DRAFT

Environmental Assessment

Issuance of Right-of-Way Permit

Praxair Dual Pipeline System Project
4.3-Mile Segment

Brazoria National Wildlife Refuge

Brazoria County, TX 77515

November 2, 2015

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List of Abbreviations and Acronyms

AMS	American Meteorological Society
APE	Area of Potential Effect
AQRV	Air Quality Related Values
ATV	All Terrain Vehicle
BGEPA	Bald and Golden Eagle Protection Act
CAA	Clean Air Act
CCP	Comprehensive Conservation Plan
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CR	County Road
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dBA	A-Weighted Decibel
DHHS	Department of Health and Human Services
EA	Environmental Assessment
EO	[TXNDD] Element Occurrence
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
ft	Feet
GIS	Geographic Information System

GLO	Texas General Land Office
HDD	Horizontal Directional Drill
in	Inch
MBTA	Migratory Bird Treaty Act
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NOI	Notice of Intent
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NSR	New Source Review
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
NO_2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
NWRS	National Wildlife Refuge System
O_3	Ozone
Pb	Lead
PHMSA	Pipeline and Hazardous Materials Safety Administration
PM	Particulate Matter
Praxair	Praxair, Inc.
PSD	Prevention of Significant Deterioration
Refuge	Brazoria National Wildlife Refuge
ROW	Right of Way
§	Section
Service	U.S. Fish and Wildlife Service
SO_2	Sulfur Dioxide
SUP	Special Use Permit
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
THC	Texas Historical Commission
TWS	Temporary Workspace

TXNDD	Texas Natural Diversity Database
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S Department of Agriculture
USDOE	U.S. Department of Energy
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTV	Utility Terrain Vehicle
WGM	Wood Group Mustang, Inc.
WOUS	Waters of the United States

Section 1 Project Overview

1.1 Introduction

The United States Fish and Wildlife Service (Service, USFWS), is considering the issuance of a right-of-way (ROW) permit to Praxair, Inc. (Praxair) to install, own and operate two pipelines within an existing, maintained pipeline corridor crossing the Brazoria National Wildlife Refuge (Brazoria NWR or Refuge). If approved, this request for a 30-year term ROW permit and Special Use Permit (SUP) would be processed in accordance with 50 CFR § 29.21. The proposed Praxair Dual Pipeline System (Dual Pipeline) project involves construction of one 24-inch (24") carbon steel pipeline for the purpose of transporting Nitrogen and one 14-inch (14") carbon steel pipeline for transporting Hydrogen through approximately 4.3 miles of the Refuge in order to deliver these products to Praxair's commercial customers in the Freeport industrial area. The proposed Dual Pipeline project involves construction of these two pipelines simultaneously utilizing conventional open-cut, guided bores, horizontal directional drilling (HDD), and pipe-push construction methods. This Environmental Assessment (EA) is being prepared to evaluate the effects associated with this proposal and complies with the National Environmental Policy Act (NEPA) in accordance with Council on Environmental Quality regulations (40 CFR 1500-1509) and Department of the Interior (516 DM 8) and Service (550 FW 3) policies (see Section 1.7 for a list of additional regulations that this EA complies with). NEPA requires examination of the effects of proposed actions on the natural and human environment. In the following chapters, two alternatives are described and environmental consequences of each alternative are analyzed.

1.2 Location

The Brazoria NWR is one of three Gulf Coast refuges comprising the Texas Mid-coast NWR Complex (Complex). The Complex includes the Brazoria, San Bernard, and Big Boggy NWRs, located in Brazoria, Fort Bend, and Matagorda Counties, Texas. The Brazoria NWR is located in southeastern Brazoria County (**Exhibit 1**).

1.3 Background

The Brazoria NWR was established in 1966 to provide wintering habitat for migratory birds as well as to preserve and enhance coastal habitats on the Texas Gulf Coast. The Refuge encompasses 44,413 acres and hosts a diverse mix of fresh and saltwater marsh, brackish sloughs, ponds, wooded thickets, coastal prairie, and active agricultural lands, which includes the largest contiguous salt marsh and coastal prairie habitats and managed fresh water wetlands on the Texas Mid-coast Refuges Complex.

The goals established in the Complex's Comprehensive Conservation Plan, September 2013, include the following:

- To implement conservation efforts and foster the ecological integrity of the Gulf Coast Prairies and Marshes Ecoregion through proven and innovative restoration, enhancement, and management practices across the Complex to preserve essential habitats for migratory birds and resident wildlife.
- To conserve, restore, enhance, and protect Complex habitats by implementing appropriate management programs to benefit native flora and fauna, including threatened and endangered species and other species of concern.

- To protect, maintain, and enhance populations of migratory birds and resident fish and wildlife, including federal and state threatened and endangered species.
- To develop and implement quality wildlife-dependent recreation programs that are compatible with each refuge's purposes and foster enjoyment and understanding of the Complex's unique wildlife and plant communities.
- To provide administrative and public use facilities needed to carry out each refuge's purposes and meet management objectives.

The proposed Dual Pipeline project is routed through the Brazoria NWR and lies within an existing and maintained 300-ft wide pipeline corridor containing 21 pipelines. The Service accepted the land with the outstanding ROW easements in place. Since it was acquired, two additional pipelines have been added to the corridor without expanding the width of the ROW corridor. Current/ongoing activity on the corridor includes regular mowing, repainting markers, gauge reading, and integrity testing.Irregular pipe maintenance or replacement may also occur over time.

The Dual Pipeline project would be constructed between an existing 40-in Department of Energy pipeline operated by Exxon Mobil Pipeline and an 8-in Buckeye pipeline, located in the eastern half of the existing pipeline corridor. If approved, the proposed pipelines would be installed concurrently beginning at FM 2004 and crossing under CR 208 to a valve station west of CR 208. The Dual Pipeline project continues southwest across the Refuge and across Austin Bayou (**Exhibit 2)**.

Praxair initially approached the refuge about the potential ROW permit in October 2013, requesting access to the pipeline to survey the existing infrastructure and determine a possible route for the duel pipeline project. Since that time, there have been a number of planning meetings and site visits between Praxair, Wood Group Mustang (WGM), and USFWS staff. These meetings and visits to the proposed project area identified construction constraints within the Refuge as well as special conditions that would be required to minimize potential impacts to refuge resources if the proposed project is found to be an appropriate and compatible use and the ROW permit is approved. As a result of these discussions, Praxair and WGM prepared the proposed *Construction Plan for Crossing the Brazoria National Wildlife Refuge (BNWR) from FM 2004 to Austin Bayou* (Construction Plan). Refuge Staff reviewed this proposed construction plan and it is consistent with early planning meetings. In addition, Praxair and WGM were informed of the requirements for a ROW permit application on land in the NWRS, per 50 CFR § 29.21. These requirements include; "a detailed environmental analysis which shall include information concerning the impact of the proposed use on the environment including the impact on air and water quality; scenic and esthetic features; historic, architectural, archeological, and cultural features; wildlife, fish and marine life, etc. The analysis shall include sufficient data so as to enable the Service to prepare an environmental assessment and/or impact statement in accordance with section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) and comply with the requirements of the National Historic Preservation Act of 1966 (16 U.S.C. 470 et seq.), the Archeological and Historic Preservation Act of 1974 (16 U.S.C. 469 et seq.), Executive Order 11593 "Protection and Enhancement of the Cultural Environment" of May 13, 1971 (36 FR 8921), and "Procedures for the Protection of Historic and Cultural Properties" (36 CFR, part 800)."

The following information was provided by Praxair/WGM and has been used in the development of this EA (and is available upon request).

- A delineation of aquatic resources was completed in April 2012) following the protocol outlined by the Corps of Engineers Wetlands Delineation Manual (Environmental

Laboratory 1987) and Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region, Version 2.0 (USACE 2010). A total of 30.2 acres of aquatic resources were mapped within the delineation survey area.

- A survey for threatened and endangered species was completed in April 2012 and updated in 2015.No threatened or endangered species or designated critical habitats were observed for the proposed project area. Construction of the Dual Pipeline project is not expected to affect listed species.

- A cultural resource survey was completed in the fall of 2014. Correspondence with the THC confirmed that no survey was necessary for the Dual Pipeline project and a Letter of Concurrence was received from the THC on August 8, 2014.

1.4 Purpose of Action

The purpose of the proposed action is to provide Praxair access to an existing pipeline corridor that crosses the Brazoria NWR; this 300 ft wide pipeline corridor pre-dates the establishment of the refuge. The purpose of Praxair's Dual Pipeline project is to transport hydrogen and nitrogen from their facility in Texas City to commercial customers in the Freeport industrial area. The project include all new construction. Pipelines have proven to provide the safest and most efficient method of transporting products such as these. The Dual Pipeline project consists of a 24" nitrogen pipeline and a 14" hydrogen pipeline that will cross the Brazoria NWR in order to deliver these products to Praxair's commercial customers in the Freeport industrial area (Alternative A). The 24-in nitrogen pipeline is a non-regulated, intra-state pipeline; the 14-in hydrogen pipeline is a Pipeline and Hazardous Materials Safety Administration (PHMSA) regulated interstate pipeline.

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1.5 Need for Action

The need for the proposed action is to respond to a right-of-way permit request submitted by Praxair to install, own and operate two pipelines within an existing, maintained pipeline corridor crossing the Brazoria NWR. This request is being considered because it is within a previously disturbed and maintained existing ROW corridor and alternative route(s) would require the establishment of a new ROW on the landscape, which would further disturb and fragment habitat. The refuge, working with Praxair and Wood Group Mustang (WGM) have agreed upon a combination of best management practices for actual installation to reduce environmental impacts along the refuge segment of pipeline. This EA will inform the compatibility determination and appropriate use evaluation process, with these methods, and the Service's final decision regarding the ROW permit application.

1.6 Decision to be Made

The Project Leader and/or Refuge Manager must decide whether to issue the proposed ROW permit for the Dual Pipeline Project or deny the permit application. This EA is an evaluation of the environmental impacts of the alternatives and provides information to help the Service fully consider these impacts and assess proposed compensatory mitigation. Using the analysis in this

EA, the Service will decide whether there would be any significant effects associated with the alternatives that would require the preparation of an environmental impact statement (EIS) or to issue a Finding of No Significant Impact (FONSI) under 42 USC § 4332 and proceed the Proposed Action Alternative (Alternative A), and allow Praxair's application for a ROW Permit and SUP to move forward in the approval process.

1.7 Regulatory Compliance

National wildlife refuges are guided by the mission and goals of the NWRS, the purposes of an individual refuge, USFWS policy, and laws and international treaties. Relevant guidance includes the NWRS Administration Act of 1966, as amended by the NWRS Improvement Act of 1997 (Public Law 105-57), Refuge Recreation Act of 1962 (16 U.S.C. 460k-460k-4), and selected portions of the Code of Federal Regulations and USFWS Manual.

The mission of the Refuge System is:
"... to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (NWRS Improvement Act of 1997, Public Law 105-57).

The lands within the NWRS were selected for their high biological value as fish and wildlife habitat as well as their ecological value for the services they provide within the larger ecosystem. The NWRS Improvement Act of 1997 provides guidelines and directives for the administration and management of all areas in the NWRS. It states that national wildlife refuges must be protected from incompatible or harmful human activities to ensure that Americans can enjoy Refuge System lands and waters. Executive Order No. 12996, 25 March 1996, 61 F.R. 13647 provided four guiding principles for the management and general use of the Refuge System, including the principle that "fish and wildlife will not prosper without high-quality habitat, and without fish and wildlife, traditional uses of refuges cannot be sustained. The Refuge System will continue to conserve and enhance the quality and diversity of fish and wildlife habitat within refuges." The Secretary of the Interior, in carrying out his/her trustee and stewardship responsibilities for the Refuge System is directed to, among other things, "ensure that the ecological integrity of the National Wildlife Refuge System is maintained for present and future generations of Americans."

This EA represents compliance with applicable federal statutes, regulations, Executive Orders, and other compliance documents, including the following:

- Administrative Procedures Act (5 U.S.C. 551-559, 701-706, and 801-808) as amended
- American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)
- Antiquities Act of 1906 (16 U.S.C. 431-433
- Archaeological Resources Protection Act of 1979 (16 U.S.C. 470)
- Bald Eagle Protection Act (16 U.S.C. 668-668d) as amended
- Clean Air Act of 1972, as amended (42 U.S.C. 7401 *et seq.*)
- Clean Water Act of 1972, as amended (33 U.S.C. 1251 *et seq.*)
- Endangered Species Act of 1973, (ESA) as amended (16 U.S.C. 1531 *et seq.*)
- Executive Order 12898, Federal Action Alternatives to Address Environmental Justice in Minority Populations and Low Income Populations, 1994.
- Executive Order 13112, Invasive Species (issued in February 1999)
- Fish and Wildlife Coordination Act of 1958, as amended (16 U.S.C. 661 *et seq.*)

- Fish and Wildlife Improvement Act of 1978 (16 U.S.C. 7421)
- Floodplain Management (Executive Order 11988)
- Migratory Bird Treaty Act (16 U.S.C. 703-712 as amended
- National Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee) as amended
- National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 *et seq.*)
- Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500 *et seq.*)
- National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 *et seq.*)
- Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 *et seq.*)
- Protection and Enhancement of the Cultural Environment (Executive Order 11593)
- Protection of Wetlands (Executive Order 11990)
- National Pollutant Discharge Elimination System, as amended (33 U.S.C. 1251 *et seq.*)
- Soil and Water Conservation Act of 1977 (16 U.S.C. 2001-2009) as amended

Further, this EA reflects compliance with applicable State of Texas and local regulations, statutes, policies, and standards for conserving the environment and environmental resources such as water and air quality, endangered plants and animals, and cultural resources.

1.7.1 Appropriate Refuge Uses

As stated in the objectives of the Appropriate Refuge Uses policy (603 FW 1): "Refuges are first and foremost national treasures for the conservation of wildlife. Through careful planning, consistent Refuge System-wide application of regulations and policies, diligent monitoring of the impacts of uses on wildlife resources, and preventing or eliminating uses not appropriate to the Refuge System, we can achieve the Refuge System conservation mission while also providing the public with lasting opportunities to enjoy quality, compatible, wildlife-dependent recreation. Through consistent application of this policy and these procedures, we will establish an administrative record and build public understanding and consensus on the types of public uses that are legitimate and appropriate within the Refuge System."

All proposed and existing uses of a national wildlife refuge over which the Service has jurisdiction must be determined as appropriate under the Appropriate Refuge Uses policy. If an existing use is not appropriate, the refuge manager will deny the use without determining compatibility. An appropriate use of a national wildlife refuge is a proposed or existing use that meets at least one of the four following conditions:

- The use is a wildlife-dependent recreational use as identified in the Refuge System Improvement Act (i.e., hunting, fishing, wildlife observation and photography, and environmental education and interpretation);
- The use contributes to fulfilling the refuge purposes, the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Refuge Improvement Act was signed into law;
- The use involves the take of fish and wildlife under state regulations;
- The refuge manager has evaluated the use following guidelines in the Service Manual 603 FW 1.11 and found it appropriate.

Rights-of-way are considered Specialized Uses of a national wildlife refuge, which require specific authorization from the Refuge System, in the form of a special use permit, letter of

authorization, or other permit document. These uses do not include uses already granted by a prior existing right. The Service makes appropriateness findings for specialized uses on a case-by-case basis. Detailed policy on rights-of-way can be found in 340 FW 3 (Rights-of-way and Road Closings) and 603 FW 2 (Compatibility).

1.7.2 Compatibility

Federal laws, regulations, and policies governing management of the NWRS require the Refuge Manager and Regional Chief to signify that any proposed or existing use of a national wildlife refuge is or is not a compatible use through a written compatibility determination. A compatible use is one that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the NWRS mission or the primary purposes for which the national wildlife refuge was established. FWS Policy, Part 603 FW 2, provides policy for determining compatibility of proposed and existing uses of lands in the NWRS. This policy states, "The Refuge Manager will not initiate or permit a new use of a national wildlife refuge or expand, renew, or extend an existing use of a national wildlife refuge unless the refuge manager has determined that the use is a compatible use." Further, "uses that we reasonably may anticipate to conflict with pursuing this directive to maintain the ecological integrity of the System are contrary to fulfilling the National Wildlife Refuge System mission and are therefore not compatible. Fragmentation of the National Wildlife Refuge System's wildlife habitats is a direct threat to the integrity of the National Wildlife Refuge System, both today and in the decades ahead. Uses that we reasonably may anticipate to reduce the quality or quantity or fragment habitats on a national wildlife refuge will not be compatible…Wildlife disturbance that is very limited in scope or duration may not result in interference with fulfilling the mission of the NWRS or refuge purposes. However, even unintentional minor harassment or disturbance during critical biological times, in critical locations, or repeated over time may exceed the compatibility threshold."

According to Compatibility policy, "the Refuge Manager must consider not only the direct impacts of a use but also the indirect impacts associated with the use and the cumulative impacts of the use when conducted in conjunction with other existing or planned uses of the refuge, and uses of adjacent lands or waters that may exacerbate the effects of a refuge use." Uses such as expansion or realignment of an existing right-of-way that will affect a unit of the NWRS are generally found to be not compatible and are denied. However, only in the case of existing rights-of-way, the use can be made compatible through replacement of lost habitat values or other compensatory mitigation. The request must adopt measures to avoid resource impacts and include provisions to ensure no net loss of habitat quantity and quality. Replacement of lost habitat values may be accomplished using compensatory mitigation for restoration or conservation of additional lands in the NWRS.

1.7.3 National Environmental Policy Act (NEPA)

The decision to issue or deny the ROW permit request and subsequent SUP by USFWS for the Dual Pipeline project is a federal action subject to NEPA (40 CFR 1500-1509).

In complying with NEPA, the potential impacts of the federal action are often first examined by a federal agency through preparation of an EA. This EA is prepared to satisfy the obligations of the USFWS under NEPA, and to comply with regulations implementing NEPA that have been adopted by the CEQ (1997).

1.7.4 Endangered Species Act (ESA)

The USFWS is responsible for ensuring compliance with the ESA for all freshwater aquatic and terrestrial plants and animals. The ESA, through USFWS, affords protection to the nation's listed threatened and endangered species. Interagency consultation procedures under Section 7 and intra-agency consultation procedures under Section 10 of the ESA will be satisfied through the regional Ecological Services field office of the USFWS.

1.7.5 Coastal Zone Management Act

The CZMA of 1972 (16 U.S. C. 1451) administered by NOAA, provides for the management of the nation's coastal resources. The goal is to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." In Texas, the CZMA is administered by the Texas GLO.

Alternative A and Alternative B are located within the coastal management zone (**Exhibit 3)** but do not involve the placement, erection or removal of materials, and is not an increase in the intensity of use in the coastal zone.

1.7.6 Floodplain Management

Executive order 11988 (1977) established policy for avoidance, "to the extent possible, of the long and short term impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative." Praxair and USFWS have coordinated to minimize impacts to the floodplain within Brazoria NWR. Section 3.12 (Land Use) of this EA and attached construction plans (**Appendix A**) detail methods for minimization of floodplain impacts.

1.7.7 Executive Order 11990, Protection of Wetlands

Executive order 11990 (1977) established policy for protection of federally-owned wetlands "to minimize the destruction, loss or degradation of wetlands." Praxair and USFWS have coordinated to minimize impacts to wetlands and other habitats on the Refuge. Section 2 of this EA describes aquatic resources, and construction methods used to minimize impacts to wetlands.

1.7.8 Migratory Bird Treaty Act (MBTA) and Bald and Golden Eagle Protection Act (BGEPA)

Bald eagles were removed from the threatened and endangered species list in 2007. Bald eagles are state listed as threatened and are afforded protection under the MBTA and BGEPA. There is potential for the presence of migratory birds protected under the MBTA within the existing ROW. USFWS is responsible for the implementation of the provisions of the MBTA (16 U.S.C. § 703) and BGEPA (16 U.S.C. § 668).

1.7.9 Clean Water Act Section 404

The CWA (1977) is an amendment to the Federal Water Pollution Control Act of 1972, which lays the framework for regulating discharges of pollutants into waters of the United States. The USACE and EPA have the final authority in determining if waters of the U.S. are present and the limits of any waters of the U.S.

Under Section 404 of the CWA, the USACE regulates the discharge of dredged or fill material into non-navigable waters of the U.S., including wetlands. Activities that discharge dredge or fill material or include mechanized land clearing, grading, leveling, ditching, structural discharges, and redistribution of material in a water of the U.S. require a Section 404 permit from the USACE. Applicants for Section 404 permits must demonstrate that they have avoided or minimized adverse effects to the extent practicable.

A wetland delineation of the project area determined that segments of the proposed Dual Pipeline project are located in jurisdictional wetlands that require USACE 404 permitting. Praxair submitted a request to the USACE Galveston District on January 15, 2015, for a Nationwide Permit Verification and Regional General Permit. The Corps approved this request under Permit No. SWG-2014-00796 in a letter dated January 29, 2015. Construction of the Dual Pipeline project was verified by Nationwide Permit (NWP) 12 pursuant to Section 404 of the CWA and Section 10 of the Rivers and Harbors Act of 1899. Nationwide Permit 12 authorizes activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in waters of the United States, provided the activity does not result in the loss of greater than ½-acre of waters of the United States for each single and complete project. The horizontal directional drills (HDD) for the proposed Dual Pipeline System were authorized by Regional General Permit (RGP) SWG-1998-02413 pursuant to Section 10 of the Rivers and Harbors Act of 1899.

1.7.10 National Historic Preservation Act (NHPA)

Section 106 of the NHPA 1996, and regulations associated with 38 CFR §800, require federal agencies to take into account the effect certain projects may have on cultural resource sites, historic districts, buildings, structures, or objects that are included in, or eligible for inclusion in, the NRHP. Criteria for inclusion on the NRHP is located in 36 CFR §60.4(a-d) and is defined as "a resource that possesses qualities of significance in American history, architecture, archaeology, engineering and culture as well as objects that possess integrity of location, design, setting, materials, workmanship or feeling and association."

