would be negligible. These impacts are further discussed in Section 4.9, *Hazardous Materials, Pollution Prevention, and Solid Waste*. If a launch failure did occur, SpaceX would follow the emergency response and cleanup procedures outlined in the HMERP. Debris and unspent fuel would be removed from the near-shore marine environment and disposed of in accordance with Federal, State, and local regulations.

4.7.2 No Action Alternative

Under the No Action Alternative, the FAA would not issue launch licenses and/or experimental permits to SpaceX for launch operations from the private site in Cameron County, Texas. SpaceX would not construct the vertical launch and control center areas. The vertical launch and control center areas would remain as they are today and there would be no impacts to water resources.

4.8 BIOLOGICAL RESOURCES (FISH, WILDLIFE, AND PLANTS)

4.8.1 Proposed Action

The following sections provide an assessment of the potential impacts to biological resources with implementation of the Proposed Action. The discussion is divided into construction and operations. The construction phase includes all activities that would occur during the construction of the vertical launch and control center areas. The operations phase includes all post-construction activities that would occur at the proposed vertical launch and control center areas during operations of the facilities throughout the year, including up to 12 proposed launches per year.

4.8.1.1 Construction

<u>Vegetation</u>

Table 4.8-1 summarizes the acreage of vegetation, including wetlands that would be impacted by proposed construction activities. Exhibit 4.7-1 illustrates the impacts to wetlands from the proposed construction of the vertical launch and control center areas. A 30 percent increase in the direct impacts from the footprint of the proposed vertical launch area was calculated to account for future design contingencies.

Table 4.8-1. Potential Direct Impacts to Vegetation and Wetlands with Implementation of the Proposed Action (acres)

Project	Non-Wetland (Upland Vegetation)	Vegetated Wetland	Unvegetated Wetland Flats	Unvegetated Depressional Wetland	Total
Vertical Launch Area					
Perimeter Access Road	0.42	0.09	0.05	0	0.56
Launch Pad/Flame Duct	0.01	0.34	0.17	0	0.52
Hangar to Pad Access Road	1.76	0.40	0	0	2.16
Parking and Roads	1.57	0.67	0.12	0	2.36
Buildings	1.05	0.68	0.01	0.07	1.81
Lightning Tower Pads	0.04	0.01	0.01	0	0.06
Storage Tanks	0.75	0.06	0	0	0.81
Utility Corridor*	1.91	0.05	0	0	1.96
Fences	1.07	0.30	0.26	0.01	1.64
Subtotal	**8.58**	**2.60**	**0.62**	**0.08**	**11.88**
Control Center Area					
Roads	1.55	0.00	0	0	1.55
Parking Areas	3.31	0.00	0	0	3.31
Buildings	2.01	0.04	0	0	2.05
Utilities	0.29	0.00	0	0	0.29

Table 4.8-1. Potential Direct Impacts to Vegetation and Wetlands with Implementation of the Proposed Action (acres)

Project	Non-Wetland (Upland Vegetation)	Vegetated Wetland	Unvegetated Wetland Flats	Unvegetated Depressional Wetland	Total
Subtotal	**7.16**	**0.04**	**0**	**0**	**7.20**
Total	**15.74**	**2.64**	**0.62**	**0.08**	**19.08**
Indirect Wetland Impacts	**0.00**	**2.54**	**0.31**	**0.00**	**2.85**
				Total Wetland Impacts (Indirect and Direct)	**6.19**

* National Wetland Inventory wetlands were used to calculate wetland acreages impacted by the proposed utility corridor and were not ground-truthed in the field or included in the USACE Preliminary Jurisdictional Determination approval.

A total of 15.74 acres of upland habitat and 3.34 acres of wetland habitat would be removed as a result of the construction of proposed vertical launch and control center area facilities and infrastructure. This permanent loss of upland vegetation would impact only a small fraction of this community in the Lower Rio Grande Valley and would not adversely affect local or regional plant diversity. In addition, the construction of buildings and roads at the vertical launch area would effectively cut off the tidal influence to 2.85 acres of wetland. These indirect wetland impacts are comprised of 2.54 acres of high marsh vegetated wetlands and 0.31 acre of unvegetated wetland salt flats.

Based on the proposed footprint for the vertical launch area, a Section 404 CWA individual permit would be required for the proposed wetland impacts prior to initiation of construction. Under an individual permit, wetland impacts would require compensatory mitigation (see Section 4.7, *Water Resources* for further discussion).

In addition, impacts could result from the potential introduction and spread of invasive species during construction. At the time of the field surveys, the giant reed (*Arundo donax*) was the only invasive species observed. The movement and spread of invasive plant and animal species within the project areas would degrade habitat and potentially directly impact ESA-listed and candidate species with implementation of the Proposed Action. Invasive species might be accidentally introduced to the area through construction of the facilities or shipment of supplies and equipment to the proposed facilities. Species that might be introduced or spread include various plants such as vitex that can degrade habitat by displacing native species and ultimately reducing food or important nesting or roosting habitat. However, these potential impacts would be avoided or minimized with the implementation of Special Conservation Measures (SCMs) to decrease erosion and sedimentation and to control the spread and introduction of invasive species. Refer to Section 6.7, *Biological Resources (Fish, Wildlife, and Plants)*, for a detailed discussion of SCMs that would be implemented under the Proposed Action. As a result, there would be no significant impacts to vegetation with implementation of proposed construction activities.

<u>Wildlife</u>

As discussed above in vegetation, long-term habitat loss would result from the construction of the proposed facilities. A total of 15.74 acres of upland habitat and 3.34 acres of wetland habitat would be removed as a result of the construction of proposed vertical launch and control center area facilities and infrastructure. This permanent loss of habitat would impact only a small fraction of this community in the Lower Rio Grande Valley and would not adversely impact the availability of habitat for wildlife populations.

Increased vehicular traffic and human presence, as well as noise from construction, may temporarily displace wildlife species, causing them to expend additional energy. Construction activities that would temporarily increase noise levels within the project area include construction equipment operating at the sites and construction/delivery vehicles traveling to and from the sites. Construction activities, including the use of an impact pile driver, could potentially create multiple, individual noise sources.

Construction point source noise (e.g., impact pile driver) is commonly measured by maximum decibel level (L_{max}), or the highest value of a sound pressure over a stated time interval. Construction activities could create noise levels that range from 73 to 101 dBA L_{max} at 50 ft from the activities (DOT 2006). Proposed pile driving would result in increased airborne noise in the vicinity of the construction site. Maximum peak levels generated during impact pile driving of a concrete pile are estimated to be 101 dBA at a distance of 50 ft from the pile. Other construction activities or equipment, such as cranes, heavy trucks, and generators will also cause noise; however, this noise level will be much lower compared to noise produced by the impact hammer. In the absence of pile driving noise, maximum construction noise will be 94 dBA at a distance of 50 ft from the activity, computed as the summation of noise of all equipment operating simultaneously (Washington State Department of Transportation 2013).

Noise from a point source spreads spherically over distance. The standard reduction for point source noise is 6 dB per doubling of distance from the source. When ground cover or normal unpacked earth (i.e., a soft site) exists between the source and receptor, the ground becomes absorptive of noise energy. Absorptive ground results in an additional 1.5 dB reduction per doubling of distance as it spreads from the source. Added to the standard reduction rate for a point source, point source noise across a soft site attenuates at a rate of 7.5 dB per doubling of distance (Washington State Department of Transportation 2013).

The reaction of a particular wildlife species to noise impacts could range from mild annoyance to panic and escape behavior. Behavioral responses to noise impacts also vary between species and between individuals due to a variety of factors such as age, sex, prior exposure, season, hearing sensitivity, reproductive status and season, time of day, behavior during the noise event, and the individual's location relative to the noise source. Other factors that influence an animal's response to noise include noise level and frequency, distance and event duration, equipment type and condition, frequency of events over time, slope, topography, and weather conditions (Delaney and Grubb 2004). In mammalian species, startle or fright is the immediate behavioral reaction to transient, unexpected, or unpleasant noise. Other mammalian behavioral reactions to noise include altered migration patterns, changes in the home range, and disruptions in mating behaviors. Bird behavioral responses to noise include nest abandonment, egg mortality, premature fledging, predation, depressed feeding rates, and habitat avoidance.

Even if proven significant, most of the effects of noise are mild enough that they may never be detectable as changes in population size or population growth against the background of normal variation (Bowles 1995). Many other environmental variables (e.g., predators, weather, changing prey base, ground based human disturbance) may influence reproductive success and confound the ability to tease out the ultimate factor in limiting productivity of a certain nest, area, or region (Smith et al. 1988). In contrast, the effects of other human intrusions near nests, foraging areas, dens, etc. (e.g., hiking, bird watching, timber harvesting, boating) are readily detected and substantial (U.S. Forest Service 1992).

Wildlife in the area is currently exposed to noise from vehicular traffic and human presence along State Highway 4 and on Boca Chica Beach. The temporary increase in noise levels from pile driving and other construction-related activities would cause wildlife species to avoid the area in the vicinity of the vertical launch area. However, there would be no long-term impacts to individuals or populations of wildlife species, including special-status species, as it is expected that wildlife species would avoid the area due to the presence of on-going activities associated with public use of Boca Chica Blvd. and Boca Chica Beach.

Direct mortality from construction equipment is unlikely since human presence and activity are likely to disperse wildlife prior to any equipment use. While the majority of the construction would occur during the day, small amounts of construction, such as pouring of concrete, would occur at night. Evidence suggests that migratory birds may be attracted to lighted areas at night, especially during overcast nights, causing them to be disoriented and colliding with buildings and other structures (Longcore and Rich 2004; Poot et al. 2008). Potential impacts from lighting would be reduced by complying with established lighting policy for minimizing disorienting effects on migratory birds. A Lighting Management Plan would be reviewed and approved by the USFWS prior to construction activities at the vertical launch area.

Increased vehicle traffic could increase the potential for wildlife collisions. As discussed in Appendix K, *Ground Traffic and Transportation*, traffic during the construction period would increase by approximately 137 vehicles per day within the Lower Rio Grande Valley Wildlife Refuge corridor and by approximately 137 vehicles per day within the corridor providing access to Boca Chica Beach and the vertical launch area. Construction employees would be educated on the potential of vehicle collisions with wildlife and would be required to maintain reduced speeds along State Highway 4 within the vertical launch and control center areas. However, with implementation of proposed SCMs such as pre-construction surveys during the breeding season for birds, incorporating raptor protection measures for utility upgrades, and designating a Field Contact Representative (FCR) (refer to Section 6.7, *Biological Resources [Fish, Wildlife, and Plants],* for more details), there would be no significant impacts on wildlife species as a result of the proposed construction activities.

<u>Special-Status Species</u>

Potential impacts on state-listed wildlife species would be similar to those described above for wildlife. Seven state-listed species occur (that are not also federally listed) or have the potential to occur within the ROI (peregrine falcon, reddish egret, sooty tern, white-tailed hawk, white-faced ibis, wood stork, and black-striped snake). Long-term habitat loss would result from the construction of the proposed facilities. However, this permanent loss of habitat would impact only a small fraction of the suitable habitat available in the Lower Rio Grande Valley and would not adversely impact the availability of habitat for sensitive wildlife populations. In addition, increased vehicular traffic and human presence, as well as noise from construction, may temporarily displace state-listed wildlife species. However, with implementation of proposed SCMs such as pre-construction surveys during the breeding season for birds, incorporating raptor protection measures for utility upgrades, and designating a FCR (refer to Section 6.7, *Biological Resources [Fish, Wildlife, and Plants],* for more details), there would be no significant impacts on state-listed species as a result of the proposed construction activities.

Potential impacts on ESA-listed species from proposed construction activities are discussed below.

Piping Plover

The proposed vertical launch and control center areas are located within designated piping plover critical habitat Unit TX-1. The critical habitat description within Unit TX-1 specifically states that it does not include densely vegetated habitat within those boundaries. The majority of the ROI is densely vegetated, and therefore not considered critical habitat for the piping plover. However, unvegetated flats and depressional wetlands that occur within the Unit are considered critical habitat. Approximately 0.70 acre of unvegetated flats and depressional wetlands occur within the proposed project footprints for the vertical launch area and would be removed under the Proposed Action. In addition, 0.31 acre of unvegetated wetland salt flats would be indirectly impacted from the construction of buildings and roads at the vertical launch area effectively cutting off the tidal influence. The total area designated as critical habitat in Unit TX-1 is 7,217 acres, while the total Texas designated critical habitat is 71,053 acres. This small amount of critical habitat that would be impacted would not affect the recovery of the species; additionally, there is other habitat nearby that the piping plover could use. Based on recent migratory and wintering surveys for piping plovers conducted within the Lower Laguna Madre region in south Texas, the piping plover is not known to use areas within the ROI in large numbers (Zdravkovic and Durkin 2011). The piping plover does not nest within the ROI; therefore, the Proposed Action would not affect piping plover nesting. As very little particulate deposition is expected from launch activities since the Falcon 9 and Falcon Heavy vehicles use liquid fuels (LOX and RP-1), proposed launch activities (at a rate of up to once a month) would have discountable impacts to critical habitat from particulate deposition.

Increased vehicular traffic and human presence, as well as noise from construction, may temporarily displace piping plovers, causing them to expend additional energy. However, piping plovers in the area are currently exposed to noise from vehicular traffic and human presence accessing Boca Chica Village and Boca Chica beach along State Highway 4. Direct mortality from construction equipment is unlikely since noise from pre-construction noise and human presence is likely to disperse wildlife prior to any equipment use. In addition, SpaceX would conduct pre- and post-construction monitoring for piping plovers. Based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is likely to adversely affect* the piping plover and its critical habitat. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS.

Northern Aplomado Falcon

Potential foraging habitat for the northern aplomado falcon does exist within the ROI. Limited perching and nesting sites (trees, yuccas, and power poles) occur within the vicinity of the proposed control center area, but outside the project footprints; however, no nesting or perching sites occur within the vicinity of the proposed vertical launch area. Falcons have been observed within the vicinity of the project area west of Boca Chica Beach. Aplomado falcons may pass through the area while moving to other areas of suitable habitat to the north and south of the project area. However, these movements would be infrequent and transitory. Increased vehicular traffic and human presence from construction activities may temporarily displace foraging aplomado falcons. Implementation of proposed SCMs (provided in Section 6.7, *Biological Resources (Fish, Wildlife, and Plants)*) would avoid and/or minimize impacts to aplomado falcons from the proposed construction activities. Based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is likely to adversely affect* the northern aplomado falcon. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS.

Jaguarundi and Ocelot

The proposed vertical launch and control center areas do not have suitable denning habitat for the jaguarundi and ocelot, and neither species have been observed within these areas. However, the area could act as a travel corridor connecting suitable habitat. While there currently is traffic along State Highway 4 due to residents of Boca Chica Village and recreational and fishing opportunities on Boca Chica Beach, the Proposed Action would increase vehicle traffic during construction of the facilities. This could potentially increase the potential for vehicle collisions with ocelots and jaguarundis. The majority of the construction would occur during the day, with only small amounts of construction, such as pouring of concrete, occurring at night. Peak ocelot activity is around sunset and sunrise, with activity continuing during the night (USFWS 2004). Jaguarundis are active during the daytime and at night. As discussed in Appendix K, *Ground Traffic and Transportation*, traffic during the construction period would increase by approximately 137 vehicles per day within the Lower Rio Grande Valley Wildlife Refuge corridor and by approximately 137 vehicles per day within the corridor providing access to Boca Chica Beach and the vertical launch area. Implementation of proposed SCMs discussed in Section 6.7, *Biological Resources (Fish, Wildlife, and Plants),* would avoid and/or minimize impacts to the ocelot and jaguarundi, including the education of construction and SpaceX personnel on the potential of vehicle collisions with ocelots and jaguarundis, reduction of vehicle speeds along State Highway 4 within the vertical launch and control center areas, and the installation of “Watch Out for Ocelots/Jaguarundis” or “Watch Out for Wildlife” signs along both sides of State Highway 4.

Based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is likely to adversely affect* the jaguarundi and ocelot. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS.

West Indian Manatee

None of the proposed construction areas are located within manatee habitat. A launch event could increase boat traffic within the vicinity of the vertical launch area during launch days. This could potentially increase the potential for seagrass beds to be disturbed from rotor wash and therefore result in a decrease in a food source for the manatee. In addition, the potential for manatee boat strikes could also increase due to an increase in boat traffic. However, launches would only occur a maximum of 12 times a year, and the public would be educated on safe and lawful areas where they could watch the launches. In addition, impacts to manatees would be minimized through the use of an educational outreach program to inform people about manatees in the area and why and how to avoid them. Furthermore, this species has not been observed within the vicinity of the project area since 1914 and does not currently occur within the ROI with any frequency that would subject it to potential direct or indirect impacts from the Proposed Action. Based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is not likely to adversely affect* the West Indian manatee (see Section 4.8.1.2, *Operation*, for discussion of potential operational impacts). In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS.

Sea Turtles

The Kemp's ridley, loggerhead, green, hawksbill, and leatherback sea turtles have all been recorded nesting within the ROI in the past. However, the Kemp's ridley sea turtle is the only one that has been recently recorded to nest on Boca Chica Beach with any regularity.

None of the proposed construction areas are located in any potential sea turtle nesting areas. The eastern boundary of the perimeter fence for the vertical launch area is greater than 500 ft west of potential beach nesting areas and is separated by sand dunes. Therefore, proposed construction activities would have no direct effect on sea turtle habitat in the terrestrial environment. Construction noise (such as the impact pile driver) may be heard on Boca Chica Beach and could potentially affect any turtles that may be nesting in the area. However, these potential impacts would be short-term and temporary, and the most significant potential impacts to sea turtles would result from launches (see Section 4.8.1.2 , *Operation,* below).

Red Knot

Long-term habitat loss would result from the construction of the proposed facilities. However, this permanent loss of habitat would impact only a small fraction of this community in the Lower Rio Grande Valley and would not adversely impact the availability of habitat for the red knot. In addition, increased vehicular traffic and human presence, as well as noise from construction, may temporarily displace the red knot. The red knot does not nest within Cameron County; therefore, nesting would not be impacted by the Proposed Action. With implementation of proposed SCMs such as pre-construction surveys during the breeding season for birds and designating a FCR (refer to Section 6.7, *Biological Resources [Fish, Wildlife, and Plants],* for more details), there would be no significant impacts on the red knot as a result of the proposed construction activities. In addition, the proposed project would not contribute to the future listing of this species.

4.8.1.2 Operation

Vegetation

Daily maintenance activities would not include disturbance to vegetation. With the implementation of appropriate handling and management procedures, hazardous wastes generated as a result of routine operation of the vertical launch and control center areas would have no significant impacts to the environment (see Section 4.9, *Hazardous Materials, Pollution Prevention, and Solid Waste* for more details). Launch activities would have minimal impacts to vegetation from potential fire. Fires are unlikely since launch activities would occur over concrete pads with no surrounding vegetation. Very little particulate deposition is expected since the Falcon 9 and Falcon Heavy vehicles utilize use fuels (LOX and RP-1) (see Section 3.9, *Hazardous Materials, Pollution Prevention, and Solid Waste* for further details). Therefore, there would be no significant impacts to vegetation from operational activities.

Wildlife

Increased vehicular traffic and human presence from operational activities may cause wildlife species found within the ROI to disperse. However, wildlife in the area is currently exposed to noise from vehicular traffic and human presence from vehicles using State Highway 4 to access Boca Chica Village and Boca Chica beach. Increased vehicle traffic could increase the potential for wildlife collisions. As stated in Appendix K, *Ground Traffic and Transportation*, the maximum number of vehicle trips per day from full-time on-site employees is anticipated to be 30 in 2013, increasing to 150 by 2022. Employees would be educated on the potential of vehicle collisions with wildlife and would be required to maintain reduced speeds along State Highway 4 within the ROI. In addition, on launch days, the public may try to get a closer look at the launch, increasing the potential for unlawful off-road use in areas within the vicinity of the ROI. This could temporarily cause wildlife species in the area to disperse and expend additional energy, and could cause impacts to the habitat from trampling and increased erosion. However, impacts would be minimized by increasing patrol of these areas on launch days and by educating the public on safe and lawful areas where they can watch launches.

The greatest potential impact to wildlife from operations would result from the visual effect of the launch vehicle and the launch noise. Studies have shown that wildlife react to visual stimuli (e.g., aircraft overflights) that are below 1,000 feet AGL (Lamp 1989; Bowles 1995). Vehicle launches and the associated noise can affect wildlife directly. Wildlife responses may include increased movement after a launch, avoiding or leaving areas where a launch occurs, changes in foraging patterns, and arousal of species-specific defensive behaviors (e.g., flight, aggression). Noise from vehicle launches may also have indirect effects on wildlife such as masking. Masking occurs when noise interferes with the perception of a sound of interest. For example, masking may affect predator avoidance and the detection of social signals (Bowles 1995).

The effects of noise from vehicle launches are difficult to assess because a number of adaptive responses may be involved, making the overt behavioral or physiological changes in response to noise highly variable. These responses include the acoustic startle, the orienting response, species-typical defensive behaviors, and responses conditioned by previous exposures to noise.

The primary concern with vehicle launches, and the associated noise, is the startle effect. For example, this occurs when birds are surprised by sudden, unexpected loud noises and leave the nest or perch suddenly. Possible negative impacts from this behavior include the expulsion of eggs or nestlings from the nest as the parent leaves suddenly, increased predation of eggs or young when parents are off the nest, and eggs or young may become chilled if the parent is off the nest for an extended period of time.

Even if proven significant, most of the effects of noise are mild enough that they may never be detectable as changes in population size or population growth against the background of normal variation (Bowles 1995). Many other environmental variables (e.g., predators, weather, changing prey base, ground based human disturbance) may influence reproductive success and confound the ability to tease out the ultimate factor in limiting productivity of a certain nest, area, or region (Smith et al. 1988). In contrast, the effects of other human intrusions near nests, foraging areas, dens, etc. (e.g., hiking, bird watching, boating) are readily detected and substantial (U.S. Forest Service 1992).

Noise from launch operations would extend outside the vertical launch area and control center area. No data is available on the physiological impacts on wildlife due to rocket launches. However, the noise from the launches would most likely temporarily displace wildlife, including migratory birds, and could cause increased heart rates, abandoned nests, and consumption of additional energy. The SEL noise levels would be as high as 148 dBA at 0.2 miles and 131 dBA at 2.0 miles (see Section 4.3, *Noise*). These noise impacts would be short-term since noise levels would last less than 1 minute and would only occur up to 12 times per year. Sonic boom modeling shows that the booms would intercept the surface more than 40-miles off the coast in the Gulf of Mexico. Therefore, noise from sonic booms would not be heard inland. Overall, there would be no significant impacts to wildlife from noise associated with operations.

Elements of the proposed facilities, including the lightning and water towers, could attract raptors and other migratory birds to the vertical launch area for nesting and perching. However, any human disturbance or noise from pre-launch operations would likely cause them to take flight prior to launch. Furthermore, the structures would be equipped with devices to discourage nest building and perching (such as monopole technology, visual fright devices). To minimize collisions of migratory birds with the proposed four lightning protection towers, they would be built in accordance with applicable USFWS guidelines for communication tower siting, construction, operation, and decommission (USFWS 2012f).

