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Office of Energy Projects
Washington, DC 20426

Texas LNG Project
Draft Environmental Impact Statement
Volume II - Appendices

Texas LNG Brownsville, LLC

October 2018
Docket No. CP16-116-000
FERC/EIS-0288D

Cooperating Agencies:

U.S. Environmental Protection Agency

U.S. Department of Transportation

U.S. Coast Guard

U.S. Department of Energy

U.S. Army Corps of Engineers

U.S. Fish and Wildlife Service

Federal Aviation Administration

National Park Service

National Oceanic Atmospheric Administration - National Marine Fisheries Service

APPENDIX A

DISTRIBUTION LIST

APPENDIX A

DISTRIBUTION FOR THE NOTICE OF AVAILABILITY

Federal Government Agencies

Federal Emergency Management Administration, Mr. Tony Robinson, TX

National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Mr. Miles Croom, FL

National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Mr. Russell Swafford, TX

National Oceanic and Atmospheric Administration. National Marine Fisheries Service, Dr. Roy Crabtree, FL

Natural Resource Conservation Service, Mr. Salvador Salinas, TX

Natural Resource Conservation Service, Cameron County, Mr. Osvaldo Longoria, Jr., TX

Pipeline and Hazardous Materials Safety Administration; Engineering and Research Division PHP-80, Mr. Buddy Secor, Jr., P.E., DC

U.S. Army Corps of Engineers, Galveston District, Col. Richard P. Pannell, TX

U.S. Army Corps of Engineers, Galveston District, Dr. Edmond J. Russo Jr., TX

U.S. Army Corps of Engineers, Galveston District, Lt. Col. Jared Erickson, TX

U.S. Army Corps of Engineers, Regulatory Division, Mr. Dwayne Johnson, TX

U.S. Army Corps of Engineers, Regulatory Division, Mr. Jayson Hudson, TX

U.S. Army Corps of Engineers, Regulatory Division, Ms. Janet Thomas Botello, TX

U.S. Coast Guard, Lt. John Robertson, TX

U.S. Coast Guard, Corpus Christi, Lt. Cmdr. Russell Pickering, TX

U.S. Coast Guard, Sector / Air Station Corpus Christi, Captain Michael S. Antonellis, TX

U.S. Coast Guard, Sector / Air Station Corpus Christi, Captain Samuel R. Creech Jr., TX

U.S. Coast Guard, Sector / Air Station Corpus Christi, Commander Lance C. Belben, TX

U.S. Coast Guard, Sector / Air Station Corpus Christi, Master Chief Ian S. Lee, TX

U.S. Department of Energy, Mr. John Anderson, DC

U.S. Department of Transportation, Mr. Timothy P. Butters, DC

U.S. Environmental Protection Agency, Region 7, Mr. Rob Lawrence, TX

U.S. Fish and Wildlife Service, Dr. Benjamin Tuggle, NM

U.S. Fish and Wildlife Service, Mr. Boyd Blihovde, TX

U.S. Fish and Wildlife Service, Mr. Ernesto Reyes, TX

U.S. Fish and Wildlife Service, Ms. Dawn Gardiner, TX

U.S. Fish and Wildlife Service, Ms. Pat Clements, TX

U.S. Environmental Protection Agency, Region 6, Mr. Bill Honker, TX

U.S. Environmental Protection Agency, Region 6, Mr. John Blevins, TX

U.S Environmental Protection Agency, Region 6, Mr. Ron Curry, TX

U.S. Army Corps of Engineers, Galveston District, Ms. Denise Sloan, TX

National Park Service, Intermountain Region Environmental Quality, Mr. David Hurd, CO

National Park Service, Intermountain Region Environmental Quality, Ms. Melissa Trenchik, CO

National Park Service, Heritage Partnerships Programs, Ms. Christine Whitacre, CO

National Park Service, Heritage Partnerships Programs, Mr. Tom Keohan, CO

National Park Service, American Battlefield Protection Program, Mr. Patrick Jennings, D.C.

National Park Service, Palo Alto Battlefield National Historical Park, Mr. Mark Spier, TX

National Park Service, Palo Alto Battlefield National Historical Park, Mr. Rolando Garza, TX

Office for Oil and Gas Global Security and Supply, Office of Fossil Energy, Kyle Moorman, DC

Office for Oil and Gas Global Security and Supply, Office of Fossil Energy, Brian Lavoie, DC

Senate Energy and Natural Resources Committee, Lisa Murkowski, DC

Army Corps of Engineers, Planning and Policy Division, Attn: CECW-P, DC

Bureau of Indian Affairs, DOI, Terry L McClung, DC

Bureau of Indian Affairs, DOI, BJ Howerton, VA

U.S. Bureau of Land Management, DOI, US Department of Interior, DC

Bureau of Ocean Energy Management, DOI, Dr. Jill Lewandowski, VA

Bureau of Safety and Environmental Enforcement, DOI, David Fish, VA

National Park Service, DOI, Patrick Walsh, CO

Bureau of Oceans & International Environmental & Scientific Affairs, DOS, Alexander Yuan, DC

Council on Environmental Quality, Edward Boling, DC

U.S. Department of Health and Human Services, Mr. Everett Bole, CHMM, DC

Environment and Natural Resources Division, DOJ, US Department of Justice, DC

Environmental Protection Agency, Lawrence Starfield, DC

Environmental Protection Agency, Jerome Blackman, DC

Environmental Protection Agency, Susan E Bromm, DC

National Center for Environmental Health, CDC, HHS, Sharunda Buchanan, GA

USDA Forest Service-Ecosystem Management Coordination, Joe Carbone, DC

Natural Resources Conservation Service, USDA, Andree DuVarney, DC

Conservation and Environmental Program Division, FSA, USDA, Nell Fuller, DC

NOAA National Marine Fisheries Service, Dept. of Commerce, NOAA National Marine Fisheries Service, MD

Office of Environment and Energy, HUD, Danielle Schopp, DC

Office of Environmental Management, DOE, Mark Whitney, DC

US Department of Energy, John Anderson, DC

Office of NEPA Policy and Compliance, DOE, Brian Costner, DC

Office of Federal Programs, Advisory Council on Historic Preservation, Charlene D Vaughn, DC

Surface Transportation Board, USDOT, Victoria Rutson, DC

Office of Assistant Secretary for Transportation Policy, USDOT, Camille Mittelholtz, DC

Office of Assistant Secretary for Transportation Policy, USDOT, Helen Serassio, DC

Pipeline & Hazardous Materials Safety Administration USDOT, William Schoonover, DC

Pipeline & Hazardous Materials Safety Administration, Office of Pipeline Safety, USDOT, Karen Lynch, DC

Office of Pipeline Safety USDOT PHMSA, Kenneth Y Lee, DC

Office of Pipeline Safety USDOT PHMSA, Melanie Stevens, DC

Office of Pipeline Safety USDOT PHMSA, Ahuva Battams, DC

US Geological Survey, Esther Eng, VA

US Customs and Border Protection Dept. of Homeland Security, Christopher Oh, DC

DoD Siting Clearinghouse, Steve Sample, DC

Office of the Deputy Under Secretary of Defense (Installations & Environment), ATTN: Chief, Mission Evaluation Branch, DC

Office of the Deputy Assistant Secretary of the Army (Energy & Sustainability), ATTN: Liaison, DoD Siting Clearinghouse, DC

Office of the Assistant Secretary of the Army for Civil Works, Assistant for Environment, Tribal & Regulatory Affairs, DC

Office of the Assistant Secretary of the Navy (Energy, Installations and Environment), DC

Office of the Deputy Assistant Secretary of the Air Force (Installations), ATTN: Liaison, DoD Siting Clearinghouse, DC

Commandant (CG-OES-4) Chief (Acting), Deepwater Ports Standards Division, U.S. Coast Guard, Curtis E. Borland, DC

Federal Senators and Representatives

Office of U.S. House of Representative Filemon Vela, Ms. Perry Brody, TX

Office of U.S. House of Representative Filemon Vela, Ms. Marisela Cortez, TX

Office of U.S. Senator John Cornyn, Ms. Ana Garcia, TX

Office of U.S. Senator Ted Cruz, Ms. Casandra Garcia, TX

U.S. House of Representatives, The Honorable Filemon Vela Jr., DC

U.S. Senate, The Honorable John Cornyn, DC

U.S. Senate, The Honorable Ted Cruz, DC

State Government Agencies

Texas Parks and Wildlife Department, Mr. Willy Cupit, TX

Railroad Commission of Texas, Mr. David Porter, TX

Railroad Commission of Texas, Mr. Ryan Sitton, TX

Railroad Commission of Texas, Ms. Christi Craddick, TX

Railroad Commission of Texas, Ms. Leslie Savage, TX

Texas Commission on Environmental Quality, Mr. David Galindo, TX

Texas Commission on Environmental Quality, Mr. Erik Hendrickson, P.E., TX

Texas Commission on Environmental Quality, Mr. Steve Hagle, TX

Texas Commission on Environmental Quality, Ms. Kate Stinchcomb, TX

Texas Commission on Environmental Quality, Ms. Ruth Alvirez, TX

Texas General Land Office, Mr. George P. Bush, TX

Texas General Land Office, Mr. Tony Williams, TX

Texas Historical Commission, Mr. David Camarena, TX

Texas Historical Commission, Mr. Mark Wolfe, TX

Texas Parks and Wildlife Department, Cameron County, Mr. David Veale, TX

Texas Parks and Wildlife Department, Ms. Julie Wicker, TX

Texas Parks and Wildlife Department, Robin Riechers, TX

State Officials

State of Texas, The Honorable Eddie Lucio Jr., TX

State of Texas, The Honorable Ken Paxton, TX

State of Texas, The Honorable Dan Patrick, TX

State of Texas, The Honorable Greg Abbott, TX

State of Texas, Secretary Carlos Cascos, TX

State Senators and Representatives

Office of Representative Eddie Lucio, III, Mr. Ruben O'Bell, TX

Office of Representative Rene Oliveira, Mr. JJ Garza, TX

Office of Senator Eddie Lucio, Jr., Mr. Louie Sanchez, TX

State of Texas, Representative Eddie Lucio III, TX

State of Texas, Representative René O. Oliveira, TX

Local Government Agencies

Brownsville Chamber of Commerce, Ms. Andrea Figueroa Benton, TX

Brownsville Independent School District, Dr. Esperanza Zendejas, TX

Brownsville Independent School District, Mr. Cesar Lopez, TX

Brownsville Independent School District, Mr. Jose Hector Chirinos, TX

Brownsville Independent School District, Ms. Minerva M. Pena, TX

Cameron County, Mr. Alex Dominguez, TX

Cameron County, Mr. Armando Lucio, TX

Cameron County, Mr. Bennie Ochoa, TX

Cameron County, Mr. Charles "Chuck" D. Hoskins, TX

Cameron County, Mr. Dan Sanchez, TX

Cameron County, Mr. David A. Betancourt, TX

Cameron County, Mr. David A. Garza, TX

Cameron County, Mr. David Garcia, TX

Cameron County, Mr. David Hanawa, TX

Cameron County, Mr. Frutoso Gomez, TX

Cameron County, Mr. Gus Reyna Jr., TX

Cameron County, Mr. Humberto Barrera, TX

Cameron County, Mr. Joe E. Vega, TX

Cameron County, Mr. Luis V. Saenz, TX

Cameron County, Mr. Omar Lucio, TX

Cameron County, Mr. Pete Sepulveda Jr., TX

Cameron County, Mr. David Garcia, TX

Cameron County, Mr. Tony Yzaguirre, Jr., TX

Cameron County, Ms. Martha Galarza, TX

Cameron County, Ms. Sofia C. Benavides, TX

Chamber of Commerce Port Isabel, Ms. Betty Wells, TX

Chamber of Commerce South Padre Island, Ms. Roxanne Guenzel, TX

City of Brownsville, Dr. Rose M.Z. Gowen, TX

City of Brownsville, Mr. Charlie Cabler, TX

City of Brownsville, Mr. Damaris McGlone, TX

City of Brownsville, Mr. Joe Chavez, TX

City of Brownsville, Mr. John Villarreal, TX

City of Brownsville, Mr. Leonardo Perez, TX

City of Brownsville, Mr. Michael Warrix, TX

City of Brownsville, Mr. Odee A. Leal, TX

City of Brownsville, Mr. Orlando Rodriguez, TX

City of Brownsville, Mr. Pete Gonzalez, TX

City of Brownsville, Mr. Ricardo Longoria Jr., TX

City of Brownsville, Mr. Robert Esparza, TX

City of Brownsville, Mr. Santana Torres, TX

City of Brownsville, Ms. Deborah Portillo, TX

City of Brownsville, Ms. Jessica Tetreau-Kalifa, TX

City of Brownsville, The Honorable Tony Martinez, TX

City of Brownsville, Mr. Cesar de Leon, TX

City of Port Isabel, Mr. Charlie Wood, TX

City of Port Isabel, Mr. Daniel Marchan, TX

City of Port Isabel, Mr. Jared Hockema, TX

City of Port Isabel, Mr. Gually Gonzalez, TX

City of Port Isabel, Mr. Jeffery David Martinez, TX

City of Port Isabel, Mr. Juan Jose Zamora, TX

City of Port Isabel, Mr. Martin C. Cantu, TX

City of Port Isabel, Mr. Rodrigo Garcia, TX

City of Port Isabel, Ms. Maria de Jesus Garza, TX

City of Port Isabel, Mr. Joe E. Vega, TX

City of San Benito, Mr. Manuel Lara, TX

City of South Padre Island, Mr. Alex Avalos, TX

City of South Padre Island, Mr. Bill DiLibero, TX

City of South Padre Island, Mr. Dennis Stahl, TX

City of South Padre Island, Mr. Marcus Smith, TX

City of South Padre Island, Mr. Randy Smith, TX

City of South Padre Island, Mr. Sam Listi, TX

City of South Padre Island, Ms. Alita Bagley, TX

City of South Padre Island, Ms. Julee LaMure, TX

Laguna Madre Water District, Mr. Jeff Keplinger, TX

Laguna Madre Water District, Mr. Rick Wells, TX

Laguna Madre Water District, Mr. Scott D. Friedman, TX

Los Fresnos, Mr. Mark Milum, TX

Point Isabel Independent School District, Dr. Lisa Garcia, TX

Point Isabel Independent School District, Mr. Henry LeVrier, TX

Point Isabel Independent School District, Mr. Joseph Furcron, TX

Point Isabel Independent School District, Mr. Jimmy Vela, TX

Point Isabel Independent School District, Ms. Bertha Zamora, TX

Point Isabel Independent School District, Ms. Cecilia Castillo, TX

Point Isabel Independent School District, Ms. Diane O'Leary, TX

Point Isabel Independent School District, Ms. Jennifer Pinkerton, TX

Point Isabel Independent School District, Ms. Olga Vega-Carter, TX

Port Isabel Chamber of Commerce, Ms. Betty P. Wells, TX

Port Isabel Chamber of Commerce, Ms. Ramona Kantack, TX

Rio South Texas Economic Council, Ms. Alma Puente Colleli, TX

South Padre Island, The Honorable Barry Patel, TX

Town of Laguna Vista, Ms. Susie Houston, TX

Town of Laguna Vista, Mr. Mike Carter, TX

Town of Laguna Vista, Ms. Wanda Reyes-Rice, TX

Town of Laguna Vista, Mr. Frank T. Davalos Jr., TX

Town of Laguna Vista, Ms. Leti Martinez Keplinger, TX

Town of Laguna Vista, Mr. Gary Meschi, TX

Town of Laguna Vista, Mr. Richard Hinojosa, TX

Town of Laguna Vista, Mr. Ronaldo Vela, TX

Town of Laguna Vista, Mr. Anthony Alan David, TX

Town of Laguna Vista, Mr. Robert McGinnis, TX

Native American Groups

Alabama-Coushatta Tribe of Texas, Mr. Bryant Celestine, TX

Alabama-Coushatta Tribe of Texas, Mr. Ronnie Thomas, TX

Apache Tribe of Oklahoma, Mr. Lyman Guy, OK

Comanche Nation, Oklahoma, Mr. Jimmy Arterberry, NM

Comanche Nation, Oklahoma, Mr. Wallace Coffey, OK

Jicarilla Apache Nation, Mr. Jeffery Blythe, TX

Jicarilla Apache Nation, Mr. Ty Vincenti, NM

Kickapoo Traditional Tribe of Texas, Mr. Juan Garza, Jr., OK

Kiowa Tribe of Oklahoma, Ms. Amber Toppah, NM

Mescalero Apache Tribe, Mr. Danny H. Breuninger, Jr., NM

Mescalero Apache Tribe, Ms. Holly Houghten, TX

Tonkawa Tribe of Oklahoma, Mr. Donald L. Platterson, OK

Ysleta Del Sur Pueblo of Texas, Mr. Frank K. Paiz, TX

Libraries

Brownsville Public Library System, Ms. Brenda Trevino, TX

Brownsville Public Library System, Ms. Corinna Galvan, TX

Port Isabel Public Library, Ms. Janie Villarreal, TX

Companies and Organizations

710 KURV, Mr. Davis Rankin, TX

Ambiotech Engineering, Dr. Carlos Marin, TX

Audubon Texas , Mr. Pete Moore, TX

Brazos Santiago Pilots Association, Captain Grant S. Wilson, TX

Brownsville Downtown Lions Club, Ms. Tina Ruiz, TX

Brownsville Economic Development Council, Mr. Gilbert Salinas, TX

Brownsville Economic Development Council, Mr. Jason Hilts, TX

Brownsville Economic Development Council, Ms. Lizzy de la Garza Putegnat, TX

Brownsville Historical Association, Ms. Tera Putenga, TX

Brownsville Nite Lions, Mr. Jesse Gonzales, TX

Brownsville Public Utilities Board, Mr. Murith Galonsky, TX

Brownsville Public Utilities Board, Mr. Fernando Saenz, TX

Brownsville Public Utilities Board, Mr. John Bruciak, TX

Brownsville Public Utilities Board, Mr. Rafael Vela, TX

Brownsville Public Utilities Board, Ms. Edna Oceguera, TX

Brownsville Rotary Club, Mr. Nick Tipton, TX

Cameron County Historical Commission, Ms. Betty Agado, TX

Economic Development Corporation, South Padre Island, Ms. Darla Lapeyre, TX

Gladys Porter Zoo, Dr. Patrick M. Burchfield, TX

Gladys Porter Zoo, Ms. Cynthia Garza Galvan, TX

Gobar Systems Inc., Mr. Rolando Gonzalez Barron, TX

International Bank of Commerce, Brownsville, Mr. Fred Rusteberg, TX

Island Services Realty, Mr. Robert Pinkerton Jr., TX

KGBT, Mr. Tom Keeler, TX

KGBT, Ms. Roni Silva, TX

KGBT, Ms. Tiffany Huertas, TX

KRGV, Ms. Shelley Childers, TX

KVEO, Ms. Marty Watson, TX

Leadership Brownsville, Mr. Eddie Sikes, TX

Lower Laguna Madre Coastal Conservation Association, Mr. Oscar Garcia, TX

Lower Laguna Madre Coastal Conservation Association, Mr. Travis Flanagan, TX

Lower Laguna Madre Coastal Conservation Association, Mr. Wes Hudson , TX

Lower Rio Grande Valley Development Council, Mayor Chris Boswell, TX

Lower Rio Grande Valley Development Council, Mr. Terrie G. Salina, TX

Port Isabel - San Benito Navigation District, Mr. Steven B. Bearden, TX

Port Isabel Economic Development Corporation, Mr. Scott Friedman, TX

"Port Isabel Economic Development Corporation, Mr. Inocente

Zurita, TX"

Port Isabel Economic Development Corporation, Mr. Jimmy Vela, TX

Port Isabel Economic Development Corporation, Mr. Larry Ellis, TX

Port Isabel Rotary Club, Ms. Jacqui Dempsey, TX

Port Isabel South Padre Press, Ms. Dina Arevalo, TX

Port Isabel/San Benito Navigation District , Mr. Steve Bearden, TX

Port of Brownsville, Mr. Ariel Chavez, TX

Port of Brownsville, Mr. Carlos Garcia, TX

Port of Brownsville, Mr. Carlos R. Masso, TX

Port of Brownsville, Mr. Eduardo A. Campirano, TX

Port of Brownsville, Mr. Eduardo Campirano, TX

Port of Brownsville, Mr. John Reed, TX

Port of Brownsville, Mr. John Wood, TX

Port of Brownsville, Mr. Mario Esquivel, TX

Port of Brownsville, Mr. Ralph Cowen, TX

Port of Brownsville, Mr. Sergio "Tito" Lopez, TX

Port of Brownsville, Ms. Beatrice G. Rosenbaum, TX

Port of Brownsville, Ms. Donna Eymard, TX

Rio Grande Valley Partnership, Mr. Julian Alvarez, TX

Rio Grande Valley Partnership, Ms. Deborah Cordova, TX

Rio Grande Guardian, Mr. Joey Gomez, TX

Rio Grande Guardian, Mr. Steve Tyler, TX

San Benito News, Mr. Jacob Lopez, TX

Texas Economic Development Corporation, Ms. Romina Black, TX

Texas Economic Development Council, Mr. Carlton Schwab, TX

Texas Rio Grande Legal Aid, Mr. Robert Duggett, TX

Texas Southmost College, Dr. Lily F. Tercero, TX

Texas Southmost College, Dr. Reynaldo Garcia, TX

Texas Southmost College, Mr. Art Rendon, TX

Texas Southmost College, Mr. Ed Rivera, TX

Texas Southmost College, Mr. Francisco (Kiko) Rendon, TX

Texas Southmost College, Mr. Ramon Hinojosa, TX

Texas Southmost College, Mr. Trey Mendez, TX

Texas Southmost College, Ms. Adela Garza, TX

Texas State Technical College, Dr. Stella Garcia, TX

The Brownsville Herald, Mr. Ryan Henry, TX

The Brownsville Herald, Mr. Steve Clark, TX

The Brownsville Herald, Mr. Ty Johnson, TX

The Monitor, Mr. Carlos Sanchez, TX

University of Texas Rio Grande Valley, Dr. Guy Bailey, TX

United Brownsville, Mr. Mike Gonzalez, TX

University of Texas at Brownsville, Dr. Jude Benavides, TX

University of Texas Brownsville, Dr. William R. Fannin, TX

University of Texas Brownsville, Mr. Irv Downing, TX

Valley Morning Star, Ms. Marci Caltabiano-Ponce, TX

Valley Regional Medical Center, Mr. Jim Tipton, TX

Valley Regional Medical Center, Mr. Steven Hoelscher, TX

Valley Regional Medical Center, Ms. Susan Andrews, TX

Workforce Solutions, Mr. Pat Hobbs, TX

Defenders of Wildlife, Mr. Jason C. Rylander, DC

Individuals

Mr. Gene N. Washburn, TX

Mr. Rob Nixon, TX

Ms. Edna Goette, TX

Ms. Helen O. Delgadilli, TX

Ms. Rhiannan Bates, TX

Mr. Rafael Salazar, TX

Ms. Lucila Martinez, TX

Mr. Gal Salazar, TX

Mr. Chris Watenpool, TX

Ms. Mary Lewis, TX

Mr. Stan O. Sterba, TX

Mr. Tommie Bucher, TX

Ms. Nancy Patterson, TX

Dr. John E. Kriller, TX

Mr. Philip Lawhon, TX

Mr. Sergio A. Saline, TX

Ms. Juliet Vallejo, TX

Ms. Viola Galvan, TX

Ms. Rebecca Hasse, TX

Ms. Maria Galasso, TX

Ms. Angie Gamez, TX

Mr. G Uhles, TX

Mr. Alex Dominguez, TX

Ms. Kristen Kline, TX

Ms. Ida Trevino, TX

Mr. Reyes Martinez, Jr., TX

Ms. Dora E. Lopez, TX

Mr. Julian Martinez, TX

Mr. Rico Roser, TX

Mr. Willy Cupit, TX

Ms. Laurel Steinberg, TX

Mr. Dutch Fisher, TX

Ms. Deborah Ruralcaba, TX

Ms. Stefanie Herweck, TX

Mr. Jim Chapman, TX

Mr. Pete Sepulueda, TX

Ms. Beatrice Martinez, TX

Ms. Diana Muzquiz, TX
Ms. Marisela Cortez , TX
Ms. Alma G. Leal, TX
Ms. Karen Boward, TX
Mr. Glenn Boward, TX
Mr. Ronaldo Garcia, TX
Ms. Diane Teter, TX
Mr. Rick Teter, TX
Mr. Faiz Rahman, TX
Mr. Raul Garza, TX
Mr. Jorge Rodarte, TX
Dr. John E. Keller, TX
Mr. Sergio Trevino, TX
Mr. Tereace Garrett, TX
Mr. Steve Mclaughlin, TX
Ms. Karin Hall, TX
Mr. Carlos Galvan, TX
Ms. Kate Cervone, TX
Ms. Cecilia Garrett, TX
Mr. Don Hockaday, TX
Mr. Marcos Munoz, TX
Mr. Greg Heig, TX
Ms. Lauren Heig, TX
Mr. Black Schroeder, TX
J.A. Escamille, TX
Ms. Charlotte A. Barker, TX
Ms. Nicole Ckstrom, TX
Ms. Cynthia Garza, TX
Ms. Norma Saenz, TX
S. Merril, TX
Ms. Margie Recio, TX
Mr. Oscar Garcia, TX
Ms. Gayle Hood, TX
Mr. Gary Snyder, TX
Ms. Cecelia DeMello, TX
Ms. Ann Banks, TX
Dr. John Keller, TX
Mr. Gary Tate, TX
Mr. Ken Rosevelt, TX
Ms. Linda Rosevelt, TX
Mr. David Suissa, TX
Ms. Laurie Howell, TX
Mr. Bill Hoenes, TX
Ms. Juliet Vallejo, TX
Mr. Josh Ballenso, TX
Mr. Kevin Horton, TX
Mr. Charles Irvine, TX
Ms. Debbie Bechulh, TX
Mr. Dennis Stahl, TX
Mr. Tom Davis, NM
Mr. Sean Oneil, TX
Ms. Debora Oneil, TX
Ms. Alice Bay, TX
Mr. Remmic Lewis, TX
Ms. LaVina Jo Meyer, TX
Ms. Sandra Vallejo, TX
Ms. Pat Younger, TX
Ms. Mel Torres, TX
Ms. Hilary Swarts, TX
Ms. Greta Daniels, TX
Ms. Julie Reardon, TX
Ms. Evelyn Merz, TX
Ms. Christine Rakestraw, TX
Mr. Michael Cateona, TX
Mr. Chalres Schmidt, TX
Mr. Guillermo Rico, TX

Ms. Susan Geery, TX

Mr. Ed McBride, TX

Ms. Jennifer Favela, TX

APPENDIX B

PROJECT-SPECIFIC ENVIRONMENTAL CONSTRUCTION PLAN

TEXAS LNG

TEXAS LNG BROWNSVILLE LLC
TEXAS LNG PROJECT

Environmental Construction Plan

Prepared by

NATURAL RESOURCE GROUP
an ERM Group company

September 2016

TEXAS LNG BROWNSVILLE LLC
TEXAS LNG PROJECT
ENVIRONMENTAL CONSTRUCTION PLAN

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1.0 INTRODUCTION

Texas LNG Brownsville LLC ("Texas LNG" or "Company") proposes to build, own, and operate the Texas LNG Project ("Project"). The Project involves the proposed development of a liquefied natural gas ("LNG") production, storage, and export facility on an approximately 625-acre leased parcel located on the Brownsville Ship Channel in Cameron County, Texas. The leased parcel and the dredging necessary to connect the parcel to the Brownsville Ship Channel are referred to as the "Project Site." The proposed Project will include two LNG trains with a total export capacity of 4 million tonnes per annum ("MTA"). The trains will be installed in two phases. Phase 1 will consist of the construction of a single 2 MTA LNG train, one approximately 210,000 cubic meter single containment LNG storage tank, and an LNG carrier loading berth with a dredged slip connected to the Brownsville Ship Channel.

The *Environmental Construction Plan* ("ECP") was developed for implementation during the construction of the Project located in Brownsville, Texas. This plan is applicable to all areas which may be disturbed by construction activities as a result of the Project including those areas which may be dredged, or be used for placement of dredged material including existing offsite confined dredged material placement areas.

This ECP was developed using best management practices ("BMP") of the oil and gas industry as well as the Federal Energy Regulatory Commission's ("FERC") Upland Erosion Control, Revegetation, and Maintenance Plan and Wetland and Waterbody Construction and Mitigation Procedures. The ECP is intended to meet or exceed applicable federal, Texas, and local environmental protection and erosion control specifications and practices.

Alternative construction procedures implemented in lieu of this ECP must provide an equal or greater level of protection to the environment, and must be approved in writing by a designated representative of Texas LNG. In addition, deviations from this plan may also require approval from FERC in advance of implementation.

Unless otherwise specified, the Construction Contractor ("Contractor") is responsible for implementing the requirements of this ECP. Texas LNG will make the requirements of the ECP and applicable environmental permits known to the Contractor. If the Contractor has questions concerning these environmental requirements, the Contractor will contact a Texas LNG representative. Unless otherwise noted within this ECP or in other contractual documents, Texas LNG will obtain the necessary permits for the construction of the Project.

2.0 SUPERVISION AND INSPECTION

Texas LNG will provide appropriate construction oversight to confirm Company and Contractor compliance with the measures of this ECP and requirements of applicable federal, state, and local permits. Texas LNG's Environmental Inspectors ("Environmental Inspector") will assist the Contractor in interpreting and implementing the requirements of the ECP, and verify compliance with these procedures for the Company. The Environmental Inspector will be expected to use judgment in the field to interpret environmental conditions and requirements, but will not be authorized to make major modifications or changes without the prior written approval of the Texas LNG representative and or FERC. The Environmental Inspector, in consultation with Texas LNG Environmental staff, will have the authority to stop activities and order corrective mitigation for actions that are not in compliance with the measures in this ECP or environmental permit requirements. The Environmental Inspector will maintain appropriate records to document compliance with these and other applicable environmental permit conditions.

At least one Environmental Inspector is required for the Project during construction and restoration. The number and experience of Environmental Inspectors assigned to the Project shall be appropriate for the types of activities being conducted. Environmental Inspectors shall have peer status with all other activity inspectors and shall have the authority to stop activities that violate the environmental conditions of FERC's Authorization, stipulations of other environmental permits or approvals, and to order appropriate corrective action.

2.1 RESPONSIBILITIES OF ENVIRONMENTAL INSPECTORS

At a minimum, the Environmental Inspector(s) shall be responsible for:

- Inspecting construction activities for compliance with the requirements of this Plan, the environmental conditions of FERC's Authorizations, the mitigation measures proposed by Texas LNG (as approved and/or modified by the Authorization), other environmental permits and approvals.
- Identifying, documenting, and overseeing corrective actions, as necessary to bring an activity back into compliance;
- Verifying that the limits of authorized construction work areas and locations of access roads are visibly marked before clearing, and maintained throughout construction;
- Verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area;
- Identifying erosion/sediment control and soil stabilization needs in all areas;
- Verifying that dewatering activities are properly monitored and do not result in the deposition of sand, silt, and/or sediment into sensitive environmental resource areas, including wetlands, waterbodies, and sensitive species habitats; stopping dewatering activities if such deposition is occurring and ensuring the design of the discharge is changed to prevent reoccurrence; and verifying that dewatering structures are removed after completion of dewatering activities;
- Ensuring that erosion control devices are properly installed to prevent sediment flow into sensitive environmental resource areas (e.g., wetlands, waterbodies, cultural resource sites, and sensitive species habitats) and onto roads, and determining the need for additional erosion control devices;
- Inspecting and ensuring the maintenance of temporary erosion control measures at least:
    - on a daily basis in areas of active construction or equipment operation;
    - on a weekly basis in areas with no construction or equipment operation; and
    - within 24 hours of each 0.5 inch of rainfall;
- Ensuring the repair of all ineffective temporary erosion control measures within 24 hours of identification, or as soon as conditions allow if compliance with this time frame would result in greater environmental impacts;

- Keeping records of compliance with the environmental conditions of FERC's Authorizations, and the mitigation measures proposed by the Texas LNG in the application submitted to FERC, and other federal or state environmental permits during active construction and restoration;
- Identifying areas that should be given special attention to ensure stabilization and restoration after the construction phase; and
- Verifying that locations for any disposal of excess construction materials for beneficial reuse do not result in adverse environmental impact and is subject to compliance with all applicable environmental survey and permit requirements.

3.0 CONSTRUCTION

3.1 APPROVED AREAS OF DISTURBANCE

Project-related ground disturbance shall be limited to the approved Project Site, temporary work space areas, borrow and disposal areas, access roads, and other areas approved in FERC's Authorization. Any Project-related ground disturbing activities outside these areas will require prior approval from Texas LNG and FERC. This requirement does not apply to activities needed to comply with this plan (e.g., dewatering structures) that do not affect sensitive environmental resource areas. All construction or restoration activities outside of authorized areas may be subject to environmental survey requirements and approval by Texas LNG and/or FERC. The construction site shall not exceed that described in the FERC application unless otherwise modified by FERC Authorization.

All construction equipment and vehicles will be confined to the approved permanent or temporary work areas. Prior to commencement of clearing or ground disturbing operations, the outer limits of the construction work area, wetlands, and waterbodies will be marked with distinctive stakes and flagging by Texas LNG. Construction will require temporary workspace adjacent to and contiguous with the permanent Project footprint. Approved temporary workspace will be identified on the construction plan. All temporary workspace must be identified by distinctive staking of the approved construction limits prior to clearing and grading. Construction activities are restricted to the approved designated areas.

Use of unauthorized workspace is prohibited without Texas LNG and FERC's approval. In all cases, the size of workspaces will be kept to the minimum necessary to safely conduct work. All approved workspace locations will be depicted on the construction plans.