Pursuant to regulations established by NHPA, the federal action agency, in consultation with the THC as the jurisdictional state historic preservation office, must determine the APE with respect to the proposed project. The federal agency must review, seek, and gather information about historic properties within the vicinity; and based on the information reviewed, identify any historic properties within the APE. These historic properties are defined by 36 CFR §800.16[1][1] as "any prehistoric district, site, building, structure, or object included in or eligible for inclusion in the NRHP maintained by the Secretary of the Interior."

1.7.11 Executive Order 11593 Protection and Enhancement of the Cultural Environment

Issued on May 13, 1971, Executive Order 11593 further enhances the purposes of NEPA and the NHPA. The order provides clarification with regard to the federal government's policy toward cultural resources, and guidance for the responsibilities of federal agencies and the Secretary of the Interior as they exist within the NEPA and NHPA frameworks.

1.8 Scoping and Public Involvement

1.8.1 Notice of Intent and Public Involvement

On June 16, 2015, the Service published in the Federal Register a Notice of Intent (NOI) to prepare an EA or an EIS for the proposed Praxair Dual Pipeline Project crossing the Brazoria NWR. That NOI and request for comments on environmental issues established a 30-day scoping period from June 16, 2015 to July 16, 2015. The Service sent out emails to potential interested parties announcing the public comment period for the scoping process in development of this EA. During the scoping period the Service received response letters with comments from two non-profit organizations and one other federal agency that were considered as part of this analysis.

1.8.2 Connected Actions

The 49 mile duel pipeline project from Texas City to Freeport provides hydrogen and nitrogen to Praxair's commercial customers. As proposed, the pipelines are completely within an existing ROW corridor. Both elements are required for the production of ammonia. Nitrogen is produced in Praxair's existing air separation facilities in Texas City. The 24-in nitrogen pipeline is a non-regulated, intra-state pipeline. Nitrogen is a nonflammable inert gas and generally transported by truck or pipeline. Hydrogen will be produced at Praxair's new facility near Lake Charles, LA which takes H2-rich waste gas (that is usually burned off as fuel or flared) and purifies it to 99.9% H2. The new H2 pipeline will tie to an existing pipeline between Lake Charles and Texas City. H2 may also be produced from natural gas and steam located along the existing pipeline. The 14-in hydrogen pipeline is a Pipeline and Hazardous Materials Safety Administration (PHMSA) regulated interstate pipeline. Hydrogen is a flammable nontoxic gas and dissipates quickly in open air. Hydrogen is generally transported by truck or pipeline. The duel pipeline project enables Praxair to avoid unnecessary flaring and waste and optimize production so as to operate more efficiently and reduce energy use. Construction of the pipelines leverage existing production infrastructure as opposed to building additional production facilities in the Freeport industrial area. The pipelines will be monitored 24/7 from Praxair's Gulf Coast Pipeline Operations Center in the Woodlands, and will be maintained according to all federal requirements.

1.8.3 Issues Identified During Project Planning and Scoping

Three letters were received during the open comment period provided in the NOI. The comments/ issues identified by interested parties are summarized below. *The Service response is provided in italics after the comment.*

1. **Statement of Purpose and Need**: The purpose and need should be a clear, objective statement of the rationale for the proposed Federal action. *See section 1.4 and 1.5 of this EA.*
2. **Appropriate Refuge Uses and Compatibility**: Construction of two new pipelines in Brazoria NWR is subject to the Appropriate Use and Compatibility Determination process. Permitting an additional pipeline is not an appropriate refuge use, nor is it compatible with the purposes for which the refuge was established. In order to find a proposed use of this magnitude compatible, Praxair would need to provide substantial compensatory mitigation. *See section 4.11 for additional information on mitigation.*
3. **Alternatives Analysis**: The EA should describe; the methodology and criteria used for determining project siting, how each alternative was developed, how it addresses each

project objective, and how it will be implemented. The alternatives analysis should include a discussion of alternatives and clearly describe the rationale used to determine whether impacts of an alternative are significant or not. Thresholds of significance should be determined by considering the context and intensity of an action and its effects (40 CFR 1508.27). Alternative A, (proposed action) is completely within the existing ROW. Alternative B is the shortest route around the refuge leaving lthe existing corridor at the north side of the refuge and returning lto the corridor at the west side of the corridor. This route would construct the least amount of new ROW and minimize the impact on the landscape.

4. **Direct, Indirect, and Cumulative Impacts**: The EA should include a comprehensive assessment of the direct, indirect, and cumulative impacts of the proposed action and alternatives to the environment (i.e. resources, ecosystem, and communities) in the vicinity of the project area, as well as mitigation measures for impacts. The analysis should include an assessment of the impacts to wildlife movement and normal behavior and activities, e.g. reproductive cycles. In addition, it should include a discussion of the cumulative impacts of existing and proposed pipeline operations and maintenance activities on natural resources and wildlife, as well as alternatives to avoid or minimize these impacts. *See Section 4 of this EA.*
5. **Temporary impacts vs. permanent impacts; mitigation plan**: Some effects of what are described as temporary impacts from utility line work, such as pipeline construction, actually persist beyond the time frames required by project impact monitoring plans, to the extent that they can be more accurately deemed permanent impacts. These impacts may include those associated with direct construction activity, use of temporary roads, material stockpiling areas, and other work access areas. The monitoring time frame for project impacts must be sufficient to accurately determine if impacts are truly temporary or should be considered permanent, and thus, appropriately mitigated. *The pipeline will be monitored for two years post construction, Because the pipeline would be within an existing ROW and construction measures (including matting the entire use area) are in place to minimize impacts and restoration will be provided if needed by Praxair, we expect recovery within that period based on previous experience.*
6. **Groundwater**: The EA should address potential adverse impacts to groundwater and satisfy recommendations to ensure groundwater resources are protected and any unavoidable impacts are fully assessed. *See Section 4.3.2 of this EA.*
7. **Stormwater Considerations**: The EA should describe the original (natural) drainage patterns in the project locale, as well as drainage patterns of the area during project operations, and discuss specific measures that may be necessary or beneficial in reducing adverse impacts to water quality and aquatic resources. The EA should identify whether any components of the proposed project are within the 50 or 100-year floodplain and document the project's consistency with applicable stormwater permitting requirements, and requirements of a stormwater pollution prevention plan should be reflected as appropriate. *See Sections 3.2.2. and 4.3.2 of this EA.*
8. **Avoidance and minimization of direct and indirect impacts to Waters of the United States and other Refuge resources**: In reference to permitting requirements under Section 404 of the Clean Water Act (CWA), this EA should include wetlands delineation for all Waters of the United States (WOUS), including wetlands and other *special aquatic sites*. The EA needs to address whether, and how, the proposed project will avoid and minimize potential impacts to wetlands due to altered hydrology and elevation, altered soil structure, and mowing and/or use of herbicides. The analysis should carefully evaluate the extent to which non-impactful or less-impacting drilling technologies can be utilized over more invasive technologies, e.g. horizontal directional

drilling in lieu of conventional open trenching. Protection of Refuge resources should take precedence in selection of construction methods. *See Sections 3.2.2. and 4.3.2 of this EA.*

9. **Biological Resources, Habitat and Wildlife**: The EA should identify all petitioned and listed threatened and endangered species and critical habitat that might occur within the project area, as well as which species or critical habitat might be directly, indirectly, or cumulatively affected by each alternative and describe possible mitigation for each species. There is concern about the potential for habitat fragmentation and obstructions to wildlife movement from construction activities associated with the project, as well as the potential impacts of construction, installation, and maintenance activities on wildlife and their habitats. The EA should describe the extent of these activities and the associated impacts on wildlife habitat, including all interrelated and interdependent facilities. The analysis should show that every attempt, including timing of construction activities, has been made to eliminate or greatly reduce disturbances to wildlife, be they visual, auditory, or otherwise. The EA should indicate the location of important aquatic and wildlife habitat areas, along with what measures will be taken to protect important habitat areas and preserve linkages between them. Similarly, ROW vegetation management techniques to be used should be described, and their potential associated environmental impacts, especially if mechanical methods or herbicides are to be used. The EA should also incorporate information on compensatory mitigation proposals for unavoidable impacts to WOUS and biological resources. *See section 3.3 and 4.4 of this EA.*
10. **Invasive Species**: Pipeline construction causes disturbance of ROW soils and vegetation through the movement of people, vehicles, and equipment along the ROW, access roads, and staging areas. Natural areas that are disturbed are prone to colonization by non-native invasive plant species. The EA should describe the invasive plant management plan, including likely species and appropriate monitoring timeframe, as well as identify methods used to limit their introduction and spread during and post-construction. *All equipment and mats will be washed and inspected before entering the refuge in accordance with the permit stipulations which address invasive species management.*
11. **Air Quality:** The EA needs to provide a detailed discussion of ambient air conditions (baseline or existing conditions), National Ambient Air Quality Standards (NAAQS) and non-NAAQS pollutants, criteria pollutant nonattainment areas, and potential air quality impacts of the proposed project, including cumulative and indirect impacts. This evaluation is necessary to understand the potential impacts from temporary, long-term, or cumulative degradation of air quality. *See sections 3.2.1 and 4.3.1 of this EA.*
12. **Hazardous Materials, Hazardous Waste and Solid Waste**: The EA should address potential direct, indirect, and cumulative impacts of hazardous waste from construction and operation of the proposed pipelines and other facilities. The document should identify projected hazardous waste types and volumes, and expected storage, disposal, and management plans. *All materials will be handled in accordance to applicable laws. No hazardous materials will be produced from construction activities.*
13. **Potential Pipeline Releases and Spills**: The EA needs to identify potential best management practices to reduce leakage of substances associated with operation of the pipelines and Praxair provide a response plan to address any potential releases. *Pipelines will be monitored 24/7 by Praxair's Gulf Coast Pipeline Operations Center in the Woodlands and in accordance with State Law. Praxair has provided the Service a copy of their Operation and Manintenance Manual: Regulated Hydrogen Gas Pipeline.*
14. **National Historic Preservation Act and Executive Order 13007 (NHPA)**: The EA should address the existence of cultural and historic resources, including Native

American sacred sites, in the project areas, and address compliance with Section 106 of the NHPA. It should also address Executive Order 13007, distinguish it from Section 106 of the NHPA, and discuss how the applicant will avoid adversely affecting the physical integrity, accessibility, or use of sacred sites, if they exist. The EA should provide a summary of all coordination with Tribes, the SHPO/THPO, or other party; and identify all NRHP listed or eligible sites, and the development of a Cultural Resource Management Plan. *Praxair has conducted a cultural and historic review and survey. Texas State Historic Presevation Office has provided a Letter of Concurrence.*

15. **Environmental Justice and Impacted Communities**: The EA should include an evaluation of environmental justice populations with the geographic scope of the project. If such populations exist, the EA should address the potential for disproportionate adverse impacts to minority and low-income populations, and the approaches used to foster public participation in these populations. Assessment of the project's impact on minority and low-income populations should reflect coordination with those affected populations. *See Section 4.5.8 of this EA.*
16. **Coordination with Land Use Planning Activities**: The EA should discuss how the proposed action would support or conflict with objectives of federal, state, tribal, or local land use plans, policies and controls in the project areas. The term "land use plans" includes all types of formally adopted documents for land use planning, conservation, zoning and related regulatory requirements. *The ROW corridor was identified with all current users in the 2013 Comprehensive Management Plan. The long term land use will not change from that identified in the Plan.*
17. **Additional Right-of-Way:** The EA should consider eminent domain issues during the evaluation of potential routing alternatives. The findings should be documented in the EA. *Eminent domain is the right of a government or its agent to appropriate property for public use, with payment of compensation. This issue is not applicable to this EA. Construction of the Praxair Dual Pipeline Project is a private undertaking with no federal funding. The Service has no authority or involvement in construction of the pipeline outside of the refuge.*
18. **Noise**: The EA needs to incorporate a discussion regarding noise disturbance associated with construction activities, operational and maintenance activities, and any other sources stemming from implementing the proposed project. The analysis should include a discussion of direct and indirect impacts to wildlife as a result of noise disturbance. *See section 4.5.6 of this EA.*

1.9 Permit Area

For the purposes of this EA, the permit area is defined as the workspace needed to construct the Praxair Dual Pipeline project within the Brazoria NWR (**Exhibit 4**).

Section 2 Description of Alternatives

When the Service is presented with a permit application, the range of alternatives for consideration is limited to two alternatives – issue the permit or deny the permit. In this EA, Alternative A represents the proposed action (issuing the permit) and Alternative B represents the no action alternative (denying the permit). This chapter presents the alternatives considered for the construction of the Dual Pipeline project and the potential environmental impacts associated with each of the alternatives. Both alternatives were presented to the Service by Praxair, who identified certain routing constraints and sensitive areas requiring detailed analysis to ensure avoidance or minimization of impacts when selecting the proposed route. Alternative A is the route utilizing the established pipeline corridor crossing the Brazoria National Wildlife Refuge. Alternative B is the nearest route to go around the refuge representing the shortest alternative and therefore having the least environmental and socioeconomic impacts.

Routing constraints influenced the development of the proposed routes and included the following:

- Identifying crossing locations of the Brazoria National Wildlife Refuge based on terrain and pipe length where locating the pipeline(s) would have the least impacts on the environment and people.
- Minimizing visual impact
- Avoiding populated areas to the extent practicable.

The routing surveys also undertook a comprehensive routing process to identify constructible centerlines and the effects on sensitive resources. The routing process comprised of engineering, construction, land and environmental specialists. These teams assessed the routes with regard to the following considerations:

Engineering

- Avoiding general engineering and constructability constraints;
- Minimizing route distance
- Reducing the number of severe pipeline bends and turning angles;
- Identifying and avoiding, where practicable, areas of water crossings;
- Identifying and evaluating opportunities for utilizing trenchless technology such as HDD and boring; and
- Identifying and avoiding, where practicable, location with a potential for blasting.

Environmental

- Minimizing impacts at any single wetland crossing to 1 acre or less wherever practicable;
- Avoiding or minimizing impacts to forested wetlands and other wetlands;
- Crossing waterbodies at 90 degree angles to minimize in-stream disturbance;
- Avoiding or minimizing crossing of major waterbodies;
- Waterbody crossings when possible by boring or use of HDD to minimize impacts;
- Minimizing impacts or contiguous upland forest by routing the centerline along tree lines or through existing cleared areas to the greatest extent practicable; and
- Identifying and avoiding contact with groundwater systems.

Land

- Minimizing impacts on private property and structures;

- Minimizing conflicts with land use; and
- Minimizing impacts on residential water wells and septic systems.

Cultural

- Avoiding or minimizing impacts on sites listed on or potentially eligible for listing on the National Register of Historic Places; and
- Identifying and avoiding, where practicable, aboveground structures that appeared to be over 50 years old.

2.1 Alternative A (Proposed Action; Issue Permit)

Under the proposed alternative, USFWS would find that through mitigation the proposal to install and operate the Dual Pipeline System within the existing ROW is compatible with the purpose of the refuge and therefore, approve a 30-year ROW permit and issue a SUP to Praxair granting access and governing construction of the Dual Pipeline project under all provisions of the SUP. Praxair coordinated with USFWS early in the planning process to ensure USFWS requirements and needs were met, and measures are taken to minimize impacts to the Refuge. Detailed aspects of the project designed to minimize impacts to Refuge resources are discussed in Section 2.4.

Alternative A will be co-located within the existing pipeline ROW. Co-location has several inherent engineering, long-term operations, maintenance, and environmental advantages. Therefore, it is generally preferred by Federal Agencies as well as land use planners and other State and local agencies. Typically, any deviation from the corridor will result in additional construction impacts, additional installation cost, and additional operating costs.

2.1.1 Project Description

Praxair proposes to construct a 49 mileDual Pipeline project, including a 24-inch (in) nitrogen pipeline and a 14-in hydrogen pipeline between their facilities in Texas City and customers in Freeport, TX. The pipelines will be constructed within an existing 300 ft wide ROW corridor that contains 21 other pipelines. A 4.3 mile section of this corridor traverses the Brazoria NWR in southeastern Brazoria County, Texas. The proposed dual pipelines will be laid parallel and simultaneously in accordance with the Construction Plan for Crossing the Brazoria National Wildife Refuge (BNWR) form FM 2004 to Austin Bayou. Alternative A begins at the bore entry and temporary work space (TWS) located north of FM 2004. After crossing FM 2004, Alternative A continues southwest, through the refuge, crossing Ditch 10 via horizontal directional drill (HDD) and CR 208 via bore. Alternative A ties into a proposed valve station west of CR 208 and continues southwest in the existing corridor. Otter Slough is crossed twice by Alternative A, both times using HDD, before this route continues southwest to Austin Bayou. The HDD to cross Austin Bayou enters from the south bank and exits on the north bank of Austin Bayou, on the Refuge. Alternative A includes the HDD entry pad and associated TWS located on the south bank of Austin Bayou. Praxair coordinated with USFWS early in the process to ensure USFWS requirements and needs were met, and measures are taken to minimize impacts to the Refuge during construction activities.

2.1.2 Pipeline Construction Timeline

It is anticipated that construction of the Dual Pipeline project may begin in April 2016 and will be completed no later than October 2016. Use of the permanent ROW and permanent access gate

located on FM 2004 and CR 208 will be required for maintenance and operation of the pipeline. Maintenance and operation are expected to continue for approximately 30 years.

2.1.3 Ancillary Facilities

The Dual Pipeline project will require above ground work sites or facilities that are associated with the pipeline. Ancillary facilities discussed in the sections below include:

- Pipeline Construction ROW
- TWS
- Pipe Stockpile Sites
- Contractor Yards (located off-site)
- Mainline Valve Station (adjacent to CR208)
- Access Roads

2.1.4 Land Requirements

A total of 54.39 acres of land would be utilized during construction of Alternative A, including the area encompassed by the 10-ft wide ROW requested by Praxair as well as approved temporary workspace. Of this total, 6.53-acres will be maintained 10' ROW and 47.86-acres will be utilized as TWS for construction purposes only. Of the 54.39 acres used for construction of Alternative A, 48.23 acres will be required on Brazoria NWR. A total of 5.16 acres will be used for permanent ROW and 41.39 acres will be used for TWS within the Refuge
Following the completion of construction, the entire ROW will be returned to preconstruction contours. This will allow for the reestablishment of hydrology within the construction ROW. Both PWS and TWS are within an existing ROW, will be allowed to revegetateand will be maintained in accordance with Praxair's and other pipelineoperation and maintenance schedules. Post-construction monitoring will include observations of the trench line for signs of excessive mounding or slumping to ensure that mounding does not block natural surface water flows and slumping contribute to saltwater intrusion within the Refuge. Praxair is committed to maintaining preconstruction contours.

2.1.5 Pipeline ROW

The typical construction ROW will be 100-ft wide for conventional open trench construction consisting of a 10-ft wide permanent ROW and 90-ft wide TWS. Both PWS and TWS are overlapping existing pipeline ROWs.. The 10-ft wide permanent ROW would be maintained within the existing 300-ft wide pipeline corridor. Additional TWS is planned in areas requiring special construction techniques and planned storage of trench spoil. TWS is further described in Section 2.1.6 and in **Appendix C**. There are 21 other pipelines within the existing corridor used by Alternative A. Letters of No Objection from parallel pipeline owners, with overlapping easements will be received prior to issuance of the SUP.

2.1.6 Temporary Workspace Space (TWS)

Open trench construction will require 90 feet of TWS for trench spoil storage, pipe welding and access roads. TWS will expand to 160-ft at the HDD entry pads for both crossings of Otter Slough. The TWS will be reduced to 32-ft within the drilled section, providing equipment and emergency access lanes around the HDD. The TWS necessary for the bores under FM 2004 and CR 208 has been incorporated into the staging area limits identified and discussed in Section 2.1.7.

The push located south of the west Otter Slough crossing will require space for a push rack and will measure an additional 177 ft for a total of 277-ft wide (10-ft PWS and 267-ft TWS) by 667-ft long. **Table 1** summarizes Temporary Workspace required construction.

Table 1. Temporary Workspace for the Alternative A Dual Pipeline project..

Crossing	Construction Technique	Distance (ft)	TWS Required (acres)
North of 2004	Open Cut	126	2.01
FM 2004	Open Cut Bore	498	0.8
Bore and Drill Sites	Bore Open Cut Drill Staging Area	684	2.38
Ditch 10	HDD	658	4.14
Typical ROW	Drill Staging Area Open Cut	1077	2.47
Bore Site and Storage	Open Cut Bore	265	1.05
CR 208	Bore	145	0
Bore Site and Storage	Bore Open Cut	788	2.71
Typical ROW	Open Cut	4936	11.33
	Open Cut Drill Staging Area	300	1.17
East Otter Slough	HDD	1770	0
	Drill Staging Area Open Cut	3004	6.83
	Travel Route		1.7
	Open Cut Drill Staging Area	300	1.16
West Otter Slough	HDD	558	6.60
	Drill Staging Area Open Cut	606	4.02
Salt Flat	Push/Pull	5868	9.03
	Push/Pull Open Cut Drill	1202	2.96
BNWR boundary Austin Bayou	HDD HDD	952	0
	Drill Open Cut	300	2.07
	Open Cut	210	0.53

2.1.7 Pipe Stockpile Sites, Contractor Yards and Equipment Wash Stations

Construction will require designated staging areas for material storage and a proposed yard for contractor equipment, pipe fabrication, and equipment washing/maintenance. Two material storage locations are required on Brazoria NWR to complete construction; they are located on either side of CR 208 south of the Dual Pipeline project centerline, an area that has been previously impacted during previous construction on the Refuge (**Exhibit 4**). These storage areas total 0.49 acre and are only for temporary pipe storage, vehicle parking, and loading/unloading of equipment. No equipment washing or maintenance will occur at these locations. As described in the Construction Plan, these areas will be matted in their entirety. A contractor yard will be located off of the Refuge, north of FM 2004 approximately 1.3-miles west of Austin Bayou (**Exhibit 2**). Equipment washing and maintenance will be completed at the contractor yard off of the Refuge property.

2.1.8 Equipment

Utility trucks or vans will be used to transport crews from material storage areas and the contractor yard to work areas. Utility trucks and vans will remain on mats within the Refuge to minimize environmental impacts. Matting will be used in all workspace areas. Detailed lists of equipment are included in the Construction Plan for Crossing Brazoria National Wildlife Refuge (**Appendix C**). A summarized list of equipment includes:

- UTVs/ATVs
- Transporter / Skids
- HDD rigs
- Boring rigs
- Excavators
- Sideboom dozers
- Tractor trailer (material delivery)
- Welding rigs
- Utility trucks and trailers
- Vans

2.1.9 Access Roads

Ingress/Egress for Alternative A will be made directly from FM 2004 and CR 208 and follow construction matting within the approved TWS. Inside the ROW, all vehicular traffic will be confined to the approved workspace areas.