In addition, evidence suggests that migratory birds may be attracted to lighted facilities at night, especially during overcast nights, causing them to be disoriented and colliding with buildings and other structures (Longcore and Rich 2004; Poot et al. 2008). Potential impacts from lighting would be reduced by complying with established lighting policy for minimizing disorienting effects on migratory birds. A Lighting Management Plan would be approved by the USFWS and implemented prior to operations.

With implementation of proposed SCMs, such as educating the public on safe and lawful areas they could watch the launch and developing a Lighting Management Plan (see Section 6.7, *Biological Resources (Fish, Wildlife, and Plants),* for more details), there would be no significant impacts on wildlife species as a result of operations.

Special-Status Species

Impacts on state-listed wildlife species are similar to those described above for wildlife. Seven state-listed species (that are not also federally listed) occur or have the potential to occur within the ROI (peregrine falcon, reddish egret, sooty tern, white-tailed hawk, white-faced ibis, wood stork, and black-striped snake). Increased vehicular traffic and human presence as well as noise from launch operations may cause wildlife species found within the vertical launch and control center areas to disperse. Elements of the proposed facilities, including the lightning and water towers, could attract raptors and other birds to the vertical launch area for nesting and perching. However, any noise from pre-launch operations would cause them to take flight prior to launch. With implementation of proposed SCMs, such as implementing USFWS guidelines for towers, educating the public on safe and lawful areas they could watch the launch, and developing a Lighting Management Plan (see Section 6.7, *Biological Resources [Fish, Wildlife, and Plants],* for more details), there would be no significant impacts to state-listed wildlife species as a result of operations.

Potential impacts on ESA-listed species from proposed facility operations are discussed below.

Piping Plover

During a launch event, the water tower would discharge 50,000-200,000 gal of water onto the launch pad. The majority of the water would evaporate during launch. Remaining deluge would be captured in a retention basin and would be sampled and analyzed to determine if the water contained controlled contaminants at levels that exceed the TCEQ water quality standards. Water containing contaminants that exceed the water quality criteria would be removed and hauled to an approved industrial wastewater treatment facility outside of the vertical launch area. All other water not containing prohibited chemicals would be pumped back to the water tower. Although the proposed vertical launch area is located next to an unvegetated flat that provides potential habitat for the plover, no water would reach the ground during the launch event. While there is a small potential for water vapor to reach this unvegetated area, it is not expected that the amount of water vapor from a maximum of 12 launches per year would be enough to alter the habitat and cause vegetation growth on the unvegetated flat, adversely modifying piping plover critical habitat.

In addition, an increase in impervious surfaces and associated runoff could increase the potential for stormwater to reach these unvegetated wetlands near the proposed facilities. This could in turn cause vegetation to grow within nearby unvegetetated critical habitat for the piping plover. However, stormwater management BMPs within the proposed vertical launch and control center areas would be added to facilitate infiltration and evaporation. No direct discharges to surface waters, including wetlands, are anticipated.

Noise from launch operations would extend outside the vertical launch and control center areas, and would displace piping plovers using adjacent suitable habitat. The SEL noise levels would be as high as 148 dBA at 0.2 miles and 131 dBA at 2.0 miles (see Section 4.3, *Noise*). However, these noise impacts would be short-term as noise levels associated with a launch would last less than 1 minute and would only occur up to 12 times per year. In addition, based on a previous Section 7 consultation between the USFWS and NASA for proposed launches at the Wallops Flight Facility, Virginia, and potential effects to piping plovers, it was determined that due to the short duration of disturbance and the limited number of launches, no significant impacts would be expected (NASA 2005). In addition, based on 12 years of monitoring of snowy plovers, a similar co-generic species, during launches at VAFB, California, startle responses were rare and reproductive success was not affected by launches. Monitoring data obtained during launches since 1995 support other observations that snowy plovers crouch and observe objects, such as helicopters or launch vehicles that mimic avian predators, or flush at launch but soon return to normal behavior. Monitoring of more than 20 rocket launches from VAFB have shown no adverse effects to nesting or wintering snowy plovers (VAFB 2009).

Modeled sonic boom events associated with proposed launches would intercept the surface more than 40-miles off the coast in the Gulf of Mexico and would not impact piping plovers.

Based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is likely to adversely affect* the piping plover and its critical habitat**.** In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS.

Jaguarundi and Ocelot

The proposed vertical launch and control center areas are located within the proposed Rio Grande Valley Wildlife Corridor which comprises a north-south coastal corridor on the eastern boundary of the Rio Grande delta that supports a matrix of native rangeland, wetland, and upland communities that may be suitable for ocelot and jaguarundi movement. While the 20-acre vertical launch area would be fenced, the fenced area would only preclude north-south movement through 2,500-ft wide area. Jaguarundis and ocelots would still be able to move through the surrounding habitat around the proposed vertical launch area. Therefore, this would not significantly impede or prevent movements by jaguarundi and ocelot through the area.

While approximately 20 acres of the vertical launch area would be fenced in, habitat is similar around the proposed area and would still provide the jaguarundi and ocelot sufficient area to freely move around the proposed vertical launch area.

Although there currently is traffic along State Highway 4 due to recreational and fishing opportunities on Boca Beach and from residents of Boca Chica Village, the Proposed Action would increase vehicle traffic during daily operations of the vertical launch and control center areas.

This could potentially increase the potential for ocelot and jaguarundi vehicle collisions. The majority of the traffic from operations would occur during daylight hours. Peak ocelot activity is around sunset and sunrise, with activity continuing during the night. Jaguarundis are known to be primarily diurnal. As stated in Appendix K, *Ground Traffic and Transportation*, the maximum number of vehicle trips per day from full-time on-site employees is anticipated to be 30 in 2013, increasing to 150 by 2022. Employees would be educated on the potential of vehicle collisions with wildlife and would be required to maintain reduced speeds along State Highway 4 within the ROI. Implementation of proposed SCMs discussed in Section 6.7, *Biological Resources (Fish, Wildlife, and Plants),* would avoid and/or minimize impacts to the ocelot and jaguarundi, including the education of construction and SpaceX personnel on the potential of vehicle collisions with ocelots and jaguarundis, reduction of vehicle speeds along State Highway 4 within the vertical launch and control center areas, and the installation of "Watch Out for Ocelots/Jaguarundis" or "Watch Out for Wildlife" signs along both sides of State Highway 4.

Noise from launch operations would extend outside the vertical launch area, and could temporarily cause ocelots and jaguarundis to avoid the area. The SEL noise levels would be as high as 148 dBA at 0.2 miles and 131 dBA at 2.0 miles (see Section 4.3, *Noise*). These noise impacts would be short-term since noise levels and would last less than 1 minute and would only occur up to 12 times per year. Modeled sonic boom events associated with proposed launches would intercept the surface more than 40-miles off the coast in the Gulf of Mexico and would not impact jaguarundi and ocelot.

Based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is likely to adversely affect* the jaguarundi and ocelot. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS.

Northern Aplomado Falcon

Potential foraging habitat for the northern aplomado falcon exists within the ROI. Limited perching and nest sites (trees, yuccas, and power poles) occur within the vicinity of the proposed control center area, but outside the project footprint; however, no nesting or perching sites occur within the vicinity of the proposed vertical launch area. Falcons have been observed within the action area west of Boca Chica Beach. Increased vehicular traffic and human presence from operational activities associated with the Proposed Action may temporarily displace foraging aplomado falcons. Construction of the facilities, including the lightning and water towers, could attract falcons to the vertical launch area for nesting and perching. However, any noise and activities from day-to day facility operations and monthly pre-launch operations would cause falcons to avoid the vertical launch and control center areas. Furthermore, the structures would be equipped with devices to discourage nest building and perching (such as monopole technology and visual fright devices). To minimize collisions with the proposed four lightning protection towers, towers would be built in accordance with the applicable USFWS guidelines for communication tower siting, construction, operation, and decommission (USFWS 2012f).

Noise from launch operations would extend outside the launch facilities, and would displace aplomado falcons potentially using adjacent suitable habitat. The SEL noise levels would be as high as 148 dBA at 0.2 miles and 131 dBA at 2.0 miles (see Section 4.3, *Noise*). These noise impacts would be short-term since noise levels would last less than 1 minute and would only occur up to 12 times per year. Modeled sonic boom events associated with proposed launches would intercept the surface more than 40-miles off the coast in the Gulf of Mexico and would not impact northern aplomado falcon.

Based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is likely to adversely affect* the northern aplomado falcon. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS.

West Indian Manatee

A launch event could increase boat traffic within the vicinity of the vertical launch area during launch days. This could potentially increase the potential for seagrass beds to be disturbed from rotor wash and therefore decrease a food source for the manatee. In addition, the potential for manatee boat strikes could also increase due to an increase in boat traffic. However, launches would only occur up to 12 times a year and the public would be educated on safe and lawful areas where they could watch the launches. In addition, impacts to manatees would be minimized through the use of an educational outreach program to inform people about manatees in the area and why and how to avoid them. Furthermore, this species has not been observed within the vicinity of the project area since 1914 and does not currently occur within the vicinity of the project area with any frequency that would subject it to potential direct or indirect impacts from the Proposed Action. Modeled sonic boom events associated with proposed launches would intercept the surface more than 40 miles off the coast in the Gulf of Mexico and would not impact manatees. Based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is not likely to adversely affect* the West Indian manatee. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS.

Sea Turtles

The Kemp's ridley, loggerhead, green, hawksbill, and leatherback sea turtles have all been recorded nesting within the ROI in the past. However, the Kemp's ridley sea turtle is the only one that has been recorded recently to nest on Boca Chica Beach with any regularity.

During launch days, patrol personnel would not be able to access the beach for up to 15 hours during the day. As a result, there is a potential for nests that are laid during the beach closure to not be found and relocated. However, as stated earlier, Kemp's ridley sea turtles primarily nest on windy days, when launch operations are unlikely to occur. Hatchlings from nests that are not relocated could potentially be disoriented by any lights from the launch facility. Potential impacts from lighting would be reduced by complying with established lighting policy for minimizing disorienting effects on sea turtle hatchlings. A Lighting Management Plan would be approved by the USFWS and implemented prior to activation of the vertical launch area. Lighting for the vertical launch area would be designed so that none of the lighting is visible seaward of the dunes. The lighting to be used on buildings would be finalized during the design process. However, the exterior lights could consist of 135W low pressure sodium "full cutoff" wall mounted fixtures and vapor proof, F32, T8, amber sleeved, fluorescent tube fixtures mounted on the ceiling underneath the overhangs. In addition, it is unlikely that lighting would cause disorientation of hatchlings since once nests are laid, eggs are retrieved from each nest and transported to an incubation facility.

Noise and vibrations from rocket launches could frighten nesting turtles, causing them to abandon their nesting attempt. The SEL noise levels would be as high as 148 dB at 0.2 miles and 131 dBA at 2.0 miles (see Section 4.3, *Noise*). However, noise and vibrations from the launch would last less than 1 minute, and would occur up to 12 times a year, thereby reducing the likelihood for the noise and vibrations to occur during the time a sea turtle is attempting to nest. In addition, since Kemp's ridley sea turtles primarily nest from April through July, they would be exposed to at most four launches a year. Vibrations could also harm incubating eggs. However, current standard procedure for all nests that are observed in Texas is for all eggs to be retrieved from each nest and transported to an incubation facility. Sea Turtle, Inc. administers nesting sea turtle patrols and relocation of eggs on Boca Chica Beach. Therefore, any vibrations from a launch would most likely only impact eggs that were laid the same day of the launch, were not found due to the beach closure during a launch, and were not relocated. However, it is expected that activities associated with digging up sea turtle eggs and relocating them to an incubating facility via vehicles would potentially subject sea turtle eggs to greater vibration and noise levels than a launch, which would only last approximately 1 minute. And to date there have been no impacts to sea turtle eggs during transport to an incubating facility due to vibration or noise. Modeled sonic boom events associated with proposed launches would intercept the surface more than 40 miles off the coast in the Gulf of Mexico and would not impact nesting sea turtles.

A launch event could increase boat traffic within the vicinity of the vertical launch area during launch days. This could potentially increase the potential for seagrass beds to be disturbed from rotor wash and therefore decrease a food source for the green sea turtle. In addition, the potential for sea turtle boat strikes could also increase due to an increase in boat traffic. However, launches would only occur up to 12 times a year and the public would be educated on safe and lawful areas where they could view the launches. This would minimize potential impacts to sea turtles in the marine environment.

During a nominal launch, the first stage of the Falcon 9 would land in the Gulf of Mexico, approximately 550 miles downrange, and would potentially be recovered by a salvage ship. In the event that the expended first stage becomes damaged and could not be located, it would subsequently sink. Spent first stages falling into the Gulf of Mexico are a potential source of pollution to marine environments. Depending on the vehicle, varying quantities of LOX and RP-1 would remain in the fuel tanks at the time of the splashdown. Localized temporary adverse impacts on marine waters in the immediate area surrounding this landing may occur. Long-term impacts however would be negligible due to the buffering capacity of the Gulf of Mexico. LOX would dissolve in marine water. However, liquid fuels such as RP-1 that are relatively insoluble in water pose a slight risk to the marine environment until evaporation occurs. When the propellant surfaces, it would form a thin film that would be broken up by wave action, sunlight, and oxygen. All traces of propellant would quickly dissipate within 1 to 2 days (NASA 2009).

Based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is likely to adversely affect* the loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS.

Red Knot

Increased vehicular traffic and human presence as well as noise from launch operations may cause red knots found within the ROI to disperse. These noise impacts would be short-term since noise levels would last less than 1 minute and would only occur up to 12 times per year. Modeled sonic boom events associated with proposed launches would intercept the surface more than 40-miles off the coast in the Gulf of Mexico and would not impact red knots. In addition, the red knot does not nest within Cameron County; therefore, nesting would not be impacted by the Proposed Action. Thus, there would be no significant impacts on the red knot as a result of operational activities. In addition, the proposed project would not contribute to the future listing of this species.

<u>Launch Failure</u>

In the event of a launch failure, an explosion could injure or kill species adjacent to the launch pad or within areas impacted by debris. However, due to the limited number of launches and the unlikely scenario of a launch failure, the likelihood of an impact on nesting sea turtles is low. Debris scatter that could occur of the Gulf of Mexico during a launch abort would also have a low probability of impacting sea turtles.

Fires could potentially start from an explosion on the pad, which could result in a temporary loss of habitat. The launch vehicle propellant tanks would likely rupture and the propellants would burn explosively. Thus, it is possible for propellants to be spilled directly or released as a burning byproduct into local surface water bodies and infiltrating soils to make contact with groundwater. The extent of potential impacts would depend on the type of propellant, the conditions of the accident, and the nature of the terrestrial and water resources affected (see Section 4.9, *Hazardous Materials, Pollution Prevention, and Solid Waste,* for more details). SpaceX would prepare and implement a HMERP to ensure that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to and followed by all personnel. In the event of a launch failure, emergency response and cleanup procedures contained in the HMERP would reduce the magnitude and duration of any impacts.

4.8.2 No Action Alternative

Under the No-Action Alternative, the FAA would not issue launch licenses and/or experimental permits to SpaceX for launch operations from the private site in Cameron County, Texas. SpaceX would not construct the vertical launch and control center areas. The vertical launch and control center areas would remain as they currently are and there would be no impacts to biological resources.

4.9 HAZARDOUS MATERIALS, POLLUTION PREVENTION, AND SOLID WASTE

4.9.1 Proposed Action

4.9.1.1 Construction

<u>Hazardous Materials and Hazardous Materials Management</u>

Construction activities would require the use of hazardous materials. The majority of the hazardous materials expected to be used are common to construction and include diesel fuel, gasoline, and propane to fuel the construction equipment; hydraulic fluids, oils, and lubricants; and welding gases, paints, solvents, adhesives, and batteries. The transport and use of hazardous materials would have the potential to result in accidental spills that could adversely impact soil, surface water, and groundwater adjacent to transportation routes or downgradient from the construction areas. Potential impacts to water resources with regards to spills are discussed in Sections 4.7, *Water Resources*. Soils adversely affected by spills would be treated on-site or would be removed and disposed of in accordance with applicable Federal and State regulations. With the implementation of appropriate handling and management procedures, hazardous materials required for construction of the proposed vertical launch and control center areas would have no significant impacts to the environment.

In accordance with the CWA, a construction stormwater discharge permit would be obtained and a SWPPP would be prepared and implemented prior to the commencement of construction activities. Every outdoor storage area where hazardous materials are proposed to be stored or staged during construction would be identified in the SWPPP and inspected on a recurring basis during the construction phase and until the permit is terminated.

Hazardous materials associated with construction activities would be delivered and stored in a manner that would prevent these materials from leaking, spilling, and potentially polluting soils, groundwater, and surface waters, and in accordance with applicable Federal, State, and local environmental and public and occupational health and safety regulations. Public transportation routes would be used for the conveyance of hazardous materials during construction. Transportation of all materials would be conducted in compliance with DOT regulations.

Hazardous materials would be stored in their original containers with their original product labels and would not be stored directly on the ground. These materials would be stored on pallets under cover and with secondary containment. Incompatible materials would not be stored together, and sufficient space would be provided between stored containers to allow for spill cleanup and emergency response access. Storage units would meet building and fire code requirements and would be located away from vehicle traffic. Storage instructions would be posted and construction employees would be trained in proper receiving, handling, and storage procedures. Material Safety Data Sheets for all materials stored on the site would be provided and available to all site personnel.

Hazardous Waste and Hazardous Waste Management

Hazardous waste would be generated during construction activities. Hazardous waste generated during construction of the vertical launch and control center areas would be expected to include empty containers, spent solvents, paints, sealants, adhesives, waste oil, spill cleanup materials (if used), lead-acid batteries from construction equipment, and various universal wastes (e.g., fluorescent bulbs, batteries). Other hazardous materials such as welding gases are expected to be consumed in their entirety and the empty gas cylinders returned to the suppliers. Construction contractors would be responsible for safely removing these construction-generated wastes from the vertical launch and control center areas and for arranging for recycling or disposal in accordance with applicable regulations.

The total monthly generation of hazardous waste during construction is anticipated to be less than 100 kilograms during a calendar month. The construction contractor would be (contractually) responsible for determining their regulatory status regarding hazardous waste generation (during construction, and obtaining and maintaining compliance) in accordance with Federal and State law and complying with the applicable regulations. With the implementation of appropriate handling and management procedures, hazardous wastes generated during the construction of the vertical launch and control center areas would have no significant impacts to the environment.

The storage and transport of hazardous waste would have the potential to result in accidental spills that could adversely impact soil, surface water, and groundwater adjacent to transportation routes or downgradient from the construction areas. Potential impacts to water resources with regards to spills are discussed in Section 4.7, *Water Resources*. Soils adversely affected by spills would be treated on site or would be removed and disposed of in accordance with applicable Federal and State regulations. Hazardous wastes associated with construction activities would be stored in a manner (per applicable regulations) that would prevent these materials from polluting soils, groundwater, and surface waters and in accordance with applicable Federal, State, and local environmental and public and occupational health and safety regulations. Individual contractors would be responsible for the safe and compliant collection, management, and transport of their hazardous wastes to an offsite permitted TSD facilities.

<u>Pollution Prevention</u>

During the site preparation and construction phase, hazardous materials, substances, and wastes would be collected, stored, and disposed of in accordance with applicable regulations and using practices that minimize the potential for spills, accidental releases, or contact with stormwater. On March 5, 2013, the reissued TPDES Construction General Permit TXR150000 became effective. This general permit authorizes the discharge of stormwater runoff associated with small and large construction sites and certain non-stormwater discharges into surface water in the state. Under this general permit, primary operators of large construction sites must develop and comply with the conditions of the permit as well as a SWPPP. The purpose of the SWPPP is to identify potential sources of pollutants that affect storm water discharges from the site; describe the practices that will be implemented to prevent or control the release of pollutants in storm water discharges; to create an implementation schedule to ensure that the practices described in the SWPPP are in fact implemented; and to evaluate the plan's effectiveness in reducing the pollutant levels in storm water discharges. The SWPPP would be fully implemented and adherence to the applicable stormwater discharge permit requirements monitored and enforced by the construction contractor during the construction phase. Adherence with the SWPPP would prevent potential spills at the construction site from affecting surface waters within the surrounding area.

<u>Solid Waste and Solid Waste Management</u>

Solid wastes generated during construction would include used brick, mortar, timber, steel, vegetation/landscaping waste, empty material containers, packing materials, food waste, and empty food and beverage containers. Scrap building materials that would be generated from construction of buildings with interior spaces (e.g., offices) would include such materials as wood, drywall, plastic, insulation, and masonry.

The construction of the vertical launch and control center areas would result in an increase in overall solid waste generation in the local community for a period of approximately 2 years. This temporary increase is not anticipated to have a significant impact on the local landfill, which has an estimated capacity life span of over 30 years (TCEQ 2011b).

Solid wastes generated during construction would be placed in covered receptacles until disposed of off-site to minimize contact with stormwater and prevent offsite deposition from wind. Excess construction materials would be salvaged or recycled to the maximum extent practicable and the remaining solid waste disposed of in appropriately permitted landfills. With the implementation of appropriate handling and management procedures, solid wastes would have no significant impacts to the environment.

Soil excavated during construction activities would be stockpiled for on-site construction and landscaping uses. Building materials such as asphalt and concrete are not expected to generate waste, since they are produced in the needed quantities and can be recycled.

Solid waste storage areas would establish and implement BMPs in accordance with CWA requirements. To minimize impacts to surface waters, solid waste storage areas would be located outside of flood prone areas and away from drainage facilities and receiving waters to the maximum extent practicable. All solid waste receptacles would be covered to prevent contact with stormwater during rain events and prevent offsite transport by wind.

4.9.1.2 Operation

Hazardous Materials and Hazardous Materials Management

Transportation, Handling, and Storage

The operation of the proposed vertical launch and control center areas would require the use and storage of hazardous materials for launch operations as well as for routine maintenance and flight support activities. Table 4.9-1 summarizes the types, quantities, and locations of the various hazardous materials anticipated to be used. The majority of these materials would be stored as close to their point of use as possible to minimize the potential for accidental spills. Transportation, handling, and storage of hazardous materials could result in adverse impacts to soil, surface water, and/or groundwater along transportation routes, and at the vertical launch and control center areas and the surrounding area if a spill were to occur. Potential impacts to water resources with regards to spills are discussed in Section 4.7, *Water Resources*. Soils adversely affected by spills would be treated on site or would be removed and disposed of in accordance with applicable Federal and State regulations. The hazardous materials storage tanks would be located within secondary containment designed to hold at least 110 percent of the tank's maximum volume. As described in Section 2.1.1.4, *Gas, Fuel, Oil, and Solvent Storage*, all tanks and containment systems would be cleaned, tested, and certified before first use; all tanks would be tested to the DOT, ASME Section VIII Pressure Vessel Code requirements, or American Petroleum Institute storage tank requirements, as applicable. Permanent over-ground lines would be installed to connect both the LOX and the RP-1 storage areas to the launch pad. These piping systems would be designed, installed, and tested in accordance with ASME B31.3 Piping Code requirements.