3.2 CONSTRUCTION WORK AREA ACCESS

Texas LNG and its contractors will plan for safe and accessible conditions at all roadway access points during construction, restoration, and operation of the facility. Access to the construction work area will be from public roadways. Vehicle tracking of soil from the construction site will be minimized by installation and implementation of BMPs such as stone pads, timber mats, or the equivalent. Installation of stone or timber mat access pads must be in accordance with applicable permits. If such BMPs are not adequate to prevent sediment from being tracked onto public roads, street sweeping, or other equivalent means of collecting sediment, must be used.

If soil is tracked onto a roadway, the Contractor must remove accumulated material from the road and deposit the material in an upland area within the approved construction workspace as soon as possible, but in no circumstances more than 24 hours after discovery. In addition, soil on roadways cannot be broomed and/or graded into the road ditch or onto the shoulder.

3.3 CLEARING

The initial stage of construction will involve the clearing of brush, trees, and tall herbaceous vegetation from the Project site. Clearing may be accomplished with chainsaws, mowers, or hydraulic tree-cutting equipment. Unless otherwise directed by Texas LNG, timber and slash will be disposed of by mowing, chipping, grinding, and/or hauling off site to an approved disposal facility or used in stabilizing erodible slopes or construction entrances. Burning of woody debris may occur in upland in accordance with local regulations and with the proper permits to be obtained by the Contractor. No chips, mulch, or mechanically cut woody debris will be stockpiled in a wetland and no upland woody debris will be disposed of in a wetland.

3.4 TEMPORARY EROSION AND SEDIMENT CONTROLS

Temporary erosion and sediment control devices ("ECD") include, but are not limited to, sediment barriers (i.e., silt fence, straw bales, biologs, etc.), stormwater diversions, mulch, and revegetation. The purpose of installing ECDs is to minimize erosion onsite, and prevent construction-related sediment from migrating offsite into sensitive resource areas such as waterbodies, wetlands, or drainage ditches (dry or flowing).

Sediment barriers are intended to stop the flow of sediments and to prevent the deposition of sediments beyond approved workspaces or into sensitive resources. Sediment barriers may be constructed of materials such as silt fence, staked straw bales, compacted earth (e.g., driveable berms across travelways), sand bags, or other appropriate materials.

In disturbed areas, the Contractor will install and maintain temporary sediment barriers at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody, wetland, or road until revegetation is successful as defined in this ECP or in accordance with permit requirements. Adequate room between the base of the slope and the sediment barrier will be provided to accommodate ponding of water and sediment deposition.

Where wetlands or waterbodies are adjacent to and downslope of construction work areas, sediment barriers will be installed along the edge of these areas, as necessary to prevent sediment flow into the wetland or waterbody. If sediment barriers are in use, when the depth of sediment reaches about one-third of the height, the sediment must be removed.

The Contractor must, at all times, maintain erosion and sediment control structures as required in the Project construction documents and as required by all applicable permits. Non-functional erosion and sediment control features must be repaired, replaced, or supplemented with functional materials within 24 hours after discovery, or as otherwise specified in the Project permits.

ECDs must be installed after initial clearing but before disturbance of the soil, and must be replaced by permanent erosion controls as restoration is completed. If temporary ECDs are removed during the day to allow equipment access, they must be reinstalled at the end of the day. Temporary ECDs will be removed when permanent ECDs are installed or revegetation has been successful.

3.5 GRADING

Grading generally follows clearing and involves leveling and smoothing the approved construction work areas as necessary to create a safe, even working surface for equipment and vehicles. Grading will be conducted to the elevations identified in the approved grading plans. Any deviations from the approved grading plans must be reviewed and approved by Texas LNG on a site-specific basis.

3.5.1 **Topsoil Segregation**

Topsoil segregation will be directed by Texas LNG based on the area to be graded (based on soil type and location within permanent footprint, temporary, workspace, etc.) and the revegetation potential of the topsoil. Excess topsoil or topsoil with limited potential to facilitate revegetation may be removed from the Project Site. Topsoil with greatest potential for use during restoration will be stored in designated areas for later use during restoration of areas temporarily disturbed by construction activities. All soil will be placed at least 10 feet from the edge of a wetland or waterbody.

Topsoil that is not suitable for restoration or that will not be used for restoration will be reused as fill or disposed of off-site. The Contractor will stabilize topsoil piles and minimize loss due to wind and water erosion with use of sediment barriers, mulch, temporary seeding, tackifiers, or functional equivalents, where necessary.

3.6 EXCAVATION

Excavation is typically accomplished with a backhoe excavator at the Project Site. Excavated material will be stockpiled within approved construction work area and stored such that the area subject to erosion is minimized.

3.6.1 **Temporary Trench Plugs**

Temporary trench plugs are intended to segment a continuous open trench prior to backfill. Temporary trench plugs may consist of unexcavated portions of the trench, compacted subsoil, sandbags, or some functional equivalent. Position temporary trench plugs, as necessary, to reduce trenchline erosion and minimize the volume and velocity of trench water flow at the base of slopes.

3.6.2 **Permanent Trench Breakers**

Trench breakers are intended to slow the flow of subsurface water along trenches. Trench breakers may be constructed of materials such as sand bags or polyurethane foam. An engineer or similarly qualified professional shall determine the need for and spacing of trench breakers. At a minimum, install a trench breaker within trenches near the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody or wetland.

3.7 BACKFILLING

Backfilling of excavated areas consists of replacing the material excavated from the construction work area or use of suitable backfill material that meets design specifications for other structures (e.g., buildings, foundations, etc.). In areas to be revegetated, subsoil will be replaced first, and topsoil will be spread uniformly over the area.

3.8 CLEANUP AND GRADING

All waste materials, including litter generated by construction crews, are to be disposed of daily by the Contractor. Cleanup involves removing construction debris (including litter generated by construction crews and excess rock). In areas to be restored following construction, final grading includes restoring disturbed areas as near as practicable to preconstruction conditions, placing topsoil where revegetation is planned, preparing a seedbed (where applicable) for permanent seeding, installing or repairing temporary erosion control measures, and installing permanent erosion controls. Grading also includes establishing final design elevations, construction of containment berms, stormwater drainage conveyances and/or collection ponds, access roads or other Project designed features which can differ from pre-construction contours. All disturbed areas will be stabilized with proper erosion controls, seeded or graveled in accordance with final design specifications.

Remove construction debris from all construction work areas unless Texas LNG approves leaving materials onsite for beneficial reuse, stabilization, or habitat restoration. Remove temporary sediment barriers when replaced by permanent erosion control measures or when revegetation is successful.

3.9 ROUGH GRADING, CLEANUP, AND TEMPORARY RESTORATION

Cleanup and grading activities may take place simultaneously. Cleanup will involve removing construction debris and grading will include restoring and the site to its intended contours and installing or repairing temporary erosion control measures. Cleanup and rough grading (including installation of temporary erosion control measures) will begin as soon as practical after backfilling, weather permitting.

Erosion control blankets, such as sewn straw mats, jute mats, coconut erosion control blankets, or biodegradable synthetic erosion control blankets, as approved by Texas LNG, will be used as directed by Texas LNG and according to the manufacturer's recommendations as to weight and material for the specific application. Erosion control blankets will be anchored according to the manufacturer’s recommendations.

3.10 WET WEATHER SHUTDOWN

During construction, certain activities may be suspended in wet soil conditions, based on consideration of the following factors:

- extent of surface ponding;
- extent and depth of rutting and mixing of soil horizons in areas where the disturbance is temporary;
- aerial extent and location of potential rutting and compaction (i.e., can traffic be rerouted around wet area); and
- type of equipment and nature of the construction operations proposed for that day.

If adverse wet weather construction impacts cannot be minimized to the satisfaction of Texas LNG, the Contractor must cease work in the applicable area until Texas LNG determines that site conditions are such that work may continue.

4.0 WETLAND AND WATERBODY CONSTRUCTION PROCEDURES

All work within wetlands and waterbodies will comply with the conditions set forth in permits issued by federal, state, and local agencies and the FERC Authorization. Prior to work within a waterbody or wetland Texas LNG will provide written notification to federal, state, and local agencies as specified in applicable permits. Texas LNG will construct the Project in accordance with timing windows, workspace, and methods as approved by federal, state, and local permits and FERC Authorization.

4.1 WATERBODY CONSTRUCTION PROCEDURES

The Project will require dredging to create the LNG carrier maneuvering basin and provide a connection to the Brownsville Ship Channel. Construction activities will include the construction of a dock and jetty for mooring of LNG carriers. A material offloading facility will also be constructed. Detailed plans depicting the construction of the marine facilities have been filed with FERC. All marine construction activities will comply with the final plans approved by the U.S. Army Corps of Engineers, other federal, state, and local agencies and approved in the final FERC Authorization. The marine facilities will be constructed within the Brownsville Ship Channel and adjacent tidal flats, there are no other waterbodies within the Project Site meeting FERC's definitions that would be disturbed by construction activities.

4.2 WETLAND CONSTRUCTION PROCEDURES

The procedures in this section apply to wetlands that will be affected by the Project and restored. These procedures do not apply to wetland areas that will be permanently impacted by construction of the Project. These procedures require that judgment be applied in the field and will be implemented under the supervision of Texas LNG and its Environmental Inspector. The intent of these procedures is to minimize construction-related disturbance and sedimentation of wetlands and to restore wetlands used as temporary workspace as nearly as possible to pre-existing conditions.

Clearing the Project site in wetlands will be similar to clearing in uplands. For construction to proceed, obstructions (e.g., trees, brush, and logs) need to be removed. Complete removal of woody debris may be required in situations where permanent wetland impacts are approved by the respective federal and state agencies for construction of above ground facilities.

Grading in a wetland must be conducted in a manner consistent with applicable federal, state, and local permits. For installation of facility piping or utilities, grading activities must be minimized to the extent practicable. In areas to be permanently converted from wetland, the Project-specific design plans must be followed to minimize overall wetland disturbance, in accordance with Project permit conditions and/or approvals.

ECDs must be installed across the wetland-upland boundary at the edge of the approved construction workspace, where necessary, to prevent sediment flow into the wetland. Where wetlands are adjacent to the construction workspace and the workspace slopes toward the wetlands, ECDs must be installed along the edge of the construction workspace as necessary to prevent sediment flow into the wetlands. ECDs must also be installed along the edge of the construction workspace as necessary to contain spoil and sediment within the approved workspace through wetlands.

ECDs must be maintained in proper working order to prevent the flow of sediment into wetlands from spoil piles or sloped approaches that are adjacent to wetlands. When the depth of sediment reaches one-third of the height of a sediment barrier, the barrier will be replaced and/or the sediment removed. Non-functional sediment-control measures will be repaired, replaced, or supplemented with functional features as soon as field conditions allow, but no later than 24 hours after discovery.

The Contractor shall restore disturbed wetlands as near as practicable to pre-construction conditions following construction of the Project. During backfilling of wetland areas, subsoil material removed during construction will be replaced so that the material is not mounded above the adjacent ground surface. Subsoil that exceeds the elevation of the ground will be removed from the wetland and disposed of in an upland area. After the construction work area has been backfilled with subsoil, previously segregated topsoil will be spread over the construction work area. In wetland areas where the proper permits have been obtained to allow permanent fill for facility modifications, the area will be restored in accordance with Project-specific design plans.

For any workspace used within a wetland, Texas LNG and the Contractor will:

- Limit construction equipment operating in wetland areas to that needed to complete installation of the facility.

- Cut vegetation just above ground level, leaving existing root systems in place, and remove it from the wetland for disposal.

- Leave stumps or root systems in place within wetlands unless the Chief Inspector and Environmental Inspector determine that safety-related construction constraints require grading or the removal of tree stumps.

- If excavations in wetlands are necessary, segregate the top 1 foot of topsoil from the area disturbed by trenching, except in areas where standing water is present or soils are saturated. Immediately after backfilling is complete, restore the segregated topsoil to its original location.

- Do not use rock, soil imported from outside the wetland, tree stumps, or brush riprap to support equipment within wetlands.

- If standing water or saturated soils are present, or if construction equipment causes ruts or mixing of the topsoil and subsoil in wetlands, use low-ground-weight construction equipment, or operate normal equipment on timber riprap, prefabricated equipment mats, or terra mats.

- Remove all Project-related material used to support equipment within wetlands upon completion of construction.

- Trench breakers will be installed near wetland boundaries where necessary maintain the original wetland hydrology.

- Restore pre-construction wetland contours to maintain the original wetland hydrology.

- Revegetate temporary workspace with a Texas LNG approved temporary seed mix. Do not use fertilizer, lime, or mulch.

- Ensure that all disturbed areas successfully revegetate with wetland herbaceous and/or woody plant species.

- Remove temporary sediment barriers located at the boundary between wetland and adjacent upland areas after revegetation and stabilization of adjacent upland areas are judged to be successful.

Wetland revegetation shall be considered successful if all of the following criteria are satisfied:

- the affected wetland satisfies the current federal definition for a wetland (i.e., soils, hydrology, and vegetation);

- vegetation is at least 80 percent of either the cover documented for the wetland prior to construction, or at least 80 percent of the cover in adjacent wetland areas that were not disturbed by construction;

- if natural rather than active revegetation was used, the plant species composition is consistent with early successional wetland plant communities in the affected ecoregion; and

- invasive species and noxious weeds are absent, unless they are abundant in adjacent areas that were not disturbed by construction.

5.0 CONSTRUCTION DEWATERING

Construction site dewatering will be conducted in a manner that does not cause erosion and does not result in silt-laden water flowing into any wetland or waterbody. Dewatering structures will be removed as soon as practicable after dewatering activities are completed.

5.1 DUST CONTROL

The Contractor will take all reasonable steps to minimize dust generated by construction activities. Control practices may include wetting the work area/spoil piles/access roads, limiting working hours, reestablishment of vegetation and/or additional measures as appropriate based on site-specific conditions. Texas LNG has prepared a Fugitive Dust Control Plan which outlines additional measures to be implemented to comply with state requirements.

6.0 WATER APPROPRIATION

Water may be drawn from local sources, waterbodies, or private or municipal wells for construction activities such as dust control and hydrostatic testing. The Project will follow applicable permit conditions for the appropriation of water.

Water will only be withdrawn from sources approved by Texas LNG and in accordance with applicable permits. Where water is appropriated from waterbodies, the intake hose will be suspended off of the waterbed bottom and equipped with a screen with less than one-inch diameter openings, or equivalent device, to prevent fish uptake. During withdrawal, adequate waterbody flow rates and volumes will be maintained to protect aquatic life and allow for downstream uses. The volume and rate of withdrawal will be monitored to comply with applicable permit conditions. No additives to the water are permitted unless written approval is received from Texas LNG and applicable permits authorize such additives.

At no time will the withdrawal rate for the water source exceed the rate specified in the applicable permits. The Contractor must measure the withdrawal rate and total volume of water appropriated with a method approved by Texas LNG and provide the data to Texas LNG, as required by the applicable permits. Where required by permit conditions, Texas LNG will sample the water during appropriation. The Contractor will assist Texas LNG in obtaining these samples. If pumps used for hydrostatic testing are within 100 feet of any waterbody or wetland, the pumps will be placed in secondary containment as described in the *Spill Prevention and Response Plan* ("SPRP") and refueling of these pumps will occur in accordance with the SPRP.

Texas LNG will notify appropriate agencies in advance of appropriations if required by permits. Reports regarding the volume and quality of the water withdrawn will be submitted to Texas LNG if required by the applicable permits.

7.0 HYDROSTATIC TEST DISCHARGES

Hydrostatic testing involves filling the new storage tanks, piping segments, and other equipment with water acquired in accordance with applicable permits, raising the internal pressure level, and holding that pressure for a specific period of time per U.S. Department of Transportation specifications. Hydrostatic testing will be done to verify that there are no flaws in the pipe or welds. Water used for hydrostatic testing will be discharged back to the waterbody it was appropriated from or to a Texas LNG-approved discharge location. After the hydrostatic test is completed, the tested systems will be depressurized and the water expelled. During withdrawal and discharge, the water will be sampled as required by permits. Water volumes must be measured and recorded.

Hydrostatic test water will be discharged in accordance with federal, state, and local permits obtained by Texas LNG. Texas LNG will provide agency notification in advance of discharges in accordance with permit conditions. Water discharged from hydrostatic tests will be sampled as required by Texas LNG issued appropriation or discharge permits. Hydrostatic water discharges will comply with permit limitations as required. If required, the Contractor will assist Texas LNG in obtaining these samples and will be responsible for complying with the permit requirements.

Prior to hydrostatic testing, the Contractor will prepare the storage tanks, piping segments, and other equipment by removing accumulated construction debris, dirt, and dust using applicable tools. The debris will be collected in a temporary receiver and shall be properly disposed of by the Contractor. Rinse water, if used, will be treated and disposed of in accordance with applicable permit conditions.

Discharge of hydrostatic test water into wetlands or waterbodies must be approved by Texas LNG and be conducted in accordance with the appropriate federal, state, and local permits. The Contractor must regulate discharge rate, use energy dissipation device(s), and install sediment barriers, as necessary, to prevent erosion, streambed scour, suspension of sediments, or excessive streamflow. At no time will the discharge rate exceed the applicable discharge rates specified in the discharge permits. In the event no maximum discharge rate is identified, discharges shall be monitored and adjusted as necessary to avoid scouring, erosion, or sediment transport from the discharge location.

To minimize the potential for introduction and/or spread of invasive species due to hydrostatic testing activities, Texas LNG will discharge water to the same source location from which it was appropriated, where approved by permits. Municipal water will be discharged in accordance with permit conditions. Test water will not be discharged to a waterbody other than the appropriation source, unless permitted through the applicable agencies.

If required by permit, Texas LNG will determine the total volume of discharged water and ensure the total volume of water discharged does not exceed the maximum volume specified in the applicable permit.

8.0 CONTROLLING SPREAD OF UNDESIRABLE SPECIES

Texas LNG will require that construction equipment be cleaned before arriving on site to prevent the introduction of undesirable species to the Project Area. It is Texas LNG's intent to minimize the potential introduction and/or spread of invasive species at its Project site. Texas LNG has prepared a *Noxious Weed and Invasive Species Control Plan* which outlines additional measures to be implemented to minimize the spread of noxious weeds and invasive plants.

9.0 SPILL PREVENTION

No storage of hazardous materials, chemicals, fuels, and lubricating oils, and no concrete washout activities will be permitted in, or within 100 feet of, any wetland unless special provisions have been implemented in accordance with Texas LNG's SPRP and prior approval is obtained from the Environmental Inspector. Vehicles and equipment left on site overnight must be parked at least 100 feet from a delineated wetland unless special provisions have been implemented in accordance with Texas LNG's SPRP, secondary containment structures are functional and properly placed, and prior approval is obtained from the Environmental Inspector.

In the event of a spill, Texas LNG will coordinate with the appropriate local, state, and federal agencies as outlined in the SPRP an initiate prompt and effective cleanup of spills of fuel and other hazardous materials. The SPRP provides additional detail regarding Texas LNG's spill prevention and response procedures.

10.0 WASTE MANAGEMENT

Proper handling and management of solid and hazardous wastes and materials are an important aspect of every job. The Contractor must properly handle, store, and dispose of all solid and hazardous materials and wastes that are used or generated by the Contractor as a result of the Project. The Contractor must determine if the materials and wastes associated with the Project are classified as hazardous materials and/or wastes in accordance with applicable federal and/or state criteria. Upon request by Texas LNG, the Contractor must provide documentation to Texas LNG to substantiate findings of the regulatory status of materials and/or wastes used and/or generated as a result of the Project.

All waste materials are to be collected daily by the Contractor. Wastes must be collected in suitable or approved containers (i.e., labeled and meeting any relevant regulatory requirements) provided by the Contractor. On a routine basis, the Contractor must remove the containers of waste from the site and properly dispose of them. Continuously throughout the duration of the Project, the Contractor must cleanup areas to the satisfaction of Texas LNG. The Contractor is responsible for proper off-site disposal of all wastes generated during the Project. No wastes are to be left on Texas LNG property, or buried in an excavation or otherwise disposed of on Texas LNG property.

Any used oil or other waste liquids generated by the Contractor as a result of maintaining its equipment during the course of the Project shall be the responsibility of the Contractor to handle in accordance with all applicable regulations and Texas LNG policies. Used oil and all other waste liquids must be stored in approved storage containers in good condition. The containers must be properly labeled. The Contractor is responsible for disposing of waste liquids in accordance with all applicable regulations.

Disposal of materials for beneficial reuse must not result in adverse environmental impact and is subject to compliance with all applicable survey, landowner or land management agency approval, and permit requirements.

10.1 HAZARDOUS WASTES

It is the responsibility of the Contractor to ensure that all workers are properly trained in the proper storage, handling and disposal of hazardous wastes generated during the Project. The Contractor must ensure that wastes classified as hazardous by federal and state regulations are properly labeled and, if liquid, stored on-site with secondary containment and in accordance with all regulatory requirements. Wastes may not be placed, spilled, or poured on or into the ground. If this should occur, the Contractor is responsible for evaluation and cleanup of contaminated soils and associated costs. The Contractor is responsible for immediately reporting the spill to Texas LNG.

If a Contractor generates a hazardous waste from materials they have brought on-site (e.g., paint clean-up solvents, waste paints, etc.), then the Contractor is responsible for proper waste collection, storage and disposal in accordance with all applicable regulations. If a Contractor generates a waste classified as hazardous as a direct result of the constituents coming from equipment, then Texas LNG will coordinate proper waste collection, storage and disposal with the Contractor. The Contractor remains responsible for the proper handling, storage and disposal of the hazardous waste. Any release of the hazardous waste as a result of the handling, storage or disposal by the Contractor in this instance is the responsibility of the Contractor to rectify to the satisfaction of Texas LNG and all applicable regulatory agencies.

10.2 CONCRETE WASHOUT

The location of any and all concrete washouts must be approved by Texas LNG in advance of construction and cannot be located near storm drains, wetlands, ditches or waterbodies. All liquid and solid wastes generated by concrete washout operations must be contained in a leak-proof containment facility or impermeable liner. A compacted clay liner that does not allow washout liquids to enter ground water is considered an impermeable liner. Concrete washouts must be sized to handle solids, wash water, and rainfall. The liquid and solid wastes must not contact the ground, and there must not be runoff from the concrete washout operations or areas. Liquid and solid wastes must be disposed of properly and in compliance with applicable Texas and/or federal regulations. The Contractor must inspect the concrete washout on a daily basis when in use.

11.0 REVEGETATION

This section was developed in conjunction with Natural Resources Conservation Service ("NRCS") guidelines and consultations performed by Texas LNG. If it is found that any conditions or requirements of this section or any other supporting documents are not in compliance with any governmental law or ordinance, the applicable law or ordinance will take precedent, but will not nullify other portions of this section or supporting documentation. In addition, Project-specific permit conditions for specific seed mixes take precedence over this section. This section applies specifically to temporary workspaces used for the construction of the Project.

Records will be maintained that identify restoration activities including method of seed application. Application rate, type of seed or mulch, type of fertilizer or modifying agent, dates of seeding and identified problems areas and how they were addressed.

11.1 PROJECT SEED SPECIFICATIONS

Seed used will be purchased on a "Pure Live Seed" ("PLS") basis for seeding (both temporary and permanent) revegetation areas. Seed tags will identify:

- purity;
- germination;
- date tested;
- total weight and PLS weight;
- weed seed content; and
- seed supplier's name and business information.

Seed will be used within 12 months of testing as required by applicable state rules and regulations. The seed tags on the seed sacks will also certify that the seed is "Noxious Weed Free". Seed rates used on the Project will be based on PLS rate, not actual weight basis. Therefore, to determine the correct application rate if not indicated on the seed tag, a correction calculation must be performed based the purity and germination. For example, a seed mix that has a specified 10 pounds PLS per acre, 95 percent germination rate, and is 80 percent pure needs to be applied at the following rate:

(95% germination × 80% purity) /100 = 76% PLS

10 pounds PLS per acre/76% PLS = 13.2 pounds per acre actual seeding rate

The species components of individual mixes are subject to availability at the time of purchase. Grass species may be substituted with alternative native or non-invasive species based on availability and subject to approval by Texas LNG.

Seed tags must be collected by the Contractor and provided to Texas LNG during seeding activities. The tags will be reviewed by Texas LNG prior to installation to ensure that the seed mix complies with Texas LNG's specifications and that it is being applied to the correct location. If bulk delivery of seed is made, the above information will still be made available to Texas LNG. Off-loading/on- loading of seed will not be performed in a designated wetland area.

Legume seed (if used) will be treated with an inoculant specific to the species and in accordance with the manufacturer's recommended rate of inoculant appropriate for the seeding method (broadcast, drill, or hydroseeding). When hydroseeding, four times the manufacturer's recommended rate of inoculant will be used.

The Contractor's proposed seed sources must be submitted to Texas LNG for review and approval prior to construction. The Contractor must also arrange for appropriate storage of the seed.

11.2 TEMPORARY REVEGETATION

The primary focus of Texas LNG's temporary revegetation measures is to quickly establish ground cover vegetation, minimize potential soil erosion, and minimize noxious weed establishment. Texas LNG's temporary seed mix was developed based on recommendations from the NRCS and/or other regulatory agencies. Unless specifically required by permit condition, Texas LNG does not intend to establish temporary vegetation in areas that will be permanently stabilized using gravel or other final non-vegetated surface material.

Temporary revegetation will be established in construction work areas where 14 days or more will elapse between the completion of final grading at a site and the establishment of permanent vegetation; and/or, where there is a high risk of erosion due to site-specific soil conditions and topography. Texas LNG may require the Contractor to conduct temporary seeding sooner than 14 days at site- specific locations near sensitive resource areas and/or areas prone to wind/water erosion.

Non-standing water wetlands will be seeded with annual ryegrass at a rate of 40 pounds per acre to provide temporary cover and allowed to revegetate naturally. The natural revegetation process will be encouraged by the seeds and rhizomes in the topsoil spread back over the construction work area. No fertilizer, lime, or mulch will be applied in wetlands.

11.3 PERMANENT REVEGETATION

Permanent reseeding will be conducted in areas disturbed within the construction work area except in wetlands and areas to be restored to non- vegetation (e.g., gravel or similar). The seed mixes for permanent seeding include native seed varieties commonly found and/or available from local seed distributors. Texas LNG's seed mixes are selected to augment revegetation via natural recruitment from native seed stock in the topsoil and are not intended to change the natural species composition. Rates provided are assumed for a drill application and must be adjusted as discussed in Section 11-1.

In consulting with the NRCS and other agencies, Texas LNG developed a standard upland seed mix for restoring disturbed areas affected by the Project. The mix includes species that will provide for effective erosion control and revegetation of the Project Site. This seed mix will be used by Texas LNG as the standard upland mix unless an alternate seed mix is specified. This seed mix is to be used in areas that will not be stabilized using gravel or similar material.

11.4 SEED BED PREPARATION AND SEEDING PROCEDURES

In areas to be revegetated, deep tillage will be performed following final grading to relieve soil compaction and promote root penetration. The soil will then be tilled to a minimum depth of 4 inches with a disc or chisel plow (or equivalent) to prepare a seedbed, breaking up large clods and firm the soil surface. The resulting seedbed must be soft enough to permit seed to be covered and mulch to be anchored, yet firm enough to support the weight of an adult plant without sinking into the soil more than about 0.5 inch. Tillage and equipment operations related to seeding and mulching will be performed parallel to ground contours as much as practicable. Fertilizer and other soil amendments will be incorporated into the soil during seedbed preparation as specified by Texas LNG. No soil amendments will be applied in wetlands.

Seed will be applied uniformly at specified rates across the prepared Project Site area by drilling, broadcasting, or hydroseeding. Seeding activities will be suspended if conditions are such that equipment will cause rutting of the surface in the designated seeding areas. Texas LNG will continue to monitor the Project site to resume seeding activities as site conditions improve and according to the general seeding timing restrictions. Seeding equipment will be capable of uniformly distributing the seed and sowing it at the required depth. Drills will be equipped with a feeding mechanism that will provide a uniform flow of seed at the desired application rate. Double-disc furrow openers equipped with depth bands and packer wheels to firm the soil over the seed will be used where practicable.

Broadcast seeding rate will be <u>double</u> the drill-seeding rate. Seed will be uniformly distributed by a mechanical or hand operated seeder. Following seeding, a cultipacker, harrow, or hand rake will be used to cover the seeds and firm the seedbed as is appropriate for the area.

Hydro-seeding rate will be <u>double</u> the drill seeding rate, or the same as broadcast seeding rate. Seed will be applied alone or in a seed, fertilizer, and/or hydro-mulch slurry. If seeding is applied alone, the amount of hydro-mulch material will be adjusted to the seed slurry to show where seeding has taken place. Hydro-seeders must provide continuous agitation and be capable of supplying a continuous, non-fluctuating flow of slurry. Hydro-seed slurry will not be held in the tank more than one hour before use. All hydro-mulch products used must be pre-approved by Texas LNG and be on the Texas Department of Transportation product list.

Upon final grading and upon the restoration of wetland and waterways, seeding and restoration/stabilization will occur within 48 hours. Other methods of stabilization will be used if temporary seeding is not appropriate (e.g., mulch, erosion control matting). Seeding will be performed within dates recommended by the NRCS during consultations with Texas LNG. If seeding cannot occur during those dates, temporary ECDs will be used until the next seeding season.

The Contractor will begin restoration of the side slopes associated with raised permanent footprint as soon as construction is complete. Restoration will consist of permanent seeding and stabilizing the slopes as directed by Texas LNG and/or permit conditions.

11.5 MULCH

Apply mulch on all slopes concurrent with or immediately after seeding, where necessary to stabilize the soil surface and to reduce wind and water erosion. Spread mulch uniformly over the area to cover at least 75 percent of the ground surface at a rate of 2 tons/acre of straw or its equivalent, unless Texas LNG approves otherwise in writing.

Mulch will be free of noxious weeds as listed in applicable state laws. The Contractor will be responsible for identifying and acquiring sources of weed-free and/or certified weed-free mulch. Sources must be approved by Texas LNG prior to purchase and copies of the applicable documentation must be provided to Texas LNG.

Mulch all disturbed upland areas before seeding if:

- final grading and installation of permanent erosion control measures will not be completed in an area within 20 days or otherwise specified by permit condition; or

- construction or restoration activity is interrupted for extended periods, such as when seeding cannot be completed due to seeding period restrictions.

If mulching before seeding, increase mulch application on all slopes within 100 feet of waterbodies and wetlands to a rate of 3 tons/acre of straw or equivalent. If wood chips are used as mulch, do not use more than 1 ton/acre and add the equivalent of 11 pounds/acre available nitrogen (at least 50 percent of which is slow release).

Ensure that mulch is adequately anchored to minimize loss due to wind and water. When anchoring with liquid mulch binders, use rates recommended by the manufacturer. Do not use liquid mulch binders within 100 feet of wetlands or waterbodies, except where the product is certified environmentally non-toxic by the appropriate state or federal agency or independent standards-setting organization.

Mulch used in conjunction with temporary revegetation efforts will be applied at a rate of 2 tons per acre unless otherwise stipulated by permit conditions. Mulch will be uniformly distributed by a mechanical mulch blower, or by hand in areas not accessible to the mulch blower. Strands of mulch will be a minimum of 8 inches in length to allow proper anchoring. Mulch will be anchored/crimped to a depth of 2-3 inches using a mulch-anchoring tool or disc set in the straight position to minimize loss by wind and water, as site conditions allow. Additional erosion control measures (e.g., silt fence, erosion control blankets, hydromulch) may also be applied.

Erosion control fabric may be used in lieu of mulch where appropriate. Erosion control fabrics with synthetic monofilament mesh/may not be used in areas designated as sensitive wildlife habitat, unless the product is specifically designed to minimize harm to wildlife. Anchor erosion control fabric with staples or other appropriate devices. Straw mulch may be used to help stabilize areas during the establishment of temporary vegetation. The Contractor will apply mulch during the establishment of temporary vegetation in areas as requested by Texas LNG or required by permit condition.

11.6 POST CONSTRUCTION MONITORING AND MAINTENANCE

Environmental Inspectors will conduct follow-up inspections of all disturbed areas, as necessary, to determine the success of revegetation. At a minimum, inspections after the first and second growing seasons will be conducted. Revegetation shall be considered successful if upon visual survey the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed lands. Revegetation efforts will continue until revegetation is successful.

Restoration shall be considered successful if the Project area surface condition is similar to adjacent undisturbed lands, construction debris is removed (unless otherwise approved by Texas LNG), revegetation is successful, and proper drainage has been restored.

Routine vegetation mowing will occur regularly within landscaped turfgrass areas within the Project site (e.g., areas surrounding administration building and permanent parking lots). Periodic vegetation mowing or clearing along fence lines, within utility corridors, and other areas within the permanent operational footprint of the facility will be conducted outside of April 15 and August 1 to minimize potential impacts on migratory birds. Texas LNG will use herbicides as necessary to maintain vegetation on site, including around fences. In areas where herbicide use is within 100 feet of wetland or waterbody, the Contractor will use only herbicides approved by Texas LNG.

11.7 RECORD KEEPING

The Contractor shall maintain records pertaining to the restoration of areas with the Project site disturbed by construction activities. These records must be provided to Texas LNG and identify:

- method of application, application rate, and type of fertilizer, pH modifying agent, seed, and mulch used;
- acreage treated;
- dates of backfilling and seeding;
- special seeding treatment and a description of the follow-up actions;
- the location of any subsurface drainage repairs or improvements made during restoration; and
- any problem areas and how they were addressed.