2.1.10 Aboveground Facilities

Alternative A will include construction of a valve station immediately west of CR 208. This valve station will be adjacent to an existing valve station (**Exhibit 4**). Standard pipeline marker signs will be spaced in accordance with regulations along the route after construction is complete.

2.1.11 Construction Procedures

Construction will be completed by conventional open cut trenching, HDD, boring, and push/pull methods. All construction activity will occur on matting.

Conventional open cut trenching is achieved with a track hoe excavator. The excavator digs a trench and side casts material parallel to the trench, typically keeping topsoil and subsoil segregated. Pipe is strung adjacent to the trench, welded together and lowered into the trench with a sideboom dozer. After lowering-in is complete, the trench is backfilled.

HDD techniques use a drilling rig to drill the initial hole using a directionally-driven pilot string bit. The bit drills the hole and pulls a "string" through the resulting hole. The string is welded onto pre-welded pipe at the drill exit. Heavy equipment connects to the string and pulls from the HDD entry point, pulling the welded pipe through the hole. The carrier or product pipe is strung, welded, pressure tested, and then, pulled into place. Final tie-in welds will then be made to connect the carrier or product pipe to the pipe just upstream and downstream of the HDD.

Other crossings involve a boring technique where the drill equipment is placed in a pit and the drill is made on a more or less horizontal plane pulling a "string" through the resulting hole, exiting in a pit at the opposite side of the road or waterway. The string is welded to the pre-welded pipe and pulled back through the hole. This method is normally used where shorter crossings are needed which are not possible using the HDD method.

Push construction is completed by open cutting a trench from the push site to the proposed termination of the push and then flooding the resulting ditch with freshwater. Several joints of pipe are welded together into sections at the push site and floatation material is attached to the pipe. The pipe is then pushed and floated into the flooded trench. Section by section the pipe is pushed and welded until the full length of the pipe is installed in the flooded trench. The floatation material is removed from the pipe which then sinks into the ditch, after which it is backfilled and the trench is dewatered. Saltwater intrusion is of concern at the push location. Trench breakers will be constructed using sacks filled with earth and sand placed around the pipelines within the trench. Trench breakers are built around the pipeline to minimize erosion and saltwater intrusion.

2.1.12 Monitoring & Inspection

Praxair will make inspections of work in progress and complete final inspections. Environmental monitoring during all phases of construction activities will be completed by a third party contractor approved by Refuge Staff .

2.1.13 Operation and Maintenance

Operation and maintenance of the Dual Pipeline within the Refuge includes pressure testing, ROW patrol, leak surveys and valve inspections.

Pressure tests are conducted to ensure the safety and reliability of pipelines. Hydrostatic testing using water is conducted under controlled conditions. Testing is conducted by sealing and pressurizing the pipeline then monitoring the pressure over a determined time.

Pipeline patrols evaluate the level and condition of pipeline cover (particularly at road and ditch crossings) and inspect for line movement. Leak surveys may be completed concurrent with ROW patrols. Patrol crews will use trucks or UTVs to access the ROW, and leak survey equipment.

Valve inspections will include partial operation of the valve at least once each calendar year. Visual and operational checks of valves will be completed as part of the inspection. If an

inspection reveals needed repairs or remedial actions, repairs will be completed before the next inspection cycle. Crews can access valve sites via access gates located along the ROW.

2.1.13.1 Mowing

Periodic mowing will be necessary to maintain access within the ROW.

2.1.13.2 Access

Access to the ROW will be maintained via locked gates located at the intersection of FM 2004 and the ROW. Additional gates will be installed on either side of CR 208 at the ROW. **Exhibit 4** depicts the location of each access gate.

2.2 Alternative B (No Action; Deny Permit)

Under this alternative the Service would deny the ROW permit, so the pipelines would not cross the refuge; however, this does not mean that the project would not be constructed. The primary difference between this alternative and the proposed action is that the pipeline would be routed around the refuge. The remainder of the alignment (outside the refuge) would remain the same.

Alternative B would route the Dual Pipeline project north of FM 2004 and south along the western edge of the BNWR along or near Austin Bayou., totaling 5.75 miles of pipeline (2.5 miles longer than Alternative A.. The longer distance of this route would require more total land then Alternative A for construction and would increase impacts on land uses, including potential forested and herbaceous wetlands and waterbodies. This alignment would run west from the PI on the north side of FM 2004 and then south across FM 2004 and Austin Bayou via HDD. Alternative B would then continue south, traversing 2 Bayous Hunting Club before rejoining Alternative A in the existing pipeline corridor (**Exhibit 5**).Construction of the Alternative B alignment would require the establishment of 2.7-miles of a new, undeveloped pipeline corridor within the 2 Bayous Hunting Club.

The added mileage of Alternative B would require construction of two valve stations along this alignment, one more than Alternative A. Valve Stations add permanent surface impacts to the route. These valve stations must be maintained and therefore add human traffic in the area as well.

Additionally, the 2 Bayous Hunting Club periodically grow and harvest rice and although the route may or may not directly impact these areas, development of a new pipeline corridor would limit both the acreage available for farming and perhaps access to these areas. Other ancillary facilities will be required such as cathodic protection communication facilities. Another impact as a result of construction or operations of the pipeline(s) is the cost of damages that would be paid to the landowner for loss of growing season or season's.

Aerial interpretation, NWI, and USDA NRCS Brazoria County Soil Survey review conclude that the 2 Bayous Hunting Club property consists of coastal prairie wetland complex habitat similar to the BNWR.

This alternative increases the number of ROWs required to be obtained by 47 residential properties and 23 commercial properties, located north of FM 2004 and visible in aerial imagery (**Exhibit 5)**. This would result in greater impacts on residential and other developed areas and a significant number of residential structures would be located within 200 feet of the construction

workspace. Disruption to residential and commercial properties would be unavoidable during construction would limit the access to residences and businesses. The shortest duration for impacts during construction could be minimized utilizing the open cut conventional lay method, however, the landowners could require that the driveways be bored, increasing the overall costs and schedule In addition, utilities, includinf telephone, cable and electricity to residences and businesses along the pipeline alignment will require extensive probing and marking prior to and during construction to ensure that none of the underground encumbrances are damaged which could result in utility outages, repair costs and most importantly, safety issues.

One property operated as a Recreational Vehicle (RV) Park has a septic system that must be crossed by this route. The septic system is located between the park's residential areas and FM 2004 near an approximate 2 acre pond. This area would require an HDD to avoid impacting the septic system. Federal Guidelines seek to avoid impacts to municipal or residential water wells or septic systems.

Although Alternative B would not require a SUP from the USFWS, it would involve Greenfield construction in previously undisturbed areas and increase the potential for additional impacts through habitat fragmentation associated with the clearing and maintenance of new ROW. Any fragmentation that has already occurred as a result of previous pipeline construction in the refuge should not be considered as an additional impact to Alternative A. In addition, the pipeline utility corridor existed prior to the formation of the refuge by the Department of Interior and the US Fish and Wildlife System.

Although efforts would be made to construct Alternative B under the conditions of NWP 12, additional impacts may result from less stringent conditions than those required by the BNWR. Examples of this include, but may not be limited to:

- Potential reduction in the number of HDD and bores
- No requirement to reduce vehicular traffic
- No requirements on the type of equipment to be utilized
- No requirement to mat TWP and access routes
- Re-vegetation would only he held to USACE standards and/or landowner requirement (potential for non-native vegetation to be used in replanting efforts).

Conventional open trench construction would be utilized as the most efficient method of pipeline installation; however it has greater impact to the environment. Trenchless construction methods such as HDD or bore minimize impacts by consolidating activity around entry and exit locations.

Long-term impacts through operations and maintenance of the pipeline(s) is regulatory driven and must be carried out to maintain pipeline safety and compliance. In Alternative B, new ROWs would need to be mowed that are currently not, causing additional disturbance to wildlife than would be done in Alternative A. Mowing already occurs in Alternative A and may be coordinated with existing pipeline operators to prevent additional impacts.

Repairs to the pipeline(s) while rare and not anticipated, may be required should integrity or operational occurrences warrant. Increasing the length of pipeline and installation of a pipeline corridor in a non-established corridor, such as in Alternative B increase the risk third party damage to pipelines.

Praxair did not select Alternative B as their preferred route, and have thence requested crossing the Brazoria NWR due the following constraints:

- Alternative B has several tight turns that would be impractical for the 24-inch pipeline, making co-location through certain areas of this alternative infeasible; and
- The alternative crosses through more densely populated areas than Alternative A, particularly north of FM 2004. This would result in significant impacts on residential and other developed areas.
- Increased Environmental, Residential and Commercial Impacts

Table 12.1 and **Table 12.2** located in Section 4.7 summarize each alternative and the impacts associated with each alternative.

2.3 Avoidance and Minimization

Construction methods identified in Appendix C have been designed to minimize impacts to Refuge resources should Alternative A be implemented. Slough and bayou crossings will be completed via HDD to avoid wetland impacts. Crossings at FM 2004 and CR 208 will be completed by bore. The PEMx wetland (also known as Ditch 10) located between FM 2004 and CR 208 will be crossed via HDD and a railroad car bridge will be used to allow for construction access across the ditch to minimize wetland impacts and reduce time and traffic . Pipeline traffic will traverse around the east Otter Slough crossing via the matted round-about on higher ground located on the east side of the slough bend to eliminate the need to access refuge beyond the pipeline corridor to move up and down the pipeline. Trench breakers will be used within the pipeline trench at the Ditch 1 crossing south of west Otter Slough to prevent the migration of saltwater along the pipeline trench. The push method of construction, to be utilized south of the west Otter Slough crossing will greatly reduce traffic from pipeliners and inspectors through the marsh habitat by constructing all pipe on the push rack. Minimal traffic will need to access the lower portion of the pipeline where saltmarsh habitats are more fragile. All work in TWS and PWS will be completed on matting to minimize soil disturbance and impacts to habitats and existing pipelines.

Section 3 Affected Environment

This chapter discusses the environmental setting of the Dual Pipeline project within a Study Area consisting of a 2.5-mile buffer around the proposed alternative - Alternative A (**Exhibit 3**). The description of the affected environment establishes the current environmental conditions considered by USFWS to be potentially affected by Alternative A and Alternative B. The evaluated resources or anthropogenic features that are likely to be affected or could potentially be affected by the covered activities and/or proposed mitigation of the Dual Pipeline project are detailed below.

3.1 Regional Environmental Setting

The Study Area is located within the southeastern portion of Brazoria County, Texas; a portion of the Study Area is located within Brazoria NWR . The Study Area encompasses 10,866 acres; 4,983 acres are within the Refuge and 5,883 acres are outside of the refuge. Brazoria County is located within the Texan biotic province and within the Northern Humid Gulf Coast Prairies and Mid-Coast Barrier Islands and Coastal Marshes ecoregions of Texas (**Exhibits 3** and **6**). The characteristics of the biotic province and of the ecoregion are discussed in the following paragraphs.

The Texan biotic province is an ecotone region between the eastern Austroriparian province and the more arid Kansan, Balconian, and Tamaulipan provinces to the west. This transitional area is characterized by intermingling of both eastern forest and western grassland species assemblages (Blair, 1950).

The Northern Humid Gulf Coast Prairies and Mid-Coast Barrier Islands and Coastal Marshes ecoregions are transitional, running from the Pineywoods, Post Oak Savanna, Blackland Prairie, and South Texas Plains ecoregions down to the Gulf of Mexico. The Gulf Coast Prairies and Marshes ecoregion is comprised of agricultural land, brushland, prairie, bottomland hardwoods, marshes, dunes, and shoreline. Bays, estuaries, and lagoons are an important component of the interface of this ecoregion with the Gulf of Mexico (Griffith, 2010). This ecoregion is underlain by Holocene alluvium (silt, sand, and clays) and by Late Pleistocene clays, silts, and sands of the Beaumont formation (U.S. Geological Survey (USGS), 2015).

Though the Gulf Coast Prairies and Marshes ecoregion is very diverse, the Study Area is limited; prairie and marsh dominate the natural landscape (**Exhibit 7**).

3.2 Physical Environment

3.2.1 Air Quality

The EPA is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. The EPA is the lead authority for administering the CAA and its amendments and have specific statutory obligations with respect to hazardous air pollutants (42 U.S.C. § 7401 et seq., as amended in 1977 and 1990). The EPA has established NAAQS for six criteria pollutants: SO_2, NO_2, PM_{10} particulates, $PM_{2.5}$ particulates, CO, O_3, and Pb.

Effective July 20, 2012, EPA designated the Houston-Galveston-Brazoria area as marginal ozone nonattainment for the 2008 ozone NAAQS. A nonattainment area is classified as a region where

air pollution levels persistently exceed NAAQS. EPA assigns nonattainment status to areas where violations of NAAQS for SO_2, PM_{10} and $PM_{2.5}$, CO, O_3, and Pb occur. Available air quality data for Freeport, Texas (C1012) and Brazoria County are summarized in **Table 2.**

Table 2. Summary of Air Quality for Freeport, Texas and Brazoria County.

Location	PM-10 (µg/m3) 24-hour	PM-2.5 (µg/m3) 24-hour	Carbon Monoxide 8-hour (ppm)	Sulfur Dioxide (ppb) 1-hour	Nitrogen Dioxide 1-hour (ppb)	Ozone	
						1-hour (ppb)	8-hour (ppb)
Freeport South Avenue I C1012 Monitoring Station	--	--	--	2.8	--	--	--
Brazoria County	--	--	--	--	14.7	59	42

Source: TCEQ, Air Quality Index Report; AirNOW-January 27, 2015.
Notes: µg = Microgram(s) ppm= Parts per million ppb = Part(s) per billion

The Federal Land Manager's AQRVs work group formed to develop a more consistent approach for Federal Land Managers to evaluate air pollution effects on resources. The primary focus of the work group is the NSR program, particularly in the review of PSD of air quality permit applications. The goals of the work group have been to provide consistent polices and processes both for AQRVs and for evaluating the effects of air pollution on AQRVs, primarily in Federal Class I air quality areas but also, in some instances, in other national parks, national forests, national wildlife refuges, wilderness areas, and national monuments. Federal Class I areas are defined in the CAA as national parks over 6,000 acres and wilderness area and memorial parks over 5,000 acres, established as of 1977 (USFWS, 2013a).

The requirements of Title V are outlined in 40 CFR § Parts 70 and 71. The permits required by these regulations are often referred to as Part 70 or 71 permits. The TCEQ has the authority to implement the Title V Federal Operating Permits Program. Texas air pollution codes are described in 30 TAC Chapter 122.

3.2.2 Water Resources

3.2.2.1 Surface Water

Several types of surface water resources are present within the Study Area:

- freshwater marsh
- freshwater ponds
- sloughs
- irrigation ditches

Overland water generally flows across the Study Area from north to south. Additional surface water resources of brackish and freshwater lakes, sloughs, marshes, and the Gulf Intracoastal Waterway are located directly south of the Study Area.

Within Brazoria NWR, the principle sources of freshwater are Austin Bayou, Bastrop Bayou, Otter Slough, precipitation, and surface runoff. Austin Bayou is located on the western side of the

Refuge and flows south into Bastrop Bayou, a tributary of Bastrop Bay. Otter Slough is located in the northwestern corner of the Refuge, and connects to Austin Bayou. Austin and Bastrop bayous are listed as ecologically significant stream segments by TPWD (31 TAC 357.8(a)). Levees have been installed across Otter Slough at several locations with water control structures installed to provide seasonal freshwater wetlands. Several other freshwater sources are located south of the designated Study Area, but are within the Refuge; these include Big Slough, Wharton Bayou, Middle Bayou, and Alligator Marsh.

Portions of Brazoria NWR have been used for ranching and rice farming. Channelization associated with these historical land uses has altered local hydrology. Rice farming continues on the Refuge on either side of CR 227 and south of FM 2004. A series of irrigation ditches, managed by the Chocolate Bayou Water Company, enter the refuge at FM2004 and terminate at Ditch 1 which connects Austin Bayou to Chocolate Bay. The Water Company may make water available to the refuge for rice farming or as wildlife water through these ditches. One thousand acres of farm fields and seasonal wetlands are fed through the ditches.

Saltwater intrusion has negatively impacted the saltwater marshes in the southwestern-most portion of Brazoria NWR (USFWS, 2013a). Saltwater intrusion may be caused by a number of factors including vessel traffic, storms, hurricanes, oil and gas exploration and production, and sea level rise.

For the portion of the Study Area outside of Refuge boundaries, Austin Bayou, Bastrop Bayou, marshes, precipitation, and surface water runoff are important sources of freshwater. County-maintained drainage ditches and privately maintained irrigation canals hold and direct surface water across the landscape (Google Earth, 2015).

3.2.2.2 Ground Water

The entire Gulf Coast region is underlain by the Gulf Coast aquifer, which stretches along the Gulf of Mexico from Florida to Mexico. The aquifer extends from the Rio Grande northeastward past the Louisiana-Texas border. Water for many counties within the state of Texas, including Brazoria County, is drawn from the Gulf Coast aquifer (Mace et al., 2006). Earlier investigators in the Gulf Coast region of Texas attempted to delineate aquifer units based on geologic formations, but in the younger Gulf Coast sediments, the aquifers consist of parts of one or more geologic formations (USGS, 1973).

A complex of hydrologically connected interbedded clays, silts, sands, and gravels of the Cenozoic age form a large artesian aquifer system comprised of four major components, the Catahoula, Jasper, Evangeline, and Chicot systems and are generally recognized as water-producing formations. The deepest is the Catahoula, which contains ground water near the outcrop in relatively restricted sand layers. Above the Catahoula is the Jasper aquifer, primarily contained within the Oakville Sandstone. The Evangeline aquifer overlies the Jasper and is contained within the Fleming and Goliad sands. The uppermost component of the Gulf Coast aquifer system is the Chicot aquifer, which consists of the Lissie, Willis, Bentley, Montgomery, and Beaumont formations, and overlying alluvial deposits.

The Chicot and Evangeline aquifers are the primary and, in some cases, only source of fresh water for many of the small towns and rural areas of the Texas Gulf Coast. The most widespread freshwater aquifer in Brazoria County, and the only aquifer containing freshwater in much of the southern part of the county, is the upper unit of the Chicot aquifer.

3.2.3 Soils and Geology

3.2.3.1 Soils

Both non-saline and saline soils are found within the Study Area. The principle non-saline soils found within the Study Area are the Aris, Bernard, Edna, Lake Charles, and Bacliff series. These soils are all listed hydric by the NRCS National Technical Committee on Hydric Soils (USDA, 2014). Soils mapped within the Study Area are considered to be somewhat poorly drained to poorly drained, and have very slowly permeable subsoil. Saline soils occurring within the Study Area are of the Francitas, Harris, and Narta series. In areas adjacent to the Gulf of Mexico the deep saline soils are normally sandy, and affected by salts from the nearby marine environment. Minor components of the Refuge soils assemblage are the of Leton, Morey, and Churnabog series. These series tend to be coastal, poorly drained silt loams and clays (NRCS, 2015). Soils within the Study Area are mapped in **Exhibit 7**.

3.2.3.2 Geology

The Study Area is in the Gulf Coastal Plain. The Beaumont formation as well as alluvial clay, silt, and sand underlie the Study Area. The Beaumont formation is composed of Pleistocene clay, mud, clayey sand, and silt and extends to more than 328 ft deep in coastal regions (Bureau of Economic Geology, 1992). Soils in Brazoria County may be up to 8 ft deep (USGS, 2014a and 2014b).

3.2.3.3 Seismic Hazards

Seismic hazards include faults, seismicity, and ground motion hazards that contribute to seismic risk. Faults are fractures along which the earth materials on either side have moved relative to each other. No faults are known to exist in the vicinity of the project, and seismic risk is very low in the region (USGS, 2014).

3.2.4 Climate and Climate Change

3.2.4.1 Climate

Brazoria County, Texas experiences a mild and humid subtropical climate. Temperature and moisture regimes are influenced by solar insolation and by air mass movements from the Gulf of Mexico; interactions of these factors produce a climate characterized by hot, dry summers, wet springs and falls, and dry, mild winters. Average temperatures generally range from the low 90's (˚F, summer highs) to the mid 40's (˚F, winter lows). Rainfall occurs throughout the year. Average rainfall at Brazoria NWR is 50 inches.

Flooding and hurricanes are common along the Texas Gulf Coast, with the most severe storms resulting from tropical disturbances moving inland during late summer and early fall. In this region, a typical storm surge is 10.7 ft above mean sea level. Storm level probability data indicate that the entire Refuge can be expected to be covered by a high tide approximately every 10 years (Harford, 2013). The majority of the Study Area lies within the FEMA 100-year floodplain (FIRM panels 48039C0465H, 48039C0470H, and 48039C0635H).

3.2.4.2 Climate Change

According to the AMS, global mean temperatures have been rising steadily over the last 40 years (AMS, 2012). In the Southwest, a temperature increase between 2˚F to 3.1˚F during the past century is documented and an increase in temperature of 8.1˚F to 11˚F in the future is projected (Sprigg and Hinkey, 2000). This trend is expected to continue, both globally and, in many cases, regionally. Climate change may be influenced by a number of variables, including natural external forces, natural internal processes of the climate system, or human activities. In the case of the current and predicted global warming trend, the cause is likely related to greenhouse gases, primarily CO_2, accumulating in the earth's atmosphere as a result of human activity. According to the EPA, energy-related activities account for over 85 percent of human-generated greenhouse gases in the United States. This is mostly in the form of CO_2 emissions from burning fossil fuels. Industrial processes (production of cement, steel, and aluminum), agriculture, forestry, and waste management are also important sources of greenhouse gas emissions in the United States (EPA, 2014).