To further minimize the potential for groundwater contamination, SpaceX would assemble an emergency response team that would be responsible for responding to hazards and spills for all Falcon program propellants, including both launch vehicle propellants as well as payload related propellant. SpaceX would prepare and implement a HMERP to ensure that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to and followed by all personnel. Emergency response and cleanup procedures contained in the HMERP would reduce the magnitude and duration of any impacts both on and off site.

Because facilities would be located within the 100 and 500-year floodplains, SpaceX would ensure the storage of hazardous materials would implement flood control measures, such as locating water-sensitive equipment, supplies, chemicals, etc. above flood level, and moving hazardous waste outside of the floodplain when substantial storms are imminent. The implementation of these measures would reduce the likelihood that a flood event might result in loss of life, injury to persons, or damage to property or otherwise be considered a “critical action” as defined in EO 11988, *Floodplain Management* (see Section 3.7, *Water Resources (Including Surface Waters, Groundwater, Wetlands, Floodplains, and Wild and Scenic Rivers),* for a discussion of EO 11988).

In addition to the materials listed in Table 4.9-1, operations at both the vertical launch and control center areas would use products containing hazardous materials, including paints, solvents, oils, lubricants, acids, batteries, surface coating, and cleaning compounds. These materials would be handled, stored, and disposed in accordance with procedures listed on their respective Materials Safety Data Sheets and in accordance with applicable Federal and State regulations. Adherence to Materials Safety Data Sheets and in accordance with applicable Federal and State regulations would minimize the potential for impacts to the vertical launch and control center areas and surrounding areas. Hazardous materials such as propellants, chemicals, and other hazardous material payload components would be transported to the facilities in accordance with DOT regulations (e.g., 49 CFR 100-199) governing interstate and intrastate shipment of hazardous materials, as applicable. With the implementation of appropriate handling and management procedures, hazardous materials required for operation of the vertical launch and control center areas would have no significant impacts to the environment.

Table 4.9-1 Hazardous Materials Associated with Proposed Operations

Falcon 9			
Stage 1			
LOX	62,000 gal		
RP-1	38,000 gal		
Stage 2			
LOX	15,000 gal		
RP-1	9,000 gal		
He gas (both stages)	~200 lb mass		
Falcon Heavy			
LOX	350,000 gal		
RP-1	200,000 gal		
Reusable Suborbital launch Vehicle			
RP-1/LOX	6,900 gal		
Payloads[1]			
Material	**Falcon 9**	**Falcon Heavy**	**Dragon**
UDMH	4,840 lb	12,000 lb	0 lb
MMH NTO Total	4,840 lb	12,000 lb	2,850 lb
He gas	500 st ft^3	1,000 st ft^3	500 st ft^3
N gas	500 st ft^3	1,000 st ft^3	500 st ft^3
ordnance (small explosive bolts)	1 lb. TNT equivalent Max	5 lb. TNT equivalent Max	1 lb. TNT equivalent Max

Table 4.9-1 Hazardous Materials Associated with Proposed Operations

Vertical Launch Area		
Material	**Quantity**	**Location**
RP-1	400 gal max	Integration and Processing Hangar
LOX	400,000 gal estimated	Propellant Storage Area
RP-1	250,000 gal estimated	Propellant Storage Area
He	20,000 st ft^3, water volume	Propellant Storage Area
N	30,000 st ft^3, water volume	Propellant Storage Area
Hangar	100 gal	Integration and Processing Hangar
Deluge water	250,000 gal	Water Tower
Heavy gear oil, hydraulic oil, kerosene, cutting oil	<300 gal	Hangar shop area or launch pad
Welding gases and supplies	10 K-bottles each Oxygen and Acetylene	Workshop and Office Area
Control Center Area		
Material	**Quantity**	**Location**
Payload fuel (UDMH, MMH or NTO)	(4,840 lb; 12,000 lb; 2,850 lb)	Payload Processing Facility
Hydrazine	0-2,000 gal	Satellite Fuels Storage
Material	**Quantity**	**Location**
Generator fuel (diesel/gasoline) (10 x 300kW)	10,000 gal	All areas

Notes: [1] Vehicle payloads would include cargo, scientific instruments or experiments, and external fuel.
LOX = liquid oxygen; RP-1 = refined petroleum-1; He = helium; UDMH = unsymmetrical dimethyl hydrazine; MMH = monomethylhydrazine; NTO = nitrogen tetroxide; N = nitrogen; st ft^3 = standard cubic feet; lb = pound; gal = gallon; kW= kilowatt; TNT = trinitrotoluene; K = wet volume of 49.9 liters

A HMMP would be developed to include strategies and procedures for storing, handling, disposing, and transporting hazardous materials in addition to responding to on-site or off-site spills. These strategies would be similar to those detailed for construction. In addition, an SPCCP would be prepared in accordance with the CWA requirements included in 40 CFR 112. The SPCCP would outline proper management and spill response procedures for the oils and fuels stored at the vertical launch and control center areas.

Launch Activities

During launch of the Falcon 9, Falcon Heavy, or reusable suborbital launch vehicle, an exhaust cloud would form near the launch pad at lift-off as a result of the exhaust plume and evaporation and subsequent condensation of deluge water. Because these launch vehicles use only LOX and RP-1 propellants, the exhaust cloud would consist of steam only and would not contain any hazardous materials (USAF 2007). As the volume of water expected to condense from the exhaust cloud is expected to be minimal, the exhaust cloud would generate less than significant impacts on surface water quality near the vertical launch area.

After a Falcon launch, the first stage of the launch vehicle would land in the Gulf of Mexico, approximately 550 miles downrange, and would potentially be recovered by a salvage ship. The salvage ship would be able to locate the first stage through telemetry signals from the stage. The recovered first stage would be returned to SpaceX facilities in Hawthorne, California. In the event the expended first stage becomes damaged and could not be located, it would subsequently sink. Spent first stages falling into the Gulf of Mexico are a potential source of pollution to marine environments. Depending on the vehicle, varying quantities of LOX and RP-1 would remain in the fuel tanks at the time of the splashdown. Localized temporary adverse impacts on marine waters in the immediate area surrounding this landing may occur. Long-term impacts would be negligible due to the buffering capacity of the Gulf of Mexico. LOX would dissolve in marine water. However, liquid fuels such as RP-1 that are relatively insoluble in water pose a slight risk to the marine environment until evaporation occurs. When the propellant surfaces, it would form a thin film that would be broken up by wave action, sunlight, and oxygen. All traces of propellant would quickly dissipate within 1 to 2 days (NASA 2009).

<u>Hazardous Waste and Hazardous Waste Management</u>

Small quantities of hazardous waste would be generated during routine operations. Most of the hazardous materials would be consumed, so no substantial volumes of hazardous waste would require disposal. Launch vehicle maintenance, propellant and fuel storage and dispensing, and facility and grounds maintenance are among those activities that may generate very small quantities of hazardous wastes. The sources of hazardous waste include waste fuel, waste oils, spent solvents, paint waste, spill response materials, and used batteries.

Up to 200,000 gal of deluge water could be discharged during a routine launch event. During a launch, all water not vaporized or expelled would be contained in a retention basin underneath the launch pad. This water would then be sampled and analyzed to determine if the water contained controlled contaminants at levels that exceed the TCEQ water quality standards. Water containing contaminants that exceed the water quality criteria would be removed and hauled to an approved industrial wastewater treatment facility outside of the vertical launch area. All other water not containing prohibited chemicals would be pumped back to the water tower.

The estimated amount of hazardous waste anticipated to be generated at the facility would qualify the facility as a small quantity generator of hazardous waste or a conditionally exempt small quantity generator as defined by 30 TAC Part 1 §335 (c).

The storage and transport of hazardous waste has the potential to result in accidental spills that could adversely impact soil, surface water, and groundwater adjacent to transportation routes at or downgradient from the vertical launch and control center areas. Potential impacts to water resources with regards to spills are discussed in Section 4.7, *Water Resources (Including Surface Waters, Groundwater, Wetlands, Floodplains, and Wild and Scenic Rivers)*. Soils adversely affected by spills would be treated on-site or would be removed and disposed of in accordance with applicable Federal and State regulations. Hazardous wastes would be managed on site in accordance with applicable Federal, State, and local regulations. Hazardous wastes would be prepared for transport in accordance with DOT regulations, and the wastes would be disposed of at approved TSD facilities and would be transported using appropriately licensed contractors. With the implementation of appropriate handling and management procedures, hazardous wastes generated as a result of routine operation of the vertical launch and control center areas would have no significant impacts to the environment.

Pollution Prevention

BMPs for pollution prevention would be implemented in accordance with the Pollution Prevention Act of 1990. In accordance with the Act, SpaceX would prevent pollution via source reduction whenever feasible. Polluting substances whose use cannot be avoided would be recycled and/or treated in accordance with applicable laws. Disposal of all polluting substances would be employed only as a last resort and would be conducted in accordance with applicable laws. All accidental releases of polluting substance would be responded to quickly and appropriate clean up measures would be implemented in accordance with applicable laws to minimize impacts to the environment.

In addition, several substance specific plans and policies would be developed and would address proper materials management and other pollution prevention strategies and practices for those substances. A HMMP and HMERP would be prepared for the Proposed Action and would outline the procedures for proper management of hazardous materials to prevent spills from occurring as well as the proper response procedures to follow should a spill occur. An SPCCP would also be prepared and implemented in accordance with regulations promulgated under the CWA. The SPCCP would outline management guidelines and response procedures for site personnel and would ultimately minimize the potential for and magnitude of releases of oil. Compliance with the procedures and protocols outlined in each of the respective plans would minimize the potential for spills to occur as well as minimize impacts to the site and surrounding areas.

Should the operation generate hazardous waste volumes that would define it as a small quantity generator of hazardous waste, a Pollution Prevention Plan would be prepared to identify and implement source reduction and waste minimization measures as required by 30 TAC Subchapter Q §335.473.

Solid Waste and Solid Waste Management

Operations would also generate solid waste, such as office waste, break room waste, and packaging from supplies. Section 2.1.3, *Personnel Levels*, indicates that by 2022, the peak full-time on-site employment under the Proposed Action would be 150 workers. However, staffing levels at the vertical launch and control center areas is anticipated to fluctuate with the highest on-site staffing levels being observed during launch campaigns (an additional 100 local or transient workers). The EPA estimates that a person generates 4.43 lbs of waste per day (EPA 2010a). Based on that amount, and assuming 150 full-time employees, it is expected that approximately 664.5 lbs of solid waste would be generated per day, resulting in approximately 86 tons of solid waste per year (assuming 260 work days). According to the TCEQ, the Lower Rio Grande Valley Region disposed of 1,124,940 tons of solid waste in 2010. Solid waste generated by the Proposed Action would increase the disposal rate by 0.008 percent. This increase is not anticipated to have a significant impact on the local landfill which has an estimated capacity life of over 30 years.

With the implementation of appropriate handling and management procedures, solid wastes generated as a result of long-term operation of the facilities would have no significant impacts to the environment. Solid wastes generated by facility operations would be salvaged or recycled to the maximum extent practicable or disposed of in a permitted landfill. Solid waste receptacles would be water tight, maintained covered, and would be located outside of flood prone areas and away from drainage facilities and receiving waters to the maximum extent practicable.

Launch Failures

In the unlikely event of a launch failure, several scenarios are possible:

1. The entire launch vehicle, with onboard propellants, fails on the launch pad and an explosion occurs.
2. The entire launch vehicle, with onboard propellants, is consumed in a destruct action (refer to Section 2.1.1.8, *Launch Failures*, for discussion of flight termination system) during flight. The launch vehicle is largely consumed in the destruct action, but residual propellant escapes and vaporizes into an airborne cloud.
3. The launch vehicle survives to strike the water essentially intact, whereupon the propellant tanks rupture, releasing liquid propellants into surface waters.
4. The launch vehicle survives water impact without tank rupture and sinks to the bottom, but leaks propellant into the water over time.

The probability of any one of these scenarios is unknown. Based on the proposed trajectories, there is a high probability that the launch vehicle would fall into the Gulf of Mexico, along with some scattered debris. Propellants and other chemicals could be released.

Should a failure occur on the launch pad, a number of possible outcomes could result, the most likely being a fire on the launch pad. An explosion on the launch pad would likely spread debris within the FAA approved hazard area and vegetation across the hazard area would likely be burned. A launch failure could result in impacts on surface waters due to contamination from rocket propellant. In the unlikely occurrence of a launch failure, spilled RP-1 could enter the tidal wetlands close to the launch pad. Because some propellant would likely be burned prior to failure, it is unlikely that the maximum amount of RP-1 held in the tanks would be spilled. SpaceX would follow the emergency response and cleanup procedures outlined in the HMERP. Procedures may include containing the spill using disposable containment materials such as absorbent berms, fences, trenches, sandbags, and cleaning the area with absorbents or other material to reduce the magnitude and duration of any impacts. If the spill is greater than 25 gal of petroleum or of any size that affects or threatens to affect surface waters (i.e., one that creates a sheen, emulsion, or sludge), it would be reported within 2 hours to the National Response Center, the Texas State Emergency Response Commission, and the TCEQ. Debris and unspent fuel would be removed from the near-shore marine environment and disposed of in accordance with Federal, State, and local regulations. Short-term impacts on the near-shore marine environment may result, but long-term impacts would be negligible due to the emergency response and cleanup procedures and the buffering capacity of the waters of the Gulf of Mexico.

A release of unspent RP-1 from the launch vehicle may create a thin film of petroleum on the water surface near the impact area. Due to the volume of this release into the nearby tidal wetlands, temporary impacts on water quality in the tidal wetlands may be adverse; however, because mitigation and cleanup measures would be implemented, the potential long-term impacts on tidal wetlands would not be substantial. If leaked into the Gulf of Mexico, the amount of water in comparison to the amount of propellant would allow the propellant to dilute so that impacts would be temporary and extremely localized. Dissipation into the Gulf waters would occur within hours due to a combination of wave movement, oxygen exposure, and sunlight (USAF 2007). Due to the small volume of this release into the Gulf of Mexico, impacts on water quality in the Gulf of Mexico would be negligible.

Other propellants such as UDMH (also known as 1,1-dimethyl hydrazine), MMH, and NTO may also be released into the environment as a result of launch failure. UDMH is highly reactive and degrades readily in environmental media. Thus, it is not likely to have significant impacts to air or water. UDMH degrades rapidly in air through reactions with O_3, hydroxyl radicals, and NO_2 with the major reaction product (approximately 60 percent) being dimethyl nitrosamine, a highly toxic substance. The estimated atmospheric half-life for UDMH in the presence of O_3 is less than 1 minute and less than 10 minutes in the presence of NO_X. In the ambient atmosphere, the breakdown product, dimethyl nitrosamine, should rapidly degrade upon exposure to sunlight (Agency for Toxic Substances and Disease Registry [ASTDR] 1997). The half-life for direct photolysis of dimethyl nitrosamine is on the order of 5 to 30 minutes (ASTDR 1989).

UDMH degrades in open aquatic systems, but the rate of degradation is dependent on specific aquatic environmental factors, including pH, hardness, temperature, oxygen concentration, and the presence of organic matter and metal ions. Oxidation and biodegradation are the primary removal mechanisms. The primary reaction pathway for hydrazine degradation in water produces nitrogen gas and water. In oxygen-deficient waters or in the presence of metal ions which serve as catalysts, ammonia may also be produced. The reported half-life of 1,1-dimethyl hydrazine in ponds and seawaters ranged from 10 to 14 days, presumably because of reaction with oxygen and other free radicals. UDMH may become concentrated in some fish living in contaminated water. However, most animals quickly digest and excrete UDMH, so high levels of this compound are not expected to remain in their bodies. Because of its high reactivity, UDMH is rapidly degraded in aquatic systems making food chain bioaccumulation unlikely (ASTDR 1997).

In soils, UDMH appears to degrade more rapidly than in water, with complete degradation occurring within 1-8 days. Oxidation and biodegradation have been identified as the main removal processes. Microbial degradation may contribute to removal of the chemical from soil (ASTDR 1997).

MMH and NTO are toxic to humans and pose environmental hazards if released in sufficient quantity to the environment. MMH is highly reactive as well, and is listed by the International Agency for Research on Cancer as a possible human carcinogen. The toxicology of MMH and NTO with marine life is not well known (NASA 2009). NTO almost immediately breaks down to nitric and nitrous acid on contact with water, and would be very quickly diluted and buffered by seawater. Therefore, there would be negligible potential for impact to marine life. Hydrazine fuels such as MMH are highly reactive substances that quickly oxidize to form amines and amino acids, which are beneficial nutrients to small marine organisms. Prior to oxidation, there is some potential for exposure of marine life to toxic levels, but for a very limited area and time. A half-life of 14 days for hydrazine fuels such as MMH in water is suggested based on the unacclimated aqueous biodegradation half-life (NASA 2009).

Because of these potential hazards, all reasonable and feasible measures would be taken by SpaceX operators and the FAA to minimize accidents and to protect human health and the environment. To minimize the risk of accidents, SpaceX would fully comply with safety requirements set forth in 14 CFR Parts 400-450, for both ground safety and flight safety, and any other applicable regulations or guidance from the FAA. In the event of a launch failure, emergency response and cleanup procedures contained in the HMERP would reduce the magnitude and duration of any impacts.

4.9.2 No Action Alternative

Under the No Action Alternative, the FAA/AST would not issue launch licenses and/or experimental permits that would allow SpaceX to launch the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of suborbital launch vehicles. The vertical launch and control center areas would not be constructed. The No Action Alternative would not result in the use of hazardous materials or the generation of hazardous or solid waste. Therefore, there would be no impact related to hazardous materials, pollution prevention, and solid waste.

4.10 SOCIOECONOMICS, ENVIRONMENTAL JUSTICE, AND CHILDREN'S ENVIRONMENTAL HEALTH RISKS AND SAFETY RISKS

This socioeconomic impact analysis focuses on the regional economic impacts of construction and operation of the Proposed Action. Economic impacts are defined to include direct effects, such as changes to employment and expenditures that affect the flow of dollars into the local economy and indirect effects, which result from the "ripple effect" of spending and re-spending in response to the direct effects.

Direct impacts are associated with the Proposed Action itself and include construction and operations jobs, the incomes earned by those workers, the economic output associated with initial purchases of local construction materials and supplies, and goods and services from operation of the Proposed Action.

Indirect impacts are the jobs, income, and economic output generated by the businesses that supply goods and services to the Proposed Action. Indirect jobs include jobs at companies that supply construction materials/supplies or support jobs directly related to operations. Indirect jobs extend to include jobs related to the manufacture of products used to construct and operate the facility. Indirect labor income includes the income earned by people working indirect jobs. Indirect output includes the total sales volume related to the supply of goods and services to SpaceX.

Induced impacts are the result of spending of the wages and salaries of the direct and indirect employees on items such as food, housing, transportation, and medical services. This spending creates induced employment in nearly all sectors of the economy, especially service sectors.

Factors considered in the analysis of socioeconomic impacts include:

- Redistribution, influx, or loss of population within the study area
- Impacts to employment and income
- Availability of housing
- Effects on community services
- Changes to the tax base

Socioeconomic impacts, particularly impacts such as those being evaluated in this EIS, are often mixed: beneficial in terms of gains in jobs, expenditures, tax revenues, etc., and potentially adverse in terms of growth management issues such as demands for housing and community services.

This analysis also addresses potential disproportionately high and adverse impacts to minority and/or low-income populations consistent with EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, and Order DOT 5610.2, *Environmental Justice in Minority and Low-Income Populations*; and disproportionate environmental health and safety risks to children consistent with EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*.

Potential impacts to traffic are addressed in detail in Appendix K, *Ground Traffic and Transportation*.

4.10.1 Proposed Action

4.10.1.1 Construction

Socioeconomics

Under the Proposed Action, SpaceX would construct a vertical launch area and a control center area in order to support the launch of the Falcon 9, Falcon Heavy, and a variety of reusable suborbital launch vehicles (see Section 2.1.2 *Construction Activities*). The proposed schedule for all construction activities is a 24-month period from start to finish. Estimated construction costs were not available at the time of this document preparation; however, given the final build-out size of the proposed vertical launch and control center areas, and other similar projects (e.g., see *Final Environmental Impact Statement for the Spaceport America Commercial Launch Site, Sierra County, New Mexico* [FAA 2008]), it was estimated for this EIS analysis that the number of construction workers on-site would not exceed 47 at any one time (see Appendix E, Tab F for calculations).

Under a maximum case scenario, it was assumed that the peak construction period would employ 47 personnel. With the high rate of unemployment in the ROI (11 percent), it would be expected that some of these positions would be filled by unemployed construction workers. It would also be possible that some construction workers would move into the ROI in response to the direct job effects in construction, but these workers would most likely leave the area for other opportunities when the 24-month construction project nears completion. Under a maximum case scenario, if all the construction workers moved to the ROI, bringing their families with them (using an average Cameron and Willacy counties household size of 3.3 persons [USCB 2012a]), it would represent less than 1 percent of the ROI population of 428,315 (USCB 2012a).

Local construction expenditures, including construction wages, during the 24-month period would have a beneficial impact on the ROI economy through direct spending and would generate economic activity that would lead to indirect job creation in areas such as the accommodation and food services and retail trade sectors. Given the high rate of unemployment in the ROI, it would be expected that these indirect, unspecialized positions would be filled by unemployed local residents. No population in-migration to the ROI would be expected as a result of indirect job growth.

If, under a maximum scenario, all construction workers enter the housing market at the same time, it would represent less than 1 percent of the total ROI housing units (148,964) and less than 1 percent of the total ROI vacant housing units (23,569) (USCB 2012a). This increase would be minimal and would not significantly change the housing purchase or rental markets. Construction activities would not be expected to result in significant effects to the housing market.

Under a maximum scenario, construction workers and their families would represent 0.04 percent of the ROI population. The annual ROI population growth rate from 2000 to 2010 has been approximately 2 percent (USCB 2012a). Therefore, any population growth due to construction activities would not be expected to strain the capacity or affect the quality of emergency response, medical, or public education services.

The expenditures associated with construction of the vertical launch and control center areas would result in increased tax revenue in the ROI and Texas. The direct construction and indirect workers would be taxed as would the income received by area businesses benefitting from the additional sale of goods and services.

<u>Environmental Justice</u>

As described above, both the ROI and Census Tract 127 have significantly higher proportions of minority and low-income populations than Texas; however, Boca Chica Village, the nearest residential area, has a lower percentage of minority population compared to Texas. Recent census low-income data are not available for Boca Chica Village.

This environmental justice analysis summarizes the potential construction impacts analyzed in Sections 4.3, *Noise*; 4.4, *Visual Resources and Light Emissions*; 4.6, *Air Quality*; 4.7, *Water Resources*; 4.9, *Hazardous Materials, Pollution Prevention, and Solid Waste*; and Appendix K, *Ground Traffic and Transportation*. Please refer to these sections for a complete discussion of potential impacts. Impacts occurring in these resource areas have the potential to disproportionately affect minority and low income populations.