APPENDIX C

TEXAS LNG CONCEPTUAL MITIGATION PLAN

TEXAS LNG BROWNSVILLE LLC
TEXAS LNG PROJECT

Conceptual Mitigation Plan

File No. SWG-2015-00175

Prepared by

an ERM Group company

March 2016

TEXAS LNG BROWNSVILLE LLC
TEXAS LNG PROJECT

CONCEPTUAL MITIGATION PLAN

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Attachment B iHGM Data Sheets

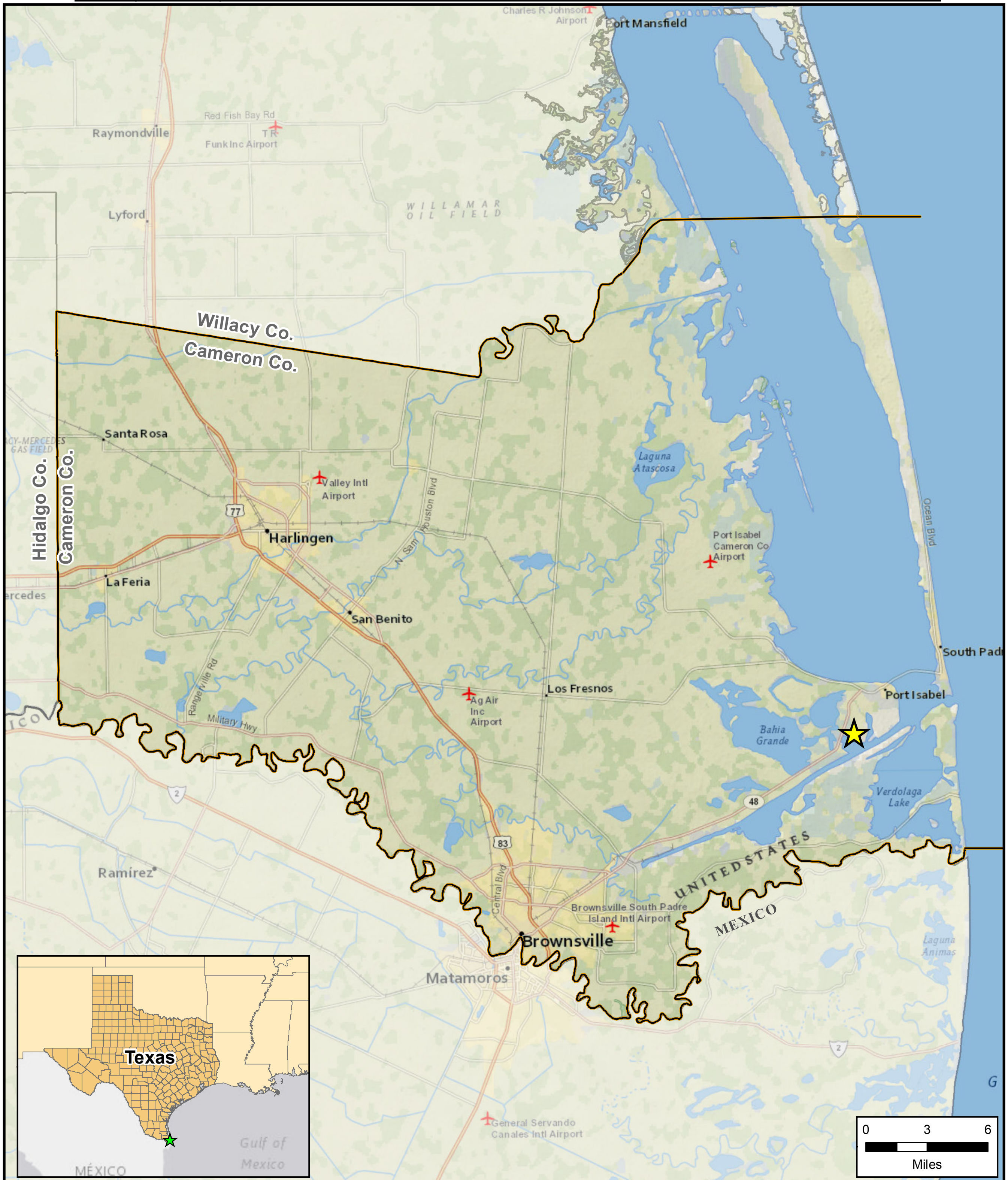
1.0 PROJECT DESCRIPTION

Texas LNG Brownsville, LLC ("Texas LNG") proposes to construct and operate a liquefied natural gas ("LNG"), storage, and export facility along the Brownsville Ship Channel in Cameron County, Texas (figure 1-1). The proposed Terminal and Marine Facilities and associated dredging within the Brownsville Ship Channel and dredged material placement activities are collectively referred to as the "Texas LNG Project," or the "Project."

The Project requires authorization from the U.S. Army Corps of Engineers ("COE") to construct structures in Navigable Waters of the United States under Section 10 of the Rivers and Harbors Act of 1899 and to discharge dredge and/or fill material into Waters of the United States ("WOUS"), including wetlands under Section 404 of the Clean Water Act ("CWA"). This Conceptual Mitigation Plan is intended to accompany Texas LNG's COE application (File No SWG-2015-00175).

The proposed Project facilities will be constructed on an approximately 625-acre site available through a long-term lease with the Brownsville Navigation District of Cameron County (the "BND") and located on the north side of the Brownsville Ship Channel, approximately five miles southwest of the Gulf of Mexico in Cameron County, Texas. The Project Site extends for approximately 3,000 feet along the Brownsville Ship Channel and is located approximately 19 miles northeast of the City of Brownsville on State Highway 48. The leased parcel and the dredging necessary to connect the parcel to the Brownsville Ship Channel are referred to as the "Project Site".

The proposed Project will include two LNG trains with a total export capacity of 4 million tonnes per annum ("MTA"). The Project will be completed in two phases. Phase 1 will consist of the construction of a single 2 MTA LNG train, one 210,000 cubic meters ("m^3") single containment LNG storage tank, and an LNG carrier loading dock with a dredged slip connected to the Brownsville Ship Channel (figure 1-2). Texas LNG intends to construct Phase 1 upon receipt of necessary permits and authorizations. The commencement of the Phase 2 construction will be based upon market demand and will include an additional 2 MTA LNG train and one 210,000 m^3 single containment LNG storage tank. All proposed impacts on WOUS associated with construction of the Project will occur during Phase 1. No additional impacts on WOUS will result as part of the construction activities associated with Phase 2.



Proposed Project Location

Cameron County Boundary

Figure 1-1
Project Site Overview

TEXAS LNG

NATURAL RESOURCE GROUP
an ERM Group company

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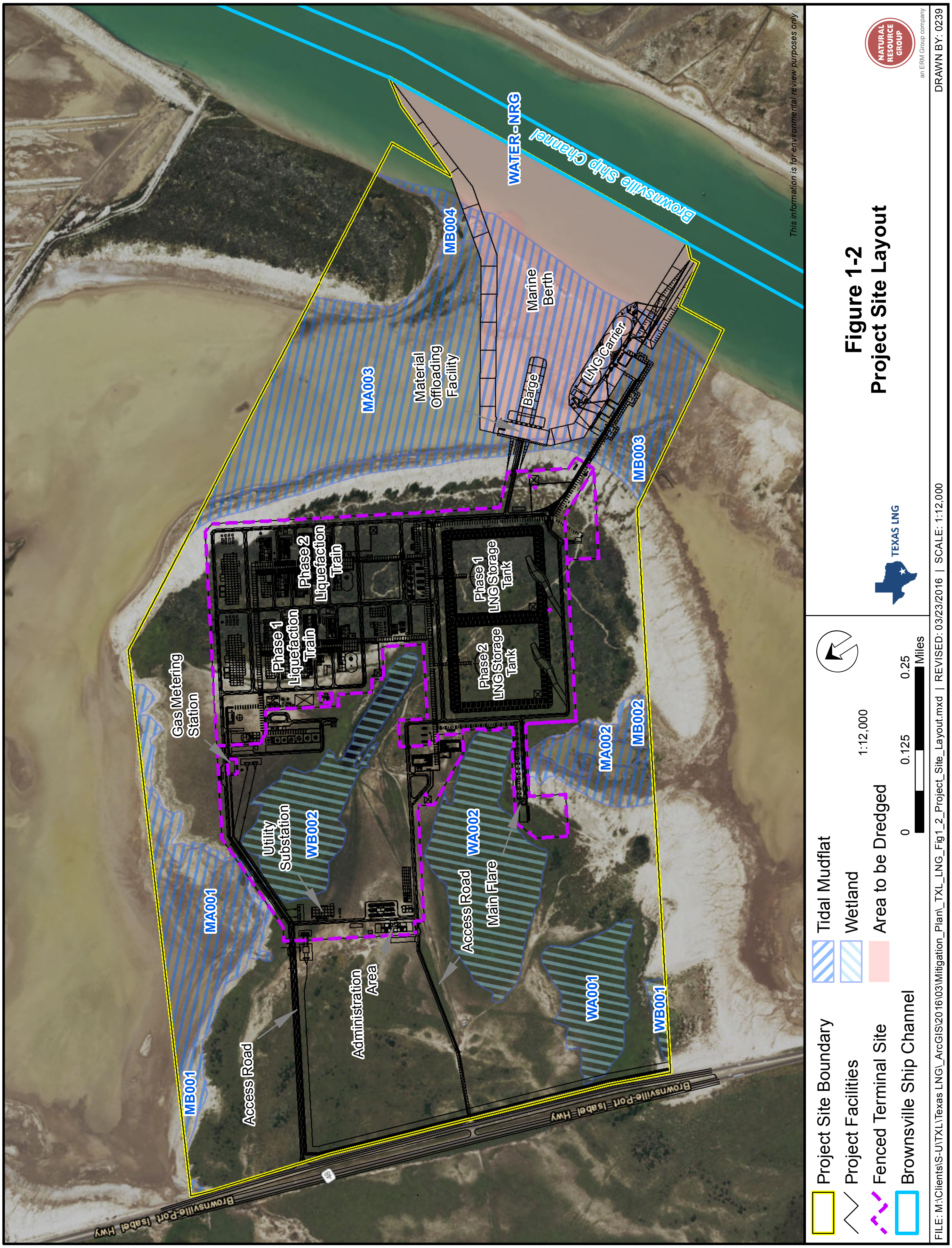
Figure 1-2
Project Site Layout
Project Site Boundary
Project Facilities
Fenced Terminal Site
Brownsville Ship Channel
Tidal Mudflat
Wetland
Area to be Dredged
1:12,000
0
0.125
0.25
Miles
Brownsville Ship Channel
WATER-NRG
Marine Berth
Material Offloading Facility
LNG Carrier
Barge
MA003
MB004
MB003
Phase 2 Liquefaction Train
Phase 1 Liquefaction Train
Phase 1 LNG Storage Tank
Phase 2 LNG Storage Tank
Gas Metering Station
Utility Substation
WB002
WA002
MA002
MB002
Access Road
Main Flare
Administration Area
MA001
MB001
WA001
WB001
Brownsville-Port Isabel Hwy
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2.0 WATERS OF THE UNITED STATES

The Project site includes four palustrine emergent depressional wetlands, a tidal mudflat, and the perennial, deepwater Brownsville Ship Channel.

As shown on figure 1-2, four separate palustrine emergent ("PEM") depressional wetlands (60 acres) and a contiguous estuarine tidal mudflat (178 acres) were delineated within the Project Site. The wetland delineation report identified 59.98 acres of PEM wetland and 181.55 acres estuarine tidal mudflat. The wetland delineation was performed prior to civil survey of the Project Site resulting in a small discrepancy between the wetland delineation and the final Jurisdictional Determination. The final civil surveyed property boundary was provided to the COE during their Jurisdictional Determination evaluation.

Texas LNG's wetland delineation was approved by the COE Galveston District's Jurisdictional Determination letter dated January 13, 2016, which also updated the wetland and tidal mudflat acreages. The large contiguous tidal mudflat surrounding the north, east, and south boundaries of the Terminal Facility was portioned into seven distinct units in the COE's Jurisdictional Determination. Each unit denotes the tidal jurisdiction for the COE (i.e., Annual High Tide ["AHT"] delineates Section 404 WOUS and Mean High Tide ["MHT"] delineates Sections 404 and 10 WOUS).

Table 2-1 lists the Cowardin wetland classification, permanent acres and temporary acres of WOUS impacts within the Project Site. In total, about 74.3 acres of WOUS will be permanently impacted and 8.9 acres will be temporarily impacted. However, of the permanent impacts listed in Table 2-1, 0.7 acre of PEM and tidal mudflat WOUS will be permanently lost due to site preparation and 39.8 acres of tidal mudflat WOUS will be converted to deepwater habitats through dredging the proposed maneuvering basin. An additional 33.8 acres of deep water habitat in the Brownsville Ship Channel will be dredged for the proposed maneuvering basin. Although 3.7 acres of impacts are associated with the LNG carrier dock and Material Offloading Facility, it is excluded in the total permanent acreage. These structures are regulated under Section 10; however, since these facilities will be supported on piles and will not result in loss of deepwater habitat, the impact is not considered a permanent loss under the criteria of Section 404 of the CWA.

Previous dredging operations in the Brownsville Ship Channel in the early and mid-1900s created a berm along the channel that reduced tidal exchange in many mudflats, including at the location of Texas LNG's proposed maneuvering basin. The berm along the channel prevents natural tidal cycles into nearly 700 acres of tidal mudflat adjacent to the Project Site. Although the surrounding mudflats receive inundation during storm events, much of the area is often dry.

The lack of tidal exchange and high evaporation rates preclude the tidal mudflat at the Project Site from performing historic Essential Fish Habitat ("EFH") functions. As demonstrated in the Bahia Grande Project (about three miles up-channel) (2009), inadequate tidal circulation in lagoons and mudflats exhibit salinity greater than 100 parts per thousand; normal seawater is about 35 parts per thousand.

TABLE 2-1

Texas LNG Project
Summary of WOUS and Proposed Impacts

Wetland ID [a]	Wetland Type	Existing Wetland Size [b] (Acres)	Permanent Impacts [c] (Acres)	Temporary Impacts (Acres)
Tidal mudflat MB002	E2US3P	7.9	0.2	0.0
Wetland WA002	PEM [d]	27.3	<0.1	0.1
Wetland WB002	PEM	19.5	0.1	0.9
Tidal mudflat MA001	E2US3P [e]	30.6	<0.1	0.1
Tidal mudflat MB001	E2US3P	10.9	0.4	0.2
Tidal mudflat MB003	E2US3P	13.5	0.6	0.9
Tidal mudflat MA003	E2US3P	110.1	38.7	4.8
Tidal mudflat MB004	E2US3P	1.6	0.4	0.0
Brownsville Ship Channel	E1UBLx [f]	33.8	33.8 [g]	1.7
Total	**N/A**	**271.7** [h]	**74.3**	**8.9**

[a] Wetlands WA001 (13.0 acres), WB001 (0.1 acre), and tidal mudflat MA002 (3.4 acres) are entirely avoided and not discussed in this section.

[b] Existing delineated wetland area was verified and approved via the COE Galveston District's jurisdictional determination letter dated January 13, 2016.

[c] Permanent impacts exclude 15.4 acres of Rock Armor because it overlaps with the Maneuvering Basin and 3.7 acres associated with of the LNG carrier dock and Material Offloading Facility, which will be supported on piles and will not result in loss of WOUS.

[d] PEM = palustrine emergent

[e] E2US3P = estuarine intertidal unconsolidated shore irregularly flooded

[f] E1UBLx = Estuarine subtidal unconsolidated bottom excavated

[g] The Brownsville Ship Channel includes the 7.1 acres verified and approved via the COE Galveston District's jurisdictional determination letter dated January 13, 2016, and the additional area to the navigation channel outside the leased project boundary.

[h] Total acres of existing wetlands on the Project Site includes avoided wetlands and deepwater habitat in the Brownsville Ship Channel.

2.1 AVOIDANCE AND MINIMIZATION MEASURES

The planning of the Terminal and Marine Facilities has employed the key principles of avoidance and minimization of environmentally sensitive features. Practicable measures have been implemented across the Project design to minimize unavoidable impacts on sensitive features, including wetlands and the tidal mudflats.

Repeated design considerations have successfully avoided much of the WOUS onsite. Of the 60 acres of palustrine emergent wetlands delineated, about 0.1 acre will be permanently filled. Of the 178 acres of tidal mudflat within the leased property, about 39.8 acres will be impacted by dredging the maneuvering basin and temporary construction basin and 0.6 acre will be permanently filled.

A detailed discussion of avoidance and minimization on WOUS is presented in the permit application supplemental narrative.

2.2 COMPENSATION

For the unavoidable Project-related impacts on WOUS that cannot be further avoided or minimized, Texas LNG is providing this conceptual mitigation plan as part of its application to the COE.

2.3 AVAILABLE MITIGATION CREDITS

As described in the COE's Final Mitigation Rule ("Mitigation Rule") (33 Code of Federal Regulations ["CFR"] 332) (COE, 2008), the fundamental objective of compensatory mitigation is to offset environmental losses resulting from unavoidable impacts on WOUS. To determine the adequacy of compensation the Mitigation Rule considers the location of the compensation site relative to the impact site, its significance within the watershed, and the costs to implement. For this reason, the Mitigation Rule often considers mitigation banks or in-lieu fee programs the environmentally preferable compensation method because they consolidate compensatory mitigation projects.

As shown on figure 2.3-1, the Project Site is located in the South Laguna Madre watershed (Hydrologic Unit Code ["HUC"]: 12110208) in the U.S. Environmental Protection Agency's, Level IV Ecoregion: Laguna Madre Barrier Islands and Coastal Marshes (34i). According to the COE's *Regulatory In lieu fee and Bank Information Tracking System* website (COE, 2016), there are no mitigation bank or in-lieu fee program service areas that include the Project Site.

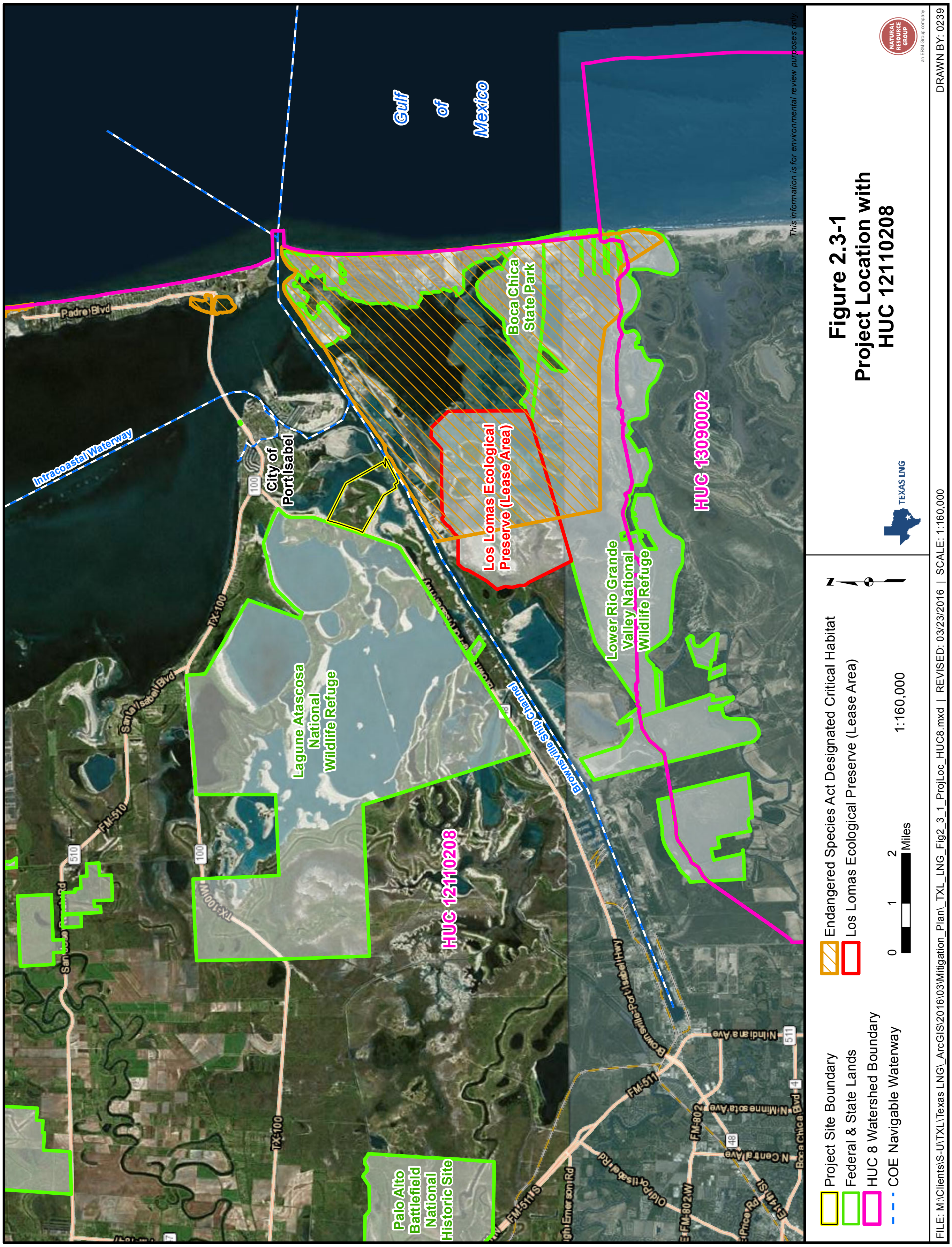
Figure 2.3-1
Project Location with
HUC 12110208
Project Site Boundary
Federal & State Lands
HUC 8 Watershed Boundary
COE Navigable Waterway
Endangered Species Act Designated Critical Habitat
Los Lomas Ecological Preserve (Lease Area)
1:160,000
0
1
2
Miles
TEXAS LNG
NATURAL RESOURCE GROUP
an ERM Group company
FILE: M:\Clients\S-U\TXL\Texas LNG_ArcGIS\2016\03\Mitigation_Plan_TXL_LNG_Fig2_3_1_ProjLoc_HUC8.mxd | REVISED: 03/23/2016 | SCALE: 1:160,000
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Gulf
of
Mexico
Padre Blvd
Intracoastal Waterway
City of
Port Isabel
Boca Chica
State Park
Los Lomas Ecological
Preserve (Lease Area)
Lower Rio Grande
Valley National
Wildlife Refuge
HUC 13090002
HUC 12110208
Laguna Atascosa
National
Wildlife Refuge
Brownsville Ship Channel
Palo Alto
Battlefield
National
Historic Site
TX-100
Santa Isabel Blvd
FM-510
FM-511
FM-802
Brownsville-Port Isabel Hwy
N Indiana Ave
N Minnesota Ave
N Central Ave
Boca Chica Blvd
Old Port Isabel Rd
FM-511S

3.0 PERMITTEE-RESPONSIBLE MITIGATION SITE SELECTION PROCESS

As described in Section 2.1, Texas LNG has avoided and minimized impacts on WOUS to the maximum extent possible. Since existing mitigation bank or in-lieu fee service areas do not include the Project Site, Texas LNG has prepared this Permittee Responsible Mitigation Plan to offset unavoidable loss of WOUS.

Texas LNG's search for a potential compensatory mitigation site used the following goals and objectives:

Goals

- Preserve aquatic ecosystem functions and hydrologic conditions in sufficient quantity to offset the Project-related impacts within the context of the South Laguna Madre watershed.

Objectives

- Identify land available for preservation within the South Laguna Madre watershed.
- Offset permanent impacts to about 40.5 acres of wetlands and tidal mudflats.
- Provide ecologically self-sustaining aquatic resource preservation.
- Secure at least 405 acres of tidal wetlands for preservation in perpetuity, preferably contiguous to existing protected land.

3.1 WATERSHED APPROACH

The goal of a watershed approach is to maintain and improve the quality and quantity of aquatic resources within watersheds through the strategic selection of compensatory mitigation sites. Therefore, factors such as current trends in habitat loss or conversion; cumulative impacts of past development activities; and chronic environmental problems such as flooding or poor water quality were used to identify potential mitigation opportunities within the same 8-digit HUC and sub-watershed as the Project Site (the South Laguna Madre watershed, HUC: 12110208) (see figure 2.3-1).

3.1.1 Current Watershed Initiatives

Below is a discussion of key watershed initiatives that Texas LNG considered during preparation of this conceptual mitigation plan.

Lower Rio Grande Watershed Initiative

The Lower Rio Grande Watershed Initiative (2016) has brought multi-national federal, state, and private stakeholders together to improve water quality by removing water quality impairments. The primary impairment is high levels of fecal indicator bacteria (e.g., *E. coli*) coming from untreated septic systems. The goal of the initiative is to establish viable and sustainable institutional mechanisms to protect water quality in this coastal watershed. Mechanisms to achieve this goal are protecting coastal wetlands and natural flood protection areas.

Lower Rio Grande Basin Study

The Lower Rio Grande Basin Study (2013) was developed by the U.S. Department of the Interior - Bureau of Reclamation to address flood control and water management. It projects that water demand will increase in the next 50 years by 35 percent. The plan identifies objectives such as preserving existing water rights and adaptive strategies such as water allocations. Potential measures could include increased water reuse.

Bahia Grande Restoration Project

The Bahia Grande Restoration Project (2009) is a local plan sponsored by Ocean Trust made up of local, state, and federal stakeholders. The project first opened a pilot channel to connect the Bahia Grande to the Brownsville Ship Channel. Later the Laguna Larga and Vadia Ancha were interconnected and subject to tidal cycles. The overarching goal is to restore historic tidal connections to many of the waterbodies between Brownsville and Port Isabel.

South Bay Coastal Preserve

The expansive seagrass beds in South Bay provide habitat to many species including federally listed sea turtles and West Indian manatee. In 1988 the General Land Office leased South Bay's approximately 3,500 surface acres to Texas Parks and Wildlife Department ("TPWD") to manage as a coastal preserve.

Draft Ocelot (*Leopardus pardalis*) Recovery Plan

In south Texas, the ocelot and Gulf Coast jaguarundi are federally listed as endangered under the Endangered Species Act. Although Designated Critical Habitat ("DCH") has not been designated for these felines, the U.S. Fish and Wildlife Service's ("FWS") Draft Ocelot (*Leopardus pardalis*) Recovery Plan, (2010) identified reconnection of sufficient habitat to support viable populations in the United States and Mexico. In the Brownsville area, efforts have been underway since 1979 to create a habitat corridor along the Laguna Madre coast connecting the Laguna Atascosa National Wildlife Refuge ("NWR") with suitable habitat in Mexico (FWS, 2015).

In 1998, an ocelot was radio-collared and tracked to determine movement patterns and habitat utilization. During tracking, the ocelot spent most days on lomas south of the Brownsville Ship Channel. In order to create a habitat corridor for the ocelot, the FWS and Brownsville Navigation District ("BND") established a wildlife corridor between State Highway 48 and the Brownsville Ship Channel to connect areas of potentially suitable ocelot and jaguarundi habitat within the Laguna Atascosa NWR's Bahia Grande Unit with suitable habitat located south of the Brownsville Ship Channel. The FWS ultimate goal is to create a corridor connecting the NWR lands habitats in Mexico.

Piping Plover

Much of the area south of the Brownsville Ship Channel surrounding South Bay is mapped DCH for the federally listed piping plover. This DCH is part of the 7,217-acre South Bay and Boca Chica TX-1 Unit. This DCH is intended to provide wintering piping plover habitat components that are essential for foraging, sheltering, and roosting.

4.0 PROPOSED COMPENSATORY MITIGATION SITE

The Project Site layout leaves minimal space to implement compensatory mitigation onsite. Therefore, Texas LNG examined available properties within the same HUC as the Project Site to identify ecosystems that could be re-established, rehabilitated, or enhanced. However, many of the surrounding properties are currently high-quality WOUS and provide potential habitat for federally listed species, which limits restoration opportunities. Furthermore, a considerable portion of the coastal habitats within this HUC is either already developed or under ownership by federal or state agencies and thus already protected. Therefore, Texas LNG focused on available high-quality coastal ecosystems within the HUC that are privately owned and could be preserved.

4.1 PRESERVATION OPPORTUNITY

Texas LNG identified a large tract of land with significant ecological value owned by the BND called Los Lomas Ecological Preserve ("LLEP") (figure 4-1). The LLEP is 4,600 acres of tidal mudflat and upland lomas about one mile south of the Project Site that was leased to the FWS in 1983 at no charge to fulfill the BND's compensatory mitigation requirements for a previous channel deepening project. However, the COE did not ultimately require compensatory mitigation for their project. Figure 4-1 identifies the location of the LLEP. In 2023 the lease with the FWS will expire and the BND may return it to their developable land holdings for future development and maintenance of the port (e.g., industrial development, expansion of dredged material placement areas, or oil and gas exploration)

Both the Project Site and LLEP are located close in proximity within the South Laguna Madre watershed (HUC: 12110208) and occupy the same hydrogeomorphic landscape position, tidal mudflat. Texas LNG proposes to preserve 405 acres at the LLEP, which is a ratio of 10:1 to Texas LNG's proposed permanent impacts on WOUS (figure 4-2). This mitigation approach is consistent with the Galveston District's recently approved SpaceX Project (SWG-2012-00381), which also provided compensatory mitigation in the form of preservation within the LLEP adjacent to the land offered by Texas LNG.

During the pre-application meeting with the COE at the Galveston District headquarters on March 11, 2015, Texas LNG proposed to use this strategy (a watershed approach to develop Permittee Responsible Mitigation based on preservation). During the discussion the COE agreed that the strategy was feasible but will likely require a higher than normal ratio and directed Texas LNG to the SpaceX Project for guidance. Subsequently, Texas LNG presented the LLEP location to the COE during a conference call on July 9, 2015, as the best mitigation opportunity available in the vicinity. The COE acknowledged that the approach had precedent in the Galveston District and Brownsville area.

Texas LNG's proposed mitigation site ("Mitigation Site") is a unique assemblage of high-quality wetland habitat. The natural tidal hydrology flows from South Bay and includes a dendritic network of tidal creeks. Aerial interpretation indicates stands of submerged aquatic vegetation and mangroves. Areas mapped by the TPWD as mangroves are shown on figure 4-1; however, aerial photos suggest that additional areas within the Mitigation Site may include mangroves. Since the water depth is shallower than the adjoining South Bay, propeller scarring is less evident and it appears to have less human interactions. The mitigation site is entirely mapped as DCH for piping plover and EFH. In general, it currently includes the characteristics that historically existed at the location of Texas LNG's proposed maneuvering basin (tidal mudflat impacts).


Figure 4-1
Los Lomas Ecological Preserve
Cameron County, Texas
SpaceX
Wetland Mitigation
Site (50 Acres)
South Bay
Loma Silvan
Loma de la Banderita
Loma de los Tequios
Loma de la Lena Seca
Loma Ochoa
Loma del Gato
Loma de las Gachupines
Loma del Burro
Loma Pelona
Loma del Divisadero
Brownsville Ship Channel
48
4
This information is for environmental review purposes only.
Project Site Boundary
Los Lomas Ecological Preserve (Lease Area) *
SpaceX Wetland Mitigation Site
COE Navigable Waterway
U.S. or State Highways
* Boundaries Approximate
1:50,000
0
0.5
1
Miles
N
TEXAS LNG
FILE: M:\Clients\S-U\TXL\Texas LNG_ArcGIS\2016\03\Mitigation_Plan_TXL_LNG_Fig4_1_Los_Lomas_EP.mxd | REVISED: 03/23/2016 | SCALE: 1:50,000
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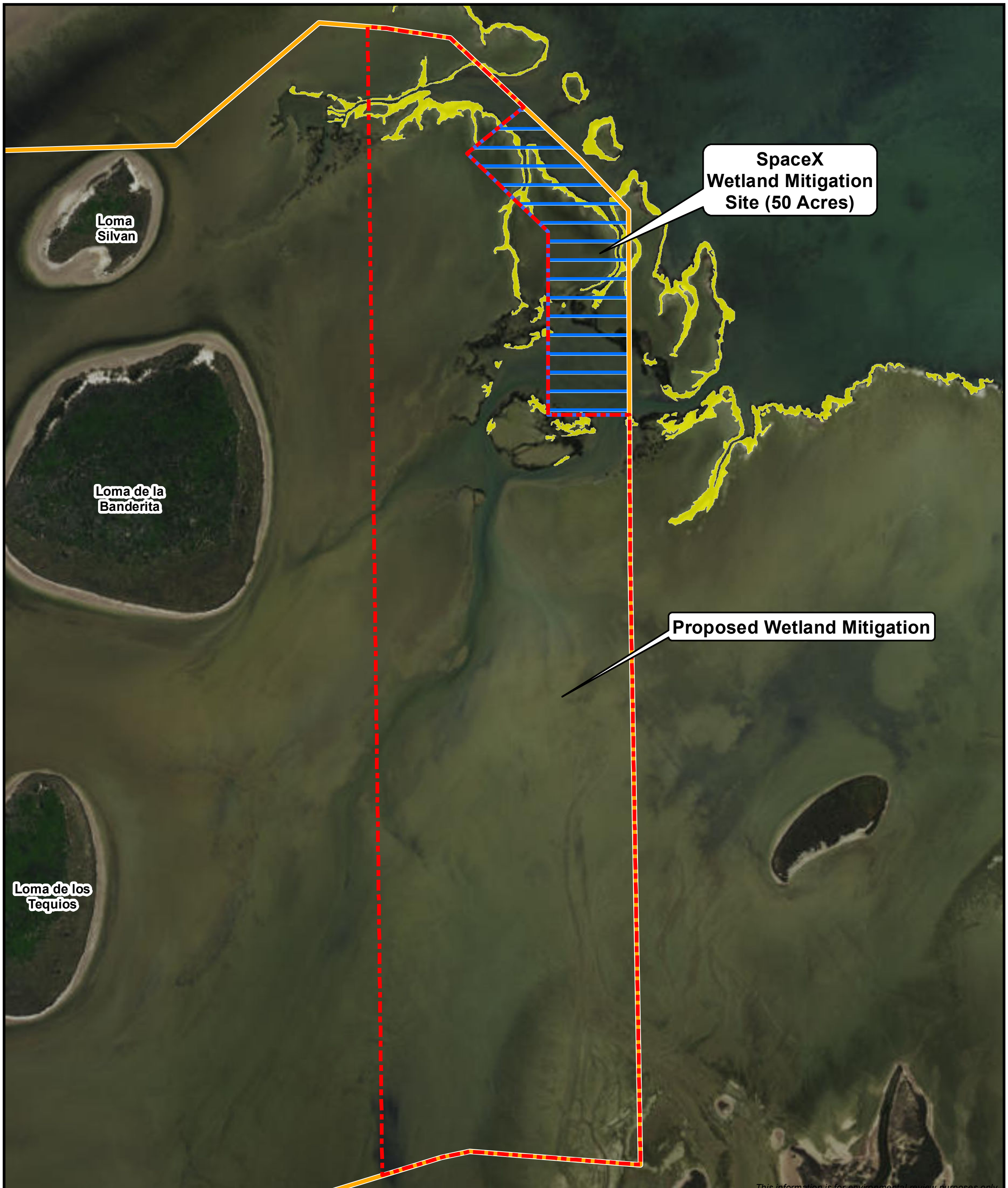

Wetland Mitigation (490 Acres)
Los Lomas Ecological Preserve (Lease Area) *
SpaceX Wetland Mitigation Site
Texas Parks and Wildlife Department Mapped Mangroves

1:15,000

* Boundaries Approximate

0 1,250 2,500 Feet

N

Figure 4-2
Texas LNG Wetland Mitigation Site
Cameron County, Texas

TEXAS LNG

NATURAL RESOURCE GROUP
an ERM Group company

M:\Clients\S-U\TXL\Texas LNG_ArcGIS\2016\03\Mitigation_Plan_TXL_LNG_Fig4_2_Los_Lomas_Wet_Mit.mxd | REVISED: 03/23/2016 | SCALE: 1:15,000 DRAWN BY: 0239

The Mitigation Site as depicted on figure 4-2 is approximately 405 acres. Texas LNG has pursued a larger site to ensure that the property will provide sufficient mitigation and allow flexibility as the Project design is finalized. This site is currently larger than preservation acres that Texas LNG estimates will be required to offset unavoidable losses of WOUS. The property boundary of the final mitigation site may be modified in consultation with the COE to match the preservation acres required and outlined in the COE's permit.