Over the next century, climate in Texas is expected to change. By Year 2100 temperatures in Texas could increase by 3°F (with a range of 1-6°F) in spring, 4°F (with a range of 1-9°F) in other seasons. Precipitation is estimated to decrease by 5-30% in winter and to increase by roughly 10% during other seasons (but could increase up to 30% during summer). The amount of precipitation on very wet or snowy days during winter is projected to decrease, while the amount of precipitation received during very wet days in summer is expected to increase. The frequency of extreme heat in summer is also expected to increase (EPA, 1997).

In the Gulf Coast region, average annual temperatures in the region are projected to increase by 4-9°F by 2080. Climate models are currently inconclusive as to whether the net change in precipitation will be an increase or decrease. Models do suggest that rainfall will arrive in heavier downpours with increased dry periods between storms, increasing the risk of both flooding and drought. The coasts will likely experience stronger hurricanes and sea level rise. Storm surge could present problems for coastal communities and ecosystems (EPA, 2013).

3.3 Biological Environment

3.3.1 Vegetative Communities

Habitats may be defined largely by attributes of the vegetative community. The Study Area is located within the Northern Humid Gulf Coastal Prairies ecoregion (**Exhibit 6**). There are two known rare vegetation communities found on the Brazoria NWR; Vertisol Coastal Prairie and Wet Coastal Prairie/Marsh. These two rare plant communities are components of the Texas-Louisiana Coastal Prairie Ecological System and have global and state conservation (vulnerability or rarity) rankings of G2/S2 (Imperiled) and G1/S1 (Critically Imperiled), respectively. The most common vegetation types within the Study Area are coastal prairie, salty prairie, salt and brackish high tidal marsh, coastal prairie pondshore, hardwood forest and woodland, and row crops (**Exhibit 7**). These habitats are described in the paragraphs below. **Table 3** provides acreage of each habitat mapped within the Study Area.

Table 3. Mapped Ecosystem Types within the Study Area.

Ecosystem Classification	Acres	Percent (%)

Ecosystem Classification	Acres	Percent (%)
Gulf Coast: Coastal Prairie	7,013.08	26.77
Gulf Coast: Salty Prairie	6,211.65	23.71
Coastal: Salt and Brackish High Tidal Marsh	3,116.46	11.90
Gulf Coast: Coastal Prairie Pondshore	2,122.07	8.10
Columbia Bottomlands: Hardwood Forest and Woodland	1,682.60	6.42
Row Crops	1,019.39	3.89
Columbia Bottomlands: Herbaceous Wetland	819.34	3.13
Coastal: Salt and Brackish Low Tidal Marsh	743.09	2.84
Non-Native Invasive: Chinese Tallow Forest, Woodland, or Shrubland	707.12	2.70
Native Invasive: Baccharis Shrubland	558.12	2.13
Pine Plantation 1 to 3 meters tall	307.66	1.17
Columbia Bottomlands: Live Oak Forest and Woodland	298.26	1.14
Open Water	270.01	1.03
Gulf Coast: Salty Prairie Shrubland	214.09	0.82
Native Invasive: Common Reed	204.41	0.78
Native Invasive: Huisache Woodland or Shrubland	175.37	0.67
Urban Low Intensity	136.51	0.52
Columbia Bottomlands: Riparian Grassland	135.29	0.52
Native Invasive: Mesquite Shrubland	133.63	0.51
Columbia Bottomlands: Riparian Hardwood Forest and Woodland	92.95	0.35
Columbia Bottomlands: Riparian Herbaceous Wetland	89.88	0.34
Columbia Bottomlands: Mixed Evergreen - Hardwood Forest and Woodland	29.57	0.11
Non-native Invasive: Rose Shrubland	27.47	0.10
Columbia Bottomlands: Deciduous Shrubland	20.54	0.08
Columbia Bottomlands: Grassland	19.93	0.08
Columbia Bottomlands: Riparian Evergreen Shrubland	13.05	0.05
Coastal: Sea Ox-eye Daisy Flats	12.25	0.05
Columbia Bottomlands: Riparian Live Oak Forest and Woodland	8.15	0.03
Native Invasive: Juniper Shrubland	5.84	0.02
Columbia Bottomlands: Evergreen Shrubland	4.28	0.02
Coastal: Salt and Brackish High Tidal Shrub Wetland	2.29	0.01
Coastal: Tidal Flat	1.48	0.01
Pineywoods: Pine Forest or Plantation	1.46	0.01

Ecosystem Classification	Acres	Percent (%)
Non-native Invasive: Saltcedar Shrubland	0.51	0.001
Barren	0.27	0.001
Total	26,198.08	
Data adapted from TPWD Texas Ecological Systems Database (2010).		

Coastal Prairie

Coastal prairie is the dominant habitat within Brazoria NWR and occupies 26.7 percent (7,013 acres) of the Study Area**.** Both upland and wetland vegetation is found in the coastal prairie; this matrix of vegetative communities is produced by ridge-and-swale microtopography. Little bluestem (*Andropogon scoparius*), brown-seed paspalum (*Paspalum plicatulum*), and switchgrass (*Panicum virgatum*) dominate the upland prairies. Diverse rush, sedge, and forb species also grow in the coastal prairie community. Soil type, fire regime, rainfall, and grazing all contribute to the establishment and persistence of prairie vegetation. In the absence of regular fire, woody shrubs and trees (e.g. Chinese tallow, *Triadica sebifera*; eastern baccharis, *Baccharis halimifolia*; yaupon, *Ilex vomitoria*) will invade this vegetative system (USFWS, 2013b).

Salty Prairie

Salty prairie represents 23.7 percent (6,211 acres) of the Study Area and is most common within the southern and eastern portions of the Study Area, nearer to the coas. This system occupies saline soils, generally on near-coast, level landforms of the Beaumont Formation. Sites may be nearly monotypic stands of Gulf cordgrass *(Spartina spartinae*). Other gramimoids that may be present to abundant include little bluestem *(Schizachyrium scoparium*), bushy bluestem *(Andropogon glomeratus*), switchgrass (*Panicum virgatum*), Gulf muhly (*Muhlenbergia capillaris*), or rat-tail smutgrass (*Sporobolus indicus*). Marshhay cordgrass (*Spartina patens*), oldfield threeawn (*Aristida oligantha*), Hartweg paspalum (*Paspalum hartwegianum*), and saltgrass (*Distichlis spicata*) may be common, particularly on lower, somewhat wetter, sites. Forbs are generally uncommon, but may include species such as sea ox-eye daisy (*Borrichia frutescens*), seaside goldenrod (*Solidago sempervirens*), narrowleaf sumpweed (*Iva angustifolia*), goldentops (*Euthamia* spp.), or other species more common to the non-saline soils nearby, or the salt marsh that may also be nearby. Microtopographic highs in the form of pimple mounds often have species more characteristic of less saline adjacent habitats. A large shrub component is generally absent from the salty prairie, though some shrubby species may invade; common invasives include species such as shrubby sumpweed (*Iva frutescens*), honey mesquite (*Prosopis glandulosa*), huisache (*Acacia farnesiana*), Carolina wolfberry (*Lycium carolinianum*), salt cedar (*Tamarix* sp.), and baccharis (*Baccharis halimifolia*).

Salt and Brackish High Tidal Marsh

Salt and brackish high tidal marsh comprises 11.9 percent (3,116 acres) within the Study Area and is most common in the southern and eastern portion of the Study Area, especially around Austin Bayou and Bastrop Bayou. These marshes occupy relatively low-lying, coastal situations on level landforms influenced by tidal fluctuations. The composition of these marshes is primarily influenced by the frequency and duration of tidal inundation. Areas of decreased frequency and/or duration of tidal inundation are often referred to as high, or irregularly flooded, marsh. These marshes are dominated by species such as marshhay cordgrass, saltgrass, sturdy bulrush (*Schoenoplectus robustus*), and three-square bulrush (*Schoenoplectus americanus*). seashore

dropseed (*Sporobolus virginicus*), shoregrass (*Monanthochloe littoralis*), and Gulf cordgrass are other common herbaceous species. Shrubs, subshrubs, and forbs, such as saltwort (*Batis maritima*), sea ox-eye daisy, shoreline seapurslane (*Sesuvium portulacastrum*), glassworts (*Salicornia* spp.), annual seepweed (*Suaeda linearis*), sea-lavenders (*Limonium* spp.), and Carolina wolfberry may be encountered in these marshes.

Coastal Prairie Pondshore

Coastal prairie pondshore is scattered throughout the Study Area and represents 8.1 percent (2,122 acres) of the Study Area. Coastal prairie pondshore is found specifically in topographic lows such as ponds and swales which occur in an otherwise level coastal prairie landscape. Soils are poorly-drained, and surface water from rainfall and local runoff is retained for much of the year. These wetlands are primarily herbaceous, sometimes with sparse woody cover, and are composed of various species, such as squarestem spikesedge (*Eleocharis quadrangulata*), hairy umbrellasedge (*Fuirena squarrosa*), sheathed umbrellasedge (*Cyperus haspan*), green flatsedge (*Cyperus virens*), beaksedges (*Rhynchospora* spp.), clubhead cutgrass (*Leersia hexandra*), gaping panicum (*Steinchisma hians*), switchgrass, bushy bluestem, Richard's yellow-eyed grass (*Xyris jupicai*), erect centella (*Centella erecta*), nipplebract arrowheads (*Sagittaria* spp.), water-primrose (*Ludwigia* spp.), waterhyssops (*Bacopa* spp.), pennyworts (*Hydrocotyle* spp.), hierba del marrano (*Symphyotrichum subulatum*), and rattleboxes (*Sesbania* spp.). Large areas of some of the occurrences may be relatively homogeneous, dominated by one or a few species. Areas of open water within the ponds may contain floating and submerged aquatic species, including sago pondweed (*Stuckenia pectinata*), coontail (*Ceratophyllum demersum*), Schreber watershield (*Brasenia schreberi*), largeleaf floating heart (*Nymphoides aquatica*), and yellow lotus (*Nelumbo lutea*) (Elliott, 2010).

Hardwood Forest and Woodland

Hardwood forest and woodland comprises approximately 1,628 acres (6.4 percent) within the Study Area and occurs primarily in the north, in the vicinity of Otter Slough. This system occurs on Quaternary alluvium and adjacent Pleistocene terraces (Beaumont and Lissie Formations) along the Brazos, San Bernard, and Colorado Rivers (as they pass through these Pleistocene formations), and adjacent streams such as Oyster Creek, Caney Creek, and Linnville Bayou. Chocolate Bayou represents the eastern extent of this system. This system occupies a generally level landscape, punctuated by a series of swales, depressions, and natural levees. Much of the flooding experienced by this system results from seasonal precipitation and tropical storms, not from over-bank flooding. Soils are frequently clayey bottomlands (such as Pledger or Brazoria clays) or loamy bottomlands (such as those of the Asa or Norwood series). This system expresses a range of communities along a moisture gradient ranging from the wettest sites along stream margins and depressions, to somewhat drier sites on ridges and natural levees.

Herbaceous communities and open water typically characterize the wettest sites, with species such as squarestem spikesedge, arrowheads, water-primroses, lizard's tail (*Saururus cernuus*), Carolina mosquito-fern (*Azolla caroliniana*), and little duckweed (*Lemna obscura*). Such very wet sites may have bald cypress (*Taxodium distichum*) and black willow (*Salix nigra*) in the overstory, or may be shrub swamps dominated by common buttonbush (*Cephalanthus occidentalis*) and/or swamp privet (*Forestiera acuminata*).

Sites inundated somewhat less frequently, such as meander scars, abandoned oxbows, and channels, are often dominated in the overstory by species including green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), and water hickory (*Carya aquatica*), while

the woody understory of these sites are typically open and may be dominated by common buttonbush and/or swamp privet. Rarely, corkwood (*Leitneria floridana*) may be a conspicuous component of the shrub layer. Herbaceous cover is often patchy and can include species such as savannah panicum (*Phanopyrum gymnocarpon*), heartleaf burhead (*Echinodorus cordifolius*), sedges (*Carex* spp.), beaksedges, lizard's tail, water smartweed (*Persicaria punctatum*), Gulf swampweed (*Hygrophila lacustris*), false nettle (*Boehmeria cylindrica*), climbing hempweed (*Mikania scandens*), and little duckweed (*Lemna obscura*). Flats and ridges that are only occasionally flooded are often dominated by sugar hackberry (*Celtis laevigata*), cedar elm (*Ulmus crassifolia*), water oak (*Quercus nigra*), and Shumard oak (*Quercus shumardii*). Shrubs on these sites include yaupon (*Ilex vomitoria*), western soapberry (*Sapindus saponaria* var. drummondii), Drummond turk's cap (*Malvaviscus arboreus* var. drummondii), coralberry (*Symphoricarpos orbiculatus*), and American beautyberry (*Callicarpa americana*). Dwarf palmetto (*Sabal minor*) and Cherokee sedge (*Carex cherokeensis*) are more abundant on these sites, and other species such as poison ivy (*Toxicodendron radicans*), narrowleaf woodoats (*Chasmanthium sessiliflorum*), creek oats (*Chasmanthium latifolium*), straggler daisy (*Calyptocarpus vialis*), basketgrass (*Oplismenus hirtellus*), and jumpseed (*Persicaria virginianum*) may be present.

Clay backflats in this landscape may be dominated by live oak and pecan (*Carya illinoinensis)*. Blackland soils on the Pleistocene surface (such as those of the Lake Charles series) are often occupied by a forest dominated or co-dominated by water oak, sugar hackberry, cedar elm, green ash, and less frequently live oak. The shrub layer on these sites is often well-developed and typically dominated by yaupon, sometimes with dwarf palmetto, roughleaf dogwood (*Cornus drummondii*), and Carolina cherry laurel (*Prunus caroliniana*) also present. Vines are commonly encountered including species such as mustang grape (*Vitis mustangensis*), poison ivy, peppervine (*Ampelopsis arborea*), and Alabama supplejack (*Berchemia scandens*). Narrowleaf woodoats, *Cherokee sedge*), Carex crus-corvi (crowfoot sedge), broadleaf signalgrass (*Urochloa platyphylla*), and *Juncus* spp. (rushes) and numerous other species are commonly found in the herbaceous layer.

It is unclear whether these typically prairie dominated surfaces are now occupied by woodland and forest due to a disruption in natural fire cycle and disturbance, or whether the unique hydrology or other environmental factors of the Columbia Bottomlands leads to this incongruity. Spanish moss (*Tillandsia usneoides*) is a frequently encountered epiphyte in these forests. Riverside woodlands, along major rivers, have American sycamore (*Platanus occidentalis*) and eastern cottonwood (*Populus deltoides*) in the canopy (David Rosen, Pers. Comm.). The non-native tree Chinese tallow (*Triadica sebifera*) may often be encountered, sometimes as a significant or dominant component of the canopy.

Row Crops

Row crops comprise 3.9 percent (1,019 acres) of the Study Area and are limited to the northern end of the Study Area. This type includes all cropland where fields are fallow for some portion of the year. Some fields may rotate into and out of cultivation, frequently, and year-round cover crops and tame hay fields are generally mapped as grassland. Rice is the most common agricultural crop within the Study Area and in some areas is grown specifically to attract and support wildlife (migratory waterfowl).

3.3.2 Wildlife

3.3.2.1 Terrestrial Species

The diversity of habitats within and near the Study Area and within the Gulf Coast Prairies and Marshes ecoregion at large favors a corresponding diversity and abundance of wildlife. Species occurrence within the Study Area is reflected in published species lists for the Texas Mid-Coast Refuge Complex (USFWS, 2013b) (Complex). Representatives of many taxa readily observed within the Complex include birds, mammals, reptiles, amphibians, and insects. Field surveys for threatened and endangered species within Alternative A were completed in January 2015.

Mammals

The Complex provides a variety of habitats supporting approximately 52 species of mammals. Species such as coyote (*Canis latrans*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), bobcat (*Lynx rufus*), nine-banded armadillo (*Dasypus novemcinctus*), white-tailed deer (*Odocoileus virginianus*), and Virginia opossum (*Didelphis virginiana*) are all readily observed. Other species which are less common and more secretive are long-tailed weasel (*Mustela frenata*), river otter (*Lutra canadensis*), eastern spotted skunk (*Spilogale punctatus*), and mountain lion (*Puma concolor*).

Feral pigs (*Sus scrofa*) and nutria (*Myocastor coypus*) are introduced, invasive species of mammals that are present within the Complex. Both individuals and signs of habitat damage by the species are observable at sites throughout the Complex (USFWS, 2013b and 2015a).

Birds

More than 350 bird species are documented to occur within Brazoria County and may occur within the Study Area; some of these species have been recorded nesting in Brazoria NWR (USFWS, 2013 and 2015a). Nesting birds at the Refuge include 10 species of bitterns and herons (e.g., great blue heron (*Ardea herodias*), white ibis (*Eudocimus albus*), roseate spoonbill (*Platalea ajaja*), white-tailed kite (*Elanus leucurus*), three species of rail e.g., yellow rail, (*Coturnicops noveboracensis*), black skimmer (*Rynchops niger*), and the scissor-tailed flycatcher (*Tyrannus forficatus*) (USFWS, 2013b).

Brazoria NWR is located within the Central Flyway, and provides a stopover for more than 50 neotropical migrant species and wintering habitat to waterfowl that winter on the Texas coast (USFWS, 2013b and 2015a). During the fall migration, birds travel south along the Central Flyway from the Great Plains to the Texas Gulf Coast; neotropical migrants continue south past the Gulf Coast to winter in Central and South America. Migratory birds return along the Central Flyway to their northern nesting grounds in the spring. Common migratory species observed on the Refuge include waterfowl (Anseriformes), shorebirds (Charadriiformes), wading birds (Ciconiiformes), raptors (Falconiformes), and perching birds (Passeriformes). Non-migratory birds, such as northern bobwhite (*Colinus virginianus*), are also present within the Refuge (**Table 4**).

Table 4. Common Birds of Brazoria National Wildlife Refuge.

Species Group	Common Name		Species Group	Common Name
Grebes	Pied-billed grebe		Pigeons and doves	Mourning dove
Pelicans	Brown pelican			Eurasian collared dove*

Species Group	Common Name	Species Group	Common Name
	Am.white pelican	Goatsuckers	Common nighthawk
Cormorants	Double-crested cormorant	Hummingbirds	Ruby-throated hummingbird
Bitterns and herons	Great blue heron	Woodpeckers	Downy woodpecker
	Great egret		Red-bellied woodpecker
	Snowy egret	Tyrant flycatchers	Eastern phoebe
	Little blue heron		Scissor-tailed flycatcher
	Tricolored heron	Swifts	Chimney swift
	Cattle egret	Swallows	Purple martin
	Green heron	Jays, Magpies, and Crows	Blue jay
			American crow
Waterfowl	Snow goose	Chickadees and Titmice	Carolina chickadee
	Green-winged teal		Tufted titmouse
	Blue-winged teal	Wrens	Carolina wren
	Northern shoveler		Sedge wren
	Gadwall	Kinglets and Gnatcatchers	Ruby-crowned kinglet
	American widgeon	Thrushes	American robin
Kites, Eagles, and Hawks	Northern harrier	Mockingbirds and Thrashers	Northern mockingbird
	Red-shouldered hawk		Brown thrasher
	Red-tailed hawk	Pipits	Sprague's pipt
Caracaras and Falcons	American kestrel	Shrikes	Loggerhead shrike
American vultures	Black vulture	Starlings	European starling*
	Turkey vulture	Vireos	White-eyed vireo**
Turkeys and Quail	Northern bobwhite	Wood-warblers	Yellow warbler
Rails, Gallinules, and Coots	Clapper rail		Yellow-rumped warbler
	American coot		Black-and-white warbler
Plovers and Oystercatchers	Killdeer		Common yellowthroat
Sandpipers and Phalaropes	Black-necked stilt	Cardinals and Grosbeaks	Northern cardinal
	American avocet		Indigo bunting
	Willet		Painted bunting
	Long-billed dowitcher	Sparrows	Savannah sparrow
	Sanderling		House sparrow*
Gulls and Terns	Laughing gull	Blackbirds and Orioles	Eastern meadowlark
	Ring-billed gull		Great-tailed grackle
	Herring gull		Boat-tailed grackle
	Forster's tern		Common grackle

Species Group	Common Name		Species Group	Common Name
	Least tern			Brown-headed cowbird

Table adapted from USFWS 2013a.
* introduced species, **species that is listed as endangered, threatened, or otherwise of conservation concern

More than thirty species of waterfowl use the Complex, primarily during the winter months ranging from November through January. Waterfowl use the various freshwater marsh, saline marsh, some agricultural land, and open water habitats along the Texas Gulf Coast as a wintering ground. Non-migratory species of waterfowl which may use the Refuge during spring and summer months include, but are not limited to fulvous whistling duck (*Dendrocygna bicolor*), black-bellied whistling duck (*D. autumnalis*), and mottled duck (*Anas fulvigula)* (USFWS, 2013b and 2015a).

More than 100,000 shorebirds of more than 30 species utilize the Complex annually during migration, and the Complex is designated as a Site of International Importance by the Western Hemisphere Shorebird Reserve Network. Shorebird use of wetlands in the Complex peaks in late April through May.

Colonial waterbirds, including gulls (*Laridae* sp.), terns (*Sternidae* sp.), skimmers (*Rynchopidae* sp.) and wading birds, nest in rookeries in several locations within the Complex. The Wolf Lake area in Brazoria NWR is a management priority for nesting colonial waterbirds (USFWS, 2013b).

Twelve raptor species are known to utilize the Complex, six of which may nest on the Brazoria NWR. Species that are suspected to nest within the Refuge include crested caracara (*Caracara cheriway*), northern harrier (*Circus cyaneus*), white-tailed kite (*Elanus leucurus*), swallow-tailed kite (*Elanoides forficatus*), white-tailed hawk (*Buteo albicaudatus*) and red-tailed hawk (*Buteo jamaicensis*), as well as great-horned owl (*Bubo virginianus*). Approximately 90 species of perching birds, including buntings, wrens, mockingbirds and thrashers, thrushes, sparrows, and warblers are also found in the Complex (USFWS, 2013b).