Noise

Construction activities that would impact community noise levels include noise from construction equipment operating at the vertical launch and control center areas and construction/delivery vehicles traveling to and from these areas. Residences within Boca Chica Village would experience increased noise levels primarily from construction activities and construction/delivery vehicles at the control center area and from construction/delivery vehicles traveling to and from the vertical launch area.

Noise levels at a given receptor would depend on the type and number of pieces of construction equipment being operated and receptor's distance from the construction site. Small increases in noise levels along truck routes would be expected as a result of the operation of delivery trucks and other construction vehicles. Noise impacts would vary widely, depending upon the phase of construction and specific task being undertaken. Increased noise levels would typically be greatest during the early stages of each construction phase, although these periods would be of relatively short duration and would typically occur during normal working hours between 8:00 a.m. and 5:00 p.m., Monday through Friday. Therefore, significant impacts to community noise levels from proposed construction related activities are not anticipated and there would be no significant environmental justice impacts.

Visual Resources and Light Emissions

A comparison of the current landscape at the vertical launch area with the landscape following construction indicates weak contrasts with regards to the characteristics of the landforms and little or no contrast with the vegetation. However, a strong contrast is indicated between the buildings and structures of the vertical launch area and the surrounding landscape. The cumulative effect of construction of the proposed vertical launch area would result in a severe impact on the visual resources.

The contrasts at the control center area would be less severe than that at the vertical launch area. A comparison of the current landscape at the control center area with the landscape following construction indicates weak contrasts with regards to the characteristics of the landforms and little or no contrast with the vegetation. A weak to moderate contrast is indicated between the buildings and structures of the control center and the existing buildings and structures of Boca Chica Village that surrounds it. The cumulative effect of construction of the proposed control center area would result in a moderate to severe impact on the visual resources.

Air Quality

Air emissions from the construction activities would primarily result due to the operation of construction equipment, both on-site and traveling to and from the project sites, and construction worker commute emissions. The estimated construction emissions would not cause an exceedance of any NAAQS. Therefore, the construction impacts on air quality would not be significant and would not result in environmental justice impacts.

Water Quality

Potential impacts to water resources include disturbance of the ground surface and soil erosion. An SWPPP would be prepared that implemented the use of BMPs during construction which would prevent indirect impacts from erosion and sedimentation to nearby water bodies. Any impacts associated with an increase of stormwater runoff to surface waters due to construction activities would be minimized by implementation of SWPPP and BMPs and would not have significant adverse impacts to surrounding surface waters.

Other potential impacts to surface water and groundwater quality during construction include contamination from spills or leaks from construction vehicles and machinery. An SPCCP and an HMMP would be implemented to minimize the potential for accidental releases of polluting substances from construction equipment. Adherence to the SPCCP and the HMMP would reduce the potential for adverse impacts to surface waters to less than significant levels. The construction of the vertical launch and control center areas would not require the use of large significant quantities of groundwater. Therefore, there would be no significant environmental justice impacts.

Hazardous Materials and Wastes

Construction activities would require the use, management, and disposal of hazardous materials and wastes. An SWPPP would be prepared and implemented prior to the commencement of construction activities. Hazardous materials and wastes associated with construction activities would be used and stored in a manner that would prevent these materials from polluting soils, ground and surface waters and in accordance with applicable Federal, State, and local environmental and public and occupational health and safety regulations. With the implementation of appropriate handling and management procedures, hazardous materials required for construction of the proposed vertical launch and control center areas would have no significant impacts to the environment. Therefore, there would be no significant environmental justice impacts.

Traffic

An additional 190 construction vehicles per day would travel State Highway 4 to the vertical launch and control center areas. This would approximately double the number of vehicles traveling State Highway 4 in the vicinity of Boca Chica Village and Beach. However, the increase in traffic due to construction activities would not affect the level of service on State Highway 4 or in Boca Chica Village. Nonetheless, there is the potential for temporary impacts to local traffic in the vicinity of the construction areas, as the trucks slow to enter the vertical launch and control center areas.

Access to the vertical launch area would be directly from State Highway 4, in the vicinity of the entrance to Boca Chica Beach. To avoid potential impacts to the daytime beach traffic, peak construction truck access could be scheduled for evening hours or other off-peak traffic time. With some flexibility to schedule major truck-intensive efforts such as concrete pours during off-peak times, it is anticipated that construction traffic in the vicinity of the vertical launch area would not contribute to significant congestion issues.

Direct access to the control center area would be located along Esperson Street and Eichorn Boulevard, small connector roads in Boca Chica Village within a few hundred ft of State Highway 4. The number of heavy trucks accessing the site would be significantly less than at the vertical launch area. However, during peak construction traffic access, there would still be some potential for the additional traffic to create some congestion within the Boca Chica Village community. Since the control center area is located within a residential community, there is less flexibility for nighttime construction traffic and activities. It is expected that there may be occasional brief periods of congestion within the Boca Chica Village, but there would be no permanent or significant traffic congestion.

Hazardous materials would be transported to the vertical launch and control center areas during construction. The transportation of these and all other hazardous materials would be required to meet DOT Hazardous Materials Regulations, 49 CFR 100-199. There is minimal additional risk with the construction; therefore, the transport of hazardous materials during construction is no anticipated to significantly impact the traffic and transportation in the vicinity of the vertical launch and control center areas. While there may be short-term traffic impacts to Boca Chica Village, no long-term environmental justice impacts are anticipated.

Environmental Justice Summary

Construction of the vertical launch area would result in significant visual impacts. Changes to the viewshed from State Highway 4 would affect all viewers equally and would not result in disproportionate impacts to environmental justice populations. Construction of the control center area would have a greater negative impact on residents of Boca Chica Village. While this residential community is not considered a minority population, low income data are not available. Construction of the Proposed Action would have some unavoidable minor impacts associated with other resource areas. These impacts would be minimized following all appropriate FAA, OSHA, DOT, and state requirements and guidelines, and would not be considered environmental justice impacts.

Children's Environmental Health Risks and Safety Risks

As described above, both Cameron County and Census Tract 127 have higher proportions of children under the age of 18 than Texas; however, Boca Chica Village, the nearest residential area, has no children under the age of 18. The control center area is located in a sparsely populated area approximately 6 miles from the nearest public school.

Potential construction impacts that could affect children's environmental health and safety are similar to those discussed above for environmental justice. Construction would have some unavoidable minor impacts to public safety. These impacts would be minimized following all appropriate FAA, OSHA, DOT, and state requirements and guidelines. No significant environmental health or safety impacts are expected due to the Proposed Action's construction activities. Therefore, construction activities would not result in disproportionate risks to the environmental health and safety of children.

4.10.1.2 Operation

Socioeconomics

Beginning in the first operational year, approximately 30 full-time personnel would be on-site year round, increasing over a 10-year period up to approximately 150 full-time workers in 2022 (see Table 2.1-2, *Personnel for Proposed SpaceX Texas Launch Site Operations*). Proposed operations would consist of up to 12 launches per year with each launch campaign lasting up to 2 weeks. During a launch campaign, an additional maximum of 100 local or transient workers would be present at the vertical launch area and/or control center area. Under a maximum case scenario, approximately 250 personnel would be present on-site, and this would represent a minimal increase—less than 1 percent of the existing ROI civilian labor force of 145,043 (USCB 2012b). The road closures of State Highway 4 for up to 15 hours, 12 times per year, as well as launch operations, would not affect any existing employment positions since there are no existing commercial activities in the vicinity of the vertical launch and control center areas.

Assuming that all permanent on-site and transient SpaceX personnel move to the area (under a maximum case scenario) and using an average Cameron and Willacy counties household size of 3.3

persons (USCB 2012a), the increase in population would be approximately 825 people. This would represent approximately 0.2 percent of the ROI population of 428,315 (USCB 2012a).

The salaries paid to the proposed on-site SpaceX personnel would represent direct annual income. Some of these earnings would be paid to taxes, and some would be saved and invested, but most would be spent on housing, consumer goods, and services in the ROI. Transient SpaceX workers would also spend earnings in the ROI during the launch campaigns, particularly on accommodations, food, and rental vehicles. This spending would, in turn, “ripple” through the economy, generating additional indirect jobs and income in areas such as the accommodation and food services and retail trade sectors and benefitting the ROI economy. Given the high rate of unemployment in the ROI (11 percent), it would be expected that these indirect, unspecialized positions would be filled by unemployed local residents. No population in-migration to the ROI would be expected as a result of indirect job growth.

Under a maximum case scenario (2022), assuming that all 150 full-time SpaceX employees/contractors plus the additional launch campaign staff of 100 workers enter the housing market at the same time, it would represent less than 1 percent of the total ROI housing units (148,964) and 1 percent of the ROI vacant housing units (23,569) (USCB 2012a). This increase would be minimal and would not significantly change the housing purchase or rental markets. Any minor effects on for-sale or rental housing would be further reduced by the gradual increase in personnel over 10 years. Therefore, the increase in personnel would not have significant impacts on the ROI housing market.

The residential area of Boca Chica Village is located approximately 2 miles west of the vertical launch area and abuts the control center area (see Exhibit 1.0-2, *Location of Proposed Vertical Launch Area and Control Center Area*). Comments received during the scoping process addressed the potential for reduced property values and quality of life in Boca Chica Village. Real property values are dynamic and influenced by a combination of factors, including market conditions, neighborhood characteristics, and individual real property characteristics (e.g., the age of the property, its size, and amenities). The degree to which a particular factor may affect property values is influenced by many other factors that fluctuate widely with time and market conditions. No definitive Federal standards exist for quantifying the impact of launches and launch complexes, nor are there previous studies conducted for similar launch facilities. Given the dynamic nature of the real estate market and the varying degree to which any combination of factors may affect the value of a particular property, it would not be possible to quantify how the Proposed Action may affect property values. However, it is possible to qualitatively describe potential impacts to Boca Chica Village property values. Potential effects to property values would reflect the subjective opinions of real estate market participants.

The presence and operation of the vertical launch and control center areas would change existing land uses in the Boca Chica Village area to a degree that might not be considered desirable for a residential area. This could result in lowered property values for private residential uses. On the other hand, the proximity of Boca Chica Village properties to a facility employing up to 150 full-time aerospace workers, plus an additional 100 transient workers who would be on-site 24 weeks per year, could create the potential for new economic opportunities. Entrepreneurs could view the Boca Chica Village properties as highly desirable locations to establish businesses that would serve the needs of SpaceX personnel. The overall impact to Boca Chica Village property values cannot be determined at this time.

Just as potential impacts to property values can be qualitatively described, so can potential impacts to quality of life for Boca Chica Village residents. Operation of the vertical launch and control center areas would change the noise environment, visual viewshed, nighttime light emissions, traffic, and numbers of people in the vicinity. These changes would affect how Boca Chica Village residents experience their neighborhood. While there may be some residents who would consider these changes as a negative impact, there could be some residents who would enjoy the vibrancy and excitement associated with the proposed launches.

The annual ROI population growth rate from 2000 to 2010 has been approximately 2 percent (USCB 2012a). The potential in-migration of 825 people to the ROI under a maximum case scenario (0.2 percent of the population) would not be expected to strain the capacity or affect the quality of emergency response, medical, or public education services.

The expenditures associated with operation of the vertical launch and control center areas would increase tax revenue collections in the ROI and Texas, including property tax, hotel occupancy tax, and gross receipts tax revenues. The direct and indirect workers would be taxed as would the income received by area businesses benefitting from the additional sale of goods and services.

The Proposed Action would be expected to attract tourists who would travel to the area specifically to view a launch. Spending by these tourists would generate revenue for ROI businesses, particularly in the hospitality industry. A detailed discussion of the potential impacts associated with tourists is presented in Section 4.12, *Secondary (Induced) Impacts*.

Environmental Justice

As described above, both the ROI and Census Tract 127 have significantly higher proportions of minority and low-income populations than Texas; however, Boca Chica Village, the nearest residential area, has a lower percentage of minority population compared to Texas. Recent census low-income data are not available for Boca Chica Village.

This environmental justice analysis summarizes the potential operations impacts analyzed in Sections 4.3, *Noise*; 4.4, *Visual Resources and Light Emissions*; 4.6, *Air Quality*; 4.7, *Water Resources*; 4.9, *Hazardous Materials, Pollution Prevention, and Solid Waste*; Appendix D, *Launch Noise Modeling Report*; and Appendix K, *Ground Traffic and Transportation*. Please refer to these sections for a complete discussion of potential impacts. Impacts occurring in these resource areas have the potential to disproportionately affect minority and low income populations.

Noise

The nearest house location, located 1.8 miles from the proposed vertical launch area, was modeled as a specific point of interest to determine the sound levels from a single launch event of a Falcon 9 and Falcon Heavy. The model predicted a maximum OASPL of 114 dBA for the Falcon 9 and 119 dBA for the Falcon Heavy at the nearest house location. Although the nearest house may experience noise levels above the 115 dBA hearing conservation guideline from a Falcon Heavy launch, the noise levels above 115 dBA would only last approximately 45 seconds and proposed launches of the Falcon Heavy would only occur a maximum of two times per year (Appendix D). The results of the noise study conclude that noise levels may exceed the 115 dBA guideline within distances up to approximately 1.2 miles for the Falcon 9 and 2.1 miles for the Falcon Heavy (Appendix D). For a launch of the Falcon 9, the short-term impacts based on the hearing conservation guideline are not anticipated to be adverse as there are no housing developments within 1.2 miles of the proposed vertical launch area. However, the short-term impacts based on the hearing conservation guideline within 2.1 miles from the proposed launch of the Falcon Heavy are anticipated to be adverse, as the 115 dBA guideline is exceeded at these distances, albeit for less than 1 minute.

To account for increased human sensitivity to noise at night, a worst-case scenario (nighttime launches) was modeled using an additional noise metric, DNL. DNL is typically used for the evaluation of community annoyance since it account for the increased human sensitivity to nighttime noise. Under a worst-case scenario, Boca Chica Village would be exposed to noise levels at or above DNL 65 dBA. Therefore, noise impacts to Boca Chica Village would be considered significant during a nighttime launch of the Falcon 9 and Falcon Heavy.

Hearing protection measures would be implemented to ensure the health and safety of Boca Chica Village residents during launch activities. For example, the residents would be notified of each scheduled launch event and potential noise hazards well in advance of the launch day (see Section 2.1.1.5, *Pre-Launch Activities*). Residents would be encouraged to remain indoors during a launch event, which can reduce noise exposure. SpaceX may also make hearing protection devices available to residents to reduce noise levels below 115 dBA at distances up to approximately 1.2 miles for the Falcon 9 and 2.1 miles for the Falcon Heavy.

The noise model also analyzed noise impacts to structures from Falcon 9 and Falcon Heavy launches. Studies based on ground testing of rocket systems indicate an expectation of 1 damage claim in 1,000 households exposed to an average continuous noise level of 111 dB, and 1 in 100 households at 119 dB. The noise levels at the nearest house, which is 1.8 miles from the vertical launch area, suggest the probability of a noise induced structural vibration damage claim would be greater than 1 in 100.

The unweighted L_{max} levels at what appears to be the closest population center in Mexico (25.858550° N, 97.268427° W) to the vertical launch area indicate the probability of a noise induced structural vibration damage claim would be less than 1 in 1,000 for a Falcon 9 launch and slightly greater than 1 in 1,000 for a Falcon Heavy launch. The maximum A-weighted OASPL levels in this area of Mexico would be less than 115 dBA hearing conservation guidelines (Exhibit 4.3-1 and 4.3-2). Mexico lies outside the DNL 65 dBA contour levels for Scenarios A and B with a small area located inside the DNL 65 dBA for Scenario C, which includes one nighttime Falcon Heavy launch (refer to Exhibit 4.1-1). However, as discussed in Section 3.3.4, *Existing Conditions*, aerial imagery south of the U.S./Mexico border has been reviewed, and the area was found to be unpopulated and undeveloped.

In addition to the launch noise, a launch vehicle can create sonic booms as a result of the shock waves created from supersonic flight, when the vehicle travels faster than the speed of sound. The sonic booms modeled for the Falcon 9 and Falcon Heavy would intercept the surface more than 40 miles off the coast in the Gulf of Mexico and would not be audible inland. Therefore, there would not be a significant impact from noise as a result of sonic booms.

Visual Resources and Light Emissions

Nighttime operations at the vertical launch area would result in increased levels of light emissions of greater intensity. Nighttime launch activities would result in particularly intense light emissions. The light emissions at the vertical launch area at night would have a severe impact on the existing low intensity and limited emissions that are currently present.

Nighttime operations at the control center area would result in somewhat greater levels of light emissions than are currently present from Boca Chica Village residences. The slightly greater light emissions would have a negligible impact on the current levels present.

Air Quality

Operational air emissions would result primarily from launches, generator operations, commuting on-site permanent and transient personnel, and delivery trucks. The operational emissions for the Proposed Action would not cause an exceedance of any NAAQS. Therefore, air quality impacts associated with operation of the Proposed Action would not be significant and would not result in a significant environmental justice impact.

Water Quality

Operation of the vertical launch area would include activity on impervious surfaces. The SWPPP would implement the use of BMPs during operation of the launch site which would prevent indirect impacts from erosion and sedimentation to the nearby water bodies. Any impacts associated with an increase of stormwater runoff to surface waters would be minimized by implementation of SWPPP and BMPs and would not have significant adverse impacts to surrounding surface waters.

Other potential impacts to surface water and groundwater quality during operation of the vertical launch and control center areas include contamination from accidental spills or leaks from operating vehicles and machinery. An SPCCP and HMMP would be prepared, reducing the potential for accidental spills or leaks. Therefore, contamination from accidental spills or leaks due to daily operations would not have adverse impacts to surrounding surface and groundwater.

Impacts of groundwater withdrawal for potable and deluge use on other possible on-site and off-site water uses would not be significant. The water balance analysis and aquifer drawdown analysis (see Section 4.11, *Natural Resources and Energy Supply*) does not show significant impacts on groundwater availability; therefore, it is unlikely that the groundwater use would result in a significant impact in the region. Because the recharge of surface water to groundwater occurs primarily inland to the west, the new impervious surfaces such as buildings, roads, and parking areas would have no impact to the recharge of surface waters to groundwater. There would not be any significant adverse impacts to floodplain function based on the operation of the water deluge system. The Proposed Action would not have a significant impact on wetlands. Therefore, effects on water quality would not have a significant environmental justice impact.

Hazardous Materials and Wastes

The operation of the proposed vertical launch and control center areas would require the use and storage of hazardous materials for launches as well as for routine maintenance and flight support activities. Hazardous materials, substances, and wastes used and generated as part of operations would be collected, stored, and disposed of using practices that minimize the potential for accidental releases or contact with stormwater and in accordance with the facility SPCCP, RCRA, DOT, and OSHA regulations. With the implementation of appropriate handling and management procedures, hazardous materials required for operation of the vertical launch and control center areas would have no significant impacts to the environment.

In the event of a failure occurring during a launch event, the launch vehicle propellant tanks would likely rupture and the propellants would burn explosively. Thus, it is possible for propellants to be spilled directly or released as a burning byproduct into local surface water bodies (e.g., lakes, rivers, oceans) and infiltrating soils to make contact with groundwater. The extent of potential impacts would depend on the amount of propellant and the conditions of the accident. However, all reasonable and feasible measures would be taken by SpaceX operators and the FAA to minimize accidents. In addition, SpaceX may enter into agreements with local security service providers, or may rely on local police and fire departments. To minimize the risk of accidents, SpaceX would fully comply with safety requirements set forth in 14 CFR Part 400-450, for both ground safety and flight safety, and any other applicable regulations or guidance from the FAA. Also, hazards to the public would be minimized during launch events by the strict enforcement of closures and checkpoints by the U.S. Customs and Border Protection and Cameron County and State of Texas law enforcement agencies (see Section 2.1.1.6, *Launch Day Activities*). Therefore, there would be no significant environmental justice impacts.

Traffic

By 2022, approximately 250 personnel would be present on-site. The addition of 250 vehicles per day would not increase traffic enough that it would downgrade the level of service condition to LOS B along State Highway 4. The potential traffic impacts associated with the Proposed Action are primarily focused at the entrances of the vertical launch area and control center area. Although the additional traffic would have minimal impact along the State Highway 4 corridor, there would likely be some associated congestion at the entrance to the vertical launch and control center areas during morning and afternoon peak hours. However, this congestion is not anticipated to be significant.

Additionally, there would be limited public access along State Highway 4 during launches. SpaceX would coordinate with U.S. Customs and Border Protection and Cameron County and State of Texas law enforcement agencies to limit public access at two pre-defined checkpoints on State Highway 4 for up to 15 hours on launch day. These checkpoints include a hard checkpoint, which is a “no pass” area determined by the FAA approved hazard area during the FAA safety and risk assessment. No one can pass by this hard checkpoint during launch operations. The second checkpoint would be a soft checkpoint on State Highway 4 just east of Massey Way, which is an area where government personnel, SpaceX personnel, emergency personnel, and anyone with property beyond it can pass, but the general public would be denied access. These closures would be in effect for approximately 15 hours for each launch. With the relatively low traffic counts for this corridor and the advanced notice that would be provided to local residents prior to each launch, these closures are not anticipated to have a significant impact on the traffic in the vicinity. Therefore, there are no significant impacts anticipated to traffic and transportation associated with the implementation of this Proposed Action.

This minimal additional risk associated with the operation of the Proposed Action is comparable to the risk to traffic during construction of the Proposed Action. Therefore, the transport of hazardous materials during construction or operations is not anticipated to significantly impact the traffic or transportation in the vicinity of the Proposed Action. Therefore, there would be no significant environmental justice impacts.

<u>Environmental Justice Summary</u>

Operation of the proposed vertical launch and control center areas would result in significant short-term community noise levels and an increased probability of noise induced structural vibration damage in Boca Chica Village. Light emissions from the vertical launch area would also be significant, especially during launch events. Boca Chica Village is not considered a minority population. Therefore, the Proposed Action would not result in a disproportionate impact to environmental justice populations. Operation of the proposed vertical launch and control center areas would have some unavoidable adverse impacts in other resource areas. These impacts would be minimized following all appropriate FAA, OSHA, DOT, and State and local requirements and guidelines and would not be considered environmental justice impacts.

<u>Children's Environmental Health Risks and Safety Risks</u>

As described above, both Cameron County and Census Tract 127 have higher proportions of children under the age of 18 than Texas; however, Boca Chica Village, the nearest residential area, has no children under the age of 18. The vertical launch and control center areas are located in a sparsely populated area 6 miles from the nearest public school.

Potential operational impacts that could affect children's environmental health and safety are similar to those discussed above for environmental justice. While children occasionally may be present in Boca Chica Village, no children live there, and there are no schools, daycares, or other similar facilities. While significant short-term noise impacts would affect Boca Chica Village up to 12 times per year, they would not be expected to significantly affect the environmental health and safety of children.

4.10.2 No Action Alternative

Under the No Action Alternative, the FAA would not issue launch licenses and/or experimental permits to SpaceX for launch operations from the private site in Cameron County, Texas. SpaceX would not construct the vertical launch and the control center areas. Under the No Action Alternative, the existing socioeconomic conditions would continue. There would be no disproportionate impacts to minority or low-income populations or risks to children's environmental health and safety.