4.1.1 Mitigation Site Preservation Criteria

The Mitigation Site will be held in perpetuity. This will maintain the high functioning tidal mudflat ecosystem and prevent future development. The Final Mitigation Rule identifies the following five criteria for using preservation as compensatory mitigation (33 CFR 332.3). In the bullets below, Texas LNG has provided verification for meeting the preservation criteria for the Mitigation Site.

- *The resources to be preserved provide important physical, chemical, or biological functions for the watershed.*
    - The Mitigation Site will match watershed priorities with a high-quality WOUS under threat of development.
    - The Mitigation Site is uniquely situated within the South Laguna Madre watershed near the mouth of the Brownsville Ship Channel and the Gulf of Mexico. According to the South Laguna Madre Watershed Environmental Plan (Medina, 2010) South Bay and adjacent tidal mudflats, with nearby upland lomas, provide physical connectivity to wildlife, water quality processes, and flood retention.
    - Previous dredging of the Brownsville Ship Channel in the early and mid-1900s created a berm along the channel that cutoff or reduced tidal exchange in many mudflats. Therefore, the Mitigation Site is unique in that the tidal exchange from South Bay has never been cutoff. This allows the South Bay and the Mitigation Site to provide a healthy exchange of nutrients supporting critical EFH functions.
    - The expansive seagrass beds in South Bay provide habitat for many species including federally listed sea turtles and West Indian manatee. In 1988 the General Land Office leased South Bay's approximately 3,500 surface acres to TPWD to manage as a Coastal Preserve. Texas LNG's proposal to protect the Mitigation Site in perpetuity will significantly augment protection of this critical South Bay resource.
    - The Mitigation Site is also within DCH for piping plover listed under the Endangered Species Act.
- *The resources to be preserved contribute significantly to the ecological sustainability of the watershed. In determining the contribution of those resources to the ecological sustainability of the watershed, the district engineer must use appropriate quantitative assessment tools, where available.*

- o The Mitigation Site will preserve high-quality WOUS within the same subbasin watershed and with sufficient ecological benefit to offset permanent unavoidable impacts on WOUS at the Project Site.
- o Texas LNG used the interim Hydrogeomorphic ("iHGM") models to quantify the ecological functions at the Project Site and the proposed Mitigation Site.

- *Preservation is determined by the district engineer to be appropriate and practicable.*
  - o In 2015, the COE Galveston District approved the SpaceX Project (SWG-2012-00381) using preservation as compensatory mitigation. As described in 33 CFR 332.3 (h) 2, the District Engineer is allowed to accept preservation as the sole source of mitigation provided the ratios are higher. Texas LNG is proposing preservation as mitigation because the proposed property augments the existing watershed plans. It is also appropriate because the tidal mudflats within the Project Site are impaired (low functioning) and the impacts associated with dredging of the maneuvering basin are a conversion rather than a permanent loss of WOUS.
- *The resources are under threat of destruction or adverse modifications.*
  - o Since the Mitigation Site is situated adjacent to a deep water channel close to the Gulf of Mexico, development potential is increased. As described above, when the lease to the FWS expires in 2023, the area may return to the BND's available lands for future development and maintenance of the port.
- *The preserved site will be permanently protected through an appropriate real estate or other legal instrument.*
  - o Texas LNG has submitted a Memorandum of Agreement to the BND to use a portion of the LLEP for this Project. If approved, Texas LNG will prepare a legal site protection instrument that complies with the COE's recommended conservation easement as described in (33 CFR 332.4 (c) 4). The Memorandum of Agreement and sample conservation easement is provided in attachment A.

4.2 SITE SELECTION

As described in Section 2.3, mitigation banks and in-lieu fee service areas are not available in the South Laguna Madre watershed (HUC: 12110208). Therefore, Texas LNG reviewed available watershed plans to identify the following key goals for selection of the wetland Mitigation Site:

- The Mitigation Site will fulfill the objectives of the Lower Rio Grande Watershed Initiative by ensuring in perpetuity that large contiguous tidal wetlands continue to perform water quality improvement functions in the South Laguna Madre watershed. Texas LNG will also ensure that the Project complies with federal and state permit water quality requirements during construction and operation.

- Both the Project Site and Mitigation Site will facilitate the objectives of the Lower Rio Grande Basin Study. The Mitigation Site will protect the tidal wetlands that dissipate flood events by storing the excess flow and discharge within an asynchronous period.
- Texas LNG's proposed maneuvering basin will augment the Bahia Grande Restoration Project by removing the berm along the Brownsville Ship Channel and restoring the historic tidal cycle to up to 700 acres of mudflat adjacent to the Project Site.
- An objective in the Draft Ocelot (Leopardus pardalis) Recovery Plan is to create a corridor for federally listed felines and other species to migrate between the NWR and Mexico. Preservation of the Mitigation Site will provide an incremental step to FWS' goal of creating a habitat corridor.
- DCH for piping plover will be protected in perpetuity by Texas LNG's proposed compensatory Mitigation Site.

4.2.1 Hydrological Conditions

The Mitigation Site is unique in that historic tidal cycles have been maintained via South Bay. Therefore, the mudflats within the Mitigation Site will continue to provide EFH. This is particularly evident around the stands of mangrove. The physical and soil characteristics of the mudflats at both the Project Site and the Mitigation Site are similar (mapped as Barrada Clay soils).

4.2.2 Watershed-scale Features

On a watershed scale, the Mitigation Site provides greater opportunity for functions than the Project Site. The South Bay and LLEP are capable to store flood water while providing refuge for wildlife on lomas. As described above, the LLEP was previously identified by the FWS as a potential corridor for federally listed felines.

4.2.3 Scale of Hydrologic Sources

Adequate hydrology is anticipated because of the tidal exchange in South Bay.

4.2.4 Land Use Compatibility

The surrounding land use is compatible with the Mitigation Site functions. Existing dredge material placement areas occur near the north boundary of the Mitigation Site and nearby to the west. These areas have restricted access therefore disturbance to wildlife will be minimal.

4.2.5 Reasonably Foreseeable Effects

Dredging of the maneuvering basin at the Project Site will restore the historic tidal cycle to a large mudflat complex adjacent to the Project Site. Texas LNG believes this will provide a significant ecological lift to mudflats adjacent to the Project Site. Texas LNG's proposed Mitigation Site will ensure that a large contiguous area of unaffected tidal mudflat is preserved in perpetuity. Preservation of the mudflats will also provide additional protection for mapped DCH for the piping plover and EFH.

4.2.6 Relevant Factors

Development trends within the BND demonstrate an increasing demand for properties with deepwater access along the Brownsville Ship Channel. The recently approved deepening of the channel by the COE to accommodate larger vessels is expected to further increase demand (COE, 2014). Additionally, oil and gas exploration is increasing in south Texas (Meyers, 2014). Texas LNG's proposed Mitigation Site within the LLEP will ensure protection from future encroachments to a high-quality ecosystem.

4.3 SITE PROTECTION

As described above, Texas LNG has submitted a Memorandum of Agreement to the BND to use a portion of the LLEP for this Project. If approved, Texas LNG will prepare a legal site protection instrument that complies with the COE's recommended conservation easement as described in (33 CFR 332.4(c)4). The Memorandum of Agreement and sample conservation easement is provided in attachment A.

4.4 BASELINE CONDITION

To quantify the ecological functions at the Project Site and provide a comparison to the proposed Mitigation Site, Texas LNG used the iHGM methodology. The iHGM methodology was developed by the COE to measure the potential of a wetland to perform critical functions. The Galveston District issued a Standard Operating Procedure memo dated September 11, 2008, outlining the iHGM methodology's role in determining compensatory mitigation requirements. Of the four iHGM assessment models offered by the Galveston District COE, the herbaceous riverine and tidal fringe models were used by Texas LNG to evaluate the wetlands and tidal flats present at the Project Site.

Although the iHGM herbaceous riverine model is not an absolute fit for the palustrine emergent wetlands (WOUS) at the Project Site, it is the best model available. The tidal mudflats (WOUS) were aggregated together as a single Wetland Assessment Area ("WAA") and evaluated using the iHGM tidal fringe model.

The iHGM herbaceous riverine model is a mathematic formula to assess the WOUS functions of each WAA. The model focuses on the following three primary functions:

- temporary storage and detention of storage water ("Physical"),
- maintain plant and animal communities ("Biota"), and
- removal and sequestration of elements and compounds ("Chemical").

However, in the iHGM tidal fringe model, the plant and animal communities are divided into "Botanical" and "Biota" functions.

To assess the functions for each WAA a subindex value was assigned to each variable that quantitatively ranks the functions. For example, a subindex is assigned to the following variables in order to characterize the Physical function:

- Distance to water greater than six feet deep;
- Average marsh width;
- Manning's roughness coefficient (describes the tidal flow);
- Predominant soil texture (e.g., clay, loam, or sand); and
- Hydroperiod (the tidal cycle).

Using the assigned subindex, the Functional Capacity Index ("FCI") is calculated for each WAA. The FCI is a numeric expression of the potential functions. The FCI value is then multiplied by the respective WAA area (WOUS acreage) to yield the Functional Capacity Unit ("FCU"). Therefore, the FCU is a numeric expression of the potential functions but is modified by the size of the WAA. The iHGM data forms are located in attachment B.

4.5 DETERMINATION OF CREDITS

Palustrine emergent wetlands at the Project Site were evaluated using the iHGM herbaceous riverine model. The pre- and post-project FCUs for the palustrine wetlands functions are included in table 4.5-1. The results of the iHGM model indicate that the functions of the palustrine emergent wetlands will be maintained after impacts occur along the perimeter of the wetland boundary associated with development of the Project Site.

TABLE 4.5-1

Texas LNG Project
Summary of Wetland FCUs at the Proposed Project Site

Function	Pre-Project FCU [a]	Post-Project FCU [b]	Net Change FCU
Physical	31.8	31.8	-0.1
Biota	32.0	31.9	-0.1
Chemical	32.6	32.5	-0.1

FCU = Functional Capacity Units
[a] Pre-Project FCU calculation is based on 60.0 acres of palustrine emergent wetlands.
[b] Post-Project FCU calculation is based on 59.9 acres of palustrine emergent wetlands.

Tidal mudflats at the Project Site were evaluated using the iHGM tidal fringe model. The pre- and post-project FCUs for the tidal mudflat functions at the Project Site are included in table 4.5-2. The results of the Botanical function component of the iHGM model indicate a loss of function in the tidal mudflat (where the maneuvering basin will be dredged). However, the results of the iHGM model for the biota, physical, and chemical components indicate a slight gain (improvement). The recorded gain of function can be attributed primarily to the result of removing the barrier to daily tidal water exchange within the Project Site.

TABLE 4.5-2

Texas LNG Project
Summary of Tidal Mudflat FCUs at the Proposed Project Site

Function	Pre-Project FCU [a]	Post-Project FCU [b]	Net Change FCU
Biota	28.0	57.0	29.0
Botanical	17.8	13.8	-4.0
Physical	92.6	96.3	3.8
Chemical	17.8	43.5	25.7

FCU = Functional Capacity Units
[a] Pre-Project FCU calculation is based on 178.0 acres.
[b] Post-Project FCU calculation is based on 137.6 acres.

The pre- and post-project FCUs for the tidal mudflat functions at the Texas LNG Mitigation Site are included in table 4.5-3. Since the Mitigation Site is targeted as mitigation through preservation, therefore no alteration of the site conditions, there will be no change (gain or loss) in functions. The Mitigation Site is expected to continue supporting the high-quality functions as it does currently.

TABLE 4.5-3

Texas LNG Project
Summary of Tidal Mudflat FCUs at the Proposed Mitigation Site

Function	Pre-Project FCU[a]	Post-Project FCU	Net Change FCU
Biota	206.5	206.5	0
Botanical	49.0	49.0	0
Physical	372.4	372.4	0
Chemical	120.0	120.0	0

FCU = Functional Capacity Units
[a] Preserving the high-quality tidal mudflat habitat will not yield a net change in FCU; the FCU will remain the same pre- and post-project.

As described above, Texas LNG's proposed permanent impacts on WOUS at the Project Site will result is a loss of about 0.7 acre of WOUS and a conversion of about 39.8 acres of tidal mudflats to deepwater habitats. However, based upon the high functioning wetlands to be preserved at the Mitigation Site, Texas LNG believes these impacts are adequately offset as demonstrated through the iHGM model analysis of impacts and mitigation above.

4.6 MITIGATION WORK PLAN

Texas LNG will survey the boundary of the proposed Mitigation Site to officially record the easement. No additional impacts on WOUS are anticipated as a result of establishing the Mitigation Site. The site consists of currently functioning wetland habitat. No grading, planting, soil management, erosion control measures or non-native species controls are therefore necessary or proposed in this plan.

4.7 PERFORMANCE STANDARDS

Performance standards for the Mitigation Site will focus on completing a conservation easement that provides appropriate protection in perpetuity. No additional performance standards are proposed by Texas LNG.

4.8 MONITORING REQUIREMENTS

Within one year of completing Phase I of the Project or as specified in the COE permit, Texas LNG will provide a summary of the mitigation site showing the civil survey of boundaries, executed conservation easement, and proposed land management entity to hold the easement in perpetuity.

4.9 LONG TERM MANAGEMENT

Texas LNG will donate the conservation of the Mitigation Site to an independent land management entity pursuant to the timeframe outlined in the permit to be issued by the COE. Texas LNG will therefore not be responsible for the long-term management of the property.

4.9.1 Ownership of the Mitigation Site

Texas LNG's proposed Mitigation Site will be owned by the BND. However, administration of the conservation easement will become the responsibility of the land management entity.

4.10 FINANCIAL ASSURANCE

The proposed Mitigation Site will be protected by a conservation easement executed pursuant to the timeframe outlined in the permit to be issued by the COE; no restoration activities are proposed by Texas LNG. Therefore, Texas LNG has not proposed additional short or long-term financial assurances to implement the Mitigation Site.

5.0 REFERENCES

Lower Rio Grande Watershed Initiative. 2016. Available online at: http://sites.utexas.edu/lrgwi/. Accessed January 2016.

Medina, I. 2010. South Laguna Madre Watershed Environmental Plan. Available online at: http://izelmedina.weebly.com/uploads/4/6/0/6/4606424/south_laguna_madre_watershed_environmental_plan_reduced_size.pdf. Accessed January 2016.

Meyers, R. 2014. Texas' Oil and Gas Industry Expands to Near-Record Levels. Available online at: http://fuelfix.com/blog/2014/07/24/texas-oil-and-gas-industry-expands-to-record-levels/. Accessed February 2016.

Ocean Trust. 2009. Bahia Grande Project. Available online at: http://www.habitat.noaa.gov/toolkits/tidal_hydro/portfolio_resources/tidalhydro_bg_11_2009_masterplanoverview.pdf. Accessed January 2016.

U.S. Army Corps of Engineers. 2008. Compensatory Mitigation for Losses of Aquatic Resources. Available online at: http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/mitig_info.aspx. Accessed January 2016.

U.S. Army Corps of Engineers. 2014. Brazos Island harbor, Texas Channel Improvement Project – Final Integrated Feasibility Report – Environmental Assessment. Available online at: http://www.swg.usace.army.mil/Portals/26/docs/BIH/Feasibility.pdf. Accessed April 2015.

U.S. Army Corps of Engineers. 2016. Regulatory In-lieu fee and Bank Information Tracking System. Available online at: https://ribits.usace.army.mil/ribits_apex/f?p=107:2. Accessed January 2016.

U.S. Department of the Interior. 2013. Lower Rio Grande Basin Study. Available online at: http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/studyrpt.html. Accessed January 2016.

U.S. Fish and Wildlife Service. 2010. Draft Ocelot (Leopardus pardalis) Recovery Plan. http://www.fws.gov/southwest/es/Documents/R2ES/Draft_Ocelot_Recovery_Plan-First_Revision.pdf. Accessed January 2016.

U.S. Fish and Wildlife Service. 2015. Creating a Wildlife Corridor. Available online at: http://www.fws.gov/refuge/Lower_Rio_Grande_Valley/resource_management/wildlife_corridor.html. Accessed January 2016.

Attachment A
Memorandum of Agreement and Sample Conservation Easement

MEMORANDUM OF UNDERSTANDING

AN AGREEMENT TO SATISFY COMPENSATORY MITIGATION REQUIREMENTS

This Memorandum of Understanding, is made and entered into by and between the Brownsville Navigation District ("BND"), and Texas LNG Brownsville, LLC ("Texas LNG"), hereinafter collectively referred to as the "Parties."

WHEREAS, the purpose of this Memorandum of Understanding is to satisfy Texas LNG's compensatory mitigation requirements;

WHEREAS, the BND, a political subdivision of the State of Texas, is the owner of approximately 40,000 acres of real property situated in Cameron County, Texas including land identified in the plot labeled "Exhibit 1";

WHEREAS, the BND has made BND land available for Space Exploration Technologies Corp.'s mitigation purposes in furtherance of Space Exploration Technologies Corp.'s regulatory approval process including approvals by U.S. Army Corps of Engineers ("USACE");

WHEREAS, the mission of the BND is to be a leader in business development by providing state of the art infrastructure expansion, developing economic opportunities, providing the best transportation facilities possible, and exhibiting high standards of public administration with the ultimate goal being to improve quality of life and create employment opportunities, gain the public's trust and confidence in order to increase growth development, and establish the port as a world class port;

WHEREAS, the BND has a long history of environmental stewardship and strives to operate the BND to support the community through economic/industrial development and at the same time protect the environment;

WHEREAS, Texas LNG is developing a 4 million metric tonnes per annum ("MTA") liquefied natural gas ("LNG") export facility located on BND property to be developed in two phases, each phase at 2 MTA, with the first phase expected to begin production in 2020;

WHEREAS, the BND deems the proposed Texas LNG export facility of such significance to the BND and to Cameron County, that the BND is willing to reasonably cooperate with Texas LNG on compensatory mitigation;

WHEREAS, the Parties entered into an Option to Lease Agreement, which was subsequently amended, whereby Texas LNG acquired from the BND, the option to lease an approximately 625 acre tract of land and a Memorandum of Understanding to implement land use restrictions to satisfy exclusion zone requirements;

WHEREAS, in the Option to Lease Agreement between the Parties, the BND agreed to reasonably cooperate with Texas LNG in securing the necessary permits and approvals from governmental authorities to develop, construct, and operate its LNG export facility;

WHEREAS, Texas LNG has taken all practical measures to avoid and minimize environmental impacts, including reconfiguring the layout of its LNG export facility to reduce wetland impacts;

WHEREAS, Texas LNG must submit an application to USACE pursuant to the Clean Water Act, Section 404, which includes a compensatory mitigation plan and site;

WHEREAS, in 2008, USACE and the U.S. Environmental Protection Agency (EPA) issued regulations clarifying compensation requirements for impacts to wetlands, streams, and other aquatic resources authorized by permits issued under Section 404 of the Clean Water Act (CWA) and/or Section 10 of the Rivers and Harbors Act (RHA) of 1899 and the 2008 Mitigation Rule incorporates recommendations from the National Research Council for improving the planning, development, implementation, and performance of wetland compensatory mitigation projects;

WHEREAS, in connection with Texas LNG's Section 404 application to USACE, the Parties have identified BND property as the mitigation site to be evaluated by USACE to fulfill Texas LNG's compensatory mitigation requirements and is attached as "Exhibit 1";

WHEREAS, the Parties are relying on 33 CFR Part 332 whereby preservation is recognized as an acceptable form of compensatory mitigation and U.S. Army Corps of Engineers Galveston District Model Conservation Easement Agreement attached as "Exhibit 2";

NOW, THEREFORE, for good and valuable consideration, the undersigned Parties agree as follows:

> Prior to Texas LNG commencing construction of its LNG export facility, the BND will preserve up to 490 acres of land identified in "Exhibit 1" through a Conservation Easement.
>
> In consideration for the BND preserving up to 490 acres of land through a Conservation Easement, Texas LNG will pay the BND ______________________________per acre within 90 days of the BND encumbering the land with a Conservation Easement.
>
> The terms of the Conservation Easement will be substantially the same as those found in U.S. Army Corps of Engineers Galveston District's Model Conservation Easement Agreement attached to this agreement as "Exhibit 2".
>
> As long as Texas LNG has an Option to Lease Agreement or Lease Agreement with the BND, the BND agrees not to cause or permit any new mortgage, deed of trust, lien, encumbrance, covenant, condition, restriction, assessment, easement, right-of-way, obligation, encroachment to be placed of record or to affect the easement estate identified in "Exhibit 1".

Texas LNG shall have the right to apply for all permits and approvals from governmental authorities to satisfy Texas LNG's compensatory mitigation requirements and the BND agrees to reasonably cooperate with these efforts.

The price per acre Texas LNG pays the BND for the Conservation Easement, will be no less favorable than that granted to any other private entity for mitigation purposes, for a period of five (5) years from the date of the execution of this agreement. The BND shall notify Texas LNG within thirty (30) days if it enters into an agreement that has a more favorable price and Texas LNG shall have the right to receive the more favorable price immediately.

Should any clause, sentence, or other portion of this agreement be held invalid or against public policy, or should any court otherwise refuse to enforce any portion of this agreement, such ruling shall not invalidate the remainder of this agreement.

IN WITNESS WHEREOF, the Parties have executed this Memorandum of Understanding on the ____________ Day of February, 2016.

Brownsville Navigation District of Cameron County, Texas

____
By: Ralph Cowen, Chairman

____
Attested to by Secretary

-and-

Texas LNG Brownsville, LLC

____
By: Langtry N. Meyer, COO & Cofounder

Exhibit 1
Mitigation Site

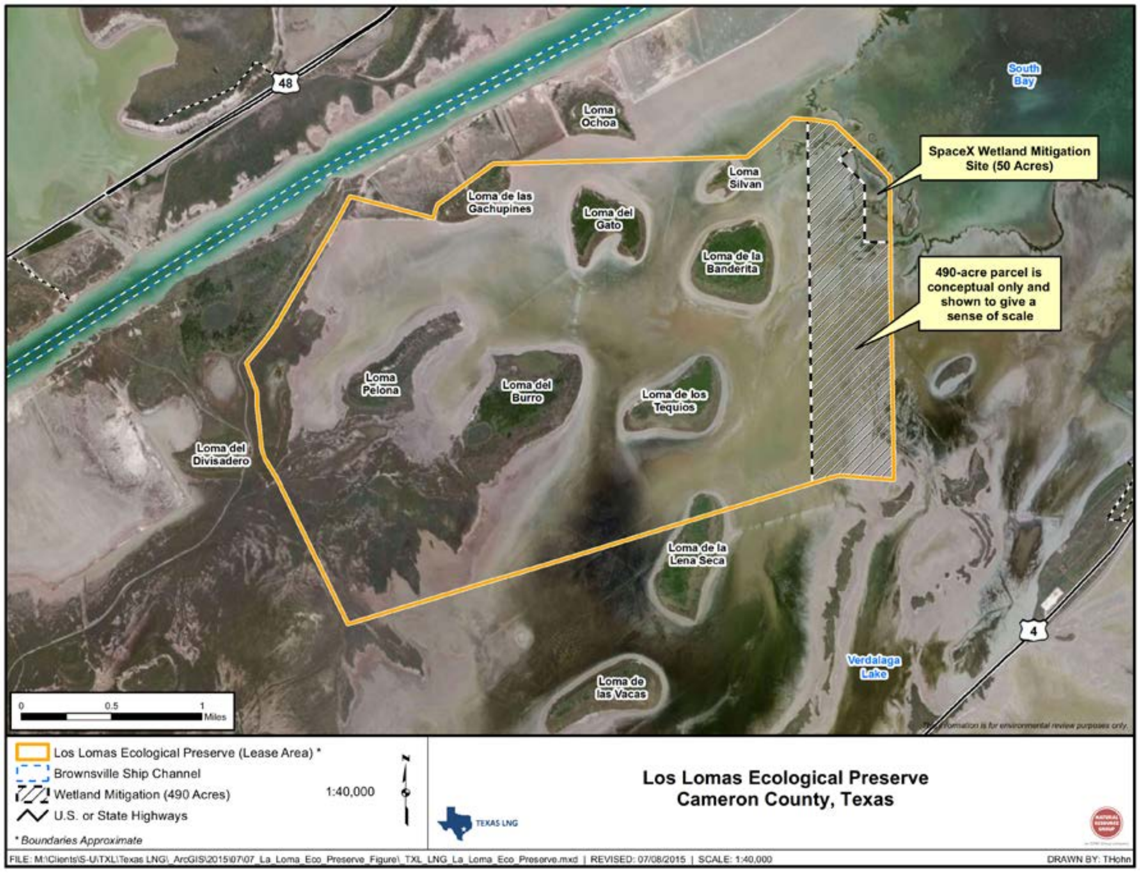

Exhibit 2
U.S. Army Corps of Engineers Galveston District
Model Conservation Easement Agreement

Accessed on January 26, 2016 at: http://www.swg.usace.army.mil/Portals/26/docs/regulatory/e-library/Conservation_Easement.pdf

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CONSERVATION EASEMENT

__________(Grantor) is the owner of that real property more particularly described and shown in Exhibit "A" (hereinafter the "Property") attached hereto and made a part hereof. The approximately _____-acre Property is also referenced in "The Mitigation Plan For ____________". The Property is subject to the conditions of Department of the Army Section 404/Section 10 Permit Number _____, dated __________, or a revision thereof. One of the conditions of the referenced permit requires restrictions be placed on the deed for the Property for the purpose of providing compensation for adverse impacts to waters of the United States". Any activities, not included in the permit which may, in the future, be conducted within the Property and will affect the vegetative and hydrologic condition outlined in the success criteria of the Mitigation Plan, must be approved by the United States Army Corps of Engineers (USACE), Galveston District, Regulatory Branch, prior to initiation. This Conservation Easement is created pursuant to the Texas Uniform Conservation Easement Act of 1983 in Chapter 183 of the Texas Natural Resources Code. It is the purpose and intent of this Conservation Easement to assure that the subject lands will be retained and maintained forever predominantly in the vegetative and hydrologic condition described in the success criteria of "The Mitigation Plan for ____________".

WHEREAS, Grantee is qualified to hold a conservation easement, and is either

(a) a governmental body empowered to hold an interest in real property under the laws of this State or the United States; or

a charitable, not-for-profit or educational corporation, association, or trust: *, qualified under §501 (c)(3) and § 170(h) of the Internal Revenue Code]*, the purposes or powers of which include one or more of the purposes (a)-(e) below;

WHEREAS, the purpose of this Conservation Easement include, without limitation, one or more of the following:

(a) retaining or protecting natural, scenic, or open-space aspects of real property;
(b) ensuring the availability or real property for recreational, educational, or open-space use;
(c) protecting natural resources;
(d) maintaining or enhancing air and water quality;
(e) preserving the historical, architectural, archaeological, or cultural aspects of real property.

The parties to this agreement include the USACE Permit Applicant, the Grantor, and the Third-Party Administrator (Grantee) who hereby agree that a conservation easement is created which will be subject to the following conditions:

1) Property Description

(Applicant) will provide as Attachment A-1:

(a) On-site photographs taken at appropriate locations on the Protected Property including all major natural features; and

(b) A copy of the deed with an accurate legal description or a current survey certified by a Texas Registered Professional Land Surveyor (RPLS) of the Protected Property.

(c) A copy of a verified wetland survey map, which delineates all waters of the United States, including wetlands within the Property.

2) **Term**

These restrictions shall run with the land in perpetuity and be binding on all future owners, heirs, successors, administrators, assigns, lessees, or other occupiers and users. The owner must file this Conservation Easement of record with the County Clerk of ______________ County, Texas within 10 days of the date this document is signed and provide a copy of the recorded conservation easement to the USACE, Galveston District within 30 days of filing.

3) **General**

Except for such specific activities as authorized pursuant to DA Permit Number _______, the following activities are prohibited on the Property subject to this Conservation Easement:

(a) There shall be no filling, excavation, mining or alteration of the Property that will affect the success criteria outlined in the Mitigation Plan unless approved in writing in advance by the USACE, Galveston District.

4) **Rights of Access and Entry**

The USACE shall have the right to enter and go upon the Property for purposes of inspection, and to take actions including but not limited to scientific or educational observations and studies, and collection of samples.

5) **Grantor's Reserved Rights**

Notwithstanding the foregoing Restrictions, Grantor reserves for Grantor, its heirs, successors, administrators, and assigns the following Reserved Rights, which may be exercised upon provision of prior written notice to Grantee and to the USACE, except where expressly provided otherwise:

(a) Reserved Rights, Grantor reserves the right to engage in all acts or uses not prohibited by the Restrictions, and which are not inconsistent with the conservation purposes of this grant, which is the preservation of the Property substantially in its natural vegetative and hydrologic condition described in the Mitigation Plan.

[Insert for approved mitigation banks: (b) Grantor reserves the sole and unrestricted right to sell credits or other entitlements or interests in the Property in order to perfect and carry out the purpose of a mitigation bank.]

[Additional, case-specific reservations may be listed e.g. wildlife management plans]

6) **Enforcement**

This Conservation Easement may be enforced by the Grantee and the USACE, or its successor agencies, in an action at law or equity against any person(s) or other entity/entities violating or attempting to violate this Conservation Easement. Any forbearance on the part of the USACE to exercise its rights in the event of a violation shall not be deemed or construed to be a waiver of their rights hereunder in the event of any subsequent failure of the Grantor to comply. In the event of a breach of the Conservation Easement by the Grantor, Grantee, or another party, or any party working for or under the direction of the Grantor or Grantee, the USACE must be notified immediately. If the USACE becomes aware of a breach of the restrictions, the USACE will notify the Grantor and Grantee of the breach. The parties shall have thirty (30) days after receipt of such notice to undertake actions that are reasonably calculated to swiftly correct the conditions constituting the breach. If the conditions constituting the breach are corrected in a timely and reasonable manner, no further action is warranted or authorized. If the Grantor or Grantee fail to initiate such corrective action within thirty (30) days or fail to complete the necessary corrective action, the USACE may undertake such actions, including legal proceedings, as are necessary to effect such corrective action.

7) Assignment or Transfer

It is understood that this Conservation Easement and any obligations under this Conservation Easement shall not be assigned by Grantee or Grantor, except to another organization qualified to hold such interest under the applicable state and federal laws. The USACE shall be notified in writing of any intention to reassign this Conservation Easement to a new Grantee. A copy of the acceptance must be delivered to the USACE. The Conservation Easement will then be recorded and indexed in the same manner as the original instrument and a copy of the new Conservation Easement must be furnished to the USACE.

8) Warranty

Grantor warrants that it owns the Property in fee simple and that there are no outstanding mortgages, tax liens, encumbrances, or other interests in the Property which have not been expressly subordinated to this Conservation Easement. Grantor further warrants that Grantee shall have the use of and enjoy all the benefits derived from and arising out of this Conservation Easement.

IN WITNESS WHEREOF, Grantor, Grantee and Applicant have executed this Conservation Easement, on the date written hereon. By its execution and acceptance of this Conservation Easement, Grantor, Grantee and Applicant accept the third-party rights of enforcement herein.

Approved by Property Owner (Grantor):

______________________ ________

Signature Date

____

Printed Name

____

Title

Approved by Grantee:

DRAFT

Signature Date

Printed Name

Title

Approved by the Applicant:

Signature Date

Printed Name

Title

Attachment B
iHGM Data Sheets

Texas LNG Project Site
Tidal Mudflats

Biota:

$$\frac{\left(\frac{\left(V_{edge}+\left(2\ x\ V_{hydro}\right)+\left(0.5\ x\ V_{nhc}\right)\right)}{3.5}+V_{typical}\right)}{2}$$

Botanical:

$$V_{typical}$$

Physical:

$$\frac{\left(V_{slope}+V_{width}+V_{rough}+V_{soil}+V_{hydro}\right)}{5}$$

Chemical:

$$\sqrt{\text{Vtypical x Vhydro}}$$

Need values for: Use the existing methods described in the tidal fringe model.