Reptiles and Amphibians

A very rich community of reptiles and amphibians can be found throughout the habitats of the Complex; 24 species of amphibians, 19 species of turtles (including sea turtles) and tortoises, 48 species of lizards and snakes, and one crocodilian are expected to occur within the Complex. Gulf Coast toad (*Incilius nebulifer*), southern leopard frog (*Lithobates sphenocephalus*), red-eared slider (*Trachemys scripta*), green anole (*Anolis carolinensis*), Texas spiny lizard (*Sceloporus olivaceus*), Texas spotted whiptail (*Aspedoscelis gularis*), broad-headed skink (*Plestidon laticeps*), western ratsnake (*Pantherophis obsoletus*), speckled kingsnake (*Lampropeltis holbrooki*), diamond-backed water snake (*Nerodia rhombifer*), northern cottonmouth (*Agkistrodon piscivorus*), and American alligator (*Alligator mississippiensis*) are all species likely to be encountered in the Complex.

Some species are less common, and are of greater conservation interest within the Complex; these species include southern crawfish frog (*Lithobates areolatus*), ornate box turtle (*Terrapene ornata*) three-toed box turtle (*Terrapene triunguis*), map turtles (*Graptemys* spp.), diamond-backed terrapin (*Malaclemys terrapin*), Kemp's Ridley sea turtle (*Lepidochelys kempii*), and timber rattlesnake (*Crotalus horridus*) (USFWS, 2013b, 2015a, 2015b).

Insects

Insects are the most diverse group of animals in existence, and hundreds of species may be found throughout the Complex. Though insects are very important within the biotic communities of the Complex, their presence is less obvious than that of many other taxa; for this reason, insects are poorly documented within the Complex (USFWS, 2013b). Unlike many other groups of insects, butterflies and dragonflies are more easily observed and documented. One-hundred nineteen species, in nine families (Papilionidae, Pieridae, Lycaenidae, Libytheidae, Nymphalidae, Satyridae, Danaidae, and Hesperiidae), of butterfly are expected to occur within the Complex. Some familiar species are tiger swallowtail (*Papilio glaucus*), variegated fritillary (*Euptoieta claudia*), and monarch (*Danaus plexippus*). Thirty species within five families (Aeshnidae, Gomphidae, Macromiidae, Corduliidae, and Libelluidae) of dragonfly are presumed to inhabit the Complex. Most are species of skippers and skimmers (USFWS, 2015a).

3.3.2.2 Aquatic and Marine Species

The Study Area possesses multiple freshwater sources, as well as connections to estuarine and saltwater resources as detailed in Section 3.5. Species included in lists published for the Complex are likely to occur within or near the Study Area. The location of the Complex within the Texas Gulf Coast and the diversity of aquatic habitats allow for a wide range of both aquatic and marine wildlife (Harford, 2013; USFWS, 2013b and 2015a). The communities of fishes and other aquatic and marine animals found within the Complex are discussed below.

Fishes

Approximately 128 species within 36 families of boney fishes and rays are expected to inhabit the waters found within and adjacent to the Complex. Freshwater species include bowfin (*Amia calva*), several species of sunfish (*Lepomis, Centrarchus, Micropterus,* and *Pomoxis* spp.), and grass pickerel (*Esox americanus*). Species inhabiting the coastal bays include red drum (*Sciaenops ocellatus*), sheepshead (*Archosargus probatocephalus*), Gulf toadfish (*Opsanus beta*), and lady fish (*Elops saurus*) (USFWS, 2015a). Many species utilize a range of habitats, moving among fresh, brackish, and saline water; some species move freely among habitats as adults, while other species are tied to specific habitats at different points in their life cycle. Twenty of the species presumed to occur within the Complex have commercial and/or recreational value (USFWS, 2013b).

Other Taxa

In addition to fishes and rays, other vertebrate and invertebrate species inhabit the waters of the Complex. These organisms include several species of crustacean and mollusk, as well as large marine mammals. Notable species are blue crab (*Callinectes sapidus*), brown shrimp (*Farfantepenaeus aztecus*), white shrimp (*Litopenaeus setiferus*), American oyster (*Crassotrea virginica*), and bottlenose dolphin (*Tursiops truncates*) (Harford, 2013; USFWS 2013b).

3.3.3 Threatened & Endangered Species and Other Special Status Species

Table 5 lists the federally and state listed threatened and endangered species and other special status species which have potential to occur in Brazoria County, Texas (TPWD, 2014a). The potential for occurrence is based on both the federal and state species lists by county, and on the Texas Mid-Coast National Wildlife Refuge Complex Comprehensive Conservation Plan and Environmental Assessment (USFWS, 2013b).

Brief species accounts for federally and state listed species with potential habitat within the Study Area are supplied below. Table 5 also identifies species that are Candidates for federal listing as well as Species of Conservation Concern for the USFWS and the Refuge Complex, such as birds protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. Documented occurrences of listed species provided by the TPWD Texas Natural Diversity Database (TXNDD), which maintains information on over 700 natural resource "elements", such as threatened and endangered species and other special status species, are shown in **Exhibit 8**. The only listed species with an Element Occurrence (EO) documented by the TXNDD within the Study Area is the jaguarundi (*Herpailurus yaguarondi*; TXNDD, 2015).

Table 5. Evaluation of Study Area for Preferred Habitat of Federally and State Listed Threatened and Endangered Species, and Refuge Species of Concern (SOC) species listed for Brazoria County, Texas.

Common and Scientific Names **Preferred Habitat Description**	**Potential to Occur in Study Area**	**Status**		
		Federal	**State**	**SOC**
Mammals				
Jaguarundi (*Herpailurus yaguarondi*) Thick brushlands near water.	Not likely to occur.	E	E	
Louisiana black bear (*Ursus americanus luteolus*) Bottomland hardwoods and large tracts of inaccessible forested areas.	No potential to occur	T	T	
Ocelot (*Leopardus pardalis*) Dense chaparral thickets, mesquite-thorn scrub and live oak motts. Avoids open areas.	No potential to occur	E	E	
Plains spotted skunk *(Spilogale putorius interrupta)* Occurs in open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie	Potentially present.		Rare	SOC
Red wolf (*Canis rufus*) Extirpated; formerly occurred throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies.	No potential to occur.	E	E	
West Indian manatee (*Trichechus manatus*) Gulf and bay systems.	No potential to occur.	E	E	
Birds				

Common and Scientific Names Preferred Habitat Description	Potential to Occur in Study Area	Status Federal	State	SOC
American Peregrine falcon (*Falco peregrinus anatum*) Year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	Potentially present during migration.	DL	T	
Arctic Peregrine falcon (*Falco peregrinus tundrius*) Migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	Potentially present during migration.	DL		
Bald eagle (*Haliaeetus leucocephalus*) Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds.	Potentially present.	DL	T	SOC
Black rail (*Laterallus jamaicensis*) Found in salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh, sometimes on damp ground, but usually on mat of previous year's dead grasses; nest usually hidden in marsh grass or at base of Salicornia.	Potentially present.		Rare	SOC
Black skimmer*(Rhynchops niger)* Breeding range almost exclusively coastal, except for some inland lakes. Prefers open sandy areas or gravel or shell bars with sparse vegetation or broad mats of seawrack on salt marsh. Strongly selects colony sites based on presence of other species, especially terns, that provide early warning and/or defense. Winter range consists of coastal beaches, sand or shell bars in estuaries, occasionally beaches of inland lakes.	Not likely to occur.			SOC
Brown Pelican (*Pelecanus occidentalis*) Found largely in coastal and near shore areas, where it roosts and nests on islands and spoil banks.	Not likely to occur.	DL	Rare	SOC
Dickcissel *(Spiza americana)* An obligate grassland specialist; nests in a variety of open grassland habitats. Suitable habitats found in native prairies, restored grasslands, hayfields, old fields in early stages of succession, lightly grazed pastures, no-till crop fields, and linear strips of grassy habitat, such as fencerows, streamsides, and road-sides.	Potentially present during breeding season.			SOC

Common and Scientific Names Preferred Habitat Description	Potential to Occur in Study Area	Status Federal	State	SOC
Eskimo curlew (*Numenius borealis*) Historically occurred during migration. Grasslands, pastures, plowed fields, and less frequently, marshes and mudflats. Texas is located along the migration route from north Alaska and Canada to South America.	Not likely to occur.	E	E	
Fox Sparrow *(Passerella iliaca)* In winter range, prefers thick cover of thickets and underbrush, especially brushy tangles on edge of woods and dense willow or weedy areas along streams.	Potentially present in winter range.			SOC
Gull-billed Tern *(Gelochelidon nilotica)* Nests on sandy beaches or sandy barrier islands in coastal waters, especially near ocean inlets; may nest on eroded earthen levees and gravel islets in shallow, brackish impoundments, exposed mudflats sparsely vegetated with salt grass or on sites composed of dredged-material. In winter range, sometimes found at inland sites such as flooded fields and seasonally flooded bottomlands.	Potentially present year-round.			SOC
Henslow's Sparrow (*Ammodramus henslowii*) Wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking.	Potentially present in winter range.		Rare	SOC
Hudsonian Godwit *(Limosa haemastica)* Variety of inland and coastal wetland habitats: estuaries, mudflats, salt marsh, sandy shores, shell banks, lakes, fresh-water marshes, brackish swamps, flooded rice fields, sewage lagoons, salt ponds, and occasionally uplands. Roost sites include salt marsh, sand spits, small islands, and grassy fields. Spring migrants arrive in North America in early April, with individuals often found well inland of mid-Texas coast. Dates of occurrence during spring migration; Texas, late Mar-late May.	Potentially present during migration.			SOC
Lark Bunting *(Calamospiza melanocorys)* Winter range, forages in sorghum stubble, loafs in tumbleweeds along ditches, frequents cattle feed lots, found in playas and lagunas with abundant green grass and willow. Texas mid-coast at eastern margin of winter range.	Not likely to occur			SOC
Le Conte's sparrow *(Ammodramus lecontei)* Preferred wintering habitat includes old fields and prairies with dense cover of grass or sedge; moist fields of broomsedge, fields with rice stubble, unmowed airfield grasslands and pastures, prairie dominated by big bluestem, Indiangrass, or little bluestem.	Potentially present in winter range.			SOC
Least Bittern *(Ixobrychus exilis)* Freshwater and brackish marshes with dense, tall growths of aquatic or semiaquatic vegetation interspersed with clumps of woody vegetation and open water. Occasionally in salt marshes and mangrove swamps.	Potentially present during breeding season.			SOC

Common and Scientific Names Preferred Habitat Description	Potential to Occur in Study Area	Status Federal	State	SOC
Least tern *(Sternula antillarum)* Usually forms colonies on bare or sparsely vegetated sand or dried mudflats along coasts or rivers, but also on sandy or shell islands and gravel and sand pits. Occasionally nests among stones. Prominent use of sand or shell beaches located just above high-tide level swept free of vegetation by periodic, high storm tides, or riverine sandbars on which vegetation is limited by seasonal flooding. Often nests on deposited dredged materials.	Not likely to occur.	E		SOC
Lesser Yellowlegs *(Tringa flavipes)* Inhabits a wide range of wetland habitats from large permanent water bodies to small ephemeral pools; typical wetland features shallow, vegetation-filled pond with adjacent open mud flats. Examples include salt, brackish, and freshwater marshes, wet meadows, mud flats (especially those with shallow tide or rain pools), estuaries, mangrove swamps, sandbars, riverbanks, lakeshores, rain puddles, sewage lagoons, reservoirs, prairie sloughs, and salt pans.	Potentially present in winter range.			SOC
Loggerhead Shrike *(Lanius ludovicianus)* Open country with short vegetation and well-spaced shrubs or low trees, particularly those with spines or thorns. Frequent agricultural fields, pastures, old orchards, riparian areas, desert scrublands, savannas, prairies, golf courses, and cemeteries; often seen along mowed roadsides with access to fence lines and utility poles. In the absence of trees or shrubs, they sometimes nest in brush piles or tumbleweeds. Breeders usually settle near isolated trees or large shrubs. Resident birds use the same habitats all year.	Potentially present year-round.			SOC
Long-billed curlew *(Numenius americanus)* Uses tidal estuaries, wet pasture habitats, and sandy beaches; use of beach habitat relatively uncommon. Commonly roosts in higher elevation salt marsh during high tide. On Gulf Coast, uses shallowly inundated mudflats; frequently moves between intertidal flats and inland areas. Uses flooded and unflooded cultivated rice, managed wetlands, evaporation ponds, and grassland habitats.	Potentially present in winter range.			SOC
Marbled godwit *(Limosa fedoa)* Habitats used by birds in winter similar to those of coastal migrants: coastal mudflats adjoining savannas or meadows, estuaries, sandy beaches, and sandflats; sometimes roosting at salt ponds. Significant roost sites in nearby marshes. During high tide, frequent scrub and fallow dry fields adjacent to bays and lagoons; during low tide, found in mangrove and salt-marsh channels, as well as pocket sandy beaches or river mouths.	Potentially present in winter range.			SOC

Common and Scientific Names Preferred Habitat Description	Potential to Occur in Study Area	Status Federal	State	SOC
Mississippi kite *(Ictinia mississippiensis)* Prefer larger, unfragmented forests, but with considerable nearby open habitat, including pasture and cropland, linear waterways, lesser-used roads, levees, and small lakes. Rarely use small woodlots in extensive areas of cultivation, narrow riparian woods, tree plantations, or isolated trees.	Potentially present during breeding season.			SOC
Nelson's sparrow *(Ammodramus nelsoni)* Winters in coastal cordgrass marshes, occasionally in cattail; birds often leave tidal marshes only when forced out by high tides, when they may become concentrated along shorelines.	Potentially present in winter range.			SOC
Northern bobwhite *(Colinus virginianus)* Requires early successional habitats that can exist across a wide variety of vegetation types. Agricultural fields and grasslands, open, park-like pine and mixed pine-hardwood forests, and grass-brush rangelands all provide high-quality habitat and can produce fall–early winter densities of 2.2–4.4 birds/ha, depending on numerous factors, such as frequency and intensity of disturbance and size of disturbance patches. Presence of invasive, exotic grasses can diminish usable habitat space present on the landscape for bobwhites by reducing native forbs and arthropods that provide seed and protein foods.	Potentially present year-round.			SOC
Painted bunting *(Passerina ciris)* Partly open situations with scattered brush and trees, riparian thickets and brush, and weedy and shrubby areas; semi-open country with scattered bushes and trees, tall roadside or streamside brush and patches of grasses (especially bristle grass [Setaria spp.]), weeds, and wildflowers; becomes scarce when trees are too scarce or too dense.	Potentially present during breeding season.			SOC
Piping plover (*Charadrius melodus*) Wintering migrant along the Texas Gulf Coast; beaches and bay shore mud and sandflats, algal flats or salt flats; barrier island beaches and spoil islands on the GIWW.	Not likely to occur..	T	T	
Red knot (*Calidris canutus rufa*) Rarely inland. Prefers coastal and bay shorelines; peat banks, salt marshes, intertidal flats, and brackish lagoons; tidal mudflats and mangroves; sandy beaches, and herbaceous wetlands.	Not likely to occur.	T		SOC
Red-headed woodpecker *(Melanerpes erythrocephalus)* In addition to mature forests and woodlands, attracted to burns and favors disturbance and restoration of savanna-like habitats; areas with numerous standing snags, beaver ponds, marshes, and swamps; gallery forests of tallgrass prairies if mast is abundant.	Potentially present in winter range.			SOC

Common and Scientific Names Preferred Habitat Description	Potential to Occur in Study Area	Status Federal	State	SOC
Reddish egret (*Egretta rufescens*) Resident of Texas Gulf Coast. Prefers brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear.	Potentially present year-round.		T	SOC
Rusty blackbird *(Euphagus carolinus)* Swamps, wet woodlands, and pond edges, usually not associated with other blackbirds. Cypress (Toxodium) lagoons, stream and pond borders, and adjacent fields. Cedar (Juniperus) thickets fringing open marsh, and swampy woodlands; small flocks feed in open fields, often near marshland.	Potentially present in winter range.			SOC
Sandwich tern *(Thalasseus sandvicensis)* Year-round resident of Texas Gulf Coast. Primarily coastal areas; nests on low, sandy, flat islands near shore, barrier islands, and artificial dredge-spoil islands. Roosts on sand bars, beaches, and reefs.	Not likely to occur			SOC
Seaside sparrow *(Ammodramus maritimus)* Occupies tidal marshes throughout most of range. Vegetation use varied and opportunistic. Most breeding populations require nest sites above spring tides, and openings in vegetation; pools and creek edges, where birds can forage on open mud and at bases of rooted vegetation. In nonbreeding period, concentrate in tall stands of smooth cordgrass, usually in sheltered areas along waterways.	Potentially present year-round.			SOC
Sedge wren *(Cistothorus platensis)* Tall growths of sedges and grasses in wet meadows, hayfields, retired croplands, upland margins of ponds and marshes, coastal marshes; frequents grassy marshes in coastal areas but dry grass fields (especially those with broom-sedge) in inland areas.	Potentially present in winter range.			SOC
Short-billed dowitcher *(Limnodromus griseus)* Prefers saltwater habitat; most common on tidal flats, beaches, salt marshes, sewage ponds, and flooded agricultural fields. Coastal mudflats and brackish lagoons.	Potentially present in winter range.			SOC
Short-eared owl *(Asio flammeus)* Almost always associated with open country supporting cyclic small mammals; typically large expanses of prairie and coastal grasslands, shrub-steppe and also agricultural areas. May use large open areas within woodlots, stubble fields, fresh and saltwater marshes, weedy fields, dumps, gravel pits, and shrub-thickets.	Potentially present in winter range.			SOC
Snowy plover *(Charadrius nivosus)* Primarily coastal habitats; beaches, tidal flats, lagoon margins, and salt-evaporation ponds; bay side mudflats and saltflats. Inland some birds regularly winter at agricultural waste-water ponds and saline lakes.	Not likely to occur.	T		SOC

Common and Scientific Names Preferred Habitat Description	Potential to Occur in Study Area	Status Federal	State	SOC
Sooty tern (*Onychoprion fuscatus*) Migratory and dispersive. Winters more widely through the tropical and subtropical areas of ocean. Rarely comes to land except to breed in colonies on rocky or coral islands, April – July. Predominately "on the wing"; does not dive, but snatches small fish and squid with bill as it flies or hovers over water.	No potential to occur		T	
Sprague's pipit *(Anthus spragueii)* Only in Texas during migration and winter, mid-September to early April; short to medium distance, diurnal migrant; strongly tied to native upland rairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.	Potentially present during migration and in winter range.	C	Rare	SOC
Swainson's warbler *(Limnothlypis swainsonii)* Variety of habitats including bottomland hardwood forests, mixed mesophytic montane forests, and early-seral pine stands. Species typically found in areas with shaded and dense understory, abundant leaf litter, and little herbaceous ground cover. Generally found in large contiguous forests, but within these can occupy different age classes of habitat provided the appropriate structure exists.	Not likely to occur. .			SOC
Swallow-tailed kite *(Elanoides forficatus)* More important than topography or specific vegetation communities is physical structure of vegetative landscape. Key feature is association of tall, accessible trees for nesting with open areas that provide sufficient small, easily subdued prey. May be small stands or tree islands in prairie-like setting; low-density forest of uneven structure interrupted by open areas of shrub, swamp, or marsh vegetation; or denser forest, frequently interspersed with various sorts of openings.	Potentially present in summer range			SOC
Whimbrel *(Numenius phaeopus)* Mostly tidal flats (mud preferred over sand); also hard mudbanks. To a lesser extent, coral reefs, lagoons, marshes, swamps, estuaries, sandy beaches, and rocky shores. Also mangroves, where birds forage in surrounding mud, roosting in trees at high tide. Also (especially at high tide) terrestrial habitats, including dunes, meadows, short grass, fields, and highland and alpine meadows.	Potentially present in winter range.			SOC
White-faced ibis (*Plegadis chihi*) Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats.	Potentially present year-round.	-	T	SOC

Common and Scientific Names Preferred Habitat Description	Potential to Occur in Study Area	Status Federal	State	SOC
White-tailed hawk (*Buteo albicaudatus*) Near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March-May.	Potentially present year-round.	-	T	SOC
Whooping crane (*Grus americana*) Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties.	Potentially present on winter range	E	E	
Wilson's plover *(Charadrius wilsonia)* Coastal areas of high salinity and sparse vegetation including salt flats, coastal lagoons, sand dunes, newly accreted beach, dry sand beach above tidal area, overwash areas, and predunes. Typical vegetation on Texas salt flats includes saltwort (Batis maritima) and glasswort (Salicornia sp.). Common plants associated with beach areas are sea oats, beach elder, salt-meadow cordgrass (Spartina patens), and Russian thistle (Salsola kali).	Not likely to occur.			SOC
Wood stork (*Mycteria americana*) Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.	Potentially present during migration and in winter range.	-	T	SOC
Worm-eating warbler *(Helmitheros vermivorum)* May be most common in spring migration along upper and central Gulf Coast of Texas and Louisiana. Probably restricted to deciduous and mixed deciduous-coniferous forests. Found in sub-canopy and shrub layers during spring migration in coastal plain areas.	Not likely to occur.			SOC
Yellow rail *(Coturnicops noveboracensis)* In winter, Yellow rails appear to prefer drier portions of Spartina stands in coastal marshes. In Texas, wintering birds were primarily associated with dense, low undergrowth dominated by Distichlis spicata and Spartina spartinae, and radio-tagged birds relocated to unburned stands following prescribed burning to managed wetland vegetation.	Potentially present in winter range.			SOC
Reptiles				