4.11 NATURAL RESOURCES AND ENERGY SUPPLY

In order to construct and operate the facilities associated with the vertical launch and control center areas, there would be demand for a variety of energy uses and natural resources. This section describes the impacts of the construction and operations of the proposed vertical launch and control center areas on energy uses such as electricity and fuels and on natural resources such as water and construction materials.

4.11.1 Proposed Action

4.11.1.1 Construction

Energy Supply

Construction of the new facilities would include activities such as construction of roads, installation of underground utilities, excavation, pouring of foundations, and building structures. The energy required for these types of activities would predominantly be associated with operating construction equipment and generators, which would require the supply of gasoline and diesel fuels. Construction may also have a minimal requirement for single-phase electrical power. With the minimal electrical requirements for construction and the proximity of the proposed construction areas to readily available sources of gasoline and diesel fuels, it is unlikely that the electrical and fuel requirements associated with construction would impact the supply to communities or other users in the area. No natural gas would be required for construction of the vertical launch area or the control center area. Therefore, no significant impact to the energy supply is anticipated as a result of construction.

Natural Resources

As established in FAA Order 1050.1E, the use of natural resources other than fuel need be examined only if the action involves a need for unusual materials or those in short supply. At this time, there are no unusual materials anticipated in the construction of the proposed vertical launch and control center areas. However, due to the amount of concrete and asphalt required for the construction of the proposed launch pad and flame duct, parking areas, and roadways, there would be a substantial requirement for aggregate (mineral materials such as sand and/or stone used in making concrete). Supply of groundwater is also of interest. Both resources are further assessed in this section.

Supply of Aggregate

There would be a substantial amount of aggregate required for the construction of the facilities in both the vertical launch and control center areas. Concrete requirements would include nearly 190,360 ft^2 of slab construction at the vertical launch area and approximately 101,989 ft^2 of slab construction in the control center area. Thicknesses in the vertical launch area range from 1 to 5 ft, with thicknesses in the control center area ranging between 1 and 1.5 ft. Additional roadway and parking areas would include approximately 85,556 ft^2 in the vertical launch area and 211,820 ft^2 at the control center area. Due to the vertical launch area's remote location at the end of State Highway 4, along the Gulf Coast, access to supplies of aggregate would be concentrated in and around the City of Brownsville, approximately 20 miles to the west. There are several suppliers located in the City of Brownsville, with additional suppliers just northwest of Brownville in the cities of San Benito and Harlingen. It is anticipated that the region surrounding Brownsville would have sufficient supply of aggregate to meet the requirements for constructing the vertical launch and control center areas without impacting the availability for other uses in the area.

Groundwater Resources

The construction of the vertical launch and control center areas would not require significant quantities of groundwater. The water usage for construction is anticipated to be less than that of operation, and because the water balance analysis and aquifer drawdown analysis below do not result in significant impacts on groundwater availability, it is unlikely that the construction groundwater use would result in a significant impact in the region. There could be small off-site water quantity (drawdown) effects in the immediate vicinity of the vertical launch area, but no changes in off-site water use are anticipated as a result of the Proposed Action.

4.11.1.2 Operation

Energy Supply

Under the Proposed Action, it is estimated that the proposed vertical launch and control center areas would have a total maximum electrical load of 3,000 kilowatts per hour (kW/hr). The lines required to supply power from the existing electrical distribution system to the vertical launch and control center areas would be buried within the State Highway 4 ROW. The specific requirements for the power lines and substation(s) necessary to meet the demands of the vertical launch and control center areas are being finalized. However, initial communications between MVEC and SpaceX indicate that an upgrade to a three-phase distribution in excess of the proposed maximum electrical load would be required (MVEC 2012b). No impact would occur to other system users in the vicinity of the proposed facilities. In addition to electricity, energy supply requirements for operations would include various propellant fuels, as well as diesel and gasoline to fuel the ground equipment necessary for launch operations. Launch vehicle propellants include LOX, RP-1, helium, and nitrogen. The Dragon spacecraft uses a form of hydrazine, a different propellant than the launch vehicle. Propellant storage for the operations would include the following:

1. LOX—350,000 gal of tank storage would be provided for LOX in the propellant storage areas at the vertical launch area.
2. RP-1—200,000 gal of tank storage would be provided for RP-1 in the propellant storage areas at the vertical launch area.
3. Helium—7,500 cubic feet (ft^3) (as water volume) of tank storage would be provided for helium in the propellant storage areas at the vertical launch area.
4. Nitrogen—15,000 ft^3 (as water volume) of tank storage would be provided for nitrogen in the propellant storage areas at the vertical launch area.
5. Hydrazine—Hydrazine would be received in closed shipping containers and stored in the control center area.

All propellants would be provided by regional or national suppliers and would be transported to the vertical launch and control center areas by truck. It is not anticipated that the supply of these propellants would impact other local uses. Similarly, the gasoline and diesel fuels required for the ground support equipment would be minimal compared to the regional uses of these fuels. Although actual demands for these fuel types have not been determined, it is not anticipated that the relatively small quantities would impact regional supplies. No natural gas would be required for operation of the vertical launch or control center areas.

Natural Resources

For operations at the vertical launch and control center areas, the only natural resource of concern with respect to short supply is groundwater. Groundwater would be potentially used for two primary uses: the supply of the deluge water for each launch and for personnel use at the facilities. Potable water would either be delivered by truck or pumped from an on-site well to a holding tank at the vertical launch area. Water distribution lines would be installed to distribute the potable water from the holding tank to the facilities to provide potable water to the area.

As described in Section 2.1.2, *Construction Activities*, a deluge water system consisting of one 250,000-gallon water tower would be installed at the vertical launch area for sound and vibration suppression. Up to 200,000 gal would be discharged during a launch event, and up to 12 launch events would be scheduled per year, resulting in a total deluge water system use of 2,400,000 gpy (7.37 afy). A well located adjacent to the water tower and drilled into a high transmissive portion (i.e., yielding relatively large water quantities) of the Gulf Coast Aquifer (the Chicot Aquifer) would provide all deluge water at an average well pumping rate of 4.6 gpm.

The operation of the vertical launch and control center areas would result in an increase of permanent and temporary personnel. The scenario resulting in the maximum number of personnel at the vertical launch and control center areas would be the 2022 scenario, with 150 permanent personnel and 100 transient personnel working 2 weeks on-site. The TWDB *2012 Texas State Water Plan* identifies the projected per capita water demand for Cameron County as 221 gal per day (80,665 gpy) in the year 2020 (TWDB 2012d). With 150 full-time SpaceX employees/contractors and 100 transient personnel working 24 of the 52 weeks in 2022, the annual potable water usage is projected to be 15,800,000 gpy (48.6 afy) based on the assumption that personnel would use 221 gpy. Assuming that water quality in the water well screened in the Chicot Aquifer of the Gulf Coast Aquifer system is adequate for potable use, this well would provide potable water at an average well pumping rate of 30.1 gpm.

It is important to note that the groundwater in the Gulf Coast Aquifer at the location of the vertical launch and control center areas likely has concentrations of TDS exceeding the National Secondary Drinking Water Regulations standard of 500 mg/L. As presented in Section 3.7.4, *Existing Conditions*, the TDS concentrations in the Chicot and Evangeline Aquifers in south central Cameron County has the highest TDS values, with concentrations greater than 10,000 mg/L (Choudhury and Mace 2007). Groundwater pumped for potable use from an on-site well would likely require treatment to remove the TDS and reduce the salinity prior to potable use.

The combined maximum water demand for the deluge system operation and potable use at the vertical launch and control center areas is projected to be 55.9 afy (18.2 MGY) in 2022. The current municipal water use in the City of Brownsville is 45,312 afy, 85 percent of the current total capacity of 53,242 afy, and 74 percent of the expanded total capacity of 61,648 afy. The city of Brownsville currently has the capacity to meet the additional water demand.

Municipal Water Supply

If all deluge water and potable water were obtained from a municipal source by trucking the water in from Brownsville, Texas, the maximum water demand of 55.9 afy (18.2 MGY) in 2022 would require delivery of an average of 50,000 gpd. If water were transported in 5,000 gal tanker trucks, the maximum water demands would require an average of 10 water deliveries per day. As presented in Section 3.11.4.2, *Natural Resources*, the municipal water demand in Brownsville in the year 2010 was 45,312 afy (14,800 MGY), and in the year 2020 it is projected to be 54,105 afy (17,600 MGY). The total municipal capacity from the Rio Grande is 47.5 MGD (53,242 afy). The 2010 municipal water usage was at 85 percent of the current treatment facilities' capacity. The 2020 projection is at 88 percent of the expanded treatment facilities' capacity. The City of Brownsville will expand the treatment facilities' capacity at the Southmost Regional Water Authority Regional Desalination Plant to meet the projected municipal demand by 2020 (Section 3.11.4.2, *Natural Resources*).

In this water source scenario, the increased population and operations at the vertical launch and control center areas in the 2022 end state would increase the demand for potable water by approximately 55.9 afy (18.2 MGY), 0.10 percent of the projected 2020 municipal usage of 54,105 afy (17,600 MGY). Because the municipal treatment system is currently operating at 85 percent of the total capacity, and is projected to be at 88 percent of the expanded capacity by 2020, the demands of 0.10 percent could be met by the Brownsville municipal water system. Therefore, only minimal impacts to municipal water supply in Brownsville would occur as a result of the Proposed Action.

Groundwater Supply

If all deluge water and potable water were obtained from an on-site water well, the maximum water demand of 55.9 afy (18.2 MGY) in 2022 would require an average pumping rate of 34.7 gpm. As presented in Section 3.7.4.2, *Groundwater*, the municipal groundwater demand for Cameron County in the year 2010 was 4,500 afy (1,470 MGY), and the projected demand in the year 2020 is 5,300 afy (1,730 MGY). The Proposed Action would result in less than significant impacts to municipal groundwater availability in Cameron County. The increased population and operations at the vertical launch and control center areas in the 2022 end state would increase the demand for potable water by approximately 55.9 afy (18.2 MGY), which is 1.1 percent of the projected 2020 municipal usage of 5,300 afy (1,730 MGY). The estimated total capacity of wells tapping groundwater in Cameron County was estimated at approximately 800,000 afy (Choudhury and Mace, 2003). Therefore, only minimal impacts to groundwater supply in Cameron County would occur as a result of the Proposed Action.

Aquifer Drawdown

Aquifer drawdown from the operational activities use of an on-site well was conservatively calculated assuming a transmissivity of 49,500 gpd/ft (Myers, 1969), a storativity of 0.0001, and a single source well. It is estimated that the water production well screened in the discontinuous sand and clay beds of the Chicot aquifer would produce water at an average rate of approximately 34.7 gpm, based on the maximum projected water demand of 55.9 afy (18.2 MGY) for potable use and for the deluge water, assuming a constant pumping rate.

Table 4.11-1 presents the drawdown at the pumping well, and at 0.5, 1, and 2 miles from the well after 10 and 20 years of aquifer withdrawal for site operation. The drawdown at the source well would range up to 2.34 ft after 20 years of withdrawal for potable and deluge use. A properly constructed water supply well would have up to 50 ft of a water column in the well, which could accommodate a 2.34-ft drawdown. Similarly, the nearest registered water well (state well no. 8907301) is 2 miles to the south of the proposed well location. This 412-ft deep well would experience a maximum drawdown of 0.74 ft, which would not impact the availability of groundwater at this location. Therefore, the impacts of this water withdrawal on other possible on-site and off-site water uses would not be significant.

Table 4.11-1. Aquifer Drawdown from Proposed Action

Years of Pumping	Distance from Withdrawal Well (miles)			
	0	0.5	1.0	2.0
	Aquifer Drawdown (feet)			
10	2.28	0.90	0.79	0.68
20	2.34	0.96	0.85	0.74

Note: Calculations completed using the Theis Equation.

4.11.2 No Action Alternative

Under the No Action Alternative, the FAA would not issue launch licenses and/or experimental permits to SpaceX for launch operations from the private site in Cameron County, Texas. The vertical launch and control center areas would not be developed. Therefore, there would be no additional energy usage or requirement for natural resources beyond the existing conditions. There would be no impact to energy use or natural resources consumption.

4.12 SECONDARY (INDUCED) IMPACTS

CEQ Regulations require agencies to evaluate indirect effects, including “growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems” (40 CFR 1508.8). FAA Order 1050.1E, *Environmental Impacts: Policies and Procedures, Change 1*, requires the FAA to identify any induced impacts to surrounding communities which may result from a Proposed Action. Secondary or induced impacts are those impacts that are caused by the Proposed Action but occur later in time and/or farther removed in distance, but are foreseeable. Types of potential secondary or induced impacts include, but are not limited to:

- Increased public service demands
- Changes in regional land use
- Changes to the regional economy
- Induced growth
- Shifts in population movement

4.12.1 Proposed Action

4.12.1.1 Construction

Under the Proposed Action, temporary impacts to the regional economy are anticipated due to construction of the vertical launch and control center areas. It is anticipated that local and regional construction contractors would be hired for construction activities; however, this would be short-term (approximately 24 months) and would not result in significant beneficial impacts to the economy. Additionally, it is assumed that construction materials would be purchased within the region and would contribute to a temporary beneficial impact to the economy. Construction activities are not anticipated to induce growth within the area or result in shifts in population. In addition, construction activities are not anticipated to result in increases in public service demand. Therefore, there would be no significant secondary impacts to public services.

4.12.1.2 Operation

The operation of the vertical launch and the control center areas is not expected to induce significant population growth in the area or result in shifts in population. The operation of the vertical launch and control center areas would result in temporary impacts to the local and regional economy during launch campaign periods due to temporary increases in transient employees and visitors.

The proposed launch campaigns would be expected to attract tourists who travel to the area specifically to view a launch event. Spending by tourists would generate revenue for local businesses, particularly in the hospitality industry resulting in a beneficial impact on the local economy. To accommodate these tourists, the Brownsville area has approximately 2,100 hotel and motel rooms. In addition, there are 12 recreational vehicle parks. Additional tourist accommodations are located in South Padre Island, Port Isabel, and Harlingen (Brownsville Convention and Visitors Bureau 2012). Tourism expenditures would have a beneficial impact on the local economy. However, the presence of increased numbers of people to view the launches may create some issues, particularly increased traffic and parking along State Highway 4. Section 2.1.1.6, *Launch Day Activities*, outlines how SpaceX would control where the tourists and general public would be allowed to travel. Specifically, SpaceX would work with the County and State officials to limit public access to State Highway 4 at two pre-defined checkpoints for up to 15 hours on launch day. SpaceX would educate the public on safe and lawful areas where they could watch launches.

Management of parks, recreational areas, wildlife refuges, or historic sites would continue to follow the regulations and management plans, as applicable, of the agencies that currently administer the lands. Likewise, within the context of Section 4(f), increased visitation to publicly owned parks, recreational areas, and wildlife refuges in the ROI that are open during launches would not result in induced impacts that would substantially impair the activities, features, and attributes of these resources. All visitors would be subject to the same rules and regulations concerning entry and use of the park, recreation area, or refuge. Moreover, increased visitation could result in beneficial impacts from additional revenues from entry fees (if applicable) and furthering the mission of the parks, recreational areas, and wildlife refuges to enrich the lives of citizens through outdoor recreational opportunities and natural and cultural heritage education programs.

The presence of increased numbers of people would bring greater attention to historic sites including the Palmito Ranch Battlefield NHL, the Cypress Pilings, the Palmetto Pilings, and the Palmetto Pilings Historical Marker (described in Section 4.5, *Historical, Architectural, Archaeological, and Cultural Resources*). Increased foot or vehicular traffic, particularly from off-road vehicles, could impact the Palmito Ranch Battlefield NHL and three historic sites located near the vertical launch area (the Cypress Pilings, the associated pilings site, and the Palmetto Pilings). Measures to minimize harm to these historic sites from increased traffic in the area are being developed in consultation with the appropriate agencies through the Section 106 process.

Under the Proposed Action, the expenditures associated with operation would result in increased tax revenue in the local community and Texas, including property tax, hotel occupancy tax, and gross receipts tax revenues. Area businesses are anticipated to benefit from the additional sale of goods and services to project-related workers and tourists resulting in positive secondary (induced) impacts as a result of the Proposed Action.

There are no known specific future development activities that would be dependent on the Proposed Action. However, some food services and lodging may be built along State Highway 4 to accommodate the increased demand of laborers, personnel, and spectators for the launches. Although there is no commercial zoning in this portion of Cameron County, appropriate permitting through Cameron County would be required prior to the construction or operation of such projects.

Under the Proposed Action, the operation of the vertical launch and control center areas is not anticipated to have significant secondary impacts to public services. During launches there may be a need for additional State and local police in the area and for emergency responders; however, launch events would occur approximately 12 times a year for a maximum duration of up to 15 hours per launch. SpaceX would coordinate with these services to make sure the needs for the launch and the community is met during launches; therefore, no significant secondary (induced) impacts are anticipated.

4.12.2 No Action Alternative

Under the No Action Alternative, the FAA/AST would not issue launch licenses and/or experimental permits that would allow SpaceX to launch the Falcon 9 and Falcon Heavy orbital vertical launch vehicles and a variety of suborbital launch vehicles. The vertical launch and control center areas would not be constructed, and no changes to the surrounding area would occur. Therefore, there would be no secondary (induced) impacts.

5.0 CUMULATIVE IMPACTS

Cumulative impacts are defined by the CEQ in 40 CFR §1508.7 as:

> The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.

The CEQ regulations further require that NEPA environmental analyses address connected, cumulative, and similar actions in the same document (40 CFR §1508.25).

Additionally, the CEQ further explained in *Considering Cumulative Effects under the National Environmental Policy Act* that "each resource, ecosystem and human community must be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters." Therefore, a cumulative effects analysis normally will encompass geographic boundaries beyond the immediate area of the Proposed Action, and a time frame, including past actions and foreseeable future actions, in order to capture these additional effects.

This chapter describes past, present, and reasonably foreseeable future actions relevant to cumulative impacts, analyzes the incremental interaction the Proposed Action may have with other actions, and evaluates cumulative impacts potentially resulting from these interactions.

5.1 PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE ACTIONS

This section identifies past, present, and reasonably foreseeable future actions that have the potential to contribute cumulative impacts to the resources in the affected environment for the proposed vertical launch and control center areas, as well as the surrounding region. An overview of these actions is presented to emphasize components of the activities that are relevant to the impact analyses. Geographic distribution, intensity, duration, and historical effects of similar activities were considered when determining whether a particular activity may contribute cumulatively to the impacts of the Proposed Action on the resources identified in the EIS. Table 5.1.-1 lists the projects assessed in this section, as well as any NEPA or environmental analysis that has been prepared or is anticipated to occur for the projects.

SpaceX has indicated publicly that it would continue to build its Falcon 9 launch vehicle in California, but when it begins manufacturing launch vehicles larger than the Falcon 9, these vehicles would be built at or near its launch site. However, even if the FAA decided to implement the Proposed Action and SpaceX constructed the proposed vertical launch and control center areas, SpaceX does not have current plans to construct a manufacturing facility near the vertical launch and control center areas. The FAA determined a SpaceX manufacturing facility is not a reasonably foreseeable action, and therefore, the facility is not addressed in terms of its potential to contribute cumulative impacts.

Table 5.1-1. Other Actions Relevant to Cumulative Impact Analysis

Action	Environmental Analysis
Past and Present Actions	
La Plaza at Brownsville Multimodal Terminal Facility	EA/FONSI, August 2006
Artisan at Port Isabel	N/A
Reasonably Foreseeable Future Actions	
South Padre Island Second Access	Final EIS in progress (Draft EIS published May 2012)
Rio Grande Wind Farm Project-Baryonyx Corporation, Inc.	Draft EIS in progress (Scoping meeting held March 28, 2012)
Rail Line from Port of Brownsville to Brownsville/South Padre Island International Airport	No environmental review has been published to date
Palmito Ranch Battlefield Viewing Platform	USFWS has completed the archaeological and wetlands surveys for the platform and parking area
Port of Brownsville Liquefied Natural Gas (LNG) Facility	U.S. Department of Energy (DOE) reviewing application. Level of environmental review not yet identified
Spacecraft Tracking and Astronomical Research into Gigahertz Astrophysical Transient Emission (STARGATE) Project	N/A

Note: EIS = Environmental Impact Statement, N/A – Not Applicable

5.1.1 Past and Present Actions Relevant to the Proposed Action

La Plaza at Brownsville Multimodal Terminal Facility— The City of Brownsville and Brownsville Urban System proposed the construction of a multimodal transit center in the Brownsville Central Business District. The Federal Transit Administration (FTA), Region 6 was the lead Federal agency. In December 2009, the City of Brownsville began constructing the new multimodal transit center in the Brownsville Central Business District, and it was completed and opened in April 2012. The FTA provided $24 million in grant funding for the approximately $31 million facility. In 2006, the FTA analyzed the potential environmental impacts of the project in an EA and issued a FONSI. The project involved developing approximately 5.4 acres of land in historic downtown Brownsville, two blocks from the Gateway International Bridge that connects the U.S. to Mexico. Development included a transit terminal, bus bays, canopies, and vehicle parking (FTA 2006). A transit passenger terminal building with approximately 24,000 square feet designed for visitor and passenger waiting areas also includes restaurants, intercity bus company counters, administrative office space, and a community room. The terminal can accommodate 24-27 buses at any given time.

Artisan at Port Isabel—Franklin Development and the Port Isabel Housing Authority teamed up to develop the Artisan, a 73 unit multi-family affordable apartment development occurring in Port Isabel, Texas, just northwest of the proposed vertical launch and control center areas (South Padre Island Breeze 2012). The apartment development is currently occupied and is operated by the Housing Authority. It is located at 106 Port Road in Port Isabel and features community amenities such as a business center, community room, playground, and an adult education classroom, among others. Long-term beneficial impacts to the community are expected as this development provides quality affordable housing opportunities for low income families.

5.1.2 Reasonably Foreseeable Future Actions Relevant to the Proposed Action

South Padre Island Second Access—The Cameron County Regional Mobility Authority, in partnership with TxDOT and the Federal Highway Administration, is proposing a transportation project provide a second access point to and from the South Padre Island. The proposed project would extend from State Highway 100 on the mainland to Park Road 100 on South Padre Island (Cameron County Regional Mobility Authority 2012). A Draft EIS was published in May 2012 to determine potential impacts to the human and natural environment in the project area, which is located within Cameron County. The Draft EIS evaluated 12 alternatives (11 build alternatives and the no-build alternative). All build alternatives would require the acquisition of a new ROW. The Final EIS is currently being developed.

Rio Grande Wind Farm Project–Baryonyx Corporation, Inc.—The Rio Grande project is a proposed wind farm of approximately 300 turbines that would be located in the Gulf of Mexico state waters, offshore of Willacy and Cameron Counties. This Rio Grande project was one of seven projects selected for funding through the DOE's Wind and Water Power Program. The project will receive an initial grant of $4 million to conduct environmental and feasibility assessments and pay for front-end engineering costs. The Rio Grande project includes the installation of three 6-megawatt direct-drive wind turbines in the Rio Grande Wind Lease areas. Upon completion of the initial phase of the seven projects, no more than three will receive up to an additional $47 million from the DOE for siting, construction, and installation (DOE 2012). If selected, the goal of the Rio Grande project is to be in commercial operation by 2017, with the ultimate goal of erecting hundreds of turbines on the more than 41,000 acres included in the two wind lease areas (Baryonyx Corporation 2013).