V_{edge}

V_{hydro}

V_{nhc}

$V_{typical}$

V_{slope}

V_{width}

V_{rough}

V_{soil}

- The tidal fringe geo-region for this model to be used is limited to the western fringes of the Gulf of Mexico WETLANDS and is only to be used for a rapid non- controversial estimate of the potential impacts and to see if the proposed mitigation will adequately address the wetland functions that are being impacted.

Texas LNG Project Site
Tidal Mudflats

V_{edge}: The amount of marsh-water meters/hectare.

Site Description	Qualitative	Quantitative	Subindex
Marsh shows deterioration due to subsidence large amounts of open water	Very High	Greater than 800 m/ha	0.8
Well-developed tidal drainage network present OR Simple tidal network with isolated ponds & depression in the marsh interior OR Large amount of shallow shoreline in relations to the entire area	High	350—800 m/ha	1.0
Simple tidal drainage network; isolated ponds and depressions are few & lacking	Moderate	200-350 m/ha	0.7
Marsh lack both tidal creeks & isolated ponds & depressions, shoreline is linear or smooth. Marsh area is large relative to shoreline length. OR the WAA is a depression that is not affected by the daily tide (i.e. high marsh)	Low	Less than 200 m/ha	0.4

V_{hydro}: Site hydroperiod or degree of hydrological modifications.

Site Description	Subindex
Site is open, no hydrologic restrictions	1.0
Moderate hydrologic restriction (i.e. low level berms that overtop frequent by waves, or has multi-breeches or large numerous culverts)	0.6
Severe hydrologic restriction (high elevation berm within frequent over-top, small culverts, single opening or breech)	0.3
Site receives water only during extreme storm events	0.1
Site is cut off from tidal exchange	0.0

V_{nhc}: Number of nekton habitat types present.

Habitat types: Within 150 feet of the edge of the WAA.

Low Marsh	High Marsh	Subtidal creeks	Intertidal creeks
Ponds or depressions	SAVs	Oyster Reef	Unvegetated flats
Algal flats	Mangroves	Coarse woody debris	

Number of habitat types	Variable Subindex
1	0.2
2	0.3
3	0.5
4	0.7
5	0.8
6	1.0

$V_{typical}$: Proportion of the site that is covered by vegetation typical of the regional subclass.

Invasive species: tallow, alligator weeds, spiny aster, common reed, rattlebox, cattail, flat sedge (*Sapium sabiferum, Alternathera philoxeroides, Aster spinosus, Phragmites drummondii, Sesbania drumondii, Typha sp, Cyperus entranianus*).

Total % Cover by typical species	Variable sub-index
10 %	0.1
20 %	0.1
30 %	0.2
40 %	0.4
50 %	0.5
60 %	0.6
70 %	0.7
80 %	0.9
90 %	1.0
100 %	1.0

V_{slope}: Distance to water greater than or equal to 6 feet deep.

Distance to Navigation Channel or water greater than or equal to 6 feet deep	Variable Sub Index
Less than 150 feet	0.1
151-450 feet	0.5
Greater than 451 feet	1.0

V_{width}: Average marsh width.

Mean Width WAA Distance (feet)	Variable Sub Index
0-30	0.1
31-75	0.25
76-150	0.5
151-225	0.6
226-300	0.8
301-375	0.85
376-450	0.9
451-525	0.95
526-600	1.0
Greater than 600	1.0

V_{rough}: Manning's roughness coefficient

$n_{base} + n_{topo} + n_{veg}$ = Manning's end

(n_{base})

Sediment surface	0.025	Base value for bare marsh soil.
	0.03	More than 25% of the sediment surface covered with gravel or broken shell

(n_{topo})

Topographic relief	0.001	WAA is flat no microtopographic or macrotopographic relief
	0.005	WAA has 5-25% topographic relief
	0.010	WAA has 26-50% topographic relief
	0.20	WAA has greater than 50% topographic relief

(n_{veg})

Vegetation	Less 50% cover	50-75% cover	76-100% cover	Description of Conditions
	0.025	0.030	0.035	Predominantly Short flexible stem grass (i.e. *Spartina alterniflora, S. patens, Distichlis spicata*)
	0.035	0.040	0.050	Predominantly short stiff trailing stems (i.e. *Batis & Salicornia*)
	0.050	0.060	0.070	Predominantly tall flexible grass (i.e. tall *Spartina alterniflora, S. cynosuroides, Scirpus* sp).
	0.070	0.100	0.160	Predominantly tall with stiff leaves or mixed with woody shrubs (i.e. *Juncus roemerianus,* Mangroves, etc.)

FCI variable sub index (rounded appropriately)

Roughness	Variable Sub Index
0.04	0.1
0.05	0.2
0.06	0.4
0.07	0.6
0.08	0.8
0.09	1.0
0.10	1.0

V_{soil}: Predominant soil texture.

Soil Texture	Variable Sub Index
Sandy	0.2
Sandy loam	0.4
Loam	0.6
Clay loam	0.8
Clay	1.0

Texas LNG Project Site
Tidal Mudflats

WAA # Mudflat Pre (178.0 acres)

Variable	Subindex
V_{edge}	0.4
V_{hydro}	0.1
V_{nhc}	0.3
$V_{typical}$	0.1
V_{slope}	0.1
V_{width}	1.0
V_{rough}	0.4
V_{soil}	1.0

WAA # Mudflat Post (137.6 acres)

Variable	Subindex
V_{edge}	0.4
V_{hydro}	1.0
V_{nhc}	0.3
$V_{typical}$	0.1
V_{slope}	0.1
V_{width}	1.0
V_{rough}	0.4
V_{soil}	1.0

Texas LNG Project Site
Tidal Mudflats

Biota:

$$\frac{\left(\frac{\left(V_{edge} + (2\ x\ V_{hydro}) + (0.5\ x\ V_{nhc})\right)}{3.5} + V_{typical}\right)}{2}$$

Pre FCI = $\frac{\left(\frac{(0.4+(2\ x\ 0.1)+(0.5\ x\ 0.3))}{3.5}+0.1\right)}{2}$ = **0.16**

Post FCI = $\frac{\left(\frac{(0.4+(2\ x\ 1.0)+(0.5\ x0.3))}{3.5}+0.1\right)}{2}$ = **0.41**

Botanical:

$V_{typical}$

Pre FCI 0.1= **0.10**

Post FCI 0.1=**0.10**

Physical:

$$\frac{(V_{slope} + V_{width} + V_{rough} + V_{soil} + V_{hydro})}{5}$$

Pre FCI = $\frac{(0.1+1.0+0.4+1.0+0.1)}{5}$ = **0.40**

Post FCI = $\frac{(0.1+1.0+0.4+1.0+1.0)}{5}$ = **0.58**

Chemical:

$\sqrt{\text{Vtypical x Vhydro}}$

Pre FCI = $\sqrt{0.1\text{ x }0.1}$ = **0.10**

Post FCI = $\sqrt{0.1\text{ x }1.0}$ = **0.32**

Functional Capacity Units (FCU); FCI x wetland acres per WAA (Tidal Mudflat)

WAA#	Pre-Project FCUs	Post-Project FCUs
Biota	28.0	57.0
Botanical	17.8	13.8
Physical	92.6	96.3
Chemical	17.8	43.5

Los Lomas Ecological Preserve
Tidal Mudflats

WAA # LLEP (490 acres)

Variable	Subindex
V_{edge}	1.0
V_{hydro}	0.6
V_{nhc}	0.8
$V_{typical}$	0.1
V_{slope}	1.0
V_{width}	1.0
V_{rough}	0.2
V_{soil}	1.0

Los Lomas Ecological Preserve
Tidal Mudflats

Biota:

$$\frac{\left(\frac{\left(V_{edge} + \left(2\ x\ V_{hydro}\right) + \left(0.5\ x\ V_{nhc}\right)\right)}{3.5} + V_{typical}\right)}{2}$$

Pre FCI = $\frac{\left(\frac{\left(1.0+(2\ x\ 0.6)+(0.5\ x\ 0.8)\right)}{3.5}+0.1\right)}{2}$ = **0.42**

Post FCI = $\frac{\left(\frac{\left(1.0+(2\ x\ 0.6)+(0.5\ x\ 0.8)\right)}{3.5}+0.1\right)}{2}$ = **0.42**

Botanical:

$V_{typical}$

Pre FCI = 0.10 = **0.10**

Post FCI 0.10= = **0.10**

Physical:

$$\frac{\left(V_{slope} + V_{width} + V_{rough} + V_{soil} + V_{hydro}\right)}{5}$$

Pre FCI = $\frac{(1.0+1.0+0.2+1.0+0.6)}{5}$ = **0.76**

Post FCI = $\frac{(1.0+1.0+0.2+1.0+0.6)}{5}$ = **0.76**

Chemical:

$\sqrt{\text{Vtypical x Vhydro}}$

Pre FCI = $\sqrt{0.1 \text{ x } 0.6}$ = **0.24**

Post FCI = $\sqrt{0.1 \text{ x } 0.6}$ = **0.24**

Los Lomas Ecological Preserve

Functional Capacity Units (FCU); FCI x wetland acres per WAA

WAA#	Pre-Project FCUs	Post-Project FCUs
Biota	206.5	206.5
Botanical	49.0	49.0
Physical	372.4	372.4
Chemical	120.0	120.0

Post-Project FCU – Pre-Project FCU = Net gain/loss

WAA#	Net gain/loss (impact)	Net gain/loss (mitigation)	Net gain/loss
Biota	29.0	206.5	235.5
Botanical	-4.0	49.0	280.5
Physical	3.8	372.4	376.2
Chemical	25.7	120.0	145.7

Texas LNG Project Site Comparison to Los Lomas Ecological Preserve Tidal Mudflats

Potential Functional Capacity impacts
{i.e. WAA 1 FCU biota loss (bl) + WAA 2 bl + WAA 3 bl + WAA 4 bl = net FCU loss}

Biota:

Texas LNG Project Site: 29.0
Los Lomas Ecological Preserve: 206.5

Botanical:

Texas LNG Project Site: -4.0
Los Lomas Ecological Preserve: 49.0

Physical:

Texas LNG Project Site: 3.8
Los Lomas Ecological Preserve: 372.4

Chemical:

Texas LNG Project Site: 25.7
Los Lomas Ecological Preserve: 120.0

- Net FCU loss is calculated by deducting the post-project FCU from the pre-project FCU per function capacity. Different functional capacity index should NEVER be summarized.

Texas LNG Project Site
Palustrine Emergent

Temporary Storage and Detention of Storage Water:

$$\sqrt{\sqrt{V_{dur}\ x\ V_{freq}}\ x\ \frac{\left(V_{topo}+\frac{(V_{herb}+V_{mid})}{2}\right)}{2}}$$

Maintain Plant and Animal Community:

$$\frac{(V_{mid}+V_{herb}+V_{connect})}{3}$$

Removal and Sequestration of Elements and Compounds:

$$\frac{\left((V_{wood}+V_{freq}+V_{dur})+\frac{(V_{topo}+V_{herb}+V_{mid})}{3}+\frac{(V_{detritus}+V_{redox}+V_{sorpt})}{3}\right)}{5}$$

V_{dur}

V_{freq}

V_{topo}

V_{wood}

V_{mid}

V_{herb}

$V_{connect}$

$V_{detritus}$

V_{redox}

V_{sorpt}

- The riverine model is designed to be used to produce an assessment of the potential function of wetlands that share a surface hydrologic connection (at least periodically during anticipated high flows) with a riverine system {i.e. it is limited to wetlands located in the floodplain and/or floodway}. This model is to be used for a rapid non-controversial estimate of the potential impacts to herbaceous riparian wetlands and to see if the proposed mitigation will adequately address the wetland functions that are being impacted.

The techniques used to determine which functional capacity index (FCI) will be used for each variable rare typically based on standard techniques described in detail in the 1987 Corps Wetland Delineation Manual, the NRCS 3rd Edition to the National Food Security Act Manual (NFSAM) and/or the "A Regional Guidebook for Application of Hydrogeomorphic Assessments to Riverine Low Gradient Wetlands (Ainslie et al., 1997). These sources will hereafter be referred to as the 87 WDM, NFSAM, and the Kentucky Riverine Guidebook, respectively.

Documentation should be made for each variable as to which method, indicator, and plot size was used for each variable. The number of sample plots is related to the variability of the site. Significantly different timber age classes or species types should be sampled separately. One of two sample plots might be sufficiently in a small uniform site, whereas, numerous sample plots would be required for a large diverse site. The following is a general definition and guidance on the methodology for each variable.

V_{dur}: **Duration of Flooding:** Indicators as described in the Wetland Hydrology Section of the 87 WDM (paragraphs 46-49) will be utilized to estimate duration of flooding. NOTE: unlike the criteria for hydrology for wetland delineation, growing season is not a factor in the variable. Those indicators associated with saturation should not be used.

V_{freq}: **Frequency of Flooding:** Indicators as described in the Wetland Hydrology Section of the 87 WDM (paragraphs 46-49) will be utilized to estimate frequency of flooding.

Utilization of the county soil survey is a particularly good tool. NOTE: unlike the criteria for hydrology for wetland delineation, growing season is not a factor in the variable.

V_{topo}: **Topography:** To determine percent for these criteria, visual estimate will be conducted. Those areas with significant topographic features will be shown on a reference map, briefly described (i.e., ridge/slough, mounds, undulations, channels/burn, etc.) and measured to determine acreage. Percent of site containing topographic features can then be determined.

V_{wood}: **Woody vegetation:** Percentage of the WAA that is covered by woody vegetation will be determined by the use of recent aerial photography. Field verification is needed to ensure land use changes have not occurred. Size and density of woody vegetation impedes water flow. For example; a few large trees in a pasture would NOT constitute "covered with woody vegetation" nor would 1 year old seedlings. It should also be noted that an area clear cut with stumps, sprouts and shrubs removed would NOT constituted "woody vegetation" and the functions should be assessed using an herbaceous model.

V_{mid}: **Midstory (Shrubs/saplings/woody vines):** The midstory layer is the layer of botanical specie located between the herbaceous and forest/tree canopy. This would include shrubs, saplings, smaller trees, small trees, and large woody vines. A measure is taken at each plot and/or a visual estimate is performed at each sample location(s).

V_{herb}: **Herbaceous layer:** Herbaceous layers are made at each data location/plot as is described it in the 87 WDM. It is recommended that 2-5 sub plots be taken at each location to account for vegetative variability.

$V_{detritus}$: **Detritus:** This variable is a measure of the percentage of areas with detritus at the soil surface. Plowed areas or areas "washed" by high velocity flood water should not be considered as areas having detritus. Determination of an A (with organic) or O horizon should be determined for the entire site by on site field information. For this variable, the A (with organic) must have a Munsell value of 4 or less. Refer to the Kentucky Riverine Model for additional details regarding this variable.

V_{redox}: **Redoximorphic process:** This variable is an indicator of periodic aerobic and anaerobic process within the top 10-12 inches of the soil surface. Redox features should be document for each sample plot/location and any other soil investigation conducted on the site. At least 50%of the must meet this criteria to be a 1 in the subindex.

V_{sorpt}: **Sorptive Soil Properties:** This variable is a general indicator of the potential that the soil has in regards to its absorptive properties. This information can be obtained by the use of the county soil survey in conjunction with the field data.

$V_{connect}$: **Connectivity to other habitat types:** This variable concentration on the geo-location of the WAA in relationship to other habitat type within 600 feet from the perimeter of the WAA.

V_{dur}: The percent of the WAA that is flooded and/or ponded due to the hydrology (i.e. flooding overbank flow) of the nearby waterway.

Criteria	Variable Sub index
In an average year at 80% of the WAA either floods and/or ponds for at least 14 consecutive days	1.00
In an average year at 80% of the WAA either floods and/or ponds for at least 7 consecutive days	0.75
In an average year at 50-79% of the WAA either floods and/or ponds for at least 7 consecutive days	0.50
In an average year at 25-50% of the WAA either floods and/or ponds for at least 7 consecutive days	0.25
In an average year all or portions of the WAA either floods and/or ponds for at least 1-7 consecutive days	0.10
The area is NOT subject to flooding	0.00

V_{freq}: The frequency that the WAA is flooded and/or ponded by nearby waterway.

Criteria	Variable Sub index
Floods or pond annually 5 out of 5 years (floodway)	1.00
Floods or ponds 3 or 4 out of 5 years (elevation data reveals in floodway and mapped w/n 100 year floodplain)	0.75
Floods or ponds 2 out of 5 years (100- year floodplain)	0.50
Floods or ponds less than 2 out of 5 years (100-500 year floodplain grey w/out elevations)	0.25
The area is not subject to flooding or ponding (500 year floodplain)	0.00

V_{topo}: The roughness associated with the WAA

Criteria	Variable Sub Index
Greater than 30% of the WAA is represented by dips, hummocks, channel sloughs and/or other topographic features	1.00
15 - 30% of the WAA is represented by dips, hummocks, channel sloughs and/or other topographic features	0.70
Less than 15% of the WAA is represented by dips, hummocks, channel sloughs and/or other topographic features	0.40
Smooth, flat, or very gentle undulating with little or no topographic features	0.10

V_{wood}: Percentage of the WAA that is covered by woody vegetation

Criteria	Variable Sun Index
Greater than 90% of the WAA is covered with woody vegetation	1.00
67 to 90 % of the WAA is covered with woody vegetation	0.75
34 to 66% of the WAA is covered with woody vegetation	0.50
11 to 33% of the WAA is covered with woody vegetation	0.25
0-10% if the WAA is covered with woody vegetation	0.10

V_{mid}: The average/mean coverage of the midstory (shrub/sapling) layer in the WAA.

Criteria	Variable Sub Index
Midstory coverage of the WAA is more than 75%	1.00
Midstory coverage of the WAA is between 50-75 %	0.75
Midstory coverage of the WAA is between 25-50%	0.50
Midstory coverage of the WAA is between 1-25%	0.25
Midstory coverage of the WAA is equal to or less than1%	0.10

V_{herb}: The average/mean coverage of the WAA by the herbaceous layer.

Criteria	Variable Sub Index
Herbaceous cover in the WAA averages greater than 75%	1.00
Herbaceous cover in the WAA averages between 50-75%	0.75
Herbaceous cover in the WAA averages between 25-50%	0.50
Herbaceous cover in the WAA average is between 1-25%	0.25
Herbaceous cover in the WAA is equal to or less than 1% (barren soil or all shrub)	0.10

$V_{connect}$: the number of habitat types within 600 feet of the perimeter of the WAA

(Habitat to be counted has to be at a minimum 5% of the size of the WAA)

Habitat Types:

Forested	Shrub/Sapling
Herbaceous/Prairie/Abandoned Agricultural field	Active Agricultural Field
Open water	Wetland
Mudflat	Lawn

Criteria:	Variable Sub Index
Wetland plus four habitats and/or surrounded by forested	1.00
Wetland plus two or more habitat type (other than forested) OR three or more habitat types	0.75
Wetland plus one other habitat types or two other habitat types	0.50
One other habitat types other than urban habitat	0.25
Surround by urban (homes, lawn, concrete, etc.)	0.10

$V_{detritus}$: The amount of the detritus on the WAA.

(A horizon must have a value of 4 or less)

Criteria	Variable Sub Index
Greater than 85% of the area possesses an O or A horizon	1.00
From 11-84% of the area possesses an O or A horizon	0.50
Less than 10% of the area possesses an O or A horizon	0.30
Site is plowed	0.10

V_{redox}: The amount of the WAA that exhibits redox features an indication of the chemical exchange.

Criteria	Variable Sub Index
Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes. (many mottles)	1.0
Redox features less than 20%	0.1

V_{sorpt}: The absorptive properties of the soils in the WAA.

Criteria	Variable Sub Index
The WAA is dominated by Montmorillonite clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1)	1.00
WAA is dominated by loamy (silt loams, very fine sandy loams, loam) or non- Montmorillonite clays	0.50
The WAA is dominated by sandy soils (sands, loamy fine sands, loamy sands)	0.10

Texas LNG Project Site
Palustrine Emergent Wetlands

WAA # WA001 Pre (13.0 acres)

Variable	Subindex
V_{dur}	0.75
V_{freq}	1.0
V_{topo}	0.1
V_{wood}	0.1
V_{mid}	0.1
V_{herb}	1.0
$V_{connect}$	0.5
$V_{detritus}$	0.3
V_{redox}	0.1
V_{sorpt}	1.0

WAA # WB001 Pre (0.2 acre)

Variable	Subindex
V_{dur}	0.75
V_{freq}	1.0
V_{topo}	0.1
V_{wood}	0.1
V_{mid}	0.1
V_{herb}	1.0
$V_{connect}$	0.5
$V_{detritus}$	0.3
V_{redox}	0.1
V_{sorpt}	1.0

WAA # WA002 Pre (27.3 acres)

Variable	Subindex
V_{dur}	0.75
V_{freq}	1.0
V_{topo}	0.1
V_{wood}	0.1
V_{mid}	0.1
V_{herb}	1.0
$V_{connect}$	0.5
$V_{detritus}$	0.3
V_{redox}	0.1
V_{sorpt}	1.0

WAA # WB002 Pre (19.5 acres)

Variable	Subindex
V_{dur}	0.75
V_{freq}	1.0
V_{topo}	0.1
V_{wood}	0.1
V_{mid}	0.1
V_{herb}	1.0
$V_{connect}$	0.5
$V_{detritus}$	0.3
V_{redox}	0.1
V_{sorpt}	1.0

Texas LNG Project Site
Palustrine Emergent Wetlands

WAA # WA001 Post (13.0 acres)

Variable	Subindex
V_{dur}	0.75
V_{freq}	1.0
V_{topo}	0.1
V_{wood}	0.1
V_{mid}	0.1
V_{herb}	1.0
$V_{connect}$	0.5
$V_{detritus}$	0.3
V_{redox}	0.1
V_{sorpt}	1.0

WAA # WB001 Post (0.2 acre)

Variable	Subindex
V_{dur}	0.75
V_{freq}	1.0
V_{topo}	0.1
V_{wood}	0.1
V_{mid}	0.1
V_{herb}	1.0
$V_{connect}$	0.5
$V_{detritus}$	0.3
V_{redox}	0.1
V_{sorpt}	1.0

WAA # WA002 Post (27.3 acres)

Variable	Subindex
V_{dur}	0.75
V_{freq}	1.0
V_{topo}	0.1
V_{wood}	0.1
V_{mid}	0.1
V_{herb}	1.0
$V_{connect}$	0.5
$V_{detritus}$	0.3
V_{redox}	0.1
V_{sorpt}	1.0

WAA # WB002 Post (19.4 acres)

Variable	Subindex
V_{dur}	0.75
V_{freq}	1.0
V_{topo}	0.1
V_{wood}	0.1
V_{mid}	0.1
V_{herb}	1.0
$V_{connect}$	0.5
$V_{detritus}$	0.3
V_{redox}	0.1
V_{sorpt}	1.0

Texas LNG Project Site
Palustrine Emergent Wetlands

Temporary Storage and Detention of Storage Water:

$$\sqrt{\sqrt{V_{dur}\ x\ V_{freq}}\ x\ \frac{\left(V_{topo} + \frac{(V_{herb} + V_{mid})}{2}\right)}{2}}$$

Pre FCI = $\sqrt{\sqrt{0.75\ x\ 1.0}\ x\ \frac{\left(0.1+\frac{(1.0+0.1)}{2}\right)}{2}}$ = **0.53**

Post FCI = $\sqrt{\sqrt{0.75\ x\ 1.0}\ x\ \frac{\left(0.1+\frac{(1.0+0.1)}{2}\right)}{2}}$ = **0.53**

Maintain Plant and Animal Communities:

$$\frac{(V_{mid} + V_{herb} + V_{connect})}{3}$$

Pre FCI = $\frac{(0.1+1.0+0.5)}{3}$ = **0.53**

Post FCI = $\frac{(0.1+1.0+0.5)}{3}$ = **0.53**

Removal and Sequestration of Elements and Compounds:

$$\frac{\left((V_{wood} + V_{freq} + V_{dur}) + \frac{(V_{topo} + V_{herb} + V_{mid})}{3} + \frac{(V_{detritus} + V_{redox} + V_{sorpt})}{3}\right)}{5}$$

Pre FCI = $\frac{\left((0.1+1.0+0.75)+\frac{(0.1+1.0+0.1)}{3}+\frac{(0.3+0.1+1.0)}{3}\right)}{5}$ = **0.54**

Post FCI = $\frac{\left((0.1+1.0+0.75)+\frac{(0.1+1.0+0.1)}{3}+\frac{(0.3+0.1+1.0)}{3}\right)}{5}$ = **0.54**

Texas LNG Project Site Tidal Mudflats

Functional Capacity Units (FCU); FCI x wetland acres per WAA.

WAA #	Pre-project FCUs[a]	Post Project FCUs[a]
Temp Storage of Water	31.8	31.8
Maintain Plant and Animal	32.0	31.9
Removal of Elements	32.6	32.5

[a] WAA area is the sum of all PEM wetlands since they all share the same functions.

Los Lomas Ecological Preserve
Palustrine Emergent Wetlands

WAA # No PEM wetlands

Variable	Subindex
V_{dur}	n/a
V_{freq}	n/a
V_{topo}	n/a
V_{wood}	n/a
V_{mid}	n/a
V_{herb}	n/a
$V_{connect}$	n/a
$V_{detritus}$	n/a
V_{redox}	n/a
V_{sorpt}	n/a

Los Lomas Ecological Preserve
Palustrine Emergent Wetlands

Temporary Storage and Detention of Storage Water:

$$\sqrt{\sqrt{V_{dur}\ x\ V_{freq}}\ x\ \frac{\left(V_{topo} + \frac{(V_{herb} + V_{mid})}{2}\right)}{2}}$$

Pre FCI = $\sqrt{\sqrt{V_{dur}\ x\ V_{freq}}\ x\ \frac{\left(V_{topo} + \frac{(V_{herb} + V_{mid})}{2}\right)}{2}}$ = **n/a**

Post FCI = $\sqrt{\sqrt{V_{dur}\ x\ V_{freq}}\ x\ \frac{\left(V_{topo} + \frac{(V_{herb} + V_{mid})}{2}\right)}{2}}$ = **n/a**

Maintain Plant and Animal Communities:

$$\frac{(V_{mid} + V_{herb} + V_{connect})}{3}$$

Pre FCI = $\frac{(V_{mid} + V_{herb} + V_{connect})}{3}$ = **n/a**

Post FCI = $\frac{(V_{mid} + V_{herb} + V_{connect})}{3}$ = **n/a**

Removal and Sequestration of Elements and Compounds:

$$\frac{\left((V_{wood} + V_{freq} + V_{dur}) + \frac{(V_{topo} + V_{herb} + V_{mid})}{3} + \frac{(V_{detritus} + V_{redox} + V_{sorpt})}{3}\right)}{5}$$

Pre FCI = $\frac{\left((V_{wood} + V_{freq} + V_{dur}) + \frac{(V_{topo} + V_{herb} + V_{mid})}{3} + \frac{(V_{detritus} + V_{redox} + V_{sorpt})}{3}\right)}{5}$ = **n/a**

Post FCI = $\frac{\left((V_{wood} + V_{freq} + V_{dur}) + \frac{(V_{topo} + V_{herb} + V_{mid})}{3} + \frac{(V_{detritus} + V_{redox} + V_{sorpt})}{3}\right)}{5}$ = **n/a**

Los Lomas Ecological Preserve

Functional Capacity Units (FCU); FCI x wetland acres

WAA #	Pre-project	Post 1 year	Post 5 year	Post 10 year
Temporary Storage	n/a	n/a	n/a	n/a
Maintain Plant and Animal	n/a	n/a	n/a	n/a
Sequestration of Elements	n/a	n/a	n/a	n/a

The LLEP does not contain any PEM wetland; only high-quality tidal mudflat. Therefore, Pre- and Post-Project estimates of FCUs are not calculated.

Texas LNG Project Site Comparison to Los Lomas Ecological Preserve Palustrine Emergent Wetlands

Potential Functional Capacity impacts
{i.e., WAA 1 FCU biota loss (bl) + WAA 2 bl + WAA 3 bl + WAA 4 bl = net FCU loss}

Temporary Storage and Detention of Storage Water:
Texas LNG Project Site: 31.8
Los Lomas Ecological Preserve: N/A

Maintain Plant and Animal Communities:
Texas LNG Project Site: 31.9
Los Lomas Ecological Preserve: N/A

Removal and Sequestration of Elements and Compounds:
Texas LNG Project Site: 32.5
Los Lomas Ecological Preserve: N/A

- Net FCU loss is calculated by deducting the post-project FCU from the pre-project FCU per function capacity. Different functional capacity index should NEVER be summarized.

APPENDIX D

TEXAS LNG PROJECT BIOLOGICAL ASSESSMENT

BIOLOGICAL ASSESSMENT FOR
TEXAS LNG BROWNSVILLE, LLC
TEXAS LNG PROJECT
FERC DOCKET NO. CP16-116-000

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ACRONYMS

APCI	Air Products and Chemicals, Inc.
API	American Petroleum Institute
BA	Biological Assessment
BND	Brownsville Navigation District
BO	Biological Opinion
C3MR	propane precooled mixed refrigerant
Certificate	Certificate of Public Convenience and Necessity
CFR	Code of Federal Regulations
Coast Guard	United States Coast Guard
CO_2	carbon dioxide
COE	United States Army Corps of Engineers
Commission	Federal Energy Regulatory Commission
DDT	dichlorodiphenyltrichloroethane
DFE	Design Flood Elevation
DOT	United States Department of Transportation
DOE	Department of Energy
DPS	distinct population segments
ECP	Environmental Construction Plan
EEZ	U.S. Exclusive Economic Zone
EI	environmental inspector
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FR	Federal Register
FWS	United States Fish and Wildlife Service
HUC	Hydrologic Unit Code
IPaC System	Information, Planning, and Conservation System
LNG	liquefied natural gas
MLLW	mean low low water
MMPA	Marine Mammal Protection Act
MOF	Materials Offloading Facility
MTPA	million tonnes per annum
NAVD 88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act

NFPA	National Fire Protection Association
NMFS	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRG	Natural Resource Group, LLC
NWR	National Wildlife Refuge
ODMDS	ocean dredge material disposal site
PA	Placement Area
PCE	primary constituent elements
PHMSA	Pipeline and Hazardous Materials Safety Administration
Plan	Upland Erosion Control, Revegetation, and Maintenance Plan
Procedures	Wetland and Waterbody Construction and Mitigation Procedures
Project	Texas LNG Project
SH	State Highway
SMMP	Site Management and Monitoring Plan
SOPEP	Shipboard Oil Pollution Emergency Plan
SPRP	Spill Prevention and Response Plan
SWPPP	Stormwater Pollution Prevention Plan
Texas LNG	Texas LNG Brownsville, LLC
TPWD	Texas Parks and Wildlife Department
TSS	total suspended solids
WSA	Waterway Suitability Assessment

EXECUTIVE SUMMARY

The purpose of this Biological Assessment (BA) is to evaluate the effects of construction and operation of the proposed Texas LNG Project (Project) on federally listed species protected under the Endangered Species Act (ESA). The Project is a proposed liquefied natural gas (LNG) production, storage, and export facility at a site located on the Brownsville Ship Channel in Cameron County, Texas. In order for construction to begin, the Project would require a Certificate of Public Convenience and Necessity from the Federal Energy Regulatory Commission (FERC) pursuant to Section 3 of the Natural Gas Act. This federal authorization triggers the consultation requirements of Section 7 of the ESA. Other federal permitting requirements include the Clean Water Act, Clean Air Act, and the National Historic Preservation Act.

This BA is being submitted to the U.S. Fish and Wildlife Service (FWS) and National marine Fisheries Service (NMFS) in compliance with requirements of ESA Section 7. It evaluates the effects of the Project on 17 species listed as threatened or endangered, including six mammals, four birds, five reptiles, and two plants, and one species proposed for listing (one mammal). Specifically, the BA evaluates effects on the Northern aplomado falcon (*Falco femoralis septentrionalis*), piping plover (*Charadrius melodus),* red knot *(Calidris canutus rufa),* whooping crane (*Grus Americana),* Gulf Coast jaguarundi *(Herpailurus (=felis) yagouaroundi cacomitli),* ocelot (*Leopardus (=felis) pardalis),* sperm whale (*Physeter macrophalus),* fin whale, (*Balaenoptera physalus),* sei whale (*Balaenoptera borealis),* Gulf of Mexico's Bryde's whale (*Balaenoptera edeni),* West Indian manatee (*Trichechus manatus),* green see turtle (*Chelonia mydas),* hawksbill sea turtle (*Eretmochelys imbricate),* Kemp's ridley sea turtle (*Lepidochelys kempii),* leatherback sea turtle (*Dermochelys coriacea),* Loggerhead sea turtle (*Caretta caretta),* South Texas ambrosia (*Ambrosia cheiranthifolia),* and Texas ayenia *(Ayenia limitaris).*

The purpose of the Project is to convert domestically produced natural gas to LNG for storage and export. Texas LNG would develop the Project to produce up to 4 million tonnes per annum of LNG. This BA includes information regarding the construction, operation, and maintenance of the Project.

<u>Impacts on Federally Listed Bird Species.</u> The Project would be located within the range of the federally endangered Northern aplomado falcon and whooping crane and the federally threatened piping plover (including its designated critical habitat) and red knot.

Based on the results from the effects analysis, we[1] expect that Northern aplomado falcons foraging within the Project Site could be affected by impacts on foraging habitat as well as increased noise, lighting, and human activity during construction and operation of the Project. However, we determined that through implementation of measures, including minimization of impacts on suitable nesting habitat as well as clearing outside the nesting season or otherwise conducting nest surveys prior to construction, the Project ***is not likely to adversely affect*** the northern aplomado falcon.