Common and Scientific Names Preferred Habitat Description	Potential to Occur in Study Area	Status Federal	State	SOC
Alligator snapping turtle (*Macrochelys temminckii*) Perennial water bodies; deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October.	Potentially present.	-	T	
Atlantic hawksbill sea turtle (*Eretmochelys imbricata*) Gulf and bay system, warm shallow waters especially in rocky marine environments, such as coral reefs and jetties, juveniles found in floating mats of sea plants; feed on sponges, jellyfish, sea urchins, molluscs, and crustaceans, nests April through November.	No potential to occur.	E	E	
Green sea turtle (*Chelonia mydas*) Gulf and bay system; shallow water sea grass beds, open water between feeding and nesting areas, barrier island beaches; adults are herbivorous feeding on sea grass and seaweed; juveniles are omnivorous feeding initially on marine invertebrates, then increasingly on sea grasses and seaweeds; nesting behavior extends from March to October, with peak activity in May and June.	No potential to occur.	T	T	
Kemp's Ridley sea turtle (*Lepidochelys kempii*) Gulf and bay system, adults stay within the shallow waters of the Gulf of Mexico; feed primarily on crabs, but also snails, clams, other crustaceans and plants, juveniles feed on sargassum and its associated fauna; nests April through August.	No potential to occur.	E	E	
Leatherback sea turtle (*Dermochelys coriacea*) Gulf and bay systems, and widest ranging open water reptile; omnivorous, shows a preference for jellyfish; in the US portion of their western Atlantic nesting territories, nesting season ranges from March to August.	No potential to occur.	E	E	
Loggerhead sea turtle (*Caretta caretta*) Gulf and bay system primarily for juveniles, adults are most pelagic of the sea turtles; omnivorous, shows a preference for mollusks, crustaceans, and coral; nests from April through November.	No potential to occur.	T	T	
Gulf salt marsh snake *(Nerodia clarkii)* Occurs in saline flats, salt marshes, coastal bays, and brackish river mouths along the Gulf of Mexico.	Potentially present.		Rare	SOC
Smooth green snake *(Opheodrys (Liochlorophis) vernalis)* Occurs in Gulf Coast Prairies and Marshes in dense, mesic coastal short grass prairie vegetation.	Potentially present.		T	SOC

Common and Scientific Names Preferred Habitat Description	Potential to Occur in Study Area	Status Federal	State	SOC
Texas diamondback terrapin *(Malaclemys terrapin littoralis)* Coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide.	Not likely to occur.		Rare	SOC
Texas horned lizard (*Phrynosoma cornutum*) Desert scrub, grassland, savanna. Open regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September.	Not likely to occur.	-	T	SOC
Texas scarlet snake *(Cemophora coccinea lineri)* Prefers mixed hardwood scrub and shrubland on sandy soils. Active April – September. Texas scarletsnakes are rarely encountered animals, found mainly in sandy thickets along the Gulf Coast. Occassionaly scarletsnakes are dug up from as deep as 2 meters (6 ft) during the construction of foundations or ditches for pipelines.	Not likely to occur.		T	SOC
Texas tortoise *(Gopherus berlandieri)* Prefers open brush with a grass understory and occupy shallow depressions at base of bushes and cactus, in underground burrows, or under objects. Active March-November and breed April-November.	Potentially present.		T	SOC
Timber (Canebrake) rattlesnake (*Crotalus horridus*) Swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto.	Potentially present.	-	T	SOC
Fishes				
American eel *(Anguilla rostrata)* Coastal waterways below reservoirs to gulf; spawns January to February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; most aquatic habitats with access to ocean, muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries; diet varies widely, geographically, and seasonally.	Potentially present in sloughs and bayous.		Rare	SOC
Blue sucker *(Cycleptus elongatus)* Occurs in larger portions of major rivers in Texas.	Not likely to occur.		T	SOC

Common and Scientific Names Preferred Habitat Description	Potential to Occur in Study Area	Status Federal	State	SOC
Sharpnose shiner (*Notropis oxyrhynchus*) Endemic to Brazos River drainage; also, apparently introduced into adjacent Colorado River drainage; large turbid river, with bottom a combination of sand, gravel, and clay-mud.	Not likely to occur.	E	-	
Smalltooth sawfish (*Pristis pectinata*) Young found very close to shore in muddy and sandy bottoms, seldom descending to depths greater than 32 ft (10 m); in sheltered bays, on shallow banks, and in estuaries or river mouths; adult sawfish are encountered in various habitat types (mangrove, reef, seagrass, and coral), in varying salinity regimes and temperatures, and at various water depths, feed on a variety of fish species and crustaceans.	Not likely to occur.	E	E	
Mollusks				
False spike mussel (*Quincuncina mitchelli*) Possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins.	Not likely to occur.	C	T	
Smooth pimpleback (*Quadrula houstonensis*) Small to moderate streams and rivers, moderate size reservoirs; mixed mud, sand, and fine gravel. Tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms. Lower Trinity (questionable), Brazos, and Colorado River basins.	Potentially present.	C	T	
Texas fawnsfoot (*Truncilla macrodon*) Little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River basins.	Potentially present.	C	T	
Texas pimpleback *(Quadrula petrina)* Flowing water of moderate-sized streams and small rivers; historically known from the San Antonio and Guadalupe River systems; not currently known to occur in the Study Area.	Not likely to occur.	C	T	
Plants				

Common and Scientific Names Preferred Habitat Description	Potential to Occur in Study Area	Status Federal	State	SOC
Coastal gay-feather (*Liatris bracteata*) Texas endemic; coastal prairie grasslands of various types, from salty prairie on low- lying somewhat saline clay loams to upland prairie on non-saline clayey to sandy loams	Occurs in the study area.	-	-	SOC
Giant sharpstem umbrella-sedge (*Cyperus cephalanthus*) On saturated, fine sandy loam soils, along nearly level fringes of deep prairie depressions; depressional areas within coastal prairie remnant on heavy black clay. Preferred soils include very strongly acid to moderately alkaline silt loams and silty clay loams.	Potentially present.	-	-	SOC
Texas meadow-rue (*Thalictrum texanum*) Mostly found in woodlands and woodland margins on soils with a surface layer of sandy loam, but it also occurs on prairie pimple mounds; both on uplands and creek terraces. Most common on claypan savannas; soils are very moist during its active growing season.	Not likely to occur.	-	-	SOC
Texas windmill-grass (*Chloris texensis*) Sandy to sandy loam soils in relatively bare areas in coastal prairie grassland remnants, often on roadsides where regular mowing may mimic natural prairie fire regimes.	Not likely to occur.	-	-	SOC
Threeflower broomweed (*Thurovia triflora*) Near coast in sparse, low vegetation on a veneer of light colored silt or fine sand over saline clay along drier upper margins of ecotone between salty prairies and tidal flats; further inland associated with vegetated slick spots on prairie mima mounds.	Occurs in the study area.	-	-	SOC
E = Endangered, T = Threatened, DL = De-Listed, C = Candidate for listing, SOC = Species of Concern or Conservation Need, "-" = not federally or state listed, TPWD considers this is a rare species or species of concern				
Adapted from: Texas Parks and Wildlife Department Annotated County List of Rare Species for Brazoria County, Revised 3/23/2015; U.S. Fish and Wildlife Service IPaC Trust Resource Report, Generated 9/9/2015; and The Texas Mid-Coast NWR Complex Comprehensive Conservation Plan, 09/2013.				

Protected species listed in **Table 5** with mapped Element Occurrence (EO) polygons or with potential preferred habitat within the Study Area are discussed in further detail below.

Mammals

Jaguarundi

The jaguarundi is federally and state listed as endangered. One mapped occurrence of jaguarundi is reported by TXNDD across the Study Area in 1991 (EO ID 2150). Preferred thick brush habitat is mapped within the Study Area by National Land Cover Database (NLCD) but does not occur within the area of permanent ROW or TWS of Alternative A. EO ID 2150 is the only record of jaguarundi on Brazoria NWR in the TXNDD. See Section 3.12,

Birds

White-faced Ibis

The white-faced ibis is state listed as threatened for Brazoria County. White-faced ibis habitat includes freshwater marshes, sloughs, and irrigated rice fields. These ibis nest in marshes, low trees, and on the ground in bulrushes or reeds, or on floating mats (TPWD, 2014a). The white-faced ibis was previously documented to nest within the Complex, however, there are no known recent sightings of nesting White faced ibis within the Complex (USFWS, 2012).

White-tailed Hawk

White-tailed hawk is state listed as threatened. White-tailed hawk habitat includes coastal prairies, live-oak scrub, and cordgrass flats; inland habitat includes prairies, mixed savanna-chaparral, and mesquite and oak savannah (TPWD, 2014a). The white-tailed hawk is state listed as threatened and is a year-round resident that nests at the Complex. This species is sensitive to human disturbance and may abandon a nest due to human disturbance (USFWS, 2012). White-tailed hawks primarily feed on small mammals.

Whooping Crane

Whooping crane is federally and state listed as endangered. The whooping crane breeds, migrates, winters, and forages in a variety of wetland and other habitats, including coastal marshes and estuaries, inland marshes, lakes, ponds, wet meadows and rivers, and agricultural fields. Bulrush is the dominant vegetation type in the potholes used for nesting, although cattail, sedge, musk-grass, and other aquatic plants are common. During migration, whooping cranes use a variety of habitats; however, wetland mosaics appear to be the most suitable. For feeding, whooping cranes primarily use shallow, seasonally and semi permanently flooded palustrine wetlands for roosting, and various cropland and emergent wetlands.

Wintering habitat in the Aransas NWR, Texas, includes salt marshes and tidal flats on the mainland and barrier islands, dominated by salt grass, saltwort, smooth cordgrass, glasswort, and sea ox-eye (USFWS, 2015b). Whooping cranes do not regularly occur on the Complex (USFWS, 2013b). Preferred inland marsh, pond and wet prairie habitat for the whooping crane is available within the Study Area.

Wood Stork

Wood storks are listed as threatened in the state of Texas. Preferred habitat, including ditches, sloughs and shallow wetlands is available in the Study Area. Wood storks are known to occur along Austin Bayou (TPWD, accessed 2015).

Plants

Coastal Gay Feather

Coastal gay-feather is a rare species listed in Brazoria County. Coastal gay-feather prefers coastal prairie grasslands ranging from salty prairie to slightly saline clay loams. Non-saline clayey or sandy loams are also preferred in upland prairies. EO ID 3062 is located along FM 2004 near the intersection of FM 208 (**Exhibit 11).**

Smooth blue-star

Smooth blue-star is a rare species listed in Brazoria County. Habitat descriptions and species accounts are scarce and limited.

3.4 Human Environment

3.4.1 Human Health and Safety

Praxair's standard operating procedures for human health and safety, compliance with federal and state regulations, as well as adherence to industry standards will be followed. Risks to public health and safety are negligible.

Hydrogen is transported as an odorless, colorless and tasteless gas. No odorant is added to hydrogen prior to transportation (USDOE, 2011). Hydrogen is non-toxic, non-poisonous, rises and rapidly disperses, and generally does not occur in high enough concentrations to cause asphyxiation.

Nitrogen is an odorless, colorless, tasteless gas. As a nonflammable gas, nitrogen is not regulated by Alternative A. Nitrogen is a known asphyxiant even at low concentrations and exposure to rapidly expanding nitrogen can cause frostbite (Praxair, 2014).

As part of the operation and maintenance performed by Praxair for the proposed project, leak detection is an important part of compressed gas systems and is part of Praxair's standard operation and maintenance. Risks to public health and safety from Alternative A are not significant.

3.4.2 Cultural Resources

The proposed pipelines will be collocated in an existing pipeline corridor for which an intensive cultural resource survey was performed in the fall of 2012 under TAC permit no. 6246. The project APE is commensurate with the previously surveyed area and construction design is such that no impact to any previously recorded cultural resource sites will occur. Therefore, no survey was recommended for the project as it exists within the Brazoria NWR. Concurrence with this recommendation was received from the THC on October 8, 2014 (**Appendix A**). The Refuge Manager was notified that no cultural resource survey would be necessary on Refuge property in January of 2015 (**Appendix A**).

A file search was conducted of relevant cultural resources and previous investigations within 0.5 mile (800 m) of the proposed Dual Pipeline project. Records utilized during this process included the THC's on-line Restricted Archaeological Sites Atlas, the National Park Service's NRHP database and GIS Spatial Data, the National Historic Landmarks Program, reports of previous archeological investigations within the proposed project study area as well as previously recorded cultural resource site files, and secondary sources concerning the prehistoric and historic background of the area were reviewed.

Prehistoric site 41BO161 is located within the Study Area where it crosses on the north bank of Austin Bayou. Site 41BO161 has been designated ineligible for the NRHP by the THC but will not be impacted as Austin Bayou will be traversed by HDD. Located 0.49 miles southeast of the project, site 41BO194 is a prehistoric site with an unknown eligibility status. This site will not be impacted by the Dual Pipeline project.

3.4.3 Land Use

As stated previously, the Study Area encompasses 26,191 acres; 12,025 acres are within Brazoria NWR and 14,166 acres are outside of the refuge. Land use within the Study Area is comprised of open water, developed land, barren land, deciduous forest, shrub/scrub, herbaceous areas, hay/pasture, cultivated crops, woody wetlands, and emergent wetlands as defined by the NLCD (**Exhibit 10**). Acreages associated with the different land uses and land cover types as classified by the NLCD are provided in **Table 6**. Land use and land cover types are defined in the NLCD at a lower resolution and in broader habitat categories than the habitat types documented on the Refuge and therefore cannot be used to determine soil saturation or constrain vehicle use within the Refuge. Further detail regarding the vegetative cover types in the Study Area is included in Section 3.10.1.

Table 6. Land Uses and Land Cover Types within the Dual Pipeline project Study Area, Brazoria County, Texas.

Land Use or Land Cover Type	Acres
Open water	582
Developed, open space	327
Developed, low intensity	141
Developed, medium intensity	17
Barren land	81
Deciduous forest	12
Shrub/scrub	377
Herbaceous	1,198
Hay/pasture	692
Cultivated crops	1,163
Woody wetlands	4,618
Emergent herbaceous wetlands	16,983
Total in Study Area	26,191

Source: National Land Cover Database (Homer et al, 2007).

Land use within the non-refuge portion of the Study Area is primarily agricultural, with smaller areas of development for residential and recreational facilities. Certain portions of the Study Area outside the Refuge are managed as seasonal wildlife habitat, primarily for waterfowl.

Overall, the primary land use of Brazoria NWR is wildlife and habitat conservation (USFWS, 2013b). The Refuge provides recreational opportunities, including hunting, fishing, scenic and wildlife observation, and education, approximately 34,000 visitors come to Brazoria NWR each year. The Refuge is open year-round. Visitors can travel to parts of the Refuge via designated vehicle routes, established foot trails, and by boat through Nicks, Salt, and Lost lakes by way of the Gulf Intracoastal Waterway or Bastrop Bayou. The Refuge Discovery Center includes a visitor center and space for educational events. Seasonal events, including tours, exhibits, and nature walks, also take place at the Refuge. Many of the foot trails and all of the designated hunting and fishing areas are located south of the Study Area (USFWS, 2013c).

3.4.4 Socioeconomic Resources

Socioeconomics measures the social and economic conditions in a region. Such measures include population and housing statistics, tax revenues, and availability of public services. The U.S. Census Bureau provides population characteristics for various geographic levels, including counties and cities. This section discusses the population demographics and economic status of neighborhoods adjacent to the project and the potential impacts of the proposed project, based on the 2010 U.S. Census.

The proposed project will end in the City of Freeport, Brazoria County, Texas, approximately 50 miles south of Houston, Texas. The City of Freeport is popular for industrial use and is located at the mouth of the Brazos River where it flows into the Gulf of Mexico. The city includes the Dow Chemical Plant, one of the world's largest petrochemical complexes (City of Freeport, 2014).

The Brazoria NWR is located approximately 10 miles from the center of Freeport. Numerous other small towns are located between 30 to 90 miles from the Refuge including Angleton, Lake Jackson, Danbury, and Rosharon. The Freeport Chamber of Commerce lists Brazoria NWR as one of the area's main attractions. The refuge averages about 34,000 visitors per year (USFWS, 2013c). Fishing, camping, boating and other water sports are listed by the Chamber of Commerce as recreation opportunities in the vicinity. The Refuge plays a role in the local economy as refuge employees typically live in the community, own property and support local businesses through routine purchases.

Demographics and Employment

The U.S. Census of 2000, indicates there were 12,708 people residing in the City of Freeport and current data from the U.S. Census of 2010, shows there has been a decrease in population to 12,049 (**Table 7**). The median household income in the City of Freeport is less than Brazoria County and Texas median incomes. An estimated 13.8 percent of people are unemployed in the City of Freeport, which are higher than Brazoria County and Texas unemployment rates.

Table 7. Demographics, Employment and Income Data from the U.S. Census Bureau (2010).

Parameter	Brazoria County, Texas	City of Freeport, Texas	Texas
Population Total	313,166	12,049	25,145,561
Population 16 years and over*	241,190	8,783	19,468,136
In labor force (percent)*	65.4	61.9	65.2
Employed Estimate (percent)*	61.1	53.3	59.4
Unemployment rate Estimate (percent)*	6.4	8.6	5.2
Estimated Median household income ($)*	67,603	33,800	51,900

Source: U.S. Census, 2010 Note (*):Data are based on 2009-2013 American Community Survey, 5 year estimates, year 2013.

In the City of Freeport, the largest industry is reported to be construction (19.8 percent); with educational services, health care, and social assistance (17.7 percent) second; and manufacturing third (16.6 percent). The smallest industries are wholesale trade (0.6 percent), information (0.6 percent), and agriculture, forestry, fishing and hunting, and mining (1.2 percent; U.S. Census Bureau, 2015).

Lake Jackson/Angleton urbanized areas had a total population of 81,000 reported in 2009. Sixty-two percent of the population was employed; 31 percent were not in the labor force (U.S. Census Bureau, 2013). The largest industry for the Lake Jackson/Angleton area was educational services, health care and social assistance (20.8 percent), followed by manufacturing (15.7 percent), construction (12.8 percent) and arts, entertainment and recreation (10.3 percent). The smallest industry was agriculture, forestry, fishing and mining (0.9 percent).

Property Value

Any potential damages to USFWS property during project operation would likely be along the permanent ROW and at above-ground appurtenant facilities. Land disturbed by the project would be restored to the extent practicable; fences and land productivity damaged or adversely affected during construction would be repaired and restored; and property owners would be compensated for any additional damages caused by project construction. Although the permanent ROW would be restored after construction, continued access to the project ROW would be required to support inspections and any necessary repairs and/or maintenance for the useful life of the project.

3.4.5 Public Use/Recreation

Recreation areas within the study area include wildlife observation areas along CR208. Mottled Duck marsh and the Butterfly Unit (north of CR 208) provide opportunities for visitors to view wildlife in a freshwater wetland and a natural prairie off of the gravel County Road. Otter Slough boardwalk and photo blind are across for the Brazoria Field Office. Austin Bayou can be accessed by boat. Fishing and wildlife watching are the primary activities along Austin Bayou.

3.4.6 Noise

Sound levels have been calculated for areas that exhibit typical land uses and population densities. In rural recreational and agricultural lands, ambient sound levels are expected to be approximately 30 to 40 dBA (EPA 1974, Harris 1991). These typical noise levels result primarily from equipment operations during ranching and farming activities and vehicular traffic on rural roads. In comparison, the noise level during normal conversation of two people 5 feet apart is approximately 60 dBA.

Noise effects wildlife in various ways. Temporary or permanent displacement and physiological effects may result from high nose levels. Increased noise may mask wildlife communications important to attract mates or defend territories, result in nest abandonment in birds, and decrease the reproductive success of effected species (EPA, 1980).

Construction and traffic noise would be elevated as a consequence of construction of the Dual Pipeline project. The greatest increase would be within the ROW along access roads, equipment operation at staging areas, during trenching, pipe placement, backfilling, HDD and boring activities. Based on the data summarized in **Table 8**, approximately 74 to 84 dBA at 50 feet and 54 to 64 dBA at 800 feet would be created by the project. These noise levels would be temporary, and limited to the construction phase of the project.

The Study Area is not located within an urban or residential area, thus large numbers of sensitive receptors are absent. However, Brazoria NWR is a space in which serenity and quiet have an elevated significance and may serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose (FHWA, 1995). Praxair will adhere to proper equipment maintenance and operation, as well as limiting idle time of equipment, in efforts to avoid and minimize unnecessary noise impacts during construction of the Dual Pipeline project.

Table 8. Appropriate Maximum A-weighted (dBA) Sound Levels for Various Noise Sources.

Noise Source	Actual at 50 feet (dBA)
Transporter/skids	84
HDD Rigs	83
Boring Rigs	83
Excavators	81
Tractor Trailers	84
Welding Rigs	74
Utility Trucks/Trailers	75

This is a simplified description of some typical noise levels that may occur within the Study Area.
Source: FHWA Construction Noise Handbook, 2006.

3.4.7 Aesthetic and Visual Resources

The aesthetic qualities of landscapes are considered visual resources, and have value to residents and visitors of an area. Visual resources may include physical terrain, hydrological features, vegetation, and anthropogenic features. Certain viewpoints such as residences, roadways, recreation areas, and rivers may heighten the importance of visual resources. All landscapes have inherent visual values that warrant different management strategies; aesthetic judgment of the landscape is often considered subjective.

3.4.8 Environmental Justice

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

In addition to Executive Order 12898, Title VI of the Civil Rights Act of 1964, addresses persons belonging to minority and low income populations. Title VI states that "No person in the United States shall, on the ground of race, color, or national origin be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance" (U.S. Department of Justice, 1998).

The identification of minority populations was based on the CEQ guidance document *Environmental Justice Guidance under the National Environmental Policy Act (1997).* Based on this guidance, the manner by which minority populations should be identified is either: (a) the minority population of the affected area exceeds 50 percent, or (b) the minority population

percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis and who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.

Based on Census 2010 demographics data, the City of Freeport consists predominately of Hispanic population of 59.9 percent, followed by a White population at 26.5 percent (**Table 9**). The Hispanic population in city of Freeport is higher than in Brazoria County and Texas. Some other races (2.4 percent) and Black or African Americans (11.2 percent) are present.

Table 9. Minority Populations for the city of Freeport, Brazoria County and Texas (U.S. Census Bureau, 2010).

	Total Pop.	**Race (percent)**							
		Hisp.	White Non-Hisp.	Black or African Am.	Native Am.	Asian	Native Hawaiian and Other Pacific	Some Other Race	Two or more Races
City of Freeport	12,049	59.9	26.5	11.2	0.2	0.5	0.0	0.1	1.4
Brazoria County	313,166	27.7	53.2	11.8	0.3	5.4	0.0	0.2	1.4
Texas	25,145,561	37.6	45.3	11.5	0.3	3.8	0.1	0.1	1.3

Source: Census 2010, Demographic Profile Data, DP-1

"Low-income" refers to a median household income at or below the DHHS poverty guidelines. The 2015 DHHS poverty guideline for a family of four is $24,250 (DHHS, 2015). The median income within the City of Freeport is estimated at $33,800 (**Table 10**), which is above the DHHS poverty guideline.