The USACE intends to prepare an EIS in compliance with NEPA to render a final decision on the permit applications. The USACE, Galveston District, decision would be either to issue, issue with modification, or deny Department of the Army permits for the proposed action. The EIS will assess the potential social, economic, and environmental impacts of the construction and operation of the offshore wind farm, associated facilities, and appurtenances and is intended to be sufficient in scope to address Federal, State, and local requirements, environmental and socioeconomic issues concerning the wind farm, and permit reviews. The Draft EIS has not been published to date.

Rail Line from Port of Brownsville to Brownsville/South Padre Island International Airport—The Brownsville Metropolitan Planning Organization published a feasibility study in May 2012 to assess if a rail link between the Port of Brownsville and Brownsville-South Padre International Airport was viable. The study found that the project should continue to be evaluated. At this time no environmental document has been prepared to analyze the potential environmental impacts for the various alternatives proposed for this project.

Palmito Ranch Battlefield Viewing Platform—The USFWS is proposing to construct a viewing platform within Palmito Ranch Battlefield to offer 270-degree views of the area, including the area where the soldiers came from, and include interpretive panels about the battle. The viewing platform would be built on the back side of a lomas on Palmito Hill Road, one of only two roads on the south side of State Highway 4 into the Battlefield. Palmito Hill Road is approximately 3 miles west of Massey Way. The water tower at Fort Brown in Brownsville, TX would be visible from the platform. The proposed viewing platform would be an "elevated deck" to be built of treated wood, approximately 75 ft by 50 ft in size. It would be built to "hurricane standards" and would be 4 ft to 6 ft above ground to protect against flooding. A small parking lot would be built in front of the platform. USFWS has completed the archaeological and wetlands surveys for the platform and parking area. The project should be complete no later than September 2013 (USFWS 2012g).

Port of Brownsville LNG Facility—The Gulf Coast LNG Export, LLC submitted an application to the DOE requesting long-term authorization to export LNG at a facility at the Port of Brownsville (FE Docket No. 12-05-LNG). The Brownsville Board of Commissioners approved a lease option agreement with Gulf Coast LNG for 500 acres of Port property. The DOE is currently evaluating the application and in February 2013 accepted comments on an LNG export study (77 FR 73627). If DOE provides authorization, Gulf Coast LNG will initiate the review process with the Federal Energy Regulatory Commission to receive authorization to site, construct, and operate the LNG terminal at the Port. The Federal Energy Regulatory Commission would prepare either an EA or EIS to analyze the potential environmental impacts of the project. The project is expected to be operational in 2018.

STARGATE Project—The University of Texas-Brownsville (UTB), Center for Advanced Radio Astronomy has proposed the STARGATE project. The project involves construction of a radio frequency technology facility that would provide students access to satellite and spacecraft tracking equipment. The facility is expected to be located in the vicinity of the proposed SpaceX control center area, although UTB has not yet acquired land for the facility. Funding for the proposed facility is being explored, and UTB is in discussions with SpaceX over a potential Memorandum of Understanding between the two organizations. No permanent on-site employees would be associated with this facility. However, transient users of the site would be present during this tracking.

5.2 CUMULATIVE IMPACT ANALYISIS FOR THE PROPOSED ACTION

This section analyzes the incremental interaction the Proposed Action may have with the actions described in the previous section and evaluates the potential cumulative impacts resulting from these interactions. Table 5.2-1 summarizes which past, present, and reasonably foreseeable future projects have the potential for cumulative impacts to the resources affected by the Proposed Action. The ROI for each resource area discussed below is the same ROI defined for that resource in Chapter 3 for direct and indirect impacts (see Chapter 3 for a description of the ROIs, as applicable).

Table 5.2-1: Summary of Past, Present, and Reasonably Foreseeable Future Projects and Associated Potential Impacts to Resources

Proposed Project	Compatible Land Use (Including Farmlands and Coastal Resources	Section 4(f) Properties	Noise	Visual Resources and Light Emissions	Historical, Architectural, Archaeological, and Cultural Resources	Air Quality	Water Resources (Including Wetlands, Floodplains, Surface Waters, Groundwater, and Wild and Scenic Rivers	Biological Resources (Including Fish, Wildlife, and Plants)	Hazardous Materials, Pollution Prevention, and Solid Waste	Socioeconomics, Environmental Justice, and Children's Environmental Health Risks and Safety Risks	Energy Supply and Natural Resources
La Plaza at Brownsville Multimodal Facility						X					
Artisan at Port Isabel						X				X	X
South Padre Island Second Access	X			X		X	X	X		X	X
Rio Grande Wind Farm Project-Baryonyx Corporation, Inc. (Wind Farm)		X		X		X	X	X		X	X
Proposed Rail Line from Port of Brownsville to Brownsville/South Padre Island Airport (Brownsville/South Padre Island Rail Line)	X		X			X					
Palmito Ranch Battlefield Viewing Platform				X	X		X				
Port of Brownsville LNG Facility						X	X	X	X	X	X
STARGATE				X	X			X			

5.2.1 Compatible Land Use (Including Farmlands and Coastal Resources)

Cumulative impacts to land use would result from projects within the vicinity of the proposed vertical launch and control center areas that contribute to changes in land use patterns as well as impacts to land use compatibility from noise of construction and operation. The South Padre Island Second Access project and the Brownsville/South Padre Rail Line project have the potential to impact land use.

The primary direct impact on land use from the South Padre Island Second Access project is the long-term conversion of undisturbed land, and possibly residential areas, to a transportation ROW. However, to address these impacts, minimization and mitigation measures have been developed for the Second Access project and would minimize impacts to land uses. In addition, the TGLO would review the South

Padre Island Second Access project plans to ensure that they meet the goals and policies of the TCMP to the maximum extent practicable.

The Brownsville/South Padre Rail Line project has the potential to impact land use due to the conversion of land to transportation ROW. However, to avoid disrupting the planned land uses or infrastructures that may one day be located within the ROW of the proposed rail corridor, the City of Brownsville could adopt zoning regulations around the proposed alignments with the assumption that the rail line would be constructed at some point in the medium- to long-term. In addition, the proposed rail alignments could be added to the City of Brownsville's Thoroughfare Plan, which would require developers of plats within the subject areas to dedicate sufficient rail ROW as a condition of any subdivision plat to be filed.

The construction activity under the Proposed Action would not result in significant impacts to land use, land use compatibility, farmlands, or coastal resources. Although land use would be changed from open space and residential to mixed use, this would not violate existing land use policies (since unincorporated areas or Cameron County do not have zoning ordinances or land use plans). However, the Proposed Action's operations would result in significant impacts to land use compatibility as a result of increased noise during launches, particularly to Boca Chica Village (a residential area) and the surrounding parks, cultural resources, and National Wildlife Refuges (considered sensitive noise receptors). There would be other minor impacts to land use during launches since public access to Boca Chica State Park, Lower Rio Grande Valley NWR, and Brazos Island State Park would be closed for safety and security reasons.

To the extent the potential compatible land use impacts from the proposed South Padre Island Second Access and Brownsville/South Padre Rail Line projects overlap with the Proposed Action's impacts, there would be cumulative impacts to land use within the surrounding communities. Since the Proposed Action would result in significant impacts related to land use compatibility (from operational noise), any cumulative land use compatibility impacts from the projects listed above would be considered significant.

5.2.2 Section 4(f) Properties

Cumulative impacts to Section 4(f) properties would result from projects within the vicinity of the proposed vertical launch and control center areas that contribute to impacts on the Section 4(f) properties assessed in Chapters 3 and 4. The Wind Farm project is the only past, present, and reasonably foreseeable action that could have an impact on these Section 4(f) properties. The Wind Farm project has the potential to have impacts on visual resources (see Section 5.2.4, *Visual Resources and Light Emissions*, below), which in turn could affect a Section 4(f) property (namely the Palmito Ranch Battlefield NHL). As discussed below, the proposed wind turbines would be approximately 13 miles from the eastern end of the NHL. There would be minimal visual impact to the Palmito Ranch Battlefield NHL because of the large distance to the wind turbines.

According to the May 2012 Feasibility Study for the proposed Brownsville/South Padre Rail Line project, the project would not affect the same Section 4(f) properties as the Proposed Action within the ROI.

The Proposed Action would not result in physical use or constructive use impacts to Section 4(f) properties in the ROI. Although the Proposed Action operations would result in noise and visual impacts, as well as periodic brief closures of some Section 4(f) properties, the Proposed Acton would not result in substantial impairment of any Section 4(f) property. Based on the minimal cumulative visual impact on the Palmito Ranch Battlefield NHL from the wind turbines, potential cumulative impacts are not expected to result in substantial impairment of any Section 4(f) property. Therefore, potential cumulative impacts on Section 4(f) properties would not be significant.

5.2.3 Noise

Cumulative impacts related to noise would result from projects within the vicinity of the proposed vertical launch and control center areas that generate noise. The Brownsville/South Padre Rail Line project is the only foreseeable action that has the potential to result in a cumulative noise impact. According to the Brownsville/South Padre Rail Line Feasibility Study, residential and non-residential sensitive noise receptors are within the study area for the proposed rail line. However, the proposed rail corridor is not anticipated to carry sufficient traffic volumes that would significantly increase ambient noise levels. As the project moves forward, noise modeling would likely be required to determine actual impacts. The feasibility study indicates that if the project is found to result in a significant increase in ambient noise levels, then appropriate abatement measures would be evaluated for incorporation into the project design where practicable.

Under the Proposed Action, there are anticipated to be significant increases in noise. However, these impacts are considered short-term and temporary because they would only occur up to 12 times per year. The actual launch would only last a few minutes in duration resulting in brief increases to community noise levels. In addition, hearing protection measures would be implemented to ensure the health and safety of the Boca Chica Village community and the general public during launch activities, including using hearing protection for affected individuals and remaining indoors during a launch event.

To the extent the noise generated from the proposed Brownsville/South Padre Rail Line project overlaps with the Proposed Action’s noise impacts, there would be cumulative noise impacts. Since the Proposed Action’s operational noise impacts would be significant, any potential cumulative noise impacts occurring during a launch would be considered significant.

5.2.4 Visual Resources and Light Emissions

Cumulative impacts to visual resources and light emissions would result from projects within the vicinity of the proposed vertical launch and control center areas that contribute to change in the viewshed or are exposed from light emissions from construction and operational activities. The South Padre Island Second Access, Wind Farm, Palmito Ranch Battlefield Viewing Platform, and STARGATE projects could contribute to cumulative impacts to visual resources and light emissions.

The South Padre Island Second Access project is located north of the proposed vertical launch and control center areas and would contribute to cumulative impacts to visual resources and light emissions. Visual changes would result from the South Padre Island Second Access project, across the Laguna Madre and near intersections where access to the new roadway would be provided. These developments would include street lights and security lighting that would be expected to result in incremental and localized increases in ambient light levels, glare, and nightglow. However, to address these impacts, where practicable, visual mitigation measures could include naturally vegetated medians, minimized ROW clearing, and incorporation of design specifications to blend into the landscape (Cameron County Regional Mobility Authority 2012). As a result of both mitigation measures proposed for the South Padre Island Second Access and the Proposed Action discussed in this EIS, cumulative impacts to visual resources and light emissions would not be significant.

The Wind Farm project has the potential to have impacts to visual resources. The USACE is currently in the process of preparing a Draft EIS which will determine if impacts would or would not occur to visual resources. When the Draft EIS is published for public comment, the document would be reviewed to determine if impacts to visual resources would occur. However, the Rio Grande South wind lease is located approximately 10 statute miles from the proposed vertical launch area and is approximately 6.5 statute miles north of the water closure area. The Rio Grande North site is approximately 6 miles farther north of the Rio Grande South site. The proposed wind turbines would be approximately 13 miles from the eastern end of the Palmito Ranch Battlefield NHL. There would be minimal visual impact to the battlefield because of the large distance to the wind farm. Therefore, the potential for a cumulative impact is unlikely.

The Palmito Ranch Battlefield Viewing Platform has the potential to have impacts to visual resources. The platform would be elevated 4 to 6 ft above the ground, so it would introduce a new element within the landscape. However, it would be constructed of wood, which would blend into portions of the landscape. The platform is not known to include lights, so the project would not contribute to light emissions.

The STARGATE project involves construction of a radio frequency technology facility that would provide students access to satellite and spacecraft tracking equipment. The facility is expected to be located in the vicinity of the proposed SpaceX control center area, although UTB has not yet acquired land for the facility. This project has the potential to impact visual resources and light emissions. The project is in the early planning stage at this time so the design of the facility is undetermined; however, it is anticipated the facility would be similar in scale to the control center area facilities. The Memorandum of Understanding between SpaceX and UTB would stipulate that UTB construct the STARGATE facility using the same mitigation measures to reduce impacts on visual resources as would be implemented for the Proposed Action, as applicable, such as using non-glare material and color to disguise the facilities and using low pressure sodium lighting where possible.

Under the Proposed Action construction of the vertical launch area would result in significant impacts to visual resources in the area as described in Section 4.4.1, *Proposed Action*. Mitigation measures would be implemented to mitigate impacts to visual resources (see Section 6.3, *Visual Resources and Light Emissions*). Additionally, the Proposed Action would have increases in light emissions as a result of operations. A Lighting Management Plan, which would reduce impacts to wildlife, is proposed for mitigation of the increase in light emissions. Additionally, the increase in light emissions may also result in minor impacts to Boca Chica Village.

When the visual and light emissions impacts are combined with the potential for visual and light emissions impacts of the future projects, there would be a cumulative impact on visual resources and light emissions. Since the Proposed Action would result in significant impacts on visual resources, any cumulative impacts from the projects listed above related to visual resources would be considered significant.

5.2.5 Historical, Architectural, Archaeological, and Cultural Resources

Review of existing documents for the projects listed in Table 5.2-1 indicate that two actions have the potential for cumulative impacts to historical, architectural, archaeological, and cultural resources near the vicinity of the vertical launch and control center areas, including the proposed USFWS Palmito Ranch Battlefield Viewing Platform and the proposed STARGATE project.

The USFWS conducted an archaeological survey for the Palmito Ranch Battlefield Viewing Platform and associated parking lot and determined that no NRHP-eligible archaeological sites would be impacted.

The STARGATE project involves construction of a radio frequency technology facility that is expected to be located in the vicinity of the proposed SpaceX control center area, although UTB has not yet acquired land for the facility. This project has the potential to impact historical, architectural, archaeological, and cultural resources, to the extent the project would affect the setting of the Palmito Ranch Battlefield NHL. The project is in the early planning stage at this time so the design of the facility is undetermined; however, it is anticipated the facility would be similar in scale to the SpaceX control center area facilities.

Under the Proposed Action, the setting of the Palmito Ranch Battlefield NHL would be adversely affected. Construction of the launch facilities, and the 250-ft water tower particularly, would introduce new features into its setting, thereby compromising its integrity. The setting is of primary significance to its eligibility. During operations of the vertical launch area, the Cypress Pilings, Palmetto Pilings, and the 1936 Texas Centennial Marker for the Palmetto Pilings would be adversely affected by vibrations from high noise levels, which could cause physical damage to structural features of these properties. Additionally, higher numbers of visitors and traffic in the area may result in secondary induced impacts to the historic properties. The FAA, in consultation with THC and consulting parties, is developing a MOA to mitigate the impacts to the physical integrity and setting of the historic properties (see Section 6.4, *Historical, Architectural, Archaeological, and Cultural Resources,* for potential mitigation measures). Therefore, to the extent the Proposed Action's impacts on the setting of the Palmito Ranch Battlefield NHL overlap with potential setting impacts created by construction of the STARGATE project, the Proposed Action would contribute to cumulative impacts to historical, architectural, archaeological, and cultural resources. With implementation of mitigation measures for the Proposed Action, these potential cumulative impacts would not be significant.

5.2.6 Air Quality

Cumulative air quality impacts would result from projects within the vicinity of the proposed vertical launch and control center areas that contribute to air quality impacts. The following projects could contribute to air emissions in the ROI: La Plaza at Brownsville Multimodal Facility, Artisan at Port Isabel, South Padre Island Second Access, Wind Farm, Brownsville/South Padre Rail Line, and the Port of Brownsville LNG Facility. However, criteria pollutants associated with the Proposed Action's operational emissions, when combined with these other projects would be unlikely to result in noncompliance with the NAAQS, and therefore, would not be significant.

The cumulative impact of the Proposed Action on the global climate in conjunction with other past, present, and reasonably foreseeable future actions is not currently scientifically predictable. Aviation has been calculated to contribute approximately 3 percent of global CO_2 emissions; this contribution may grow to 5 percent by 2050. Actions are underway within the U.S. and by other nations to reduce aviation's contribution through such measures as new aircraft technologies to reduce emissions and improve fuel efficiency, renewable alternative fuels with lower carbon footprints, more efficient air traffic management, market-based measures and environmental regulations including an aircraft CO_2 standard. The U.S. has ambitious goals to achieve carbon-neutral growth for aviation by 2020 compared to a 2005 baseline, and to gain absolute reductions in GHG emissions by 2050. At present there are no calculations of the extent to which measures individually or cumulatively may affect aviation's CO_2 emissions. Moreover, there are large uncertainties regarding aviation's impact on climate. The FAA, with support from the U.S. Global Change Research Program (USGCRP) and its participating Federal agencies (e.g., NASA, NOAA, EPA, and DOE), developed the Aviation Climate Change Research Initiative in an effort to advance scientific understanding of regional and global climate impacts of aircraft emissions, with quantified uncertainties for current and projected aviation scenarios under changing atmospheric conditions (Brown 2010).

Annual GHG emissions associated with the Proposed Action operations are compared to U.S. 2010 GHG emissions (EPA 2012d) and the 2011 global CO_2 emissions in Table 5.2-2. The estimated CO_2 emissions from the annual operations at the vertical launch area and control center area are less than a thousandth of 1 percent of the total GHG emissions generated by the U.S. in 2010 and less than a millionth of 1 percent of the total CO_2 emissions generated worldwide (European Commission–Joint Research Centre 2012).

Table 5.2-2. Estimated Carbon Dioxide (CO_2) Emissions from the Proposed Action

Annual Emissions	Metric Tons CO_2e per Year
U.S. 2010 Total GHG Emissions	$6,821.8 \times 10^6$
Global Total CO_2 Emissions	$3,400 \times 10^7$
10 Falcon 9 Launches	3,871
2 Falcon Heavy Launches	4,074
Commuting Staff	460
Supply/Delivery Truck	8
Generator Operations	757
Total	**9,170**
Percentage of U.S. 2010 GHG Emissions	0.00013
Percentage of Global CO_2 Emissions	0.00003

Emissions of GHGs from the Proposed Action alone would not cause appreciable global warming that would lead to climate changes. However, these emissions would increase the atmosphere's concentration of GHGs, and, in combination with other past, present and reasonably foreseeable future project emissions from all other sources, contribute incrementally to the global warming that produces the adverse effects of climate change. Adverse climate change impacts to the southwest U.S. where the Proposed Action would occur include increasing scarcity of water supplies; increasing temperature, drought, wildfire, and invasive species. All of these all of which would accelerate landscape transformation; increased frequency and altered timing of flooding; and degradation of unique tourism and recreation resources (USGCRP 2009). At present, no methodology exists that would enable estimating the specific impacts (if any) that this increment of warming would produce locally or globally.

5.2.7 Water Resources (Including Surface Waters, Groundwater, Wetlands, Floodplains, and Wild and Scenic Rivers)

Cumulative impacts to water resources would result from projects within the vicinity of the proposed vertical launch and control center areas that contribute to water quality or removal or fill of wetland and floodplain areas from construction and operational activities. The following projects could contribute to impacts on water resources in the ROI: South Padre Island Second Access, Wind Farm, Palmito Ranch Battlefield Viewing Platform, and the Port of Brownsville LNG Facility.

The South Padre Island Second Access project is located north of the proposed vertical launch and control center areas and would contribute to cumulative impacts to water resources. Surface waters, groundwater, wetlands, and floodplains would be impacted from the South Padre Island Second Access project. However, to address these impacts, an SWPPP would be followed and BMPs would be implemented throughout construction of the Second Access project, including erosion control logs, silt fencing, vegetative filter strips, and cross drainage would minimize impacts to water resources by reducing the amount of sediment and pollutants that may be carried into surrounding surface waters that may affect water quality. In addition, grass-lined swales and stormwater management ponds would be incorporated to minimize adverse effects to surface water quality. Each of the alternatives evaluated for the Second Access project include impacts to varying amounts of wetlands. Mitigation for wetlands impacts would include a combination of both on-site and off-site mitigation. Viable wetland mitigation alternatives are in the process of being investigated; however, on-site mitigation would likely include creation or enhancement of existing wetlands in the ROW, and off-site mitigation options consist of expanding existing wetlands, creation of water filtration wetlands, regulating water levels in streams or impoundments, and establishment of riparian habitat (Cameron County Regional Mobility Authority 2012).

The Wind Farm project could have temporary and localized impacts to water quality as a result of sediment disturbance along cable corridors and wind turbine foundations. However, construction and operational controls would be implemented to control adverse impacts to water quality and would include plans such as SPCCPs, SWPPPs, and BMPs. Through the control of exposure of contaminants by the proper application of chemicals, inside storage of chemicals when possible, and similar BMPs, adverse impacts to water resources associated with marine vessels and other equipment during construction of the wind turbines could be avoided. Additionally, as currently proposed, the project would not fill surface areas or wetlands other than temporary side-cast material from trench construction, and horizontal drilling under unavoidable wetlands will be considered where practicable for burial of transmission cables from the wind turbines to offshore substations.

The Palmito Ranch Battlefield Viewing Platform could have impacts to water resources, including wetlands. The USFWS conducted a wetlands survey and received clearance on the survey (USFWS 2012g). Therefore, the project would not result in significant impacts to wetlands.

The Port of Brownsville LNG Facility has the potential to have impacts to water resources from the installation of a downstream pipeline. Specific impacts to water resources are not available, as a full environmental review under NEPA has not yet been initiated. Nonetheless, preliminary information available from the application indicates that there would be the potential to impact these resources.

In addition to the projects identified in Table 5-2.1, review of the Galveston Corps District Public Notice website indicated two permit applications in Cameron County that are in the vicinity of the Proposed Action that could contribute to wetland impacts in the region. The Brownsville Navigation District is seeking to amend their current permit so they can excavate 1.2 million yd^3 of dredged material in an area associated with the Brownsville Ship Channel. The Port Isabel Public Improvement District has applied for a permit to fill approximately 4.95 acres of jurisdictional area. The Brownsville Navigation District project would not result in the fill of jurisdictional wetlands; however, the Port Isabel Public Improvement project would result in the fill of jurisdictional wetlands.