Whooping cranes within the Project Site could be affected by modifications to wintering habitats within the Project Site; increased noise, flaring and artificial lighting, and human activity; mortality due to interaction with construction activities; accidental spills or leaks of hazardous materials, and the introduction of invasive species due to ballast water discharges. However, abundant suitable habitat exists in the Project area, such as that present in the Laguna Atascosa NWR. Therefore, we conclude that the Project ***is not likely to adversely affect*** the whooping crane.

[1] "We," "us," and "our" refer to the environmental staff of FERC's Office of Energy Projects.

Based on the results from the effects analysis, we expect that piping plovers within the Action Area could be affected by modification of wintering habitat within the Project Site; increased noise, flaring and artificial lighting, and human activity; and the introduction of invasive species due to ballast water discharges. However, given that the piping plover was not observed within the Project Site during surveys in 2015 and 2016, that suitable wintering habitat impacted by construction of the Project is abundant in the region, and that 120.6 acres of suitable wintering habitat would be undisturbed within the Project Site, impacts from the Project are not expected to have a measurable effect on the species. Therefore, we conclude that the Project ***is not likely to adversely affect*** the piping plover.

In addition, because designated critical habitat along the Brownsville Ship Channel has been modified by previous and ongoing use for dredged material placement, construction and operation of the Project would result in ***no adverse modification of designated critical habitat*** for the piping plover.

Based on the results from the effects analysis, we expect that red knots within the Action Area could be affected by modifications to migratory stopover and wintering habitats within the Project Site; increased noise, flaring and artificial lighting, and human activity; accidental spills or leaks of hazardous materials, and the introduction of invasive species due to ballast water discharges However, given that the red knot was not observed within the Project Site during surveys in 2015 and 2016, that suitable wintering habitat impacted by construction of the Project is common in the region, and that 120.6 acres of suitable wintering habitat would be undisturbed within the Project Site, impacts from the Project are not expected to have a measurable effect on the species. Therefore, we conclude that the Project ***is not likely to adversely affect*** the red knot.

Impacts on the Ocelot and Gulf Coast Jaguarundi. The Project would be located within potentially suitable foraging/transient habitat for the federally endangered ocelot and Gulf Coast jaguarundi.

Based on the result from the effects analysis, if present within the Action Area, the ocelot and Gulf Coast jaguarundi could be affected by a reduction in foraging/transient habitats within the Project Site, increased noise and human activity, and mortality due to increased interaction with roadway traffic. However, while the ocelot may occur within the Project Site, it is likely rare and limited to transient individuals. Therefore, based on the impact minimization measures that Texas LNG would implement as well as the rarity of the species, we conclude that the Project ***is not likely to adversely affect*** the ocelot and Gulf Coast jaguarundi.

Impacts on Listed Whale Species and Whale Species Proposed for Listing. The Project would be within the range of the federally endangered sperm whale, fin whale, sei whale, blue whale, and the Gulf of Mexico Bryde's whale (proposed for listing).

Based on the results from the effects analysis, we expect the listed whale species and the Gulf of Mexico Bryde's whale could be susceptible to the effects of spills either by direct encounter or ingestion of contaminated prey. Additionally, it is possible that a vessel could strike a whale resulting in injury or mortality. However, based on the limited occurrence of the listed whale species and the Gulf of Mexico Bryde's whale in the Gulf of Mexico waters along the Texas coast, the implementation of *Vessel Strike Avoidance Measures and Reporting for Mariners*, and maintenance of a Shipboard Oil Pollution Emergency Plan (SOPEP) on each LNG carrier, we conclude that the Project ***is not likely to adversely affect*** the listed whale species and ***is not likely to jeopardize*** the Gulf of Mexico Bryde's whale.

Impacts on the West Indian Manatee. The Project would be within the range of the federally endangered West Indian manatee.

Based on the results from the effects analysis, we expect the West Indian manatee could be susceptible to the effects of spills either by direct encounter or ingestion of contaminated seagrass. Additionally, barges, support vessels, and LNG carriers would call on the LNG terminal, increasing ship traffic within the Brownsville Ship Channel and Gulf of Mexico, resulting in increased potential for vessel strikes. However, based on the limited and transient occurrence of West Indian manatees in Texas coastal waters, the lack of suitable seagrass habitat within the Action Area, and with the implementation of the *Vessel Strike Avoidance Measures and Reporting for Mariners* and maintenance of a SOPEP on each LNG carrier, the likelihood of construction or operation of the Project impacting the manatee is negligible. Therefore, we conclude that the Project ***is not likely to adversely affect*** the West Indian manatee.

Impacts on Listed Sea Turtles. The Project would be within the range of the federally threatened green and loggerhead sea turtles and the federally endangered hawksbill, Kemp's ridley, and leatherback sea turtles.

Based on the results of the effects analysis, we expect the Project could directly affect sea turtles as a result of dredging, pile driving, and LNG carrier transit. In addition, we expect that Project-related noise, lighting, and human activity could result in disturbance and/or displacement of sea turtles. However, given the rarity of sea turtles to be present within the Project Site as well as the implementation of avoidance and minimization measures both during Project construction and operation of the LNG carriers, we conclude that the Project ***is not likely to adversely affect*** the listed sea turtles while in the marine environment. Further, based on habitat present at the Project Site, as well as known nesting locations for these species, we conclude that the Project would have ***no effect*** on nesting sea turtles.

Consultations with NMFS also indicated that there is potential for vessels to divide floating *Sargassum* designated as critical habitat for loggerhead sea turtles in the Gulf of Mexico; however, this would not affect the primary constituent elements (Designated Critical Habitat Unit LOGG-S-02). Further, given the temporary nature of potential damage and maintenance of a SOPEP, vessel transit through designated critical habitat is expected to have negligible impacts on *Sargassum* habitat. Therefore, we conclude that the Project would result in ***no adverse modification of designated critical habitat*** for the loggerhead sea turtle.

Impacts on Listed Plant Species. The Project would be within potentially suitable habitat for the federally endangered South Texas ambrosia and Texas ayenia.

Based on the results of the effects analysis, if present within the Project Site, we expect the listed plant species could be affected by clearing associated with construction activities, stormwater discharges, and spills or leaks of hazardous materials. Species-specific surveys were conducted for the South Texas ambrosia and the Texas ayenia during the species' flowering season. Neither of the listed plant species were documented during the survey efforts. Therefore, we conclude that the Project would result in ***no effect*** on the listed plant species.

1.0 INTRODUCTION

1.1 PURPOSE OF THE BIOLOGICAL ASSESSMENT

The purpose of this Biological Assessment (BA) is to evaluate the effects of construction and operation of the proposed Texas LNG Project (Project) on federally listed species protected under the Endangered Species Act (ESA). Texas LNG Brownsville, LLC (Texas LNG) is seeking a Certificate of Public Convenience and Necessity (Certificate) from the Federal Energy Regulatory Commission (FERC or Commission) authorizing Texas LNG to site, construct, and operate facilities necessary to liquefy natural gas at a proposed site located on the Brownsville Ship Channel in Cameron County, Texas.

The FERC is the lead federal agency responsible for implementation of the National Environmental Policy Act (NEPA) review. We prepared the draft Environmental Impact Statement (EIS) for the Texas LNG Project in cooperation with the Department of Energy (DOE), United States Coast Guard (Coast Guard), United States Army Corps of Engineers (COE), United States Department of Transportation's (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA), United States Fish and Wildlife Service (FWS), United States Environmental Protection Agency (EPA), National Park Service (NPS), National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS), and Federal Aviation Administration as the "cooperating agencies" under NEPA. Cooperating agencies have jurisdiction by law or provide special expertise with respect to environmental impacts involved with a proposal. The draft EIS includes a general summary of this BA and presents our findings of effects for each federally listed species that may be affected by the Project.

Federal action agencies are required to consult with the FWS and/or the NMFS to determine whether federally listed threatened or endangered species or designated critical habitat are found in the vicinity of the proposed project, and to determine the proposed action's potential effects on those species or critical habitats. For actions involving major construction activities with the potential to affect listed species or designated critical habitat, the federal agency must prepare its BA for those species that may be affected. FERC must submit its BA to the FWS and/or NMFS and, if it is determined that the action would likely adversely affect the listed species, the federal agency must submit a request for formal consultation to comply with Section 7 of the ESA. In response, the FWS and/or NMFS would issue a Biological Opinion as to whether or not the federal action would likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat. Only after a determination is made that the Project would not jeopardize the continued existence of a federally listed threatened or endangered species and would not adversely modify designated critical habitat in consideration of all efforts to avoid, minimize, and mitigate potential impacts, would the other federal or federally-delegated agencies be able to proceed with issuance of a permit or other authorization to allow the Project to proceed. Therefore, we are requesting concurrence from the FWS and NMFS with our determinations of effect for the federally listed species presented in this BA.

1.2 PROPOSED ACTION

Texas LNG proposes to build, own, and operate a liquefied natural gas (LNG) production, storage, and export facility at a site located on the Brownsville Ship Channel in Cameron County, Texas (figure 1.2-1). As described in further detail in section 2 of this BA, the Project would be constructed on approximately 285 acres (including temporary workspace) of a 625-acre parcel of land leased from the Brownsville Navigation District (BND), with an additional 26.5 acres outside of the 625-acre parcel necessary to provide deep water access to the Brownsville Ship Channel. The Project would be located approximately 2.5 miles southwest of the Town of Port Isabel, Texas and 19 miles northeast of the City of Brownsville, Texas population center. The Project would be constructed in two phases with Phase 1 expected to begin operating in 2023. Phase 2 would only be constructed if a customer for production of

LNG enters into an agreement sufficient to finance the Phase 2 construction cost. Each phase would produce approximately 2 million tonnes per annum (MTPA) of LNG for a total of 4 MTPA. Additional details regarding the Project can be found in the draft EIS.

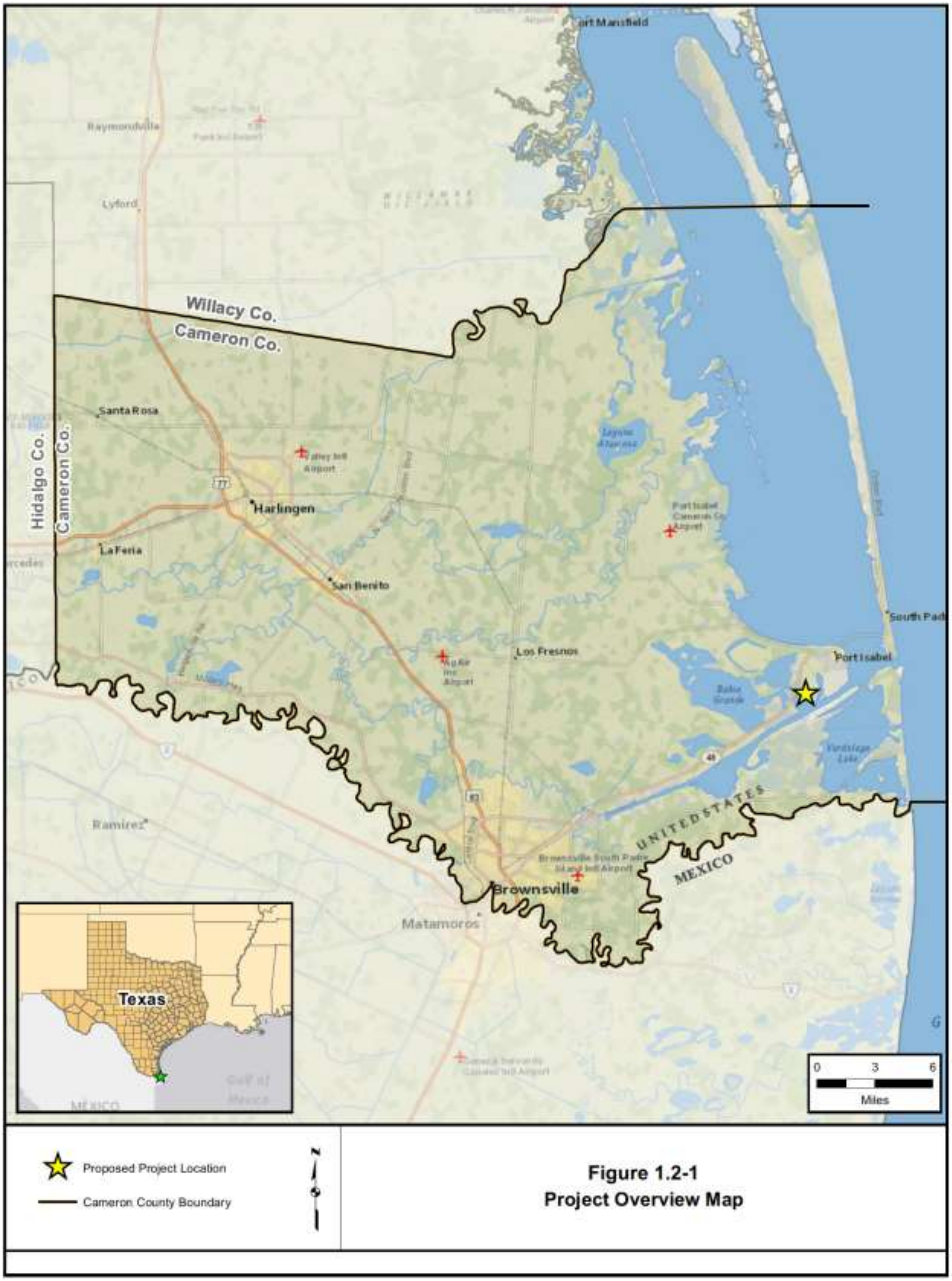

Figure 1.2-1 Project Overview Map

1.3 KEY TERMS

The key terms used throughout this BA are presented below. Some terms are defined in Title 50 of the Code of Federal Regulations (CFR) Section 402.02 and some are defined in the Consultation Handbook issued by the FWS and NMFS (FWS and NMFS, 1998). Terms are grouped according to subject rather than listed alphabetically. These definitions apply only to analysis associated with Section 7 of the ESA and should not be confused with the terms when used in relation to NEPA or other environmental laws.

- Project Site. The 651.5-acre area encompassing facilities and activities related to the Texas LNG Project, including the 625-acre leased parcel and the 26.5-acre portion of the maneuvering basin within the Brownsville Ship Channel (see figure 1.3-1).

- Action Area. The Action Area (as defined in Section 7(a)(2) of the ESA) considered in this BA includes the following areas that could be directly or indirectly affected by the Project, which are depicted on figure 1.3-2:

    - Project Site (defined above).

    - Project Site Buffer. Areas beyond the footprint of the Project Site that could be affected by Project activities (e.g., resuspension and/or deposition of sediments outside of the Project Site due to construction activities, elevated noise and/or lighting levels in the vicinity of the LNG terminal). It is anticipated that elevated noise levels would extend furthest from the Project Site; therefore, the buffer includes the area where sound levels would be greater than 55 decibels on the A-weighted scale (the noise threshold adopted by FERC) during construction of the Project.

    - Vessel Transit Routes. Waterways through which barges, support vessels, and LNG carriers would transit to or from the LNG terminal, including the Brownsville Ship Channel, Intracoastal Waterway, and portions of the Gulf of Mexico within the U.S. Exclusive Economic Zone (EEZ). Although the specific vessel transit routes are unknown, vessel transit within the EEZ (up to 200 nautical miles from the Gulf Coast) was also considered part of the Action Area.

    - Dredged Material Placement Areas. Material dredged from the maneuvering basin would be placed into an offsite, existing Confined Dredge Disposal Facility, located south of the Brownsville Ship Channel. The preferred disposal site is Placement Area (PA) 5A (owned by the BND).

- Direct Effects. Effects on a listed species or its habitat that are caused by or would occur during construction and/or operation of the Project.

- Indirect Effects. Effects on a listed species or its habitat caused by or resulting from the Project that are later in time, but still reasonably certain to occur.

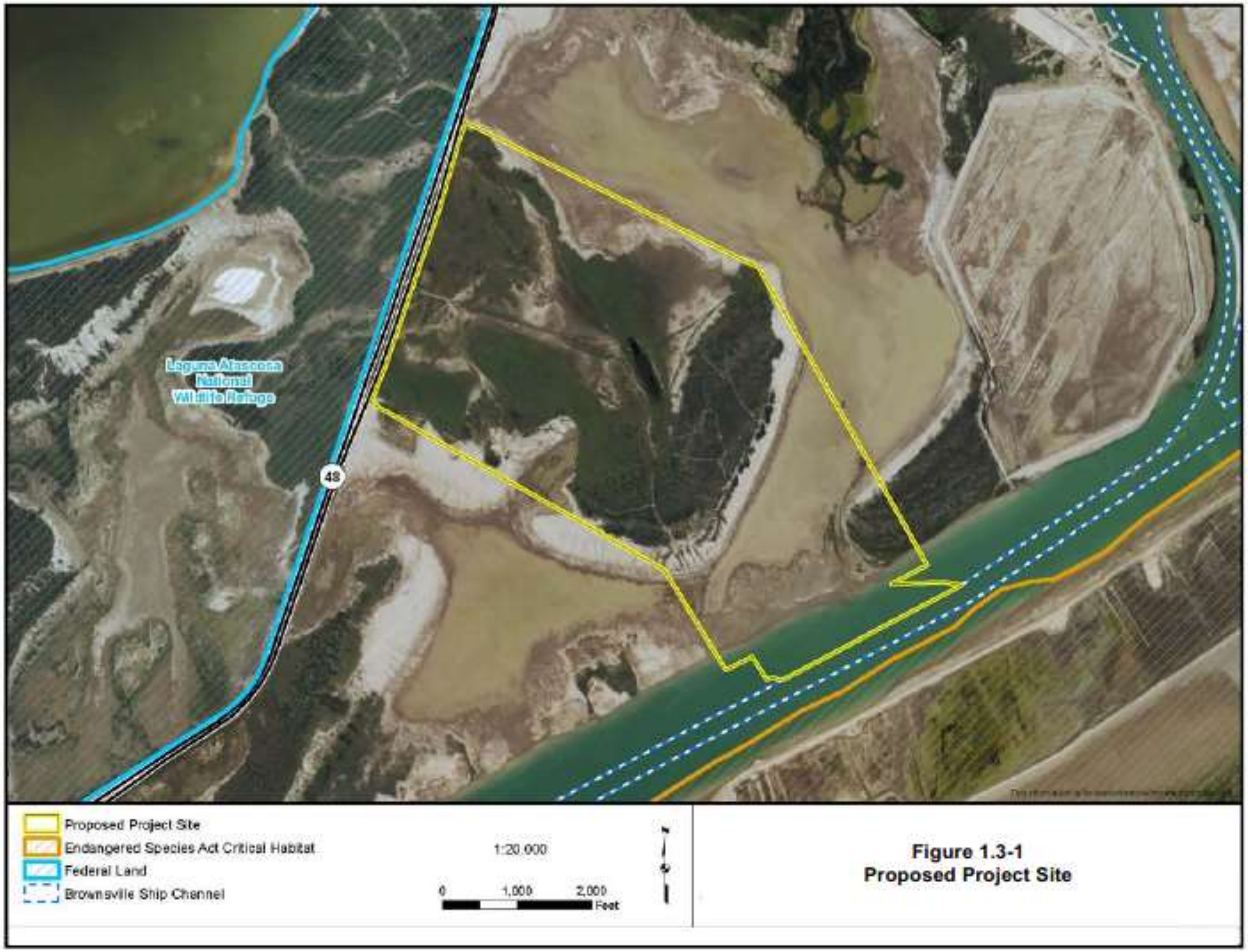

Figure 1.3-1 Proposed Project Site

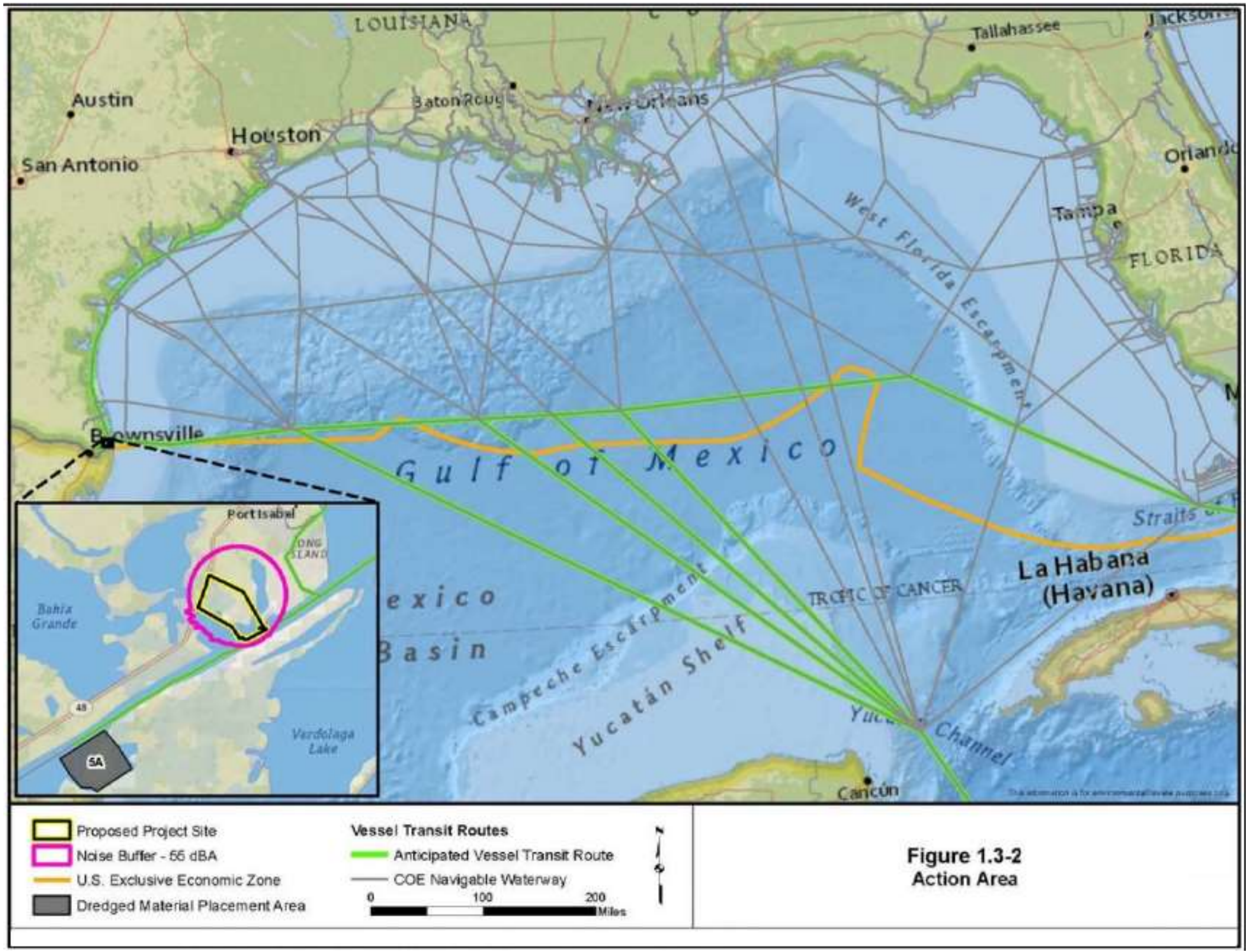

Figure 1.3-2 Action Area

- Determination of Effect. Based on the analysis of potential direct and indirect effects from the Project, a determination is provided for each species and designated critical habitat. One of the following three determinations would apply for listed species (*determinations for designated critical habitat are provided in italics):*

    - No effect (*no adverse modification*). The determination that the Project would have no impacts, positive or negative, on species or designated critical habitat. Generally, this means that the species or critical habitat would not be exposed to the Project and its environmental consequences.

    - May affect, but is not likely to adversely affect (*may affect, but is not likely to adversely modify critical habitat).* The determination that the Project would have discountable, insignificant, or completely beneficial impacts on species or critical habitat. Discountable effects are extremely unlikely to occur. Insignificant effects relate to the size of the impact and would not reach the scale where take of a listed species occurs.[2] Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

    - May affect, and is likely to adversely affect (*may affect, and is likely to adversely modify critical habitat*). The determination that the Project would result in any adverse effect on species or critical habitat. In the event the overall Project would have beneficial effects on listed species or critical habitat, but is also likely to cause some adverse effects, then the Project may affect, and is likely to adversely affect the listed species.

1.4 AGENCY COORDINATION AND COMMUNICATION

In January 2015, Texas LNG sent a letter to the FWS notifying them of intent to participate in FERC's pre-filing process and offering the FWS the opportunity to participate. Since sending the introductory letter to the FWS, Texas LNG has engaged the FWS in early coordination regarding the Project, which included an initial meeting at the Laguna Atascosa National Wildlife Refuge (NWR), three field visits to the Project Site (in May and September 2015 and February 2016), one conference call, and several written exchanges. In addition, the FWS participated in the FERC pre-file process and preparation of the draft EIS as a cooperating agency. As such, FERC has similarly participated in several conference calls, site visits, and written exchanges with the FWS throughout the FERC process. Through consultations with Texas LNG, the FWS assigned the Project the Consultation Reference Number 02ETCC00-2015-TA-0369.

In April 2015, Texas LNG sent a letter to the NMFS, Protected Resources Division notifying them of the intent to participate in FERC's pre-filing process and offering the NMFS the opportunity to provide preliminary comments on the Project. Since sending the introductory letter to the NMFS, Texas LNG has engaged the NMFS in early coordination regarding the Project, which has included a conference call to discuss potential Project impacts on the sperm whale, sea turtles, and designated critical habitat for the loggerhead sea turtle. Similar to the FWS, the NMFS is a cooperating agency that participated in the FERC pre-file process and assisted in the preparation of the draft EIS.

1.5 PROJECT SETTING

[2] The term "take" is defined under the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct.

The Project is located along the Brownsville Ship Channel, approximately 5 miles southwest of the Gulf of Mexico and approximately 19 miles northeast of the City of Brownsville, Texas population center on State Highway (SH) 48 in Cameron County, Texas (see figure 1.1-1). The Project Site (or Site), as defined in section 1.3 of this BA, is located on the north side of the Brownsville Ship Channel.

Uniformly distributed annual rainfall, along with warm and humid temperatures, allows the growing season to extend to more than 300 days per year (Texas Parks and Wildlife Department [TPWD], 2018). The Project is located entirely within the Laguna Madre Barrier Islands and Coastal Marshes Level IV Ecoregion within the larger Western Gulf Coastal Plain (Handley et al., 2007). This ecoregion is distinguished by its hypersaline lagoon system, seagrass meadows, tidal mud flats, and a narrow barrier island with a number of washover fans (Griffith et al., 2007). The lagoon system of this region is naturally hypersaline from the lack of streams draining into the area and high evaporation rates as compared to precipitation. Combined with the Laguna Madre just south in Mexico, it is one of the largest hypersaline systems in the world (Griffith et al., 2007).

The TPWD recently completed its Ecological Systems Classification Project, which describes vegetation types in support of the Texas Comprehensive Wildlife Conservation Strategy. Based upon a combination of satellite, Soil Survey Geographic Database soils data, and other parameters, as well as limited field verification, the TPWD produced a land classification distribution map and detailed descriptions of the ecological systems, or vegetative cover types present within Texas (TPWD, 2018; TPWD, 2010). The TPWD indicates that accuracy of its land classification distribution map is lower in the vicinity of the Project Site because of the wide variety of cover types and the difficulty of differentiating deciduous and evergreen shrublands remotely (TPWD, 2010). Previous field visits to the Project Site by staff from Natural Resource Group, LLC, an ERM Group Company (NRG) (representing Texas LNG) and the FWS indicated that the mapped land classifications were not accurate for the site. Therefore, a habitat assessment was conducted in October 2015, which classified and mapped vegetation communities within the Site using Ecological Systems defined by the TPWD. In addition, habitat quality was ranked from poor to high quality based on the level of human disturbance, fire suppression, and species diversity. Vegetation communities present within the Project Site include salt and brackish high tidal marsh, sea ox-eye daisy flat, tidal flat, salty prairie, loma deciduous shrublands, loma evergreen shrublands, and loma grasslands.

1.6 SPECIES CONSIDERED

Early coordination with the FWS' Corpus Christi Ecological Services Field Office and the NMFS' Protected Resources Division, as well as review of the FWS' Information, Planning, and Conservation System (IPaC System), identified a total of 18 federally listed species and one species proposed for listing, potentially present within Cameron County, Texas.[3] In addition, critical habitat has been designated for two species within or off the Gulf Coast of Cameron County, Texas. Table 1.6-1 provides the species status and indicates whether suitable habitat for the species is present within the Action Area.

[3] The IPaC System identifies the interior least tern (*Sterna antillarum)* as a conditionally protected species within Cameron County, Texas. This species only needs to be considered for wind-related projects that are within the migratory route. Therefore, the interior least tern is omitted from further discussion in this BA.

TABLE 1.6-1 Federally Listed and Proposed Species Identified in Cameron County			
Common Name ***Scientific Name***	**Listing Status**	**Agency Jurisdiction**	**Suitable Habitat Present within the Action Area (Yes/No)**
Birds			
Northern aplomado falcon *Falco femoralis septentrionalis*	Endangered	FWS	Yes
Piping plover *Charadrius melodus*	Threatened Designated Critical Habitat	FWS	Yes
Red knot *Calidris canutus rufa*	Threatened	FWS	Yes
Whooping Crane *Grus americana*	Endangered	FWS	Yes
Mammals			
Gulf Coast jaguarundi *Herpailurus (=felis) yagouaroundi cacomitli*	Endangered	FWS	Yes
Ocelot *Leopardus (=felis) pardalis*	Endangered	FWS	Yes
Sperm whale *Physeter macrophalus*	Endangered	NMFS	Yes
Fin whale *Balaenoptera physalus*	Endangered	NMFS	Yes
Sei whale *Balaenoptera borealis*	Endangered	NMFS	Yes
Blue whale *Balaenoptera musculus*	Endangered	NMFS	Yes
Gulf of Mexico Bryde's whale *Balaenoptera edeni*	Proposed	NMFS	Yes
West Indian manatee [b] *Trichechus manatus*	Threatened	FWS	Yes
Reptiles			
Green sea turtle *Chelonia mydas*	Threatened	FWS/NMFS [a]	Yes
Hawksbill sea turtle *Eretmochelys imbricata*	Endangered	FWS/NMFS [a]	Yes
Kemp's ridley sea turtle *Lepidochelys kempii*	Endangered	FWS/NMFS [a]	Yes
Leatherback sea turtle *Dermochelys coriacea*	Endangered	FWS/NMFS [a]	Yes
Loggerhead sea turtle *Caretta caretta*	Threatened Designated Critical Habitat	FWS/NMFS [a]	Yes
Plants			
South Texas ambrosia *Ambrosia cheiranthifolia*	Endangered	FWS	Yes
Texas ayenia *Ayenia limitaris*	Endangered	FWS	Yes

TABLE 1.6-1 Federally Listed and Proposed Species Identified in Cameron County			
Common Name ***Scientific Name***	**Listing Status**	**Agency Jurisdiction**	**Suitable Habitat Present within the Action Area (Yes/No)**

[a] Sea turtles are under the jurisdiction of the FWS when nesting on land and NMFS when in the water.

2.0 DESCRIPTION OF THE PROPOSED ACTION

This section provides a summary of the proposed Project, including description of the Project components; deepwater access to the Gulf of Mexico; land requirements; construction schedule and procedures; operations, maintenance, and safety; and an alternative analysis.

The Project would be constructed within a 651.5-acre area, which includes a 625-acre parcel available through a long-term lease with the BND of Cameron County and 26.5 acres within the Brownsville Ship Channel. This area, referred to as the Project Site, is located on the north side of the Brownsville Ship Channel, approximately 5 miles southwest of the Gulf of Mexico in Cameron County, Texas. The Project Site is located 19 miles northeast of the City of Brownsville, Texas population center on SH 48 and extends for approximately 3,000 feet along the Brownsville Ship Channel. The property is located between SH 48 and the channel; the coordinates are 26°02’27” N and 97°13’57” W (see figures 1.3-1 and 1.3-2).

The Project would be constructed in two phases. Texas LNG plans to initiate construction of Phase 1 upon receipt of all required authorizations and Phase 2 would be constructed when a customer for the production enters into a long-term tolling agreement that is sufficient to support the financing of the Phase 2 construction cost. Each phase is designed to produce 2 MTPA of LNG for export. Phase 1 and Phase 2 each would include a single liquefaction train and a full containment storage tank with a capacity of approximately 210,000 cubic meters (m^3) of LNG.

2.1 PROJECT FACILITIES

All of Texas LNG’s proposed Project components would be sited, constructed, operated, and maintained in accordance with all applicable federal and state regulations. The following facilities, discussed in greater detail below, would be constructed as part of the Project:

- gas gate station and interconnect facility;
- pretreatment utilizing Honeywell/UOP technology for carbon dioxide removal and dehydration;
- Open art turboexpander technology for pentane plus heavy hydrocarbon removal;
- Liquefaction Plant – consisting of two (2) liquefaction trains utilizing Air Products and Chemicals, Inc. (APCI) propane precooled mixed refrigerant (C3MR) technology and ancillary support facilities;
- two (2) approximately 210,000 m^3 LNG aboveground full containment LNG storage tanks with cryogenic pipeline connections to the Liquefaction Plant and berthing dock;
- LNG carrier berthing dock and recessed berthing area – capable of receiving LNG carriers between approximately 130,000 m^3 and approximately 180,000 m^3 capacity;
- Materials Offloading Facility (MOF) to allow waterborne deliveries of equipment and material during construction and mooring tug boats while an LNG carrier is at berth;

- maneuvering basin extending into the Brownsville Ship Channel with deepwater access to the above referenced LNG berthing dock;
- warm wet flare, cold dry flare, spare flare, acid gas flare (all mounted on a single main flare), marine flare, and thermal oxidizer; and
- administration, control, maintenance, and warehouse buildings and related parking lots; electrical transmission line and substation, water pipeline, septic system, natural gas pipeline, and stormwater facilities/outfalls.