Table 10. Income and Poverty Characteristics from U.S. Census Bureau (2010).

Area	**Population**	**Estimated Median Household Income***	**Percent Estimate of Families Below Poverty Level****
City of Freeport	12,049	33,800	23.6
Brazoria County	313,166	67,603	8.2
Texas	25,145,561	51,900	13.7

Note (*): Median household income based on American Community Survey, 2009-2013 5 yr estimates. Note (**): Poverty based on American Community Survey, 2009-2013 5 yr estimates; S1702

As reported by the American Community Survey in 2009, the median income of households in Lake Jackson-Angleton urbanized area was $49,478 in 2009; 16 percent of the population was reported to be in poverty.

Section 4 Environmental Consequences

4.1 Resources Analyzed in this Environmental Assessment

Implementation of the alternatives discussed in this EA could potentially affect the following resources:

Physical Environment

- Climate and Climate Change
- Air Quality
- Soils and Geology
- Water Resources

Biological Resources

- Threatened and Endangered Species
- Vegetation
- Wildlife

Human Environment

- Visual and Aesthetic Qualities
- Cultural Resources
- Land Use
- Socioeconomics
- Environmental Justice
- Human Health and Safety
- Noise Quality

4.2 Definition of Impact Significance

Potential environmental consequences to these resources resulting from each of the considered alternatives are analyzed for each resource. Environmental consequences, or impacts, are defined by NEPA as no impact, negligible, minor, moderate, or significant based on the context and intensity of expected potential impacts (**Table 11**).

Table 11. Levels of Impact Significance.

Impact Level	Description
No Impact	Impacts would not be expected.
Negligible	Impacts would not be expected to be measurable or would be measurable but too small to cause any change in the environment.
Minor	Impacts would be measurable but within the capacity of the affected system to absorb the change.

Impact Level	Description
Moderate	Impacts would be measurable and not within the capacity of the affected system to absorb the change; the impacts could be compensated for with mitigation so the impact would not be substantial.
Significant	Impacts would be measurable and not within the capacity of the affected system to absorb the change, and without major mitigation, could be severe and long lasting.
Quality	Beneficial – would have a positive effect on the physical, social, or cultural environment Negative – would have an adverse effect on the physical, social, or cultural environment
Proximity	Local – would occur within the Study Area Regional – would occur within and outside of the Study Area
Duration	Temporary – would occur during the proposed construction period and within 5 years of disturbance Permanent – would occur when resources have been modified to the extent they would not return to pre-construction conditions.

The nature of the potential impacts may be direct, indirect, or cumulative. Direct impacts result from the action of the project and occur at the same time and place as the action. Indirect impacts occur later in time or farther in distance from the project site, but are still reasonably foreseeable. Cumulative impacts are discussed later in this section.

The environmental consequences of constructing and operating the project would vary in both duration and significance for each resource. Two levels of impact duration were considered for this project: temporary and permanent. This section discusses the affected environment, impacts from construction and operations, and mitigation for each affected resource of the three alternatives analyzed. Note that mitigation is not required under NEPA, but is included when feasible to reduce, avoid, or offset negative impacts.

4.3 Cumulative Impacts Analysis Method and Identified Cumulative Actions

Cumulative impacts are defined as impacts to the environment that result 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 the action. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time (40 CFR 1508.7).

This analysis will address the cumulative impacts of the Proposed Action in combination with other projects or management activities. Activities (past, present, and reasonably foreseeable) that are either located in the vicinity of the project area or have been identified as having the potential for cumulative impacts when considered in addition to the impacts of the Proposed Action are discussed below. These actions will be addressed as appropriate in Section 4.4 through 4.6.

As described in Section 1.3, the proposed Dual Pipeline project lies within an existing and maintained 300-ft wide pipeline corridor crossing the northwest corner of the Refuge that contains

21 pipelines. The Service accepted the land with the outstanding ROW easements in place. Since the land was acquired in fee-title, two additional pipelines have been added to the corridor. On-going operations and maintenance activities on the corridor by existing operators include mowing, surveying, repainting and/or replacing pipeline markers, monitoring gauges and valve stations, integrity testing and monitoring, and maintenance or replacement of pipe and valve stations. In addition, Dow Hydrocarbons and Resources LLC was previously issued a permit to install two, 12-in pipelines in the same corridor. The first of the two, a 12-in propane pipeline, was installed in spring 2014 and Dow is scheduled to install the second, a 12-in ethane pipeline, beginning in January 2016. Construction activities for the second Dow pipeline are anticipated to run until the end of March 2016. Another connected action that will impact the Refuge is a pending 3-D seismic survey by Samson Exploration, LLC (Samson) that is currently planned for the second quarter of 2017. The Service acquired all lands comprising the Brazoria NWR subject to the exercise of privately-held subsurface mineral rights, which include the exploration and development of oil, gas and other hydrocarbons. An Operations Plan and EA were completed in 2013, and a FONSI was issued in March 2014 to conduct the 3-D seismic survey, which will encompass the entire Refuge. The USACE Galveston District approved Samson's permit for the project as a whole in June 2015.

For the purposes of this analysis, projects were considered "reasonably foreseeable" if they could be implemented by 2018. Projects identified in the foreseeable future are construction of a Dow pipeline through the Refuge scheduled to begin in January of 2016 and completed in March, and a 3-D seismic exploration program expected to begin the second quarter of 2017.

The proposed Dow pipeline will use the same corridor as Alternative A. Impacts from construction of the Dow pipeline are expected to be similar to impacts identified for Alternative A during a two month period.

Impacts from the 3-D seismic exploration program are generally minor or moderate. Impacts to soils, hydrology, wildlife and aesthetics will be minimized to the extent possible resulting in short-term and temporary impacts. Historic and archaeological resources will be avoided by the 3-D seismic program. No permanent impacts to land use are expected. Minor impacts to recreational resources are expected because of temporary closures of areas and noise generated during shothole drilling.

4.4 Physical Environment

4.4.1 Impacts to Air Quality

Alternative A

Pipeline construction is expected to take approximately six months. Activities described in Alternative A would result in localized short-term, temporary increases in emissions during ROW grading, trenching, pipe delivery, pipeline installation, welding, backfilling, reclamation and demobilization from the Refuge. Pollutants generated during construction activities would include emissions from vehicles and heavy equipment and fugitive dust (PM_{10} and $PM_{2.5}$) associated with soil disturbance and travel on unpaved roadways. Typical trenching and boring construction activities for the pipeline would occur 6 days/week, 10 hours/day. HDD construction activity would occur 7 days/week, and 24 hours/day. When construction activities are complete, air quality impacts associated with these activities would diminish and decrease to near zero over current levels as vegetation is reestablished.

Construction-related equipment would produce air pollutants associated with diesel and gasoline combustion (nitrogen oxides, carbon and sulfur oxides, hydrocarbons, and PM). These emissions would be confined to the daytime hours and would be generated only during active construction periods. Due to the linear nature of the project, construction-related activities would be short-lived and transient.

The width of pipeline ROW clearing would be kept to a practical minimum to allow for safe construction and operation of the Dual Pipeline project and avoid undue disturbance to existing vegetation. Where trenching is not necessary, clearing will be limited to removal of above ground vegetation to avoid disturbance of root systems, which will help reduce any fugitive dust. Matting used within TWS and the area of permanent ROW will minimize soil disturbance and reduce fugitive dust.

Vehicle and equipment emissions would also occur during the operation and maintenance of the Project, but since these activities would occur infrequently and be of short duration, impacts to air quality from operation and maintenance are expected to be negligible. No permanent impacts to air quality are anticipated; temporary impacts from dust, and construction emissions will occur.

Alternative B

The construction activities under Alternative B are similar to Alternative A. Matting would not be used along the entire route of Alternative B, resulting in greater impacts to soils, vegetation, and increased fugitive dust emissions. Fugitive dust from Alternative B could impact the Refuge during north winds. Alternative B is a longer route increasing construction by approximately 1 month and increasing emissions by approximately 20 percent.

Cumulative Impacts

The cumulative impacts of the project on air quality are minor due to the negligible sources of air emissions associated with construction and operation of Alternative A. Projects in the reasonably foreseeable future would utilize similar equipment and have an equally negligible impact to air quality.

4.4.2 Impacts to Water Quality and Quantity

Alternative A

Impacts to water resources under Alternative A would be minor, local, and temporary. Disturbance of wetlands and streams would be minimized by using HDD techniques under Austin Bayou and Otter Slough (two crossings). Access around Otter Slough at the east crossing, will be on an elevated passage around the edge of the slough. Vehicle will not be permitted in the slough, even if it is dry. Construction activity will be restricted to areas which have been matted to minimize rutting and erosion which is known to contribute to saltwater intrusion. Open cut construction methodologies will be backfilled and returned to pre-construction contours to minimize saltwater intrusion through the pipe trench. The exit hole for the HDD at Austin Bayou will be located at least 100 yards away from the bank of the bayou to eliminate the potential of soil compaction and saltwater intrusion.

The restoration of site contours to pre-construction elevations will allow for the restoration of surface hydrology and sheet flow across the areas in which construction has occurred. Concrete trench breakers will be placed where pipe trenches intersect open water bodies known to contain

tidal flows and prevent additional sources of saltwater intrusion. All water accumulated in pits or the trench will be pumped and returned to the nearest waterbody if necessary.

Alternative B

Impacts to water sources under Alternative B would be similar as Alternative A. A single HDD would be used to cross both Austin Bayou and FM 2004. One unnamed stream near Austin Bayou, Otter Slough and Ditch 10 would be crossed by open cut trench. Concrete trench breakers would be used at the open cut crossings to minimize saltwater intrusion.

Cumulative Impacts

Past impacts to water sources during previous construction of pipelines within the existing corridor appear to be negligible and short-term based on review of aerial photography along the alignment. Minor, temporary impacts to features such as drainage and disturbance of vegetation in wetlands, and impacts to stream stability within the corridor are typical for pipeline construction.

Alternative A will employ matting, erosion control BMPs and trench breakers to avoid and minimize impacts to water resources. The backfilled trench will also be monitored for slumping to avoid saltwater intrusion. No additional cumulative impacts to downstream freshwater habitats from saltwater intrusion are expected from construction of the Dual Pipeline project. Minor, short-term cumulative impacts to water sources may occur from construction of Alternative A in combination with the proposed Dow pipeline and 3-D seismic programs.

4.4.3 Impacts to Soils and Geology

Alternative A

There will be no impacts on the geology from Alternative A. The HDD drilling operations will not be more than 30 foot in depth. Minor impacts to soil may result from pipeline construction activities such as clearing, grading, trench excavation, backfilling, equipment traffic, and restoration along the construction ROW. Potential impacts could include soil erosion, loss of topsoil, soil compaction, soil mixing, and soil contamination. The proposed Construction Plan (**Appendix C**) and Operation and Maintenance Manual incorporates measures that would prevent or minimize these effects to soils on the refuge.

Under Alternative A, Praxair would take special precautions with heavy mechanized equipment when passing near sensitive wetland and transitional upland habitats to minimize impacts. To reduce the potential for soil disturbance through rutting and compaction and the runoff of loose soils, accelerated erosion, and sedimentation of adjacent areas, Praxair will use new timber matting or clean synthetic matting throughout the TWS and area of permanent ROW. New timber matting or clean synthetic matting reduces compaction and mixing of soil, and reduces erosion and runoff from active construction. Wetland soils are easily compacted by traffic. Compaction disrupts hydrology within the soil column and impacts vegetation stabilizing soil.

Implementation of temporary erosion control measures such as erosion control matting or mulching, trench breakers, and slope-breakers or water bars will reduce the likelihood of construction-related erosion. All displaced soils will be side-cast onto matting then returned to preexisting surface elevations. Topsoil and subsoil will be stockpiled separately. Areas disturbed by construction along the pipeline ROW would be allowed to naturally re-vegetate.

Based on the evaluation of potential seismic hazards within the Study Area, the risk of pipeline rupture from earthquake ground motion is negligible. Alternative A does not cross any known active faults and is located outside of known zones of high seismic hazard, reducing the risk of soil contamination due to pipeline rupture.

No significant impacts to soils are anticipated due to the temporary nature of the impact, and all activities occurring within a currently maintained pipeline ROW. No new impacts to soils or geology outside the existing pipeline ROW would occur.

Alternative B

There will be no impacts on the geology from Alternative B. The HDD drilling operations will not be more than 30 foot in depth. Impacts to soils from the construction and operation of the Dual Pipeline project under Alternative B would be minor, and permanent. Under Alternative B, 2.7 miles of new ROW would need to be established west of Austin Bayou, creating new impacts. The same construction and operation practices would be employed as for Alternative A to minimize or avoid more significant impacts from occurring, especially in and around wetlands. Construction of the pipeline will include grading of the new ROW, trenching, backfilling, returning TWS to preconstruction conditions (where trenching is employed), and re-vegetating to complete the restoration of the ROW. Topsoil will be stripped and stockpiled separately from subsoil.

Cumulative Impacts

Minor cumulative impacts may occur to soils in the form of compaction, loss of top soil, erosion or contamination. Cumulative impacts to geology will be negligible.

4.4.4 Impacts to Climate and Climate Change

Alternative A

Alternative A will have a negligible effect upon climate or climate change, nor will it be impacted by climate or climate change over the life of the project. Impacts from construction and operation of the Dual Pipeline project would be negligible.

Alternative B

Impacts on climate and climate change under Alternative B would be the same as that of Alternative A. Impacts from the construction and operation of the Dual Pipeline project would be negligible.

Cumulative Impacts

Projects in the reasonably foreseeable future would utilize similar equipment and have an equally negligible impact to climate change. The cumulative impacts of the project on climate change are negligible due to the minor sources of air emissions associated with construction and operation of Alternative A.

4.5 Biological Environment

4.5.1 Impacts to Vegetative Communities/Habitat

Alternative A

Of the five rare plant species listed for Brazoria County, the coastal gay-feather, giant sharpstem umbrella sedge and Texas broomweed have the potential of occuring within the ROW. The umbrella sedge would be near the margins of Otter Slough. Impact to this species should not occur with the HDD operations and the routing of traffic around the eastern crossing. Coastal gay-feather and three-flower broomweed could occur on the ROW where irregular mowing of the ROW allowed the plants to establish from adjoining prairie.

Under Alternative A, short-term impacts to vegetation occurring from activities such as grading and trenching would be moderate, local, and temporary. Matting which will overlay existing vegetation on the TWS, will enable rapid restoration of the ROW, should sufficient rain fall. The trench or area of permanent ROW will be exposed soil until vegetation is able to restore itself on the disturbed soil. Separating the top soil from the lower soils through "double ditching" will enable quicker restoration of the ROW. However, if needed, the contractor will be utilized to perform re-vegetation of the ROW with local and native seed mixture, impacts would be minor, local, and temporary.

During operation of the pipelines, within the area of permanent ROW, vegetation would be mowed and maintained in a similar manner as it currently is within the pipeline corridor. Once restored, vegetation within the TWS would continue to be mowed on an annual basis by the underlying pipeline operators. If reseeding were to occur to encourage restoration of the permanent ROW or TWS, a slight shift in species composition will occur, however it will not have a significant impact on the overall Study Area. All activities will occur within previously established, currently maintained pipeline ROW; therefore, all impacts to vegetation associated with construction of the proposed project would be local, temporary and minor.

Alternative B

Alternative B crosses two mapped EOs for the coastal gay-feather (EO ID 3162, last observation in 1991) and smooth blue-star (EO ID 1330, last observation in 1970) (**Exhibit 11**). Alternative B was not surveyed for species of concern.

Under Alternative B, impacts to vegetation occurring as a result of 2.7 miles of new ROW establishment would be moderate, local, and temporary to permanent. During pipeline construction, activities such as grading and trenching would remove existing vegetation. After construction, the permanent ROW will naturally re-vegetate and be maintained through periodic mowing. Any vegetation cleared outside of the permanent ROW for temporary work space would be allowed to regenerate. This will result in a shift in species composition, but will not have a significant impact on the overall study area. The impact will be local, permanent and moderate.

Cumulative Impacts

Alternative A will be constructed between 21 pipelines in an existing 300-ft corridor; no permanent change in existing habitat will occur. Impacts to vegetation occurred during construction of previous pipelines currently located within the corridor and continue as

maintenance requirements on existing pipelines adhere to policies governed by the Texas Railroad Commission.

Minor cumulative impacts to vegetation resulting from clearing, soil compaction and disruption of topsoil may occur in the Brazoria NWR. The combined effects of trench excavation, HDD and bore areas, material storage, heavy equipment and additional traffic from Alternative A and foreseeable projects could result in minor, short-term impacts upon vegetation within the ROW. Construction matting will minimize impacts to vegetation and soil by reducing ground disturbance and compaction of topsoil.

Minor cumulative impacts may occur upon vegetation within Alternative A by mowing after construction. The mowed vegetative community in the permitted area of permanent ROW for Alternative A will be similar to the existing pipeline ROW within the corridor but will cause a shift, while vegetation restores, contributing a minor, negative impact to cumulative impacts upon vegetation in the study area. The shift of vegetation within the ROW is minor, being it is already disturbed (mowed on a regular basis) and does not support the species composition and diversity nor cover similar to the adjoining natural habitats. There are no anticipated changes to existing site conditions.

4.5.2 Impacts to Wildlife

Alternative A

During construction and operation of the pipeline, wildlife will experience impacts including, the loss of life, due to collision, and the loss of feeding, roosting, or nesting habitats, due to construction activities, either through removed habitat in the work area or disturbance. Effects of loss of habitats modify an animal's behavior or movements that impact the animal's energy usage and may increase competition due to the loss of available habitat. Because of the amount of available adjacent and suitable habitats, impacts are expected to be minor, local and temporary.

Impacts to aquatic species are not expected during pipeline construction or operation activities. Migratory bird nest surveys would be conducted prior to construction and raptor nests would be given a minimum 328-ft (100 meter) buffer from construction activities during the nesting period of February 1 through July 15.

Alternative B

Conversion of existing prairie to mowed, maintained pipeline ROW would disrupt wildlife movements and result in change of habitat. Noise from heavy equipment and increased traffic during pipeline construction would result in minor, local, and temporary impacts to wildlife.

With the current disturbance of FM 2004, wildlife habitat quality is minimal and the new ROW would not greatly impact species in this area. However, after crossing FM2004 the ROW traverses the 2 Bayou Hunt Club. This property is managed to benefit wildlife habitats providing food, water and shelter for migratory birds and resident wildlife. Impacts to wildlife through this area will be similar to those of Alternative A. Impacts to aquatic species would be similar to Alternative A.

Cumulative Effects

Past construction of pipelines within the corridor resulted in minor, permanent impacts to wildlife habitat. Conversion of wetland and coastal prairie habitat to maintained ROW contributed to fragmentation of those habitats and likely caused minor, long-term impacts to wildlife and their habitats. Loss of habitat, disruption of travel routes, disturbance from heavy equipment and increased traffic during construction and maintenance of existing pipelines within the corridor, likely resulted in minor, short-term impacts to wildlife.

Moderate, short-term cumulative impacts to wildlife resources may occur as a result of Alternative A in combination with the previously permitted Dow pipeline and Samson 3-D seismic survey. The frequency of heavy equipment work and human activity in the Brazoria NWR due to proposed projects in 2016 (Dow and the proposed Dual Pipeline project) and 2017 (3-D seismic) could result in short-term, moderate disturbance to wildlife on the Refuge and in the vicinity. The potential for increased mortality, disrupted wildlife movement and behavior, and reduced available habitat are expected to have a moderate and short-term cumulative impact upon wildlife across the Refuge.

4.5.3 Impacts to Threatened and Endangered Species

Alternative A

Table 12 shows the Threatened and Endangered Species listed for Brazoria County that have potential for being impacted. All other T&E species do not occur within the vicinity of the project site and will not be impacted.

Table 12. Occurrence and impact on potential T & E and candidate species

Species	Potential for Occurrence on Brazoria NWR	Potential Impact if species were present
Arctic peregrine falcon	Low overall – however, chances of encountering the bird increase during winter season. April and October pose the greatest risk of encountering and impacting this species	An individual may be disturbed by activity on the ROW. However because it chases and strikes birds flushed by other disturbance it may utilize disturbance along the ROW for finding prey. Collision with traffic on the ROW while hunting is a possibility.
Northern aplomado falcon	Low – Very Rare Visitor - utilizes open prairie for hunting grassland birds similar to that adjoining ROW.	An individual may be disturbed by activity on the ROW. However because it chases and strikes birds flushed by other disturbance it may utilize disturbance along the ROW for finding prey. Collision with traffic on the ROW while hunting is a possibility.
Bald eagle	Low – may utilize nearby wetlands for hunting	An individual may be disturbed by activity on the ROW. Loss of hunting habitat at Otter Slough due to disturbance of prey species.
White-faced ibis	Low – may utilize nearby	An individual may be disturbed

	wetland for feeding	by activity on the ROW.
White-tailed hawk	Moderate – White-tailed hawks nest on Brazoria, may utilize adjacent prairie and ROW for hunting prey.	An individual may be disturbed by activity. The pipeline ROW and adjacent habitats will not be available for hunting due to pipeline activities.
Whooping crane	Very Low – Very rare visitor – would be more likely to be found utilizing open water, saltmarsh and farm field habitats.	An individual may be disturbed by activity along ROW.
Wood Stork	Moderate – Summer resident can be found utilizing flooded fields and wetlands.	An individual may be disturbed by activity along ROW.
Sprague's pipet	Low – Winter resident can utilize natural and mowed prairie (ROW) for feeding and roost. April and October pose the greatest risk of encountering and impacting this species.	Birds will not be here during the construction phase, however until the pipeline is fully revegetated following construction, the habitat may not be suitable for use.
Alligator Snapping Turtle	Low –may utilize Otter Slough but unlikely to be found in Austin Bayou.	An individual may be disturbed by activity near the banks of Otter Slough.

Although the potential of conflict for an individual bird with Alternative A exists at a low or even moderate level for white-tailed hawk and wood storks, impacts would not affect the population as a whole. Adequate suitable habitat is available on the refuge at other locations to support the presence of these species on the refuge.