The Proposed Action would result in the fill of approximately 3.30 acres of wetlands at the vertical launch area, 0.04 acre of wetlands at the control center area, and the total indirect impact to approximately 2.85 acres of wetlands. In addition, approximately 4.22 acres of floodplain would be filled in Zone V10 in the proposed vertical launch area, approximately 4.37 acres would be filled in Zone A8 in the western portion of the vertical launch area, and approximately 12.4 acres would be filled in Zone A8 of the control center area. Therefore, the Proposed Action when combined with past, present, and reasonably foreseeable future projects would result in cumulative impacts to wetlands and floodplains. However, final project engineering designs submitted for State and Federal permits would include evaluation of alternatives and avoidance and minimization measures to reduce potential impacts to wetlands. Appropriate wetland mitigation would be implemented to ensure no net loss of wetlands. In addition, in order to comply with the local floodplain zoning required for participation in the NFIP and to obtain development permits, a hydraulic analysis of the floodplain associated with the vertical launch and control center areas would need to be conducted during the preliminary engineering design phase of the project to comply with the local county requirements. The hydraulic analysis would determine if the fill and construction of facilities within the floodplain would affect the base flood elevation. If the study determines that construction would not affect the base flood elevation, a “No-Rise” Determination would be submitted to the county. However, if the hydraulic study determined that the base flood elevation would be affected, further engineering design would need to be conducted to mitigate for the change in base flood elevation in order to comply with NFIP and Cameron County building regulations as required by the National Flood Insurance Act Title 42. Compliance with the NFIP as well as county regulations would ensure that the construction would have no significant impacts on floodplain storage and base flood elevations. As a result of mitigation measures proposed for the reasonably foreseeable future projects and the Proposed Action discussed in this EIS, cumulative impacts to water resources would not be significant.

5.2.8 Biological Resources (Fish, Wildlife, and Plants)

Cumulative impacts to biological resources would result from projects within the vicinity of the proposed vertical launch and control center areas that contribute to disturbance and removal of wildlife habitat as well as impacts to from noise of construction and operational activities. The following projects could contribute to impacts on biological resources in the ROI: South Padre Island Second Access, Wind Farm, the Port of Brownsville LNG Facility, and STARGATE.

The South Padre Island Second Access project is located approximately 4.5 miles north of the proposed vertical launch and control center areas and would contribute to cumulative impacts to biological resources if implemented. Wildlife habitat, including brush, riparian and dune vegetation, rangeland, seagrasses, and wetlands would be impacted from the Second Access project. If this project is implemented approximately 41 acres of aplomado falcon habitat, 153 acres of ocelot/jaguarundi habitat, 34.1 acres of piping plover habitat, and 623 acres of migratory bird habitat would be impacted. In addition, sensitive wildlife species such as the jaguarundi, ocelot, and piping plover occur within South Padre Island Second Access project area and could be impacted from loss of habitat, noise from construction and traffic once the project is complete. However, to address these impacts, minimization and mitigation measures developed for the South Padre Island Second Access project, such as preserving intact habitat (thorn-scrub, coastal grasslands), mitigation of wetlands/habitat, and creating effective wildlife crossings, would minimize impacts to biological resources.

The Wind Farm project has the potential to have impacts to biological resources. Installation of transmission lines from the rows of wind turbines to offshore substations has the potential to impact vegetation, seagrasses, dunes, reefs, and other habitat, and marine mammals, sea turtles, birds, and fisheries. The routing and scheduling of the work to install the cables would be designed to minimize impacts to these biological resources. Additionally, horizontal drilling for burial of the transmission cables under unavoidable seagrass beds, dunes, and reefs will be considered where practicable.

The Port of Brownsville LNG Facility has the potential to have impacts on biological resources from the installation of a downstream pipeline and construction of dock facilities. Installation of the pipeline and facilities has the potential to impact vegetation, marine mammals, sea turtles, birds, and fisheries. Specific impacts to biological resources are not available, as a full environmental review under NEPA has not yet been initiated. Nonetheless, preliminary information available from the application indicates that there would be the potential to impact these resources.

The STARGATE project involves construction of a radio frequency technology facility that would provide students access to satellite and spacecraft tracking equipment. The facility is expected to be located in the vicinity of the proposed SpaceX control center area, although UTB has not yet acquired land for the facility. No permanent on-site employees would be associated with this facility. However, transient users of the site would be present during this tracking. Construction and operation of the STARGATE facility has the potential to impact biological resources. The project is in the early planning stage at this time so the design of the facility is undetermined; however, it is anticipated that the facility would be similar in scale to the SpaceX control center area facilities. The Memorandum of Understanding between SpaceX and UTB would stipulate that UTB operate the STARGATE facility using the same mitigation measures to reduce impacts on biological resources as would be implemented for the Proposed Action, as applicable, such as encouraging users of the site to reduce speeds along State Highway 4 to avoid the potential of vehicle collisions with ocelots and jaguarundis.

A total of 15.74 acres of upland habitat and 6.19 acres of wetland habitat would be removed as a result of the construction of proposed vertical launch and control center area facilities and infrastructure. Approximately 0.70 acre of piping plover critical habitat (unvegetated flats and depressional wetlands) occur within the proposed project footprints for the vertical launch area and would be removed under the Proposed Action. There would be no significant impacts to vegetation or wildlife species with implementation of proposed construction activities. The FAA has determined that the Proposed Action's construction activities *may affect, is likely to adversely affect* the piping plover and its critical habitat, the northern aplomado falcon, and the jaguarundi and ocelot. The FAA has also determined that the Proposed Action's construction activities *may affect, is not likely to adversely affect* the West Indian manatee. None of the proposed construction areas are located in any potential sea turtle nesting areas. Proposed construction activities would have no direct effect on sea turtle habitat in the terrestrial environment. With implementation of proposed SCMs such as educating the public on safe and lawful areas they could watch the launch and developing a Lighting Management Plan, there would be no significant impacts on wildlife species (including state-listed wildlife species) as a result of the Proposed Action. Based on the analysis presented in the BA, the FAA has determined that the Proposed Action *may affect, is likely to adversely affect* the piping plover and its critical habitat, the northern aplomado falcon, the jaguarundi and ocelot, and sea turtles. The Proposed Action *may affect, is not likely to adversely affect* the West Indian manatee.

Cumulative impacts to the aplomado falcon, the jaguarundi and ocelot, and piping plover habitat would occur. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS. If mitigation measures are implemented for the Wind Farm and South Padre Island Second Access projects, it is anticipated that the cumulative impacts to biological resources would not be considered significant.

5.2.9 Hazardous Materials, Pollution Prevention, and Solid Waste

Review of existing documents for the projects listed in Table 5.2-1 indicate that the only action that would have the potential for cumulative impacts to hazardous materials, pollution prevention, and solid waste near the vicinity of the vertical launch and control center areas would be the Port of Brownsville LNG Facility. The proposed site for the LNG Facility is across from a spoil area and has the potential for impacts to hazardous materials, pollution prevention, and solid waste. However, specific impacts are not available, as a full environmental review under NEPA has not yet been initiated. Nonetheless, preliminary information available from the application indicates that there could be a potential impact to this resource.

Under the Proposed Action there would be an increase in the number of hazardous materials in the area of the vertical launch and control center areas. However, with the implementation of appropriate handling and management procedures for hazardous materials, hazardous wastes and solid wastes generated during the operation of the vertical launch area (including launches) and the control center area, there would be no significant impacts to the environment. When past, present, and reasonably foreseeable projects are analyzed in conjunction with the Proposed Action, cumulative impacts would not be significant.

5.2.10 Socioeconomics, Environmental Justice, and Children's Environmental Health Risks and Safety Risks

Cumulative impacts to socioeconomics, environmental justice, and children's environmental health risks and safety risks would result from projects within the vicinity of the proposed vertical launch and control center areas that contribute to community and social impacts.

The Artisan at Port Isabel affordable apartment development project is anticipated to bring both short-term and long-term positive socioeconomic impacts to the area.

The South Padre Island Second Access project is located north of the proposed vertical launch and control center areas and would contribute to cumulative impacts to socioeconomic resources. Residents and business owners could be displaced by the acquisition of the ROW. However, to address these impacts, relocation assistance, including financial assistance, reimbursements for moving expenses and reestablishment expenses may be offered to the displaced persons or businesses, and would minimize cumulative impacts to residents and business owners. The South Padre Island Second Access project would enhance interaction between the mainland and the island by providing a second access, relieving congestion and improving accessibility and mobility. The overall impact of the project can be expected to have minor negative impacts and more pronounced positive impacts to socioeconomics resources (Cameron County Regional Mobility Authority 2012).

The Wind Farm project has the potential to have impacts to socioeconomic resources. The USACE is currently in the process of preparing a Draft EIS, which would determine if impacts would or would not occur to socioeconomic resources. When the Draft EIS is published for public comment, the document would be reviewed to determine if impacts to socioeconomic resources would occur. It is anticipated that these impacts would be positive in nature and they may result in the contribution of cumulative impacts to socioeconomic resources. No impacts to environmental justice communities or children's environmental health and safety are anticipated as a result of the Rio Grande Project. The Draft EIS has not been published to date.

The Port of Brownsville LNG Facility has the potential to have beneficial impacts to socioeconomics. The applicant estimates the facility would generate more than 3,000 construction jobs and more than 250 permanent operational jobs, and provide economic benefits to the regional and national economies. Specific impacts to socioeconomics, environmental justice, and children's health and safety are not available, as a full environmental review under NEPA has not yet been initiated. Nonetheless, preliminary information available from the application indicates that there would be positive cumulative impacts to these resources.

Implementation of the Proposed Action would result in local construction expenditures, including construction wages, which would have a beneficial impact on the ROI economy through direct spending and would generate economic activity that could lead to indirect job creation in areas such as the accommodation and food services and retail trade sectors. Construction activities would not be expected to result in significant effects to the housing market. Additionally, the Proposed Action would not be expected to strain the capacity or affect the quality of emergency response, medical, or public education services. The Proposed Action would not negatively affect children's environmental health and safety. Construction of the control center area would have negative visual impacts on residents of Boca Chica Village. Operation of the Proposed Action would result in significant short-term community noise levels and an increased probability of noise-induced structural vibration damage in Boca Chica Village. Light emissions from the vertical launch area would also be significant, especially during launch events. Therefore, the Proposed Action would result in an environmental justice impact to Boca Chica Village.

When past, present, and reasonably foreseeable projects are analyzed in conjunction with the Proposed Action, positive impacts to socioeconomics would occur within the region, and no impacts to children's health and safety. There would be no significant environmental justice impacts. Several mitigation measures would be implemented to minimize the visual and light emissions impacts to Boca Chica Village from the Proposed Action (refer to Section 6.0, *Mitigation*). As a result of the mitigation measures proposed for the Proposed Action discussed in this EIS, cumulative impacts to environmental justice would not be significant.

5.2.11 Natural Resources and Energy Supply

Cumulative impacts to energy supply and natural resources would result from projects within the vicinity of the proposed vertical launch and control center areas that contribute to the depletion of natural resources and impacts to the energy supply.

The Artisan at Port Isabel affordable apartment development project is anticipated to require increases in electricity and water for residents. For the construction of the apartments, natural resources were expended in the form of lumber, aggregate, and fossil fuels (oil and gas), and those could be used for operations as well. It is anticipated that suppliers could accommodate these increases and no significant impacts would occur.

The South Padre Island Second Access project is located north of the proposed vertical launch and control center areas and would contribute to cumulative impacts to energy supply and natural resources. Construction-related energy consumption would be short-term in nature and could be offset by operational energy efficiencies gained through the use of an improved transportation facility over many decades. The project could improve fuel efficiencies as traffic moves from the existing roadway network to the new facility thereby improving traffic mobility across the project area. No mitigation is proposed for energy uses within the project area however steps to increase energy efficiency of the project's construction and operation would be taken whenever applicable (Cameron County Regional Mobility Authority 2012).

The Wind Farm project has the potential to have impacts to natural resources and energy supply. Aggregate and fossil fuels would be used to build the foundations of the wind turbines and the offshore facilities. Construction-related energy consumption would be short-term. Upon completion, the project would contribute beneficial impacts to natural resources and energy supply by harnessing offshore wind resources to provide electrical generation capacity for current markets in Texas. Therefore, it is anticipated that no significant impacts to natural resources and energy supply would occur and there would not be a cumulative effect to these resources as a result of the Proposed Action when combined with the Rio Grande Project. The Draft EIS has not been published to date.

The Port of Brownsville LNG Facility has the potential to have beneficial impacts to energy supply. Specific impacts to energy supply are not available, as a full environmental review under NEPA has not yet been initiated. Nonetheless, preliminary information available from the application indicates that there would be positive impacts to these resources.

Under the Proposed Action there would be increases in the consumption of fuel, oil, propellants, electricity, aggregate, water and groundwater. Recent studies indicate that local, regional, and nationwide suppliers would be able to accommodate the increases in consumption of fuel, oil, propellants, electricity, and aggregate and no significant impacts would occur. Additionally, the groundwater supply would also be able to accommodate the increased consumption and drawdown with no significant impacts to the groundwater supply.

When past, present, and reasonably foreseeable projects are analyzed in conjunction with the Proposed Action, there would be a cumulative increase in the demand on energy supply and natural resources within the surrounding communities. However, the cumulative impacts are not anticipated to be significant.

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6.0 MITIGATION AND SPECIAL CONSERVATION MEASURES

This chapter summarizes measures that SpaceX would implement to reduce or offset the potential environmental consequences of construction and operational activities. Measures described in the following sections include management plans and procedures, BMPs, and SCMs that would be implemented during construction and operation. Further measures may be considered in consultation with Federal and State agencies, and implemented, if necessary.

Development of the specific plans and other BMPs during the construction phase would be the responsibility of SpaceX, to be delegated to the contractor, as necessary, during construction of the vertical launch and control center areas. The contractor would be required to apply the current construction industry BMPs in accordance with Federal requirements, NPDES General Permit Requirements, and applicable regulations of the TCEQ. SpaceX would oversee all contractor performance to ensure that the contractor complies with these requirements.

The following sections provide a description of mitigation and SCMs that are considered feasible if the Proposed Action were to be implemented. All mitigation will be finalized once agency consultations have been completed. These will be included in the Final EIS and ROD.

6.1 COMPATIBLE LAND USE (INCLUDING FARMLANDS AND COASTAL RESOURCES)

Closure of nearby beaches and State Highway 4 would be necessary to ensure safety and security during wet dress rehearsals, static fires, and launch operations. Measures that SpaceX would implement to reduce impacts to land use due to these closures include the following:

- SpaceX would become a Beach Guardian in the Adopt-a-Beach Program organized by the TGLO. SpaceX would adopt a 3-mile portion of Boca Chica Beach centered on the terminus of State Highway 4. At a minimum, SpaceX would:
    - Participate in the two annual cleanups organized by the TGLO.
    - Organize a minimum of one additional cleanup of Boca Chica Beach. This additional cleanup would involve the community as much as possible and include features, paid for by SpaceX, such as:
        - Guest educational speakers to teach the community about topics such as the area’s wildlife, the area’s history, the sources of the debris on the beach, and how the cleanup benefits the beach. These speakers could come from several sources, including the Cameron County Parks and Recreation Department and the nearby universities.
    - Organize SpaceX personnel to teach the community about topics such as the space program, rocket engineering, and the site design characteristics that are intended to minimize environmental impact.

- Complete monthly cleanups of the beach, focusing on large pieces of litter. During each cleanup, SpaceX would record information about trash collected on data cards provided by the Adopt-A-Beach Program, and return the cards to TGLO.

6.2 SECTION 4(F) PROPERTIES

Measures that would be implemented to reduce the impacts on Section 4(f) properties include the following:

- Using non-reflective material and light color, to the extent practicable, to disguise the proposed facilities, the water tower, and the lightning protection towers, so that they would blend in with the natural colors of the landscape

6.3 VISUAL RESOURCES AND LIGHT EMISSIONS

Measures that would be implemented to reduce impacts on visual resources include the following:

- Prior to construction and operational activities, a Draft Lighting Management Plan would be provided to the NPS (and USFWS, see Section 6.7, *Biological Resources [Fish, Wildlife, and Plants],* below) for review and comment. The Final Lighting Management Plan would be approved by the NPS and USFWS. Potential measures from the Lighting Management Plan, which SpaceX would adhere to, include the following:
    - Where lighting is not essential for safety or security, timers would be installed to switch lights off in the evening. Where applicable and not a threat to security, motion-detector switches may be installed.
    - The size, type, and number of exterior lights would be minimized and would be restricted to low pressure sodium, to the extent practicable.
    - Directing, shielding, or positioning the lighting of the facilities to the extent possible (without decreasing safety and security) to minimize lateral light spread and decrease uplighting.
- Using non-reflective material and light color, to the extent practicable, to disguise the facilities, the water tower, and the lightning protection towers, so they would blend in with the natural landscape, thus minimizing impacts within areas visible from the Palmito Ranch Battlefield NHL.

6.4 HISTORICAL, ARCHITECTURAL, ARCHAEOLOGICAL AND CULTURAL RESOURCES

The adverse effects to the five historic properties could be reduced through a variety of mitigation measures, including:

- Using non-reflective material and light color, to the extent practicable, to disguise the facilities, the water tower, and the lightning protection towers, so that they would blend in with the natural colors of the landscape
- Documenting the sites through mapping, high resolution photography, detailed description, sampling, and evaluative testing

- Adding interpretive signage about the historic sites in this area at the pullout for the historical marker across from the vertical launch area

Section 106 consultation with THC and NPS on potential mitigation measures is ongoing. The FAA is in the process of developing a MOA with the Section 106 consulting parties to mitigate the potential adverse effects on historic properties. The final mitigation measures will be included in the Final EIS.

6.5 AIR QUALITY

BMPs would address potential air quality impacts during construction or operations. The emission of any air pollutants as a result of ground disturbance, use of equipment, coatings application, or other construction activities would be controlled by incorporating the following BMPs: minimal idling of engines, watering of soils to be disturbed, water and dust abatement applied to dirt roads, use of low volatility coatings, and other recognized controls.

6.6 WATER RESOURCES (INCLUDING SURFACE WATERS, GROUNDWATER, WETLANDS, FLOODPLAINS, AND WILD AND SCENIC RIVERS)

Mitigation measures that could be implemented to reduce and minimize impacts to water resources include the following:

- Checking construction equipment daily for leaks of petroleum products, fuels, coolants, hydraulic fluids
- Construction of on-site infrastructure to prevent downstream high water velocity erosion and to retain sediment
- Construction of vegetated infiltration swales and bio-retention cells (rain gardens) with native plantings

If a Department of the Army permit is authorized, it would be conditioned to require compensatory mitigation to offset the loss of function to waters of the U.S. resulting from the Proposed Action. Currently, SpaceX's compensatory mitigation plan proposes to preserve in-kind, high-quality wetlands at a ratio of five times the amount of wetlands impacted by the Proposed Action. The mitigation site would either be conveyed to a State or Federal natural resource agency or held by a third-party in a perpetual conservation easement.

6.7 BIOLOGICAL RESOURCES (FISH, WILDLIFE, AND PLANTS)

6.7.1 Special Conservation Measures

The following SCMs would be implemented as part of the Proposed Action to avoid and minimize the effects of proposed construction and operational activities associated with the vertical launch and control center areas on vegetation, including wetlands; wildlife, including birds protected under the MBTA; and special-status species.

6.7.1.1 Construction

1) In conjunction with final design, a Stormwater Pollution Prevention Plan (SWPPP) would be prepared. The SWPPP would include BMPs for erosion and sedimentation controls, including techniques to diffuse and slow the velocity of stormwater to reduce potential impacts (e.g., soil loss and sedimentation) to water quality during construction. All construction activities with the potential of impacting water quality due to potential runoff from the site would be conducted in accordance with SWPPP requirements. SpaceX would provide the Draft SWPPP to the USFWS for review and comment.
2) To the maximum extent practicable the following would be followed:
    a. The perimeter of all areas to be disturbed during construction or maintenance activities would be clearly demarcated using flagging or temporary construction fence, and no disturbance outside that perimeter would be authorized (in particular tidal flats and dunes). All access routes into and out of the proposed disturbance area would be flagged, and no construction travel outside those boundaries would be authorized. When available, areas already disturbed by past activities or those that would be used later in the construction period shall be used for staging, parking, and equipment storage.
    b. Construction speed limits would not exceed 35 miles per hour (mph) on major unpaved roads and 25 mph on all other unpaved roads. Night time travel speeds would not exceed 25 mph.
    c. Roads would be designed and located where roadbed erosion into federally listed species habitat is avoided or minimized and the potential for entrapment of surface flows within the roadbed due to grading would also be avoided or minimized.
    d. The depth of any pits created would be minimized so animals do not become trapped.
    e. Materials such as gravel or topsoil would be obtained from existing developed or previously used sources, not from undisturbed areas adjacent to the property.
    f. Drip pans underneath equipment, containment zones used when refueling vehicles or equipment, and other measures would be implemented.
    g. Non-hazardous waste materials, litter, and other discarded materials, such as construction waste, would be contained within secured containers until removed from the construction site. All trash containers would have secured closures to prevent animal foraging.
3) Prior to entry into the project area, all equipment would be cleaned to prevent importation of non-native plant species, and inspected to ensure that hydraulic fittings are tight, hydraulic hoses are in good condition and replaced if damaged, and there are no petroleum leaks.
4) No excavated or fill material would be placed in delineated CWA Section 404 waters of the U.S. except as authorized by a permit from the U.S. Army Corps of Engineers (USACE). Concrete mixing and placement activities would be conducted to ensure discharge water associated with these activities would not reach surrounding water bodies or pools unless specifically authorized in a CWA discharge permit.

5) SpaceX would designate a Field Contact Representative (FCR) that would be present during the beginning of the construction period to provide all construction personnel and SpaceX employees with an environmental worker-education briefing that would include but not be limited to the following:
    a. Information regarding endangered species with potential to occur in the area, impacts that may occur, conservation measures being implemented, their responsibilities under the Endangered Species Act, and avoidance and reporting procedures.
    b. Wildfire prevention measures would be implemented, including restricting smoking to areas clear of vegetation, ensuring no fires of any kind are ignited, and equipping vehicles with spark arrestors and fire extinguishers.
    c. The spread of noxious weeds would be limited by cleaning all equipment and vehicles at designated locations and by inspecting all vehicles to ensure absence of loose soil and plant debris before leaving the project areas.
    d. Requirements for safe handling and disposal of hazardous wastes would be implemented.
6) If proposed construction activities occur during the recognized avian breeding season (15 February through 31 August), construction would occur in accordance with the MBTA to avoid impacts to nesting migratory birds within the project area. Specifically, a biologist would check the proposed areas of construction activities, including laydown areas, for nests (in shrubs and on the ground) once before the construction phase has begun. If the biologist finds an active nest, construction workers would not directly or indirectly disturb the nest or adjacent areas until the biologist determines the nest is no longer in use.
7) To comply with the MBTA, project design and any above-ground utility upgrades within the control center area would incorporate raptor protection measures, as appropriate and applicable. For example, structures would be equipped with devices to discourage nest building and perching (e.g., monopole technology and visual fright devices).
8) SpaceX employees and construction personnel would be educated on the potential for vehicle collisions with wildlife, particularly ocelots and jaguarundis, and encouraged to reduce their speeds along State Highway 4 between the vertical launch and control center areas.
9) SpaceX would coordinate with the TxDOT regarding funding the installation of “Watch Out for Ocelots/Jaguarundis” or “Watch out for Wildlife” signs along State Highway 4. The number and placement of the signs would be determined by SpaceX coordinating with TxDOT and the USFWS.
10) SpaceX would coordinate with the TxDOT to maintain clear shoulders on road edges to allow drivers to more easily see wildlife, such as ocelots and jaguarundis, along the road edge and reduce incidents of vehicle/wildlife collisions.
11) SpaceX would designate an FCR who would be responsible for overseeing compliance with these conservation measures and any other required terms and conditions resulting from consultation between the FAA and USFWS. The FCR would have the authority to halt construction, operation, or maintenance activities that are in violation of these requirements.
12) A qualified biologist would conduct pre-construction monitoring for piping plovers, red knots, and aplomado falcons. Monitoring would be conducted within 1 mile of construction areas. The

monitoring would include presence/absence surveys and would record the number and location of all candidate and federally listed species observed, including the piping plover, red knot, and aplomado falcon, as well as all migratory birds. A monitoring report would be sent to the USFWS approximately 2 weeks following the survey.