The proposed Project facilities are illustrated on figures 2.1-1 (aerial map) and 2.1-2 (U.S. Geological Survey 7.5-minute series topographic map).

2.1.1 Gas Gate Station and Interconnect Facility

The Project would receive natural gas from a non-jurisdictional intrastate natural gas pipeline at the gas gate station, which would be constructed onsite near the north central part of the Project Site (see figure 2.1-1). The gas gate station would contain pipeline equipment, a connection for a pig receiver a filter/separator, custody transfer meters, an emergency shut down valve, and a gas analyzer. The Interconnect Facility located at the LNG terminal end of the gas gate station would include a tie-in to the inlet flange of the LNG terminal meter, an emergency shutdown valve, a flange insulating kit, and a gas analyzer.

2.1.2 Liquefaction Plant

The main process components and associated support facilities of the LNG terminal include a gas pretreatment facility necessary to remove unwanted gas components from the supply gas stream, and LNG trains using the APCI C3MR propane precooled mixed refrigerant technology, as further described below. These facilities are collectively referred to as the "Liquefaction Plant." The design of the Liquefaction Plant is based on a feed gas delivery pressure of approximately 615 pounds per square inch gauge, for both the Phase 1 and Phase 2 facility at the inlet of the gas gate station.

2.1.2.1 Pretreatment Process

Pipeline-quality feed gas arriving at the LNG terminal would require the removal of various constituents ahead of the liquefaction process, including mercury, carbon dioxide (CO_2), water, and heavy hydrocarbons (pentane and heavier [C5+]). The natural gas delivered to the LNG terminal would be composed primarily of methane (between 91 and 98 percent), but would also contain other gas components; ethane, propane, butane, and other heavy end hydrocarbons (between 2 and 9 percent), in addition to small quantities of nitrogen, oxygen, CO_2, and water. Pipeline-quality natural gas typically contains very small quantities of these constituents, the presence of which has no significant effect on operational efficiency when the gas is used as an energy source for domestic, commercial, or industrial applications. However, these constituents can negatively affect liquefaction equipment when the same gas is used as feed stock for LNG production. The pretreatment process is designed to remove a range of unwanted components from the feed gas to enable the liquefaction process to operate reliably.

The pretreatment process involves five sequential steps:

1. inlet facilities to remove pipeline debris (dirt, scale, dust, and oil);
2. treatment to remove mercury in mercury guard bed;
3. treatment to remove CO_2 in an amine acid gas removal system;
4. treatment to remove water in molecular sieve dehydration vessels; and

5. treatment to remove heavy hydrocarbons in a heavy hydrocarbon removal system.

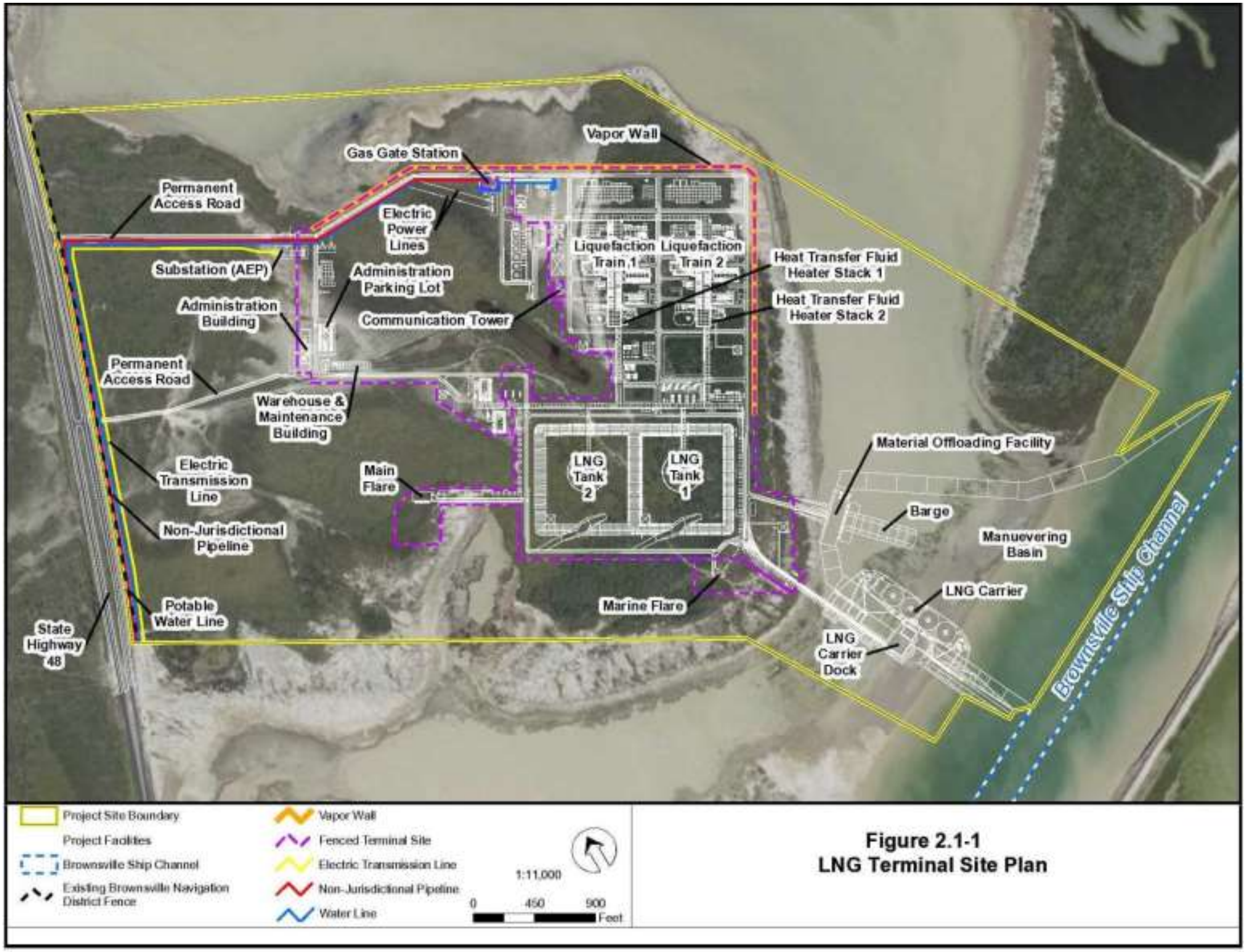

Figure 2.1-1 LNG Terminal Site Plan (Aerial Map)

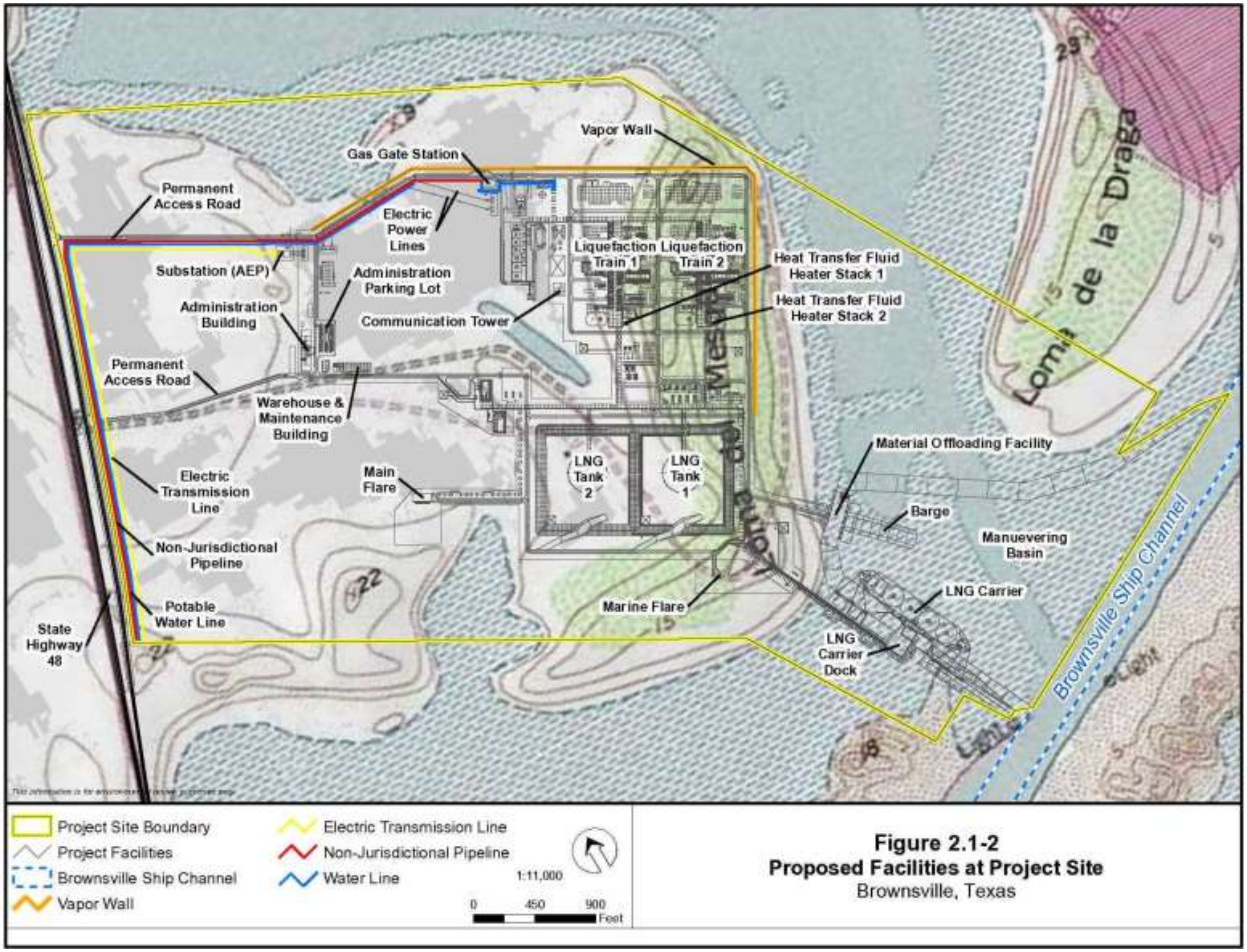

Figure 2.1-2 **Proposed Facilities at Project Site (Topographic Map)**

2.1.2.2 Liquefaction

Following pretreatment and heavy hydrocarbon removal, the natural gas would be condensed into a liquid at close to atmospheric pressure by cooling it to -260 degrees Fahrenheit utilizing APCI C3MR technology. To achieve this, treated gas pressure would be boosted as necessary by an electric motor-driven residue gas compressor to achieve the necessary operating pressure at the inlet to the liquefaction system. Air-cooled heat exchangers would cool the gas to remove the heat of compression. In each liquefaction train, gas leaving the residue gas compressor would be processed to produce LNG. Once both phases of the Project are operational, the average production rate would be 4 MTPA of LNG.

2.1.3 LNG Storage

The LNG storage tanks would be approximately 290 feet in outer tank diameter and 190 feet in height from grade to the top of the dome roof, with a net usable capacity of approximately 210,000 m^3 of LNG. The tanks would be a full containment design featuring a 9 percent nickel inner tank surrounded with a reinforced concrete outer tank to contain the LNG vapors. The outer reinforced concrete container of a full containment LNG tank is capable of containing the LNG in the event that the 9 percent nickel steel inner container fails. The tanks would be placed within earthen berms that would provide additional containment in the event of a spill. The storage tanks, like all of the facilities at the LNG terminal, would be built to the requirements of the National Fire Protection Association (NFPA) Standard 59A, DOT regulations at 49 CFR Part 193, and all other applicable regulations, codes, and standards. Prior to being placed in service, the LNG storage tanks would be hydrostatically tested in accordance with the requirements of American Petroleum Institute (API) Standard 620, Q8.3. Hydrostatic testing is further discussed in section 2.4.2.2.

2.1.4 LNG Carrier Loading

As indicated on figures 2.1-1 and 2.1-2, the LNG carrier maneuvering basin would be recessed into the shoreline of the Brownsville Ship Channel. To create the recessed maneuvering basin and berth access from the Brownsville Ship Channel, excavation and dredging would be required. Dredge material volumes and placement is further discussed in section 2.3.2.

The LNG carrier maneuvering basin would be dredged and maintained to -43 feet mean low low water (MLLW) with a 2-foot allowable over depth to accommodate LNG carriers with capacities up to approximately 180,000 m^3 of LNG. The maneuvering basin would be dredged with sidewalls sloped to a 3 to 1 ratio in order to match the sidewall slope of the Brownsville Ship Channel. Portions of the slopes would be armored with riprap to prevent erosion or slumping of the slopes during operation of vessels.

The LNG carrier maneuvering basin would feature a 140-foot by 150-foot concrete jetty head platform, which would be supported on piles. The platform would support three loading arms and one vapor return arm to allow LNG transfer to berthed LNG carriers. During LNG carrier loading, LNG would be pumped from the LNG storage tank(s) to the LNG carrier berthing dock using in-tank pumps, where it would be transferred to ocean-going carriers and exported. The LNG carrier berthing dock would also include four breasting dolphins (each with 48-inch battered piles) and six mooring dolphins (each with 48-inch battered piles) to secure the LNG carrier while docked. The LNG carrier would be at the loading dock for approximately 24 hours depending on the size of the LNG carrier. Regardless of the size of the LNG carrier, the LNG transfer rate to the LNG carrier would not exceed 12,000 m^3 per hour.

Texas LNG's current projections indicate that one LNG carrier per 10 to 11 days would make port calls at the LNG terminal when operating at the completion of Phase 1 and twice that frequency at the completion of Phase 2. The actual number of port calls would depend on the export volume and the capacity of the specific vessels. The maximum number of vessel calls per year is expected to be 74 when the facility is producing 4 MTPA of LNG.

The MOF would be designed to receive ocean going barges and larger vessels such as heavy load carriers. During construction, the MOF would be used for delivery of a portion of the materials, equipment, and modular plant components necessary for the Project via barge or other ocean-going vessels. During operation, the MOF would be maintained to import large replacement parts for ongoing facility maintenance and would serve as the tug berth while an LNG carrier is docked. The MOF would consist of a 400-foot-long and 122-foot-wide, rectangular platform. The barges and other vessels would dock along the 400-foot side, which would face the Brownsville Ship Channel.

The MOF would also support the backup seawater pumps for the firewater system. The system would be composed of five pumps with separate suction intakes. Construction of Phase 1 of the Project would include installation of two pumps, each with a maximum pumping rate of 3,000 gallons per minute using an intake approximately 12 inches in diameter. During Phase 2, three additional pumps would be installed, each with a maximum pumping rate of 4,500 gallons per minute utilizing an intake of approximately 16 inches. The intakes would include screens with mesh sizes ranging from 0.25 to 1.0 inch to prevent entrainment of fish and other aquatic life. Further, the intake pipes would be placed a minimum of 5 feet below the water surface.

During operation, LNG carriers require water for cooling of the main engine/condenser, diesel generators, and fire main auxiliary and hotel services. To do this, LNG carriers take on water from the surrounding area, transfer heat from the equipment to the water, and discharge the water back to the surrounding area. LNG carriers calling on the LNG terminal are anticipated to conduct cooling water uptakes and discharges while in the maneuvering basin. Texas LNG estimates that a 174,000 m^3 LNG carrier would discharge an estimated 972,500 gallons of cooling water per hour, approximately 0.1 percent of the total volume of the maneuvering basin. In addition to cooling water discharges, the LNG carrier would discharge approximately 15 million gallons of ballast water while at the LNG terminal.

The Coast Guard’s ballast water management regulations (33 CFR 151.2025 and 46 CFR 162) established a standard for the allowable concentration of living organisms in ships’ ballast water discharged into waters of the U.S. The Coast Guard also established engineering requirements and an approval process for ballast water treatment systems installed on ships. All ships calling on U.S. ports must either carry out open sea exchange of ballast water or ballast water treatment, in addition to fouling and sediment management. In addition, the International Maritime Organization has adopted this regulation and requires each vessel to install and operate a ballast water management system (as defined in 33 CFR 151.2026).

2.1.5 Buildings and Facility Roads

The LNG terminal would include separate permanent buildings for administration, control room, warehousing, and maintenance shop functions. The administration building, warehouse, and maintenance shop would be located near the center of the LNG terminal; whereas, the control room would be located near the Liquefaction Plant, as shown on figure 2.3-1.

Access to the LNG terminal during construction and operation would be via SH 48. Because there are no existing roads within the LNG terminal site, internal roads would be constructed, including roads providing ingress and egress routes to the LNG terminal. As shown on figure 2.3-1, the westernmost facility road would be the primary permanent road providing access to the administration area as well as the LNG facilities (e.g., liquefaction trains, LNG storage tanks, and LNG carrier berthing dock). The easternmost facility road would provide access to the utility areas on site as well as provide secondary access to the LNG facilities. Both access points would be controlled with a security gate.

2.1.6 Water, Power, and Communications

Texas LNG anticipates that water supply during construction would be imported from off-site and sanitary waste would be handled by self-contained portable facilities. Water necessary for industrial processes and domestic water supply would be supplied by the BND via a water supply line. To provide potable water to the LNG terminal, the BND would install an approximately 7.4-mile-long, 6-inch-diameter potable water line from an existing potable water line near Fishing Harbor, west of the Project Site. The entirety of the potable water line would be constructed parallel to and within the construction corridor of, the intrastate natural gas pipeline, on the south side of SH 48.

Sanitary waste water would be treated by an onsite septic system. The septic system would be constructed to the requirements of the Texas Commission on Environmental Quality and Cameron County. A freshwater fire tank would be used to charge the firewater main and would be used as first response in the event firewater is needed. The firewater tank is designed to provide firewater at the design supply rate for at least two hours. A seawater firewater back-up system is also included in the design and would automatically activate on detection of a low water level in the freshwater firewater tank.

Electric power for the Project would be supplied by AEP connected to the local electric transmission grid. AEP would construct a substation within the LNG terminal (see figure 2.1-1). The main power load would be the electric motor drivers coupled to refrigeration compressors. Other primary plant electrical loads would include: in-tank LNG pumps, boil-off gas compressors and residue compressors, and the multiple fin-fan motors that would be used for air cooling of the process during liquefaction.

The telecommunications systems for the Project would include a telephone connection, internet connection, operations very high frequency radio system, marine very high frequency radio system, operation back-up communication (phone), computer network, plant telecommunications network, and closed-circuit television system. There would be an approximately 150-foot-high radio communication tower near the main control building. In addition, marine band very high frequency radios would facilitate communication with the LNG carriers.

2.1.7 Ancillary Facilities

Ancillary facilities and structures at the LNG terminal would include the following:

- firewater system;
- process and marine flares (discussed in further detail below);
- flare knock-out drums
- thermal oxidizer;
- boil-of gas compressors;
- control rooms;
- heat transfer fluid heaters;
- instrument air system;
- truck loading and unloading;
- substation;
- oily water treatment unit;
- miscellaneous piping, racks, sumps, and spill containment system;

The process flares would be infrequently used for start-up, shutdown, and non-routine venting of excess pressure. The warm wet flare, cold dry flare, acid gas flare, and spare flare would all be mounted on one, 315-foot-high structure called the main flare (see figure 2.1-1). A second 180-foot-high flare structure, the marine flare, would be located southwest of the LNG storage tanks (see figure 2.1-1).

2.2 DEEPWATER ACCESS TO THE GULF OF MEXICO

LNG carriers would access the LNG terminal from the Gulf of Mexico through the Brownsville Ship Channel. The Brownsville Ship Channel is currently maintained to a depth of 42 feet MLLW and width of 250 feet. The channel is essentially a straight waterway with no bridges or other air-draft obstructions for its entire 19-mile length. Due to its width, the channel is operated for single-lane, one-way traffic, with vessel traffic managed by the BND.

In a letter dated February 16, 2015, Texas LNG submitted its Letter of Intent and preliminary Waterway Suitability Assessment (WSA) to the Coast Guard as required by 33 CFR 127.007. The Coast Guard requested additional information and a follow-on WSA was submitted by Texas LNG February 25, 2016. In a letter dated February 14, 2018, the Coast Guard issued the LOR for the Project, which stated that the Brownsville Ship Channel is considered suitable for LNG marine traffic in accordance with the guidance in the Coast Guard Navigation and Vessel Inspection Circular 01-2011.

Federal and state statutes require that all large commercial vessels be directed and controlled by a licensed marine pilot while underway in the navigable waters of the U.S. The LNG carriers would navigate from their point of origin to the pilot station near the sea buoy just outside the jetties protecting the entrance to the Brownsville Ship Channel. A pilot from the Brazos Santiago Pilots Association would navigate the LNG carrier from the sea buoy, through the Brazos Santiago Pass, into the Brownsville Ship Channel. When an LNG carrier enters the Brownsville Ship Channel, the Coast Guard would establish a safety zone around the vessel. As a safety and security precaution, no vessels are allowed to meet, cross, or overtake LNG carriers in transit or otherwise enter the security zone without the express permission of the Coast Guard. At its discretion, the Coast Guard may elect to provide escort to boats during LNG carrier transits to enforce the moving security zone. Figure 2.2-1 identifies the LNG carrier route between the Gulf of Mexico and the LNG terminal.

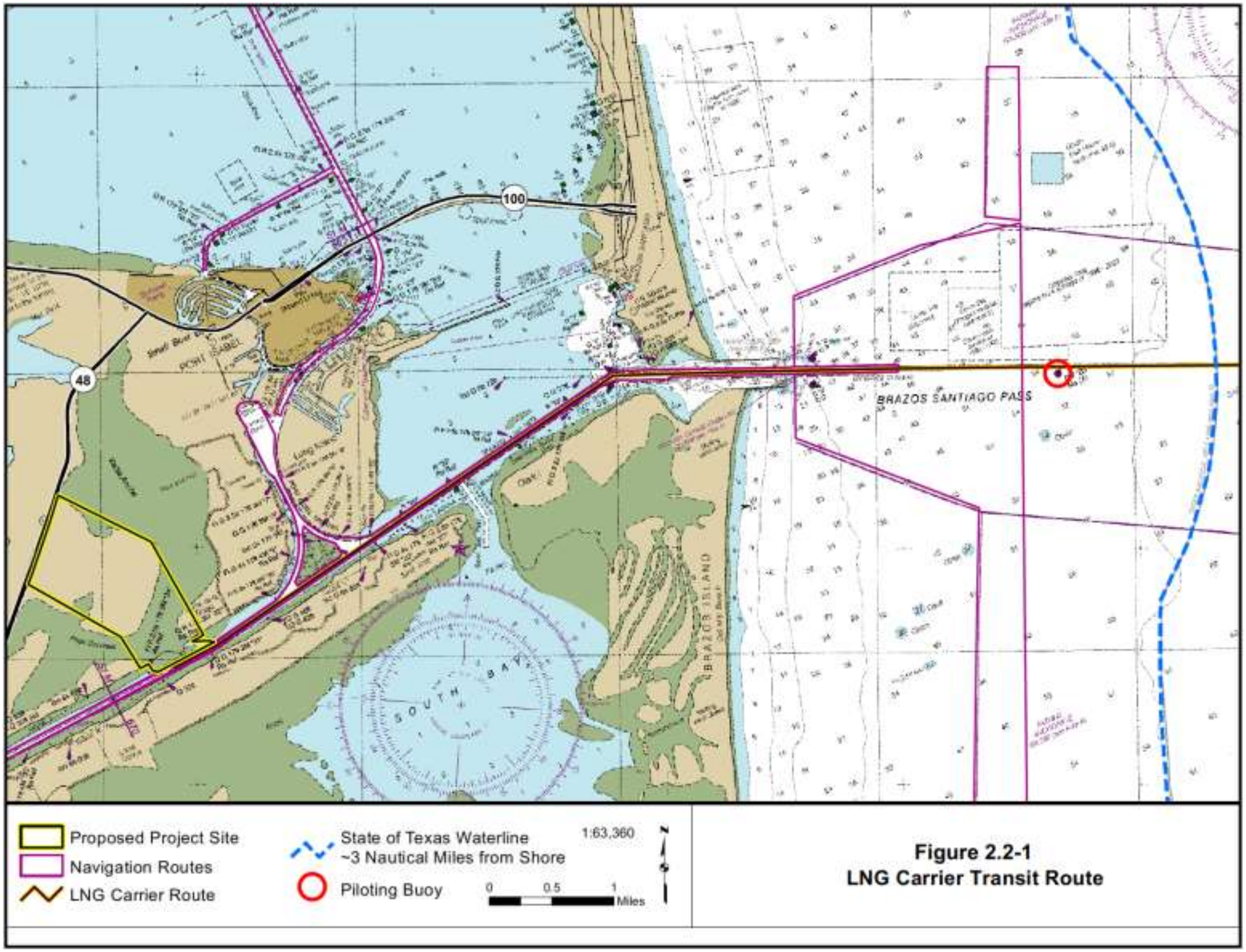

Figure 2.2-1 LNG Carrier Transit Route

LNG carriers calling on the LNG terminal would utilize the maneuvering basin so that while moored at the LNG carrier berthing dock, the LNG carrier bow would be facing toward the channel. The Project would be designed to accommodate LNG carriers with capacities of up to 180,000 m^3. These design vessels have a draft of approximately 39 feet when loaded with LNG, maximum beam of 165 feet, and length of approximately 1,000 feet. Three tractor tugs would be required to turn the LNG carrier and maneuver it to berth. After the LNG carrier is berthed, at least one of the tugs would remain nearby at the MOF.

2.3 LAND REQUIRMENTS

2.3.1 Project Facilities

The LNG terminal would be constructed on a 625-acre parcel owned by the BND, with an additional 26.5 acres necessary outside of the parcel to allow for deep water access to the Brownsville Ship Channel (collectively referred to as the Project Site) (see figure 2.3-1). In total, construction of the Project would require 311.5 acres, with 282.0 acres permanently maintained for operation of the LNG terminal (referred to herein as the Project footprint). The remaining 340.0 acres of the Project Site would be undisturbed, although approximately 36 acres (including approximately 7 acres of temporary workspace) would be enclosed within the Project fence (see figure 2.1-1). In addition to the land requirements at the Project Site, Texas LNG would utilize the existing 704-acre placement area 5A (PA 5A) for disposal of dredge material associated with construction of the Project, as further discussed in section 2.3.2. Land requirements for the Project are summarized in table 2.3-1.

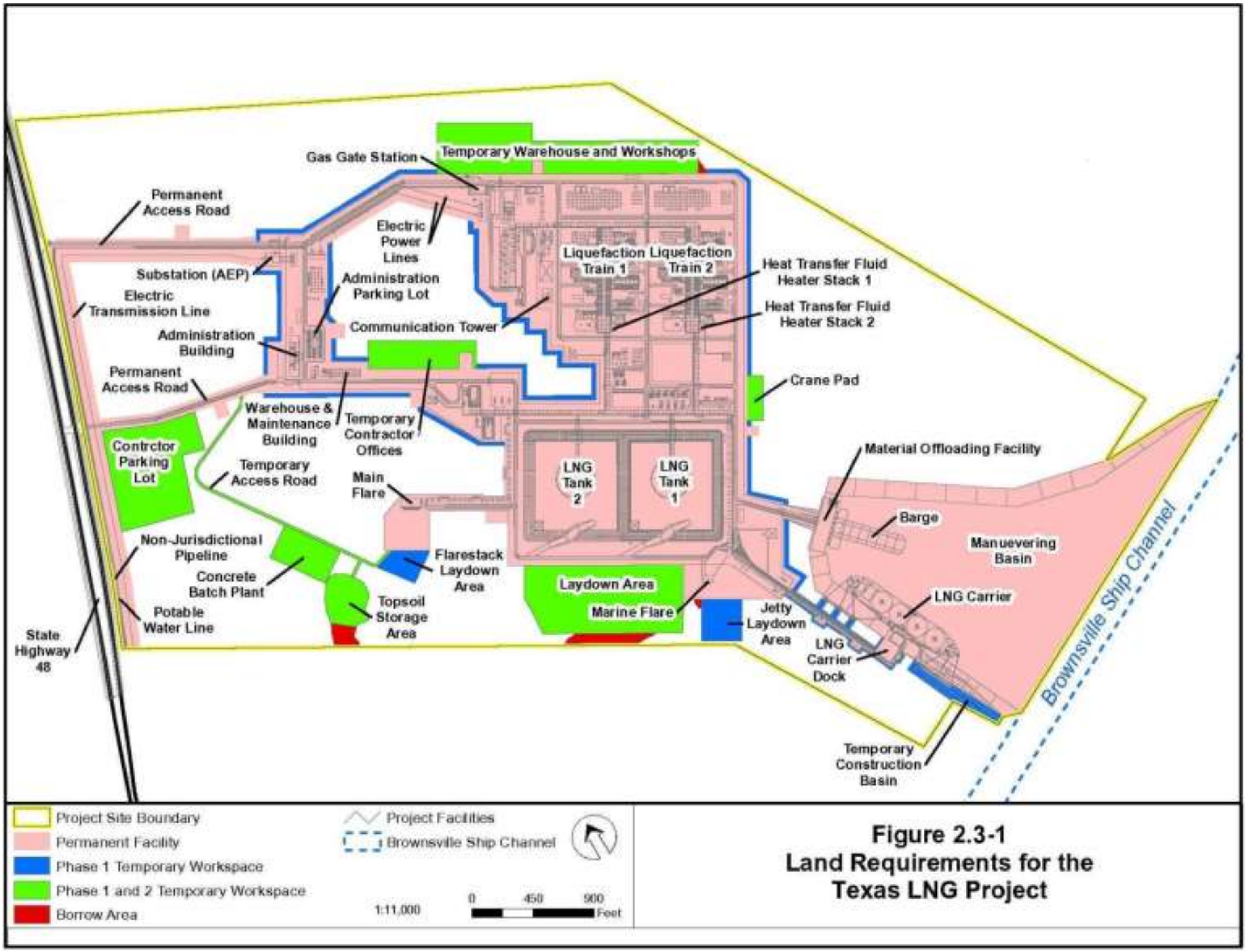

Figure 2.3-1 Land Requirements

TABLE 2.3-1
Land Requirements for the Texas LNG Project

Facility	Land Required for Construction (acres)	Land Required for Operation (acres)
PERMANENT FACILITIES		
Liquefaction Process Area and LNG Storage Tanks [a]	156.6	156.6
Maneuvering Basin [b]	72.0	72.0
LNG Carrier Berthing Dock	1.5	1.5
Permanent Access Road	6.7	6.7
Non-jurisdictional Facilities within the Project Site [c]	11.4	11.4
Permanent Facilities Subtotal	**248.2**	**248.2**
TEMPORARY WORKSPACE AND LAYDOWN AREAS [d]		
Phase 1 Temporary Workspace		
Temporary Construction Basin	1.5	0.0
Jetty and Flarestack Laydown Areas	3.4	0.2
LNG Carrier Berthing Dock	1.0	0.0
Site Preparation Temporary Workspace	9.0	0.0
Borrow Areas	2.0	2.0
Phase I Temporary Workspace Subtotal	**16.9**	**2.2**
Phase 1 and 2 Temporary Workspace		
Concrete Batch Plant	2.7	0.0
Warehouse and Workshops	12.8	12.8
Laydown Areas	12.9	12.9
Contractor Offices	3.5	3.5
Contractor Parking Lot	10.0	0.0
Crane Pad	1.0	0.0
Topsoil Storage Area	2.4	2.4
Temporary Access Road	1.1	0.0
Phase I and 2 Temporary Workspace Subtotal	**46.4**	**31.6**
PROJECT SITE TOTAL	**311.5**	**282.0**
DREDGE MATERIAL PLACEMENT AREA		
PA 5A	704.0	704.0

[a] Includes all areas contained within the liquefaction and storage tank areas of the fenced LNG terminal, including but not limited to the administration building, gas gate station, utility substation, and communication tower.
[b] Includes the acreage associated with the MOF.
[c] Includes the portions of the non-jurisdictional natural gas pipeline, electric transmission line, and potable water line located within the Project Site.
[d] Impacts presented in the “Operation” column under “Temporary Workspace and Laydown Areas” represent areas used for construction in which contours would not be restored. Following construction in these areas, all temporary buildings and equipment would be removed and the area would be revegetated; however, contours would not be restored, resulting in a permanent impact.

2.3.2 Dredge Material Placement

Texas LNG plans to utilize the existing dredge material PA 5A located approximately 4 miles southwest of the Project Site on the south side of the Brownsville Ship Channel for disposal of dredge material (see figure 2.3-2). Additionally, Texas LNG anticipates using up to 10 percent of the estimated 3.9 million cubic yards of dredge material as general site fill, accounting for about a third of the estimated 1.22 million cubic yards of imported fill required for the site. PA 5A is an existing confined dredge material disposal facility owned by the BND and operated under an easement agreement by the COE.

The berms surrounding PA 5A are currently 9 feet North American Vertical Datum of 1988 (NAVD 88).[4] Texas LNG estimates that in order to contain the dredge material from the Project, the berms would need to be raised by 5 feet to a total of 14 feet NAVD 88. Texas LNG would raise the berms by excavating existing materials from within the placement area for placement on top of the existing berms; therefore, the overall footprint of PA 5A would remain unchanged (see figure 2.3-2).

[4] A vertical datum is an elevation of "0 feet" that is used as a reference point so that heights of other points can be assigned using a consistent system of measurement. NAVD 88 is the official vertical datum for the conterminous United States and Alaska (National Geodetic Survey, 2014).