Alternative B

Noise from heavy equipment and increased traffic during pipeline construction, as well as the operation and maintenance of a new pipeline (60 ft) ROW would result in moderate, local, and both temporary and permanent impacts to wildlife. Alternative B includes approximately 56.97 acres of preferred habitat for white-faced ibis, white-tailed hawk, whooping crane, and wood stork is located within the area of permanent ROW and TWS of Alternative B as it crosses 2 Bayous Hunt Club (west of Austin Bayou) .

Cumulative Impacts

Alternative A will be constructed between 21 pipelines in an existing 300-ft corridor; no permanent change in habitat would occur. Impacts to vegetation and wildlife occurred during construction of pipelines currently located within the corridor. Past impacts to vegetation communities, wildlife and available habitat within the corridor are anticipated to be minor, local and temporary.

4.6 Human Environment

4.6.1 Impacts to Human Health and Safety

Alternative A

The Brazoria NWR is day-use only and open for wildlife watching, waterfowl hunting and fishing. Construction and work zone signs, flagging personnel and controlled access to work areas will be required necessary to prevent Refuge visitors from entering active construction areas. Hunting is generally limited to the south portion of the Refuge.

Praxair's standard operating procedures and industry standards seek avoidance and minimization of impacts to human health and safety from construction and operation of Alternative A. Subcontractors and construction crews would adhere to industry health and safety standards for pipeline construction. Risks to properly trained construction crews are not significant.

Alternative B

Impacts to human health and safety under Alternative B are similar to Alternative A.

Cumulative Impacts

Cumulative impacts to human health and safety are not significant due to the surrounding land use, adherence to federal and state safety regulations, standard operating procedures, and industry safety standards.

4.6.2 Impacts to Cultural Resources

Alternative A

The proposed project construction and operation activities within the Brazoria NWR would have no impacts to any previously recorded cultural resource sites. As the project APE is commensurate with an intensive investigation performed in 2012 under TAC permit no. 6246, the THC concurred that no additional survey work was necessary within the Refuge and construction activities should be allowed to proceed without further consultation (**Appendix C**). If cultural resources are encountered during construction of the proposed project, construction will cease at that location until a qualified professional archeologist can assess the significance of the findings in consultation with federal and state agencies.

Alternative B

Implementation of Alternative B for the Dual Pipeline project would result in no new impacts to any cultural resource sites within the Brazoria NWR. Outside the Refuge, file review showed that no impacts to any previously recorded cultural resources would be anticipated as a result of Alternative B. No previous investigations have been performed along the Alternative B alignment; proximity to previously recorded sites in the area, perennial waterways, remnant channels and oxbow lakes, there is high probability of impacting previously unrecorded prehistoric cultural material along the Alternative B alignment.

Cumulative Impacts

Contribution to the cumulative impacts to cultural resources in the Refuge resulting from construction would result in above and belowground disturbances within the APE. The project APE is commensurate with an area previously subject to an intensive archaeological investigation under TAC permit no. 6246. This investigation was performed in accordance with NHPA of 1966 (PL 89-665), as amended, NEPA of 1969, the Procedures for the Protection of Historic and Cultural Properties (36 CFR 800), the guidelines set forth by the Council of Texas Archaeologists, the THC, the Register of Professional Archaeologists, and Section 4(f) of the US Department of Transportation Act of 1966 (PL 89-670). These investigations resulted in the identification of no new cultural resource sites within the Refuge or within the existing ROW (Scott 2012). Previously recorded site 41BO161 along Austin Bayou will be avoided by current construction plans to HDD the waterway. No impacts to any cultural resource sites, NRHP properties, or NRHP-eligible properties are anticipated.

THC concurrence for the recommendation of no additional survey within the Brazoria NWR and recommendation to allow construction to proceed as planned was received on August 8, 2014 (**Appendix C**). If cultural resources are encountered during construction of the proposed project, construction will cease at that location until a qualified professional archeologist can assess the significance of the findings.

4.6.3 Impacts to Land Use

Alternative A

Changes in land use due to construction would be minor, local and temporary. Alternative A follows existing maintained pipeline corridor. With the exception of the mainline valve site, all disturbed areas will be restored to preconstruction contours and allowed to naturally re-vegetate. At the conclusion of the proposed Dual Pipeline project, all land will be allowed to revert to preconstruction uses.

Expected impacts to land use during operation of Alternative A would be negligable, local, and temporary. No significant impacts to land use are anticipated due to the temporary nature of the impacts. After completion of construction, land use will be similar to the adjacent pipeline corridors.

Alternative A does not involve the placement, erection or removal of materials, and is not an increase in the intensity of use in the coastal zone. Pre-construction contours will be restored following construction. No impacts to the local floodplain are expected from construction of Alternative A.

A letter of consistency was received from USACE ensuring the Dual Pipeline's consistency with the Texas Coastal Management Plan (**Appendix B)**.

Alternative B

Land use would be permanently altered under Alternative B, as 5.75 miles of new ROW would need to be established west of Austin Bayou. This would temporarily impact approximately 1.2 acres of PEM habitat, 13.6 acres of upland grassland and permanently impact 6.1 acres of upland forest. These habitats would become mowed, maintained pipeline corridor.

Cumulative Impacts

Cumulative impacts to land use are negligible. The land within Alternative A and immediately adjacent is an existing, cleared pipeline corridor. Minor, local and temporary impacts to land use would result from construction of pipelines within and along this corridor in the future. The proposed 3-D seismic program would not significantly impact land use (Cardno Entrix, December 2013).

4.6.4 Impacts to Socioeconomic Resources

Alternative A

No adjacent communities or neighborhoods would be bisected by Alternative A. Implementation of Alternative A would not result in any changes to the surrounding neighborhoods; sections of the Study Area are already developed by existing pipelines. The Study Area includes 15 houses which are located anywhere from 0.5 mile and 2.0 miles from the project; none are immediately adjacent to the proposed Preferred Alternative alignment within the Brazoria NWR.

The Dual Pipeline project would result in short-term positive economic benefits within Brazoria County; local expenditures by associated subcontractors and crews on food and lodging, local purchase of supplies and fuel, and potentially, local leasing or contracting of auxiliary services would occur. The short-term nature of the project reduces the likelihood of most local residents being affected socially or economically because of the proposed action. Brazoria County would likely receive most of the short-term socioeconomic benefits; the Brazoria NWR is at least 7 miles away from more dense populations.

Alternative B

A total of 17 driveways to commercial or residential properties are within or immediately adjacent to the Alternative B alignment, immediately north of FM 2004 and would be bisected by Alternative B. The properties are within the city of Angleton, zip code 77515. The homes are within Census Tract 6624, Block Group 4, and Block 4078. Census data is available for census tract but not for block group or at block level.

Implementation of Alternative B would result in short-term changes and indirect impacts to the surrounding neighborhood as a result of construction of the project and if driveways to existing properties are impeded. Access to the properties would be hindered and property owners would potentially need to be rerouted to homes and businesses. No residences are immediately adjacent to Alternative B workspaces; no neighborhoods would be directly affected.

Like Alternative A, the Dual Pipeline project would result in short-term positive economic benefits within Brazoria County; local expenditures by associated subcontractors and crews on food and lodging, local purchase of supplies and fuel, and potentially, local leasing or contracting of auxiliary services would occur. The short-term nature of the project reduces the likelihood of most local residents being affected socially or economically because of the proposed action. Brazoria County would likely receive most of the short-term socioeconomic benefits.

Cumulative Impacts

Alternative A crosses the Brazoria NWR, an undeveloped wildlife refuge. No significant cumulative impacts to adjacent communities or neighborhoods would occur from construction of Alternative A or projects identified in the reasonably foreseeable future.

4.6.5 Impacts to Public Use/Recreation

Alternative A

Construction activities will negatively impact wildlife observation from CR208. Enhanced vehicular activity in and out of the pipeline will short-term and moderate during the estimated 6 months required to complete the pipeline. The HDD at Austin Bayou will have a negative impact on fishing and wildlife observation activities at Austin Bayou for the approximate one week of activity to complete the HDD.

Alternative B

Construction activities will negatively impact wildlife observation along FM2004 during construction. Enhanced vehicular traffic just north of FM2004 will be short-term and moderate during the estimated 4 months of construction.

Cumulative Impacts

No significant cumulative impacts to public use/recreation would occur from construction of Alternative A or projects identified in the reasonably foreseeable future.

4.6.6 Noise Disturbance

Alternative A

Construction and operation of Alternative A would create typical noise from pipeline construction as described in **Table 11**. Noise generated by construction activities will vary along the 4.3-mile project depending on the particular activity occurring at that time in the construction sequence. The FM 2004 to CR 208 segment will be the first segment completed (approx. 5 weeks) Once completed, this segment will not be reentered except immediately adjacent to CR208. The push/pull method for the western most 6,730 feet will reduce the noise along this segment as transport of welders, and inspectors will not be required due to the method of construction. Noise levels associated with the HDD operations will produce short-term but moderate impacts while those operations are in place due to the large machinery needed for the operations. The CR 208 to the start of the push/pull method will have the greatest noise impacts as daily traffic will access the area for approximately 4 months. Noise impacts from construction would be short-term and moderate during the estimated 6 months required to complete construction within the Refuge. Occasional typical operation and maintenance activities would produce temporary, minor, local noise impacts.

Alternative B

Noise impacts from Alternative B would be similar to impacts identified for Alternative A but occurring at closest, in proximity to the Brazoria NWR. The temporary nature of the noise impacts would be extended approximately 1 month beyond the 6 month construction period for

Alternative A. Minor noise impacts would occur for the adjacent residences and one commercial business north of FM 2004. The 2 Bayous Hunt Club, located south of FM 2004, is secluded but intensively managed for hunting.

Cumulative Impacts

Cumulative impacts from construction-related noise as a result of Alternative A when added to other past, present, and reasonably foreseeable future actions are moderate, local and short-term. An increase above ambient noise levels is an expected result of additional traffic on local roads and heavy equipment operation during construction or moving about the Refuge.

4.6.7 Impacts to Aesthetic and Visual Resources

The aesthetic qualities of landscapes are considered visual resources, and have value to residents and visitors of an area. Visual resources may include physical terrain, hydrological features, vegetation, and anthropogenic features. Certain viewpoints such as residences, roadways, recreation areas, and rivers may heighten the importance of visual resources. All landscapes have inherent visual values that warrant different management strategies; aesthetic judgment of the landscape is often considered subjective.

Alternative A

Construction and operation of the project within the Brazoria NWR would have minor, temporary, and local visual impacts resulting from removal of existing vegetation, exposure of bare soils, earthwork and grading, trenching, and machinery and pipe storage.

Permanent impacts to visual and aesthetic qualities would result from construction of the valve site located west of CR 208 (**Exhibit 4** and **Appendix E**).

Visual impacts resulting from ROW disturbance would be temporary since construction will only occur in herbaceous habitats. These impacts will be mitigated after seeding and reestablishment of the ROW.

Backfilling and grading at the conclusion of construction would restore the ROW to its previous contours; re-vegetation would ultimately return the ROW to its previous condition. After backfilling and grading, cleanup would begin to ensure the removal of construction debris, final contouring, and installation of erosion control features. The ROW would be re-vegetated as soon as possible after the completion of cleanup and the ROW would be inspected after the first growing season to determine the success of re-vegetation. Any unsuccessfully re-established areas would be re-vegetated and any eroded areas would be restored.

Permanent, aboveground appurtenances, such as valve sites, will be constructed adjacent to other similar above-ground features. Therefore, no additional visual impacts are anticipated.

No significant impacts to visual and aesthetic qualities are anticipated due to the primary impacts being temporary in nature. Impacts from the one valve site would be considered insignificant as the facilities will be outside of visually sensitive areas. Aesthetic impacts would largely be visible from some places along existing roadways where it intersects with the pipeline ROW, including FM 2004, CR 227, and CR 208, but will be temporary in nature and affect small portions of ROW. No significant impacts to aesthetic resources of the Refuge would be expected

from the construction of the Dual Pipeline project under Alternative A; proposed construction activities occur within currently maintained ROW.

Alternative B

Under Alternative B, construction and operation of the Dual Pipeline project would have result in minor, temporary and permanent, and local visual impacts. Alternative B proposes a pipeline route north and south of FM 2004, making pipeline construction and permanent ROW and above-ground structures much more visible from the roadway. The ROW traversing the 2 Bayou Hunt Club will be a new ROW, requiring regular maintenance, where none currently exists. The increased mileage of Alternative B requires two valve stations to comply with pipeline codes. The addition of another valve station increases the visual impact of Alternative B. Steps would be taken to minimize visual impacts resulting from construction and operation of the pipeline, including backfilling and grading to preconstruction elevations, and re-vegetation of the ROW.

Cumulative Impacts

Cumulative impacts on visual resources exist from past and current use of the existing pipeline corridor. Pipeline markers, valves and above-ground appurtenances within the existing pipeline corridor contrast from surrounding wetland and coastal prairie habitats. Construction typically includes signage, exposed soil, erosion control devices, stockpiled materials, heavy equipment activity on the refuge access roads, and increased traffic on local roads. These items are typically removed or restored to pre-construction conditions after completion of the project, and are thereby short-term impacts to visual and aesthetic resources.

The primary difference would be that the maintained ROW is periodically mowed which might look different to adjacent natural habitats. As the maintained ROW recovers from mowing, it becomes less conspicuous when compared to adjacent natural habitats. The proposed Dow pipeline is expected to have similar, minor impacts to visual and aesthetic qualities. Impacts to aesthetics from the 3-D seismic program are expected to be temporary; placement of equipment and traffic during seismic exploration activity may crush or clear vegetation. In conjunction with projects identified within the foreseeable future, minor, short-term cumulative visual and aesthetic impacts from projects in the reasonably foreseeable future are expected.

4.6.8 Environmental Justice

Alternative A

The study area has some residential and commercial use; no residences occur within the existing pipeline corridor. Rural areas predominate within the Refuge and the Study Area; therefore, impact to environmental justice populations is unlikely.

Alternative A (its construction or operation) would not result in indirect, direct, or cumulative adverse and disproportionate impacts on environmental justice populations because Alternative A is located in an area that does not contain a disproportionately high concentration of minority or low-income populations. Implementation of the proposed action is anticipated to benefit the surrounding communities.

Alternative B

The alignment for Alterative 1 crosses a small community of 42 residences and 20 commercial properties. Based on the aerial review of the community conditions in the study area and reported low poverty level at 16 percent, in 2009 for the Lake Jackson-Angleton area, it is unlikely that impacts to environmental justice populations would occur.

Alternative B (its construction or operation) is not anticipated to result in indirect, direct, or cumulative adverse and disproportionate impacts on environmental justice populations because Alternative B is located in an area that does not contain a disproportionately high concentration of minority or low-income populations. Implementation of the proposed action is anticipated to benefit the surrounding communities.

Cumulative Impacts

No low-income or minority populations are located near the proposed Preferred Alternative. The land surrounding Alternative A is dominated by undeveloped land. Foreseeable future projects (Dow pipeline; 3-D seismic survey) will have similar footprints with regards to Refuge access and use. Cumulative impacts would be negligible with regard to environmental justice concerns.

4.7 Summary of Impacts

A summary of expected impacts from Alternative A and Alternative B presented in **Table 12.1** and **Table 12.2** below.

Table 12.1. Summary of physical attributes of Alternative A and Alternative B for the Dual Pipeline project, Brazoria County, Texas.

Project Feature		Alternative A	Alternative B
Alignment Length (miles)		4.75	5.75
Within Brazoria NWR	Permanent ROW (acres)	5.16	0
	TWS (acres)	41.39	0
Outside Brazoria NWR	Permanent ROW (acres)	1.37	20.92
	TWS (acres)	6.47	56.11
Matting (LF)		22,248	14,960*
Construction Time (months)		6	7
HDD crossings (count)		4	1
HDD crossing length (LF)		4,319	1,302
Bore crossings (count)		2	2
Bore crossing length (LF)		278	230
Valve Stations		1	2

Table 12.2. Summary of Impacts to Resources from Alternative A and Alternative B for the Dual Pipeline project, Brazoria County, Texas.

Resource	Alternative A	Alternative B
*NWI Wetlands (acres)	17.40	16.55
Hydric Soils Crossed (LF)	25,071	30,380
Preferred Habitat (acres)	54.45	58.20
National Wildlife Refuge Crossed (LF)	22,489	0
Cultural Resources (Potential impact, Y/N)	No impacts to previously recorded sites. THC concurrence for no survey required.	No impacts anticipated to previously recorded sites. Crosses high probability area.
Air Quality	Diesel and gasoline emissions, fugitive dust typical of construction.	Diesel and gasoline emissions, fugitive dust typical of construction.

Resource	Alternative A	Alternative B
		Approximately 20 percent more emissions than Preferred Alternative due to extended construction time.
Land Use change	No change in land use of permanent ROW. All TWS will be allowed to re-vegetate.	Permanent change to 20.39 acres of new permanent ROW.
Socioeconomics	No adjacent residences. Short-term economic benefits to Brazoria County.	Indirect impacts to 47 residences and 23 commercial properties. Access to properties hindered during construction.
Environmental Justice	No impacts on environmental justice populations	Not likely to impact environmental justice populations.
Human Health and Safety	Risks are not significant.	Risks are not significant.
Noise	Brazoria NWR is secluded and a high-value, low noise area. Moderate impacts to wildlife and visitors to the Refuge from noise are expected.	Minor impacts to residences and commercial business. Negligible impacts to wildlife. Secluded, but 2 Bayous Hunt Club is managed intensively for recreational hunting.

Table 12.3. Summary of Findings to Resources from Alternative A and Alternative B for the Dual Pipeline project, Brazoria County, Texas.

Resource	Alternative A	Alternative B
Climate and Climate Change	No Effect	No Effect
Air Quality	Adverse, local, temporary and negligible	Adverse, local, temporary and negligible
Geography	No Effect	No Effect
Soil	Adverse, local, temporary and minor	Adverse, local, permanent and minor
Water Resources	Adverse, local, temporary and minor	Adverse, local, temporary and minor
Threatened and Endangered Species	Adverse, local, temporary and minor	Adverse, local, temporary and minor
Vegetation	Adverse, local, temporary	Adverse, local, permanent

Resource	Alternative A	Alternative B
	and moderate	and moderate
Wildlife	Adverse, local, temporary and moderate	Adverse, local, temporary and minor
Visual and Aesthetic Resources	Adverse, local, temporary and negligible	Adverse, local, temporary and negligible
Cultural Resources (Potential impact, Y/N)	No Effect	Adverse, local permanent and minor
Land Use change	No Effect	Adverse, local, permanent and minor
Socioeconomics	Beneficial, regional, temporary and minor	Beneficial, regional, temporary and minor
Environmental Justice	No Effect	No Effect
Human Health and Safety	No Effect	No Effect
Noise	Adverse, local, temporary and moderate	Adverse, local, temporary and moderate

4.8 Irreversible and Irretrievable Commitment of Resources

An irreversible or irretrievable commitment of natural resources refers to impacts on or losses to resources that cannot be recovered or reversed. Irreversible refers to the loss of future options and primarily applies to non-renewable resources or resources which are only renewable over long periods of time. Irretrievable refers to the loss of production, harvest, or use of natural resources.

Project construction would require the irretrievable commitment of fossil fuels (diesel and gasoline), oils, and lubricants used by heavy equipment and vehicles. Natural resources used to manufacture pipe and appurtenant components of the Dual Pipeline project would be required. Alternative A would result in unavoidable minor harassment to some wildlife in the immediate vicinity of ongoing construction. Unavoidable loss of opportunity for wildlife watching in the CR 208 vicinity of Alternative A will occur during construction. Minor and temporary inconvenience may be realized by visitors having to avoid or tolerate heavy equipment along CR 208 which traverses Brazoria NWR.

4.9 Indirect Effects

Indirect effects are anticipated to occur as a result of the project and are removed by distance or time, but remain in the reasonably foreseeable future (US DOT FHWA 1/21/2015). The construction phase of the pipeline will ultimately have the greatest impact on wildlife. During construction, avoidance and flushing from the ROW corridor are the greatest indirect impacts on wildlife resources. The only way to reduce indirect impacts is to reduce the length and amount of exposure.

Alternative A will co-construct two pipelines within an existing, maintained 300-ft pipeline corridor. The existing corridor contains 21other pipelines and has been in use since prior to 1944. Future pipelines may be forced to expand the existing corridor, establish a new corridor through Brazoria NWR or find an alternate route, potentially impacting additional similar resources in the region.

4.10 Short-Term Use of the Environment vs. Long-Term Productivity

Construction of Alternative A would result in use of a permanent pipeline easement and associated above-ground facilities. Impacts to long-term productivity of wetlands and coastal prairie crossed by the pipelines are not anticipated to occur. Most impacts will be temporary and minor to moderate; pre-construction contours will be restored and the easement will be allowed to re-vegetate to closely resemble adjacent natural vegetation. Large tracts of similar habitat are adjacent to the pipeline corridor.

4.11 Unavoidable Adverse Effects and Mitigation Measures

All action alternatives have some unavoidable adverse impacts. The selection of Alternative A to utilize space within an existing ROW for the installation of the Praxair Duel Pipeline Project would require mitigation for the short-term and long-term impacts to refuge resources. Praxair has agreed to minimize the impacts during construction activities to the soil, vegetation and wetlands with the use of matting the entire TWS and HDD under the wetlands. Although the long-term impacts of the pipeline will be negligible do to its being managed in the same manner as its current state, short-term impacts will be moderate both from direct and indirect impacts on wildlife and vegetation communities. Mitigation is required through the conservation of similar habitats that will be managed by the National Wildlife Refuge System in perpetuity. To achieve this end, mitigation funds will be directed to a third party non-profit organization and utilized for acquisition for the Texas Mid-coast National Wildlife Refuge Complex.

Section 5 Consultation, Coordination and Document Preparation

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Section 6 Exhibits

Exhibit 1 – Vicinity Map

Exhibit 2 – Site Map

Exhibit 3 – Biotic Province and Coastal Management Zone Map

Exhibit 4 – Alternative A (Proposed Alternative) Project Map

Exhibit 5 – Alternative B Project Map

Exhibit 6 – Texas Ecological Systems Classification Map

Exhibit 7 – USGS Soils Map

Exhibit 8 – Texas Natural Diversity Database Map