13) Prior to construction, SpaceX will provide the USFWS with monitoring plans tracking potential induced vegetative changes as a result of proposed construction activities, fencing, security, stormwater discharge, and launch activities, including pre-, during, and post-construction presence/absence surveys of piping plovers, aplomado falcons, red knots, and migratory birds. The draft monitoring plans would be made available to the USFWS for review and final comment prior to construction.
14) Prior to construction and operational activities, a Draft Lighting Management Plan would be provided to the USFWS for review and comment. The Final Lighting Management Plan would be approved by the USFWS (and NPS; see Section 6.3, *Visual Resources and Light Emissions,* above) and implemented prior to construction activities to minimize overall lighting impact, including potential direct impacts and cumulative glow, on wildlife and adjacent sea turtle nesting beaches. Examples of lighting requirements that would be incorporated into the plan include:
    a. SpaceX would issue annual notices to all complex personnel prior to sea turtle nesting season reminding personnel of light use requirements and responsibilities.
    b. The USFWS may conduct on-site inspections coordinated with SpaceX to verify compliance and make recommendations for changes and revisions to the plan, limited to once per year.
    c. SpaceX would direct, shield, or position the lighting of facilities to the extent possible (without decreasing safety and security) to avoid visibility from the beach, minimizes lateral light spread, and decrease uplighting. Low-pressure sodium lighting would be used where possible.
    d. Where applicable, new lighting would be installed with multiple levels of control so that lighting levels can be matched with specific activities.
    e. Where lighting is not essential to safety or security, timers would be installed to switch lights off in the evening. Where applicable and not a threat to security, motion-detector switches may be installed.
    f. Should there be the need for additional local temporary lighting to support construction activities, the following requirements would be adhered to:
        - Whenever possible, lights shall be placed in such a way that they do not shine directly towards the beach. Additionally, to the maximum extent possible, no uplighting would be used.
        - Lighting would be extinguished upon completion of work in that area.
        - The size, type and number of exterior lights would be minimized and would be restricted to low pressure sodium, to the extent practicable, during sea turtle nesting season.
        - Fixtures would be shielded or screened whenever practical.
        - Lighting would be monitored on a routine basis by anyone utilizing the lights.

6.7.1.2 Operations

1) Educate the public on safe and lawful areas where they may watch launches.
2) SpaceX employees and contractors would be educated on the potential for vehicle collisions with wildlife, particularly ocelots and jaguarundis. SpaceX employees would then be mandated, with strict internal repercussions, to reduce their speeds along State Highway 4 between the proposed vertical launch and control center areas. Vehicles would be restricted to existing paved and dirt roads, parking areas, and authorized construction sites. Operators of vehicles within the vertical launch and control center areas would observe speed limits not to exceed 25 miles per hour.
3) As stated above in SCM 14, a Lighting Management Plan would be prepared prior to the start of construction activities. The Final Lighting Management Plan would be implemented as part of standard operational activities at the vertical launch area.
4) An FCR would conduct pre- and post-launch surveys for piping plovers, red knots, and aplomado falcons. Monitoring would be conducted within 1 mile of the vertical launch area the day before the launch and the day after the launch. The monitoring would include presence/absence surveys and would record the number and location of all candidate and federally listed species observed, including the piping plover, red knot, and aplomado falcon, as well as all migratory birds. A monitoring report would be sent to the USFWS approximately 2 weeks following the launch.
5) To the maximum extent possible, SpaceX would avoid launches at dusk and dawn during the most active time for jaguarundis and ocelots, and will avoid nighttime launches during sea turtle nesting season (March 15–October 1).

6.7.2 Mitigation Measures

In accordance with Section 7 of the ESA, formal consultation is ongoing between the USFWS and the FAA regarding potential impacts to ESA-listed species under the jurisdiction of the USFWS.

6.8 HAZARDOUS MATERIALS, POLLUTION PREVENTION, AND SOLID WASTE

Measures that would be implemented to reduce impacts of hazardous materials and solid waste include the following:

- Having spill response materials (e.g., sorbents, drain covers, mops, brooms, shovels, drum repair materials and tools, warning signs and tapes, and personal protective equipment) readily available for use in storage areas, during fueling, and during transport in the event of an unplanned release

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7.0 UNAVOIDABLE ADVERSE IMPACTS

CEQ regulations that implement the procedural requirements of NEPA require consideration of "any adverse environmental effects which cannot be avoided should the proposal be implemented" (40 CFR 1502.16). Unavoidable adverse impacts (also referred to as residual impacts) are the effects that would still remain after mitigation measures have been applied. In some cases, unavoidable adverse impacts occur because there is no reasonable or effective mitigation to reduce the impact. In other cases, mitigation is not expected to be effective enough to reduce the level of impact to a low or negligible level. The primary unavoidable adverse impacts on the environment resulting from implementation of the Proposed Action would be noise impacts from launch vehicle operations and the effects of the permanent facilities at the vertical launch and control center areas on visual resources, historic resources, and water resources.

Significant increases in noise from launch vehicle operations would result in an unavoidable adverse impact for Boca Chica Village residents. The FAA considered conventional environmental noise mitigation measures, but is not requiring them because they are not feasible or practical. For example, airport building sound insulation strategies, consisting of replacement acoustical windows and doors, have not been tested rigorously for application to launch noise. Therefore, no mitigation measures are described in Section 6.0, *Mitigation*.

The proposed vertical launch and control center areas would likely have a significant adverse impact on the visual resources of the ROI. Construction of the facilities at the vertical launch and control center areas would markedly contrast with the existing landscape. The buildings and structures would introduce new features into what is generally an open, undeveloped landscape. The boxy forms, straight lines, and smooth textures of the facilities would stand in strong contrast to the gently undulating, horizontal lines of the sand dunes and tidal flats that currently characterize the landscape. There would be less of a contrast between the buildings and features of the control center area with those of the Boca Chica Village. The daytime operations at the control center area would have no impact on the light emission in the area during the daylight hours. Nighttime launch operations would result in considerably higher levels of light emissions than those currently present from Boca Chica Village. There are several measures that would be taken to reduce the identified impacts to visual resources and light emissions. These measures are described in detail in Section 6.0, *Mitigation*.

Construction of the proposed vertical launch and control center areas would not directly impact any historic property. No significant archaeological resources were found during the pedestrian survey and shovel probing of the vertical launch area. Construction of the vertical launch and control center areas would indirectly impact the setting of the Palmito Ranch Battlefield NHL. Three historic properties in proximity to the vertical launch area (the Cypress Pilings, Palmetto Pilings, and Palmetto Pilings Historical Marker) could be impacted by vibrations from high noise levels, which could cause physical damage to structural features. The FAA, in consultation with THC and consulting parties, is developing a Memorandum of Agreement to mitigate the impacts to the integrity of the historic properties. Additional measures described in detail in Section 6.0, mitigation would reduce the identified effects to historic sites.

A total of 15.74 acres of upland habitat and 6.19 acres of wetland habitat would be removed as a result of the construction of proposed vertical launch and control center area facilities and infrastructure. Approximately 0.70 acre of critical habitat (unvegetated flats and depressional wetlands) for the threatened piping plover occur within the proposed project footprints for the vertical launch area and would be removed under the Proposed Action. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA to minimize the impacts to the piping plover. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS. Approximately 4.22 acres of floodplain Zone V10 would be filled in the proposed vertical launch area and approximately 4.37 acres of Zone A8 would be filled in the western portion of the vertical launch area. Based on the expected notable adverse impacts on the floodplain, the Proposed Action would result in significant floodplain encroachment per DOT Order 5650.2. Adverse impacts to surface water, groundwater resources, groundwater quality, and wetlands are expected to be less than significant with appropriate mitigation. Impacts to wetlands would be addressed during the permitting process and impacts to other water resources would be minimized through the use of an SWPPP and BMPs, which are described in detail in Section 6.0, *Mitigation*.

8.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

CEQ regulations that implement the procedural requirements of NEPA require consideration of “the relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). The activities addressed in this EIS that would be categorized as short-term include the construction of facilities at the vertical launch and control center areas. There would be minor short-term impacts to land use during launches since public access to Boca Chica State Park, Lower Rio Grande Valley NWR, and Brazos Island State Park would be closed for safety and security reasons. In addition, short-term increases in the noise levels received in the community from the proposed launch of the Falcon Heavy are anticipated to be significant in terms of Federal government limits for permissible noise exposure. Boca Chica Village falls under the DNL 65 dBA contour for Scenarios B and C (Exhibit 4.1-2). Both scenarios involve a nighttime launch: one nighttime launch of the Falcon 9 (Scenario B), and one nighttime launch of the Falcon Heavy (Scenario C). Under Scenario B, 13 households would be affected. Under Scenario C, 35 households would be affected. Therefore, noise impacts to Boca Chica Village would be considered significant during a nighttime launch of the Falcon 9 and Falcon Heavy only. However, the majority of launches would be conducted between the hours of 7:00 a.m. and 7:00 p.m., and only one nighttime launch per year is being proposed.

From a long-term perspective, the Proposed Action would fulfill the mission of the FAA/AST, which is to ensure protection of the public, property, and the national security and foreign policy interests of the U.S. during commercial launch and reentry activities and to encourage, facilitate, and promote commercial space transportation. Some long-term negative impacts of fulfilling this mission for the Proposed Action would be the permanent fill of wetlands and floodplains, changes to the viewshed, nighttime light emissions, traffic, and numbers of people in the vicinity. These changes would affect Boca Chica Village residents, the surrounding parks, cultural resources, and National Wildlife Refuges. However, as discussed in Section 6.0, *Mitigation*, measures would be implemented to reduce the impacts.

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9.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

CEQ regulations (40 CFR § 1502.16) require that an environmental consequences discussion in an EIS include identification of any irreversible or irretrievable commitments of resources that would be involved in the Proposed Action or reasonable alternative(s), should they be implemented. An irreversible or irretrievable commitment of resources refers to impacts on or losses to resources that cannot be recovered or reversed. Examples include permanent conversion of wetlands and loss of cultural resources, soils, wildlife, agricultural production, or socioeconomic conditions. The losses are permanent. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over long periods of time. Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. For example, if farm land is used for a non-agricultural event, some or all of the agricultural production from an area of farm land is lost irretrievably while the area is temporarily used for another purpose. The production lost is irretrievable, but the action is not irreversible.

The Proposed Action would involve irretrievable commitments of both nonrenewable and renewable resources. Fuel, construction materials, and labor would be expended during construction of facilities. Operating the new facilities would require energy to heat, cool, and light the buildings. Conducting maintenance activities and launch operations would also expend fuel, construction materials, and labor. Commitment of these resources would not be considered significant. The total amount of construction materials (e.g., concrete, insulation, wiring, etc.) required for the Proposed Action is relatively small when compared to the resources available in the region. The construction materials and energy required for facility development and operations are not in short supply. Moreover, the use of construction materials and energy is not anticipated to be excessive in terms of region-wide usage and would not have an adverse impact on the continued availability of these resources.

A total of 15.74 acres of upland habitat and 6.19 acres of wetland habitat would be removed as a result of the construction of proposed vertical launch and control center area facilities and infrastructure. Approximately 0.70 acre of critical habitat (unvegetated flats and depressional wetlands) for the threatened piping plover occur within the proposed project footprints for the vertical launch area and would be removed under the Proposed Action. In accordance with ESA Section 7, formal consultation is being conducted between the USFWS and the FAA to minimize the impacts to the piping plover. The conclusion of the consultation and associated Biological Opinion from the USFWS will be provided in the Final EIS. A total of approximately 8.59 acres in two different floodplain zones would be permanently filled for construction of the vertical launch area. Mitigation measures would be implemented to compensate for the loss of the wetlands through the permitting process (see Section 6.0, *Mitigation*). The Proposed Action would not result in the destruction of environmental resources such that the range of potential uses of the environment would be limited, nor impact the biodiversity of the region.

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Brownsville Public Library
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Brownsville, TX 78521

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Oliveira Library
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Alfredo Carranza

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Alma Rubio

Alma Walzer

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David Abrejo
David Belleperche
David Benn
David Cromwell
David Marquez
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Deborah Cox
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Doroteo Garcia Jr.
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Gastavo Ramson

Geoffrey Bogorad

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Gina Bouquet

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Guillermo Fernandez de Jauregui

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Harry Leggett

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Heidi Gomez

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Irlanda Benevidez

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Jackie Robinson

Jaime Solis

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Jeremy Barnard

Jim Holt

Jimmy Luo

Joe Boswell

Joette Van Doesburg

John Bruciak

John Foerster

John Gray

John Lopez

Jorge Alonso

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Jose Perez

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Kevin T. Doyle

Kyle Sloane

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Larry A. Brown

Larry Jokz

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Laura Robles

Laura Rosenbaun

Laura Tamez

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13.0 GLOSSARY OF TERMS

airspace	Airspace is the defined space above a nation, which is under its jurisdiction. Airspace is limited horizontally, vertically, and temporally, and is regulated by the FAA.
ambient air quality standards	Standards established on a State or Federal level, that define the limits for airborne concentration of designated “criteria” pollutants (nitrogen dioxide, sulfur dioxide, carbon monoxide, particulate matter, ozone, and lead), to protect public health and an adequate margin of safety (primary standards) and to protect public welfare, including plant and animal life, visibility, and materials (secondary standards).
aquifer	Underground layers of rock, sand or gravel that contain water.
archaeological site (resource)	Any location where humans have altered the terrain or discarded artifacts during either prehistoric or historic times.
attainment area	A region that meets the Environmental Protection Agency’s National Ambient Air Quality Standards for a criteria pollutant under the Clean Air Act.
C-weighted sound level (dBA)	A number representing the sound level that is frequency weighted according to a prescribed frequency response established by the American National Standards Institute and accounts for the response of the human ear for low frequency sounds.
criteria pollutant	A pollutant determined to be hazardous to human health and regulated under the Environmental Protection Agency’s National Ambient Air Quality Standards. The 1970 amendments to the Clean Air Act require the EPA to describe the health and welfare impacts of a pollutant as the “criteria” for inclusion in the regulatory regime.
cultural resources	Archaeological materials (artifacts) and sites that date to the prehistoric and historic periods and that are currently located on the ground surface or buried beneath it; standing structures or their component parts that are over 50 years in age; and cultural and natural places, select natural resources, and sacred objects that have importance for Native Americans.
cumulative impacts	The combined impacts resulting from all activities occurring concurrently at a given time.
day night level (DNL)	The average sound level over an entire day with 10 dB added between 10 pm and 7 am to account for the increased annoyance caused by noise during these hours.
decibels (dB)	A unit for describing the ratio of two powers or intensities, or the ratio of a power to a reference power. In measurement of sound intensity, the pressure of the reference is usually taken as 20 micropascals (µPA).
dry dress rehearsal	A mission rehearsal without propellants on board
endangered species	A plant or animal that is in danger of extinction throughout all or a significant portion of its range.

Environmental Justice	No group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, State, local, and tribal programs and policies. Executive Order 12898 directs Federal agencies to make achieving environmental justice part of their missions.
experimental permit	"An experimental permit authorizes launch or reentry of a reusable suborbital rocket (14 CFR 437.7). The FAA will issue an experimental permit for (1) research and development to test new design concepts, new equipment, or new operating techniques; (2) showing compliance with requirements for obtaining a license; or (3) crew training before obtaining a license for a launch or reentry using the design of a rocket for which the permit would be issued." (14 CFR 437.5)
hazardous waste	A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, a waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in 40 CFR 261.20 through 40 CFR 261.24 (i.e., ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the Environmental Protection Agency in 40 CFR 261.31 through 40 CFR 261.33.
historic resources	Archaeological sites, architectural structures, and objects produced after the advent of written history, dating to the time of the first Euro-American contact in an area.
hypergolic	Igniting spontaneously upon contact with a complementary substance (especially of rocket-fuel propellant constituents).
impacts	An assessment of the meaning of changes in all attributes being studied for a given resource, an aggregation of all of the adverse effects, usually measured using a qualitative and nominally subjective technique.
ionosphere	The part of the Earth's upper atmosphere which is sufficiently ionized by solar UV radiation so that the concentration of free electrons affects the propagation of radio waves; its base is at approximately 70 or 80 kilometers and it extends to an indefinite height.
land use	Land use refers to the current or proposed use or classification of land tracts for economic production; for residential, recreational or other purposes; and for natural or cultural resource protections.
launch	To place or try to place a launch vehicle or reentry vehicle and any payload from Earth – (a) in a suborbital trajectory; (b) in Earth orbit in outer space; or (c) otherwise in outer space, including activities involved in the preparation of a launch vehicle or payload for launch, when those activities take place at a launch site in the United States.
launch campaign	Preparation for and conducting of a launch event.
launch operator	A person who conducts or will conduct the launch of a launch vehicle and any payload.

launch operator license	"A launch operator license authorizes a licensee to conduct launches from on launch site, within a range of launch parameters, of LVs from the same family of vehicles transporting specified classes of payloads. A launch operator license remains in effect for 5 years from the date of issuance." (14 CFR 415.3[b])
launch site	The location on Earth from which a launch takes place as defined in a license the FAA issues or transfers and necessary facilities at that location.
launch-specific license	"A launch-specific license authorizes a licensee to conduct one or more launches, having the same launch parameters, of one type of LV from one launch site. The license identifies, by name or mission, each launch authorized under the license. A licensee's authorization to launch terminates upon completion of all launches authorized by the licensee or the expiration date stated in the license, whichever occurs first." (14 CFR 415.3[a])
mesosphere	The atmospheric shell between about 45-55 kilometers and 80-85 kilometers, extending from the top of the atmosphere to the mesopause; characterized by a temperature that generally decreases with altitude.
monomethylhydrazine	Monomethylhydrazine is a volatile hydrazine compound that is a component of rocket fuel.
National Register of Historic Places	The official list of the Nation's cultural resources that are worthy of preservation. The National Park Service maintains the list. Buildings, structures, objects, sites, and districts are included in the National Register for their importance in American history, architecture, archaeology, culture, or engineering. Listed properties can be significant at the national, State, or local level.
noise	Sound that is unwanted either because of its effect on humans, its effect on fatigue or malfunction of physical equipment, or its interference with the perception or detection of other sounds.
oxidizer	A substance such as chlorate, perchlorate, permanganate, peroxide, nitrate, oxide, or the like that yields oxygen readily to support the combustion of organic matter, powdered metals, and other flammable material.
ozone	The tri-atomic form of oxygen, comprising approximately one part in three million of all of the gases in the atmosphere. Ozone is the primary atmospheric absorber of UV-B radiation.
payload	The material carried by a vehicle over and above what is necessary for its operation.
propellants	Balanced mixture of fuels and oxidizers designed to produce large volumes of hot gases at controlled, predetermined rates, once the burning reaction is initiated.
Pounds per square foot	A unit of pressure equal to the pressure resulting from a force of 1 pound applied uniformly over an area of 1 square foot. The sonic boom overpressure is measured in pounds per square foot.

public	People or property that are not involved in supporting a licenses launch; includes those people or property that may be located within the boundary of a launch site, such as visitors, any individual providing goods or services not related to launch processing of flight, and any other launch operator and its personnel.
region of influence	A geographic area within which the principal direct and indirect effects of actions are likely to occur.
Section 4(f) properties	Section 4(f) properties are a special class of public lands or resources whose use by agencies in the Department of Transportation is restricted unless no feasible and prudent alternative exists. Section 4(f) properties include publicly owned parks, recreational areas, wildlife or waterfowl refuges, or cultural resources that are listed on or are eligible for listing on the National Register of Historic Places (RHP).
socioeconomics	The basic attributes and resources associated with the human environment, in particular population and economic activity. Socioeconomic resources consist of several primary elements including population, employment, and income. Other socioeconomic aspects that are often described may include housing, community services, and the local economy.
soil	Unconsolidated mineral or organic surface material that serves as a natural medium for the growth of plants. Soil is composed of minerals, organic matter, water, and air. Soil and sediments are typically described in terms of their composition, slope, and physical characteristics. Differences among soil types potentially affect their ability to support or sustain agriculture, filtration, and natural detoxification processes.
soil quality	Soil quality refers to organic matter content, nutrient and water-holding capacity, soil tilth (the physical condition of the soil with respect to its fitness for the growth of a specific crop), structure, and internal drainage.
stratosphere	The layer of the Earth's atmosphere 20 to 50 kilometers above the surface, where ozone forms.
suborbital rocket	A rocket-propelled vehicle intended for flight on a suborbital trajectory whose thrust is greater than its lift for the majority of the powered portion of its flight.
sonic boom	Sound, resembling an explosion, produced when a shock wave formed by the noise of an aircraft or launch vehicle traveling at supersonic speed reaches the ground.
storativity	The volume of water released from storage per unit decline in hydraulic head in the aquifer, per unit area of the aquifer
telemetry	Automatic data measurements and transmission from remote sources, such as space vehicles, to receiving stations for recording and analysis.
threatened species	Plant and wildlife species likely to become endangered in the foreseeable future.
trajectory	The path described by an object moving through space.
transmissivity	The rate which groundwater flows horizontally through an aquifer

troposphere	The portion of the atmosphere from the Earth's surface to the tropopause, that is, the lowest 10 to 20 kilometers of the atmosphere.
unsymmetrical dimethyl hydrazine	Unsymmetrical dimethyl hydrazine is a chemical compound often used in hypergolic rocket fuels as a bipropellant in combination with the oxidizer nitrogen tetroxide or liquid oxygen.
viewpoint	In visual resource management, a point from which the scenic values are observed or likely to be observed.
viewshed	The area visible from a particular point of view.
visual resources	The aesthetic qualities of natural landscapes and modifications to them, the perceptions and concerns of people for landscapes and landscape change, and the physical or visual relationships that influence the visibility of proposed landscape changes.
wet dress rehearsal	A mission rehearsal with propellants on the vehicle.

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14.0 INDEX

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