Figure 2.3-2 **Dredge Placement Area 5A**

2.4 CONSTRUCTION SCHEDULE AND PROCEDURES

2.4.1 Construction Schedule

Texas LNG plans to begin construction of Phase 1 of the Project in 2019 and begin production in 2023. Phase 2 construction schedule would be dependent upon future customer needs; however, Phase 2 construction is anticipated to take 43 months and could begin as soon as 18 months after the start of Phase 1 construction.

2.4.2 Construction Procedures

2.4.2.1 Environmental Compliance, Training, and Inspection

All facilities would be designed, installed, tested, operated, and maintained in accordance with applicable laws, regulations, and standards that are intended to prevent facility accidents and failures, ensure public safety, and protect the environment. Texas LNG plans to utilize a Project-specific Environmental Construction Plan (ECP) (see appendix B of the draft EIS). The ECP details the measures that would be implemented during construction by Texas LNG and/or its contractor to minimize environmental impacts.

During construction, the potential exists for spills of hazardous materials, such as hydraulic fluid and diesel fuel for equipment and vehicles. To address these concerns, Texas LNG has developed and would adhere to a Spill Prevention and Response Plan (SPRP) during construction and operation of the facility. Texas LNG would also prepare a Spill Prevention, Containment, and Countermeasure Plan, as consistent with applicable regulations and permit requirements prior to operation of the facility.

Due to the ground disturbance, the increase in impervious surface, and changes in topography resulting from construction of the Project, there is potential for increased stormwater runoff from the Project Site during construction and operation of the Project to carry unconfined debris or materials into adjacent portions of the Action Area. In accordance with the Construction General Permit (to be issued by the EPA, Texas LNG would implement its Stormwater Pollution Prevention Plan (SWPPP) to minimize erosion and sediment transport during construction and restoration of the Project. Erosion control devices would be installed as necessary and maintained in accordance with the applicable permit conditions after initial clearing but before disturbance of the soil. Temporary erosion and sediment control devices would include, but are not limited to sediment barriers, storm water diversions, trench breakers, mulch, and revegetation. The goal of erosion control devices is to minimize wind and water erosion onsite, and to prevent construction-related sediment from migrating offsite into sensitive resource areas (e.g. open water, tidal flats, tidal marsh). In addition, erosion and sediment control structures would be maintained at all times as required in the Project construction documents and as required by applicable permits.

For purposes of quality assurance and to support regulatory compliance, Texas LNG would employ at least one environmental inspector (EI) to monitor construction activities at the LNG terminal during all phases of construction, including clean-up and restoration. The responsibilities of the EI employed by Texas LNG are outlined in its Project-specific ECP (included in appendix B of the draft EIS). The ECP is based on the 2013 FERC Upland Erosion Control, Revegetation, and Maintenance Plan (Plan) and Wetland and Waterbody Construction and Mitigation Procedures (Procedures),[5] which are a set of construction and mitigation measures developed in collaboration with other federal and state

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[5] The FERC Plan and Procedures can be viewed on the FERC website at http://www.ferc.gov/industries/gas/enviro/plan.pdf and http://www.ferc.gov/industries/gas/enviro/procedures.pdf.

agencies and the natural gas industry to minimize the potential environmental impacts of the construction of natural gas projects, in general.

The EI's responsibilities would include verifying that environmental obligations, conditions, and other requirements of permits and authorizations are met. Texas LNG has requested deviations from the FERC Plan and Procedures, as described in section 4.4.3 of the draft EIS. Although adequate justification has been provided for these alternative measures, Texas LNG would be required to otherwise comply with the requirements of the Plan and Procedures. The EI would inspect construction and mitigation activities to verify environmental compliance.

The EI would have authority to stop work or require other corrective action(s) to achieve environmental compliance. In addition to monitoring compliance, the EIs would assist with environmental training for Project personnel and report compliance status on the required basis as defined in the ECP. The environmental training program would be designed to ensure that all individuals receive training before beginning onsite work. Adequate training records would be maintained and refresher training provided, as necessary.

2.4.2.2 Project Site

Site Preparation

The proposed Project Site would require significant site preparation work, including clearing, grubbing, grading, soil stabilization, and filling to increase ground elevation, some of which must be performed prior to foundation development and terminal construction. Most of the LNG facility components (e.g., storage tanks, liquefaction trains) would be located on the highest portion of the site, which currently has elevations ranging between 2 and 25 feet NAVD 88. As part of the site preparation, the portion of the site on which the LNG facilities would be constructed would be modified by cut and fill activities to an elevation of 16 feet NAVD 88. The LNG storage tank area would be at an elevation of 10 feet NAVD 88, but would have secondary containment berms at 22 feet NAVD 88. Non-critical components of the LNG terminal, such as access roads, would be constructed at 7 feet NAVD 88. Figure 2.4-1 identifies the final grade of facilities located within the Project Site. Prior to grading, Texas LNG would remove topsoil from the locations where permanent facilities would be installed. Much of the topsoil located within the Project Site has limited potential for restoration due to high salinity (Natural Resources Conservation Service [NRCS], 2017). Texas LNG plans to segregate topsoil from areas within the Project workspace with the greatest potential for successful revegetation of disturbed areas following construction. Stockpiled topsoil not suitable for reuse on the site would be disposed of at an approved off-site disposal facility in compliance with local requirements.

Texas LNG estimates that 1.22 million cubic yards of fill would be required to achieve the intended elevations. Additionally, soils would require improvement and stabilization to provide a load-bearing surface suitable for construction. Commonly used stabilizers include portland cement and hydrated lime. The source of fill material to be used on site includes local commercial sources, material to be excavated from the maneuvering basin, and borrow areas located within the Project Site (see figure 2.4-1). Texas LNG would borrow from areas on site that are above 16 feet NAVD 88 and anticipates using up to 10 percent of dredge material for reuse on site. The use of dredge material for general construction is limited by structural requirements. Texas LNG has not yet completed geotechnical studies of the proposed maneuvering basin, necessary to further evaluate the extent that dredge material would be used on site. Aggregate materials such as gravel, shells, and/or crushed stone sourced from regional commercial operations on geotextile layers would be delivered to the site by truck and would be used to level and finish temporary workspace and operational areas, as necessary. Texas LNG's Noxious Weed and Invasive Plant Species Management Plan describes methods to prevent and minimize the introduction or spread of noxious weeds and invasive plant species during construction of the Project.

Temporary workspace that contains temporary workshops, contractor offices, etc. would be graded to an elevation of 7 feet NAVD 88. Temporary site roads and parking areas would be constructed at existing grade and would be stabilized and compacted for heavy load traffic. The final grade for these areas is shown on figure 2.4-1.

Grading of the site would be conducted so as to ensure efficient and environmentally protective stormwater drainage in accordance with Section 402 of the Clean Water Act. Texas LNG would slope the site to direct stormwater discharges towards perimeter outfalls through a system of ditches and filtration devices during construction to prevent high sediment loads from reaching receiving waterbodies. Stormwater controls would be installed as necessary.

During operation, stormwater from areas that do not have a potential for contamination would be conducted directly to an outfall located on the pilings on the LNG carrier loading dock. Stormwater conveyance from areas that have potential for oil contamination or amine contamination would be designed to prevent untreated stormwater from flowing to the environment. The oil-contaminated water would flow to the oily water treatment system. Areas with potential for oil contamination include oil storage tanks; areas containing compressors using lubricating oil; water from the flare knock-out drum; and water from the plant air compressor. If the stormwater is contaminated with amine, the water would drain to the amine contaminated stormwater tank, the source of the amine leak would be repaired, and the amine contaminated water would be trucked off-site by a licensed contractor and disposed of in accordance with applicable federal, state, and local regulations.

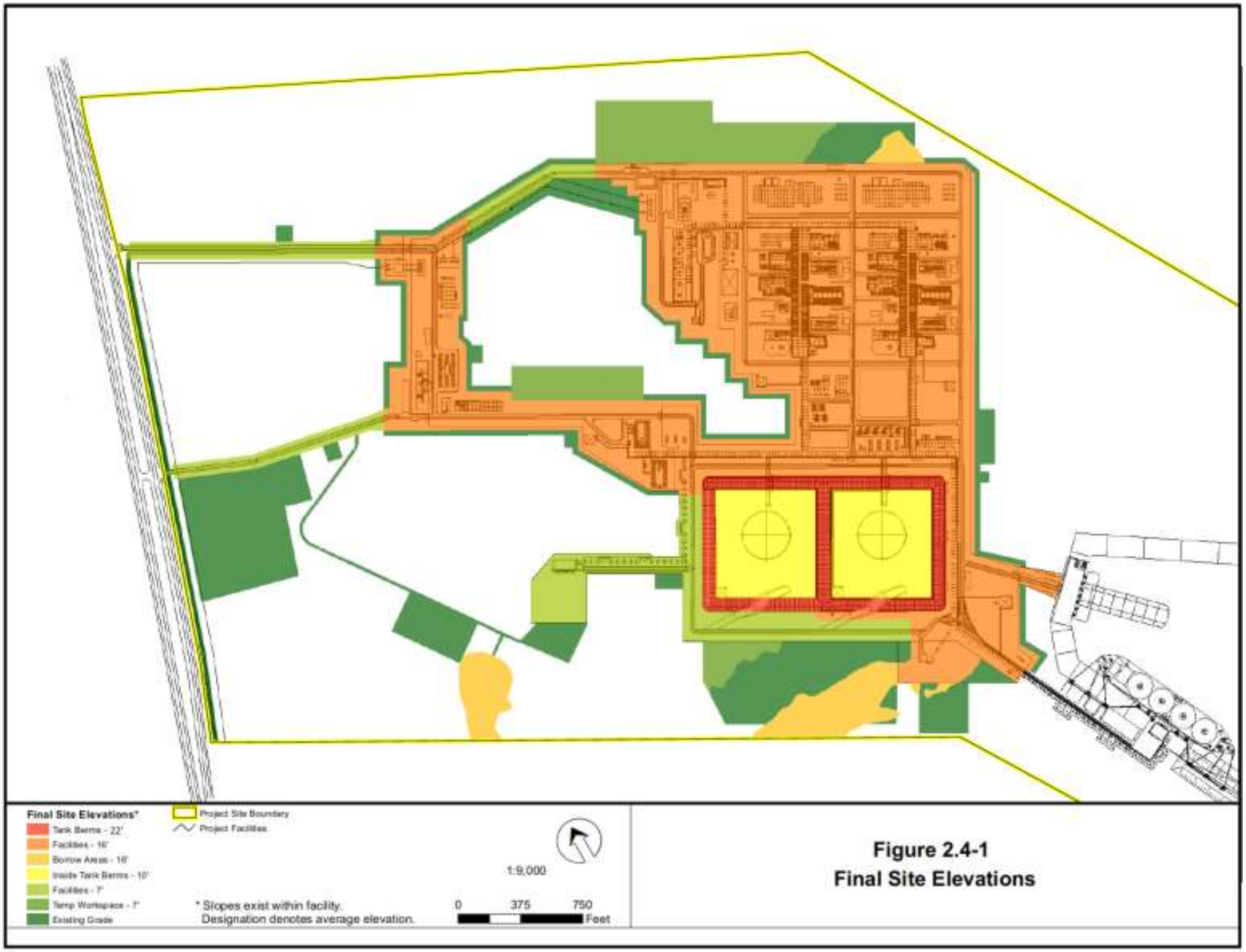

Figure 2.4-1 Final Site Elevations

Following the cutting, filling, and soil stabilization activities described above, Texas LNG would install temporary fencing to isolate construction areas from other areas of the Project Site that would not be disturbed. The temporary site roads would generally follow the anticipated layout of the permanent facility roads and would be paved with asphalt, shell, or gravel depending on anticipated traffic loads. Texas LNG would also install any electrical, communications, and water systems needed during construction at this time.

Facility Foundations

The Liquefaction Plant foundation construction would begin with the installation of piles to provide a firm base for the structures supporting the liquefaction trains. Pile specifications would be based on guidance in FERC's 2007 *Draft Seismic Design Guidelines and Data Submittal Requirements for LNG Facilities* and Section 7.2.2 of the NFPA Standard 59A.

Most structures (e.g., pretreatment equipment, liquefaction trains, LNG storage tanks) would be supported by 18-inch-square precast concrete piles; the LNG loading platform, breasting dolphins, and mooring dolphins would be supported by op-ended steel pipe piles with 42- and 48-inch diameter. The piles would be delivered to the site by barge or other ocean going vessel, and/or truck. Pile driving activities would occur between the hours of 7:00 a.m. and 5:00 p.m. for up to 6 days per week as a worst-case scenario (pile driving would typically occur Monday through Friday, although pile driving may also occur on Saturdays). Onshore piles would be driven by impact pile drivers. Marine piles would be driven by vibratory pile drivers and finished with impact pile drivers, which may include both land-based and floating rigs. For each phase, pile driving operations would take place over approximately 13 months, but peak pile driving would occur over about 4 months. After the piles have been positioned, using pre-drilled holes and/or pile-driving, caps would be installed and the concrete pad poured.

Liquefaction Plant

The liquefaction systems would be interconnected with the gas gate station and LNG storage tanks by buried and aboveground piping interconnects; the latter on steel-framed support racks. Pipe spools would be primarily fabricated off-site and delivered to the site by truck or barge. Pipe sections would be painted, coated, or insulated, as necessary. Coatings and insulation, if required, would be applied to welds after welds have been tested in accordance with applicable codes.

Certain larger equipment units, such as pretreatment systems and liquefaction and refrigerant compressors, would be assembled as modules in prefabrication yards. This off-site modular approach allows equipment assembly in a more controlled environment than that encountered under the on-site "stick-built" approach, facilitating final hook-up and testing. Larger modular units would be transported to the MOF, offloaded, and transported to their respective foundations. Other equipment would be shipped to the site by truck or barge. All equipment would undergo quality assurance/quality control inspection and testing at its place of origin and upon installation at the Project Site.

Once foundations have been set, work on the liquefaction trains, piping interconnects, and associated utility systems can occur within the same general timeframe, but would be coordinated such that various inter-dependent systems (e.g., electrical and instrumentation) can be installed and tested according to an appropriately sequenced schedule. After the equipment and piping has been set in place, cable systems would be installed. Ultimately, road paving, final site grading, seeding, and clean-up would be completed. Temporary construction facilities would be left in place for Phase 2 construction. After Phase 2, these temporary construction facilities would be disassembled and removed when they are no longer needed.

Prior to being placed into service, natural gas pipelines, piping, equipment and storage tanks would be tested to ensure structural integrity. The cryogenic piping would be pneumatically tested and the non-cryogenic piping would be hydrostatically tested. The LNG storage tanks would require hydrostatic testing, which would involve filling the tanks with water meeting the requirements of American Petroleum Institute 620, Q.8.3. Prior to hydrostatic testing, Texas LNG would prepare the equipment to be tested by removing accumulated construction debris, dirt, and dust, as appropriate.

Texas LNG would withdraw water from the Brownsville Ship Channel for hydrostatic testing of the LNG storage tanks and municipal water from the BND would be used for hydrostatic testing of piping and other storage tanks. Texas LNG estimates that a total of approximately 73,327,654 gallons of water would be used for hydrostatic testing. Table 2.4-1 summarizes the source and volume of water anticipated to be used for hydrostatic testing of each Project phase and component.

TABLE 2.4-1
Estimated Water Usage for Hydrostatic Testing

Phase/Project Component	Water Source	Volume of Discharge (gallons)
Phase 1		
LNG Storage Tank	Seawater [a]	35,405,174
Other Storage Tanks	Potable water [b]	1,231,723
Plant Piping	Potable water [b]	1,017,583
Phase 1 Subtotal		**37,654,480**
Phase 2 Temporary Workspace		
LNG Storage Tank	Seawater [a]	35,405,174
Other Storage Tanks	Potable water [b]	73,169
Plant Piping	Potable water [b]	194,831
Phase 2 Subtotal		**35,673,174**
PROJECT TOTAL		**73,327,654**

a Seawater would be withdrawn from the Brownsville Ship Channel.
b Potable water would be appropriated from the BND or other municipal source.

Seawater used for hydrostatic testing would be sourced from permanent water intake structures located on the MOF or by using temporary pumps appropriated directly from the channel. The permanent intake structures would be screened and are intended to be used as part of the back-up fire suppression system; however, they would be installed during construction of the MOF and available for use for water withdrawals for hydrostatic testing. Each pump used for water withdrawals would be capable of withdrawing water at a rate of 3,000 to 4,500 gallons per minute; however, Texas LNG anticipates a maximum rate of 3,000 gallons per minute to be utilized for withdrawals. Multiple pumps may be utilized at once to minimize the duration of withdrawal activities. Texas LNG anticipates that the total combined water withdrawal rates for hydrostatic testing would be between 6,000 and 12,000 gallons per minute.

To limit bacteria and other components that can be corrosive, chemical additives may be required during the hydrostatic test process where seawater is used. Before returning the water to the Brownsville Ship Channel, Texas LNG would filter the water to remove suspended solids and neutralize or biodegrade the chemical additives into non-hazardous materials. Texas LNG has indicated that it would seek authorization from the EPA to use additives and would provide specific additives and the intended concentrations prior to construction.

Potable water would be used to test piping and other storage tanks (i.e., not the LNG storage tanks). Small quantities of potable water (quantities that are not anticipated to reach a surface waterbody or wetland) used for hydrostatic testing may be discharged directly to the ground at a rate not to exceed 1,000 gallons per minute. Larger quantities of potable water used for hydrostatic testing would be discharged directly to the Brownsville Ship Channel or onsite, in accordance with EPA and Railroad Commission of Texas hydrostatic test discharge permits at a rate up to 10,300 gallons per minute. To minimize the potential for erosion and scour at the discharge locations, Texas LNG would use pumps, energy dissipation devices, sediment barriers, and other erosion and sediment control methods, as applicable. Refer to the Project-specific ECP in appendix B of the draft EIS for additional mitigation measures to be implemented during hydrostatic testing.

Berth/Dock/Material Offloading Facility

Approximately 1,400 feet of an abandoned, underground, 4.5-inch-diameter natural gas gathering pipeline is located parallel and adjacent to the Brownsville Ship Channel, crossing the proposed maneuvering basin. The pipeline is located within the proposed dredge footprint and would need to be removed prior to commencing dredging activities.

As discussed in further detail in section 2.1.4, excavation and dredging at the Project Site and within the Brownsville Ship Channel dredge area would be required for construction of the LNG carrier maneuvering basin. Dredging would be completed over a period of 11 months, working 7 days a week and 24 hours a day. Texas LNG expects to use a barge-mounted hydraulic cutterhead for dredging activities. Because the speed can be adjusted to match the sediment properties (e.g., stiff clay to silt), the use of hydraulic cutterhead reduces the turbidity levels associated with dredging activities. As the cutterhead cuts into the material, the hydraulic suction dredge removes the material, which is then moved through the temporary pipeline to a disposal area. Texas LNG anticipates the dredged material would be transported through the temporary pipeline to existing PA 5A.

Over time, the dredged maneuvering basin would be subject to accretion of material from the natural movement of sediments within the Brownsville Ship Channel and the surrounding area. Texas LNG estimates that the rate of accretion would be up to 100,000 cubic yards annually or 2.5 million cubic yards over 25 years. This volume equates to approximately 1 foot per year of average deposition; however, the distribution of shoaling would reduce the available underkeel clearance and would determine the frequency of maintenance dredging. Maintenance dredging would be conducted via hydraulic cutterhead dredge and dredge material would be placed in an approved placement area in accordance with all applicable authorizations from the BND and COE, as necessary. Texas LNG anticipates that maintenance dredging would be necessary every 3 to 5 years. Texas LNG would seek authorizations to conduct maintenance dredging, as needed.

During construction, Texas LNG anticipates that a portion of materials, equipment, and modular plant components would be brought to the site by barge or other ocean-going vessel. This would require development of a separate MOF to allow deliveries during construction.

During operation, the MOF would be maintained to import large replacement parts for ongoing maintenance of the facility. When an LNG carrier is docked, the tugs would remain close. While in the maneuvering basin, the tugs would tie up to the MOF. When there is no LNG carrier at the berth, the tugs would go back to the tug service provider and would not reside at the MOF. The MOF is not designed to accept deliveries from barges or other vessels while an LNG carrier is present.

Site Drainage

During site preparation, topographic grading plans would be designed to ensure efficient and environmentally protective stormwater drainage. The Project Site would be sloped to direct discharges towards perimeter outfalls through a system of ditches and filtration devices during construction to preclude high sediment loads from reaching receiving waters. Stormwater controls (including placement of gravel or other suitable material to provide a stable, well-drained surface) would be installed.

Stormwater from areas that do not have potential for contamination would be carried directly to outfalls. Stormwater from areas that have potential for oil contamination would flow to the oily water treatment system for treatment prior to discharge. Portions of the Project Site where the topography remains unchanged would retain their natural drainage. In accordance with the Construction General Permit (to be issued by the EPA), Texas LNG would implement its SWPPP to minimize erosion and sediment transport during construction and restoration of the Project.

The design and operation of all stormwater discharge and treatment facilities would be in accordance with applicable regulations and permits, including the EPA's National Pollution Discharge Elimination System regulations under the Clean Water Act and Federal Emergency Management Agency regulations which embody the local requirements of Cameron County, Texas. Throughout construction, Texas LNG would follow the erosion and sedimentation control procedures described in its ECP and SWPPP.

Vapor Wall

To meet safety requirements, the eastern and southern boundary of the LNG terminal would be surrounded by a 20-foot-tall vapor wall that is designed to limit the spread of hydrocarbon vapor in the unlikely event of a spill. The vapor wall would be 4,945 feet long and made from prefabricated concrete supported by 990, 40-foot-long concrete piles. Construction would commence in incremental sections from uplands in order to drive the piles into position. Crane assemblies would then lower the wall panels, which would be attached to the concrete piles.

2.4.3 Site Access and Traffic

The LNG terminal would be accessed from SH 48 during both construction and operation of the facility via two proposed ingress/egress routes as shown on figure 2.1-1. Permanent access roads would be constructed to an elevation of 7 feet NAVD 88 and width of 26 feet. Texas LNG would install culverts under the roads, where necessary, to maintain drainage and hydrologic connection between wetlands and tidal flats. Temporary access roads would be used during construction to provide additional access to the main flare and temporary workspace areas, including the temporary concrete batch plant (see figure 2.1-1).

Texas LNG estimates that the total number of vehicles arriving and departing the facility per day during peak construction of Phase 1 and Phase 2 would be 1,220 and 1,000, respectively. During the Peak Impact Scenario, an estimated 1,454 vehicles would arrive and depart the facility per day during construction. The majority of these vehicle trips would be associated with the construction workforce, which is estimated to arrive at the Project Site prior to 7 am and depart after 5 pm, outside of peak traffic hours. During operation, Texas LNG estimates that there would be 65 vehicle trips per day during peak traffic hours.

2.4.4 Post-construction Revegetation and Monitoring

Implementation of the ECP during construction and post-construction monitoring at the Project Site and within the facility workspace would help ensure that ground disturbance and restoration activities are managed in an environmentally protective manner. To ensure proper functioning, Texas LNG's EI would inspect temporary erosion control devices on a regular basis and after each rainfall event of 0.5 inch or greater, as specified in the EPA's General Permit for Construction Stormwater Discharge for Construction Activities. Following completion of construction, areas that would not be paved, graveled, or occupied by aboveground facilities would be stabilized by the re-establishment of vegetative cover in accordance with the ECP. Temporary erosion control devices would be maintained until the construction workspace is successfully revegetated or otherwise stabilized. All temporary erosion and sedimentation control devices (e.g., silt fences, straw bales, matting) would be removed when vegetation is successfully established. The EI would conduct follow-up inspections of all disturbed areas, as necessary, to determine the success of revegetation. At a minimum, inspections after the first and second growing seasons would be conducted. Revegetation would be considered successful if upon visual survey the density and cover of non-nuisance vegetation are similar in density and cover to adjacent undisturbed lands. Revegetation efforts would continue until revegetation is successful.

During construction, Texas LNG and its contractor would periodically monitor areas disturbed during construction of the Project to allow for early detection of weed and invasive plant infestations in accordance with its Noxious Weed and Invasive Plan Species Management Plan[6]. Appropriate control measures would be implemented in an attempt to minimize the spread of weeds and invasive plants.

Following construction, weeds and invasive plants would be monitored as part of Texas LNG's restoration monitoring activities and in accordance with permit requirements. Texas LNG's operations staff would monitor and treat weeds as a part of its normal operations and maintenance activities. To prevent the introduction of weeds and invasive plants to the Project Site, Texas LNG would require that all construction equipment, including timber mats, be cleaned prior to arriving on site. Texas LNG would also implement best management practices in construction areas to minimize the time that bare soil is exposed, minimizing the opportunity for weeds or invasive plants to become established. In areas to be revegetated, Texas LNG would utilize certified invasive plant and weed-free, native seed mix developed through consultation with the local NRCS. In addition, all imported fill and topsoil used in areas to be revegetated would be obtained from commercial sources and be free of weeds and invasive plants. Mulch or straw bales used for erosion control, would be similarly free of weeds and invasive plants.

2.5 OPERATIONS, MAINTENANCE, AND SAFETY

2.5.1 Operations and Maintenance

All facilities would be operated and maintained in accordance with government safety standards and regulations that are intended to ensure adequate protection for the public and to prevent facility accidents and failures including 49 CFR 193, 33 CFR 127, NFPA 59A, Executive Order 10173, and the Railroad Commission of Texas Chapter 14, *Regulations for Liquefied Natural Gas*. Operating procedures for the facility would be prepared after the final design is completed.

Comprehensive training would be provided to ensure that all facility personnel are familiar with the fundamental science, safety procedures, operating procedures, and maintenance procedures utilized at the LNG terminal. The training program would be conducted by professional instructors with expertise in

[6] The Noxious Weed and Invasive Plant Plan is publicly available on the FERC's website under Docket No. CP16-116-000 (Accession Number 20160331-5064).

their particular area of responsibility. The training program would include testing to demonstrate that the personnel are competent to perform their assigned duties. These procedures would address safe start-up, shutdown, cool down, purging, upset response, and routine operation and monitoring. A process training simulator would be developed to train operators. During emergency response training, coordination with and involvement of appropriate local emergency responders would be undertaken to ensure effective integration with local communication and emergency response systems.

2.5.2 Safety

The Project would contain many complementary layers of safety, hazard prevention, and mitigation systems and controls. These layers, as described below, include: 1) primary containment of the LNG; 2) secondary containment in the event of a leak; 3) control systems, operational integrity and protocols, operator knowledge, training, and experience; 4) safeguard systems and separation distances; and 5) firefighting contingency planning and exercises and emergency response.

The Project has been designed to withstand a hurricane and to resume operations soon after it passes through the area. Many design features built into the facility make it possible to withstand the wind and floodwaters associated with hurricanes. The guiding design parameters for wind are found in 49 CFR §193.2067, which states that LNG facilities must be designed to withstand, without loss of structural or functional integrity, a sustained wind velocity of not less than 150 miles per hour. FERC guidance requires that LNG facilities be constructed above the 500-year flood level, which is calculated to be 15.9 feet NAVD 88 and is the Design Flood Elevation (DFE). The Liquefaction Plant, LNG storage tank berm crests, marine berth deck level, main buildings, and utilities would be constructed at an elevation above the DFE, to reasonably assure the structural and functional integrity of the facilities. Primary internal access roads, but not all roads, would also be above the DFE to ensure the movement of personnel and equipment around the Project facilities for the control of fire or during other emergencies. The Emergency Response Plan and Hurricane Preparedness would be incorporated into the Standard Operating Procedures as part of the normal response to any threat or recovery due to a hurricane, regardless of severity.

2.6 ALTERNATIVES ANALYSIS

Texas LNG completed an alternatives analysis that evaluated the No Action Alternative as well as the following focus areas: Energy Source Alternatives; System Alternatives; Location, Site, and Facility Alternatives; Process Alternatives; Site Layout Alternatives; and Dredged Material Placement Alternatives. The alternatives analysis is discussed in further detail in section 3.0 of the Environmental Impact Statement. The following sections provide an overview of that detailed assessment.

2.6.1 No Action Alternative

The No Action Alternative would result in the Project not being constructed. This would not meet the Project purpose, which is to convert domestically produced natural gas to LNG for storage and export.

This alternative was eliminated from further consideration, as it does not meet the purpose of the Project.

2.6.2 System Alternatives

System alternatives are alternatives to the Project that would make use of other existing or proposed LNG production, storage, and export systems, with or without modifications, to meet the

Project purpose. Texas LNG identified proposed and planned LNG export projects in the vicinity of the Project and the Gulf Coast region, including proposed expansions at existing LNG terminals to determine if the LNG production rate of the Project (i.e., 4 MTPA of LNG for export) could be accommodated within one of those systems. Collectively, projects at 16 existing, proposed, or planned LNG terminals were reviewed for the purposes of that study (see draft EIS) and determined not to be viable system alternatives. In general, those projects have already been approved to export to FTA and/or Non-FTA countries. To accommodate the additional volume approved by the DOE for Texas LNG to export to FTA countries, additional facilities similar to those of the proposed Project would be required. Any such project would require review and authorization of the additional facilities and would likely not result in a significant environmental advantage. Therefore, this system alternative was not evaluated further.

2.6.3 Site Alternatives

Based in part on the information provided by Texas LNG, we evaluated site alternatives in the general area of the proposed Project Site. In order to meet the stated objectives of the Texas LNG Project, we applied screening criteria to identify sites that would be reasonable and most likely to provide some environmental advantage over the proposed Project Site. The screening criteria included two tiers of site alternatives, Tier 1, were those sites located within port areas including: Calhoun Port, Port of Port Arthur, Port of Brownsville, and Port of Corpus Christi in Texas; and six various sites identified by the COE as potential alternative sites that should be assessed: Port Aransas (Harbor Island and Brown and Root), Berry Island, Navy Electromagnetic Roll Facility, Naval Station Ingleside, and the Navy Unused Site in Port of Corpus Christi (see figures 2.6-1 and 2.6-2). In addition to location, alternative onshore sites were evaluated based off the safety requirements of the FERC, Coast Guard, and the DOT. In addition to safety requirements, we also evaluated the overall area to determine the optimum location for siting an LNG facility based upon size and configuration requirements. The screening included the following criteria:

- <u>Land Availability</u> – Siting an LNG facility requires a suitable amount of land for all project components, be available to lease or purchase, and to meet safety requirements (a minimum of 300 acres for the proposed Project). The proximity to a deepwater channel was also analyzed, as water depths greater than 40 feet below mean sea level are required to allow access for LNG carriers.
- <u>Natural Gas Pipelines and Transmission Lines</u> – When compared to other sites evaluated, sites located closer to natural gas sources capable of supplying natural gas for up to 25 years were considered preferable.
- <u>Population Centers/Residences</u> – Sites that are not in proximity to population centers or residences were considered preferable in order to meet the regulatory requirement for LNG vapor dispersion and thermal radiation exclusion zones. In general, a distance of at least 2,000 feet was determined to be necessary.

Using the Tier 1 screening criteria described above, we evaluated ten potential development areas to determine the least environmentally damaging practicable alternative port for the Project (four port sites and six additional COE-identified sites depicted in figures 2.6-1 and 2.6-2, respectively). Based on the screening criteria, all of the sites meet the land lease/purchase availability criteria, were near deepwater channels, and near natural gas pipelines. However, only five of the ten identified areas were located at least 2,000 feet from residential areas, which removed the Bean Tract - Calhoun Port Authority, Port of Corpus Christi, Port of Port Arthur, Naval Station Ingleside, and Berry Island from further consideration. Of the ten sites, only two (with the exception of the Port of Brownsville) meet the land size requirements, Naval Station Ingleside and Navy Unused Sites; however, each of those sites were removed from consideration as one is adjacent to a residential area, and the other does not have adequate water frontage. Therefore, it was determined that the Port of Brownsville was the only area evaluated that had available land that met all of the Tier 1 siting criteria outlined above. We then used the following Tier 2, criteria to identify sites in the Port of Brownsville area that would be reasonable and most likely to provide an environmental advantage over the proposed Project Site. The screening included the following criteria:

- Land Availability – Siting an LNG facility requires a suitable amount of land for all project components. Based on the information provided by Texas LNG it was determined that approximately 300 acres would be required for the Project. This site size would also ensure that all safety requirements are met. There would also need to be a 2,400 foot minimum length of shoreline at the site to allow construction of a recessed marine berth.
- Population Centers/Residences – Sites that are not in proximity to population centers or residences (at least 2,000 feet away) were considered preferable in order to meet the regulatory requirement for LNG vapor dispersion and thermal radiation exclusion zones (distances for dispersion and thermal radiation exclusion zones differ based on topography).
- Waterfront Access – In addition to the required shoreline, proximity to the Gulf of Mexico was considered preferable to allow for deepwater access for LNG carriers.
- Elevation – Areas that are naturally elevated were preferred to minimize the required fill that would be needed to meet DFE. Due to the limited amount of dredge material that can be used as structural fill, smaller volumes of fill are considered preferable as it would limit the amount of imported fill that would be needed. The desired elevation for the LNG terminal is 16 feet NAVD 88.
- Wetlands – Sites that do not contain wetlands (as indicated by the FWS NWI database) were considered preferable.
- Endangered Species Habitat – Potential habitat for the threatened and endangered ocelot and jaguarundi is in the area. Sites that would result in minimal disturbance of suitable habitat and/or are located at a greater distance from the existing FWS wildlife corridor (see figure 2.6-3) were considered preferable.

Using the screening criteria described above, we evaluated three alternative sites for the LNG terminal (Alternative Sites 1, 2, and 3), in addition to the proposed site. The general locations of the three alternatives and the proposed site are shown in figure 2.6-3. While Texas LNG identified Alternative Sites 1 and 3 as potential alternative sites, they do not contain the minimum acreage necessary to be considered a feasible alternative site. Therefore, Alternative Sites 1 and 3 were removed from consideration and are not further discussed. A comparison of each alternative site to the proposed site is presented in table 2.6-1 and discussed below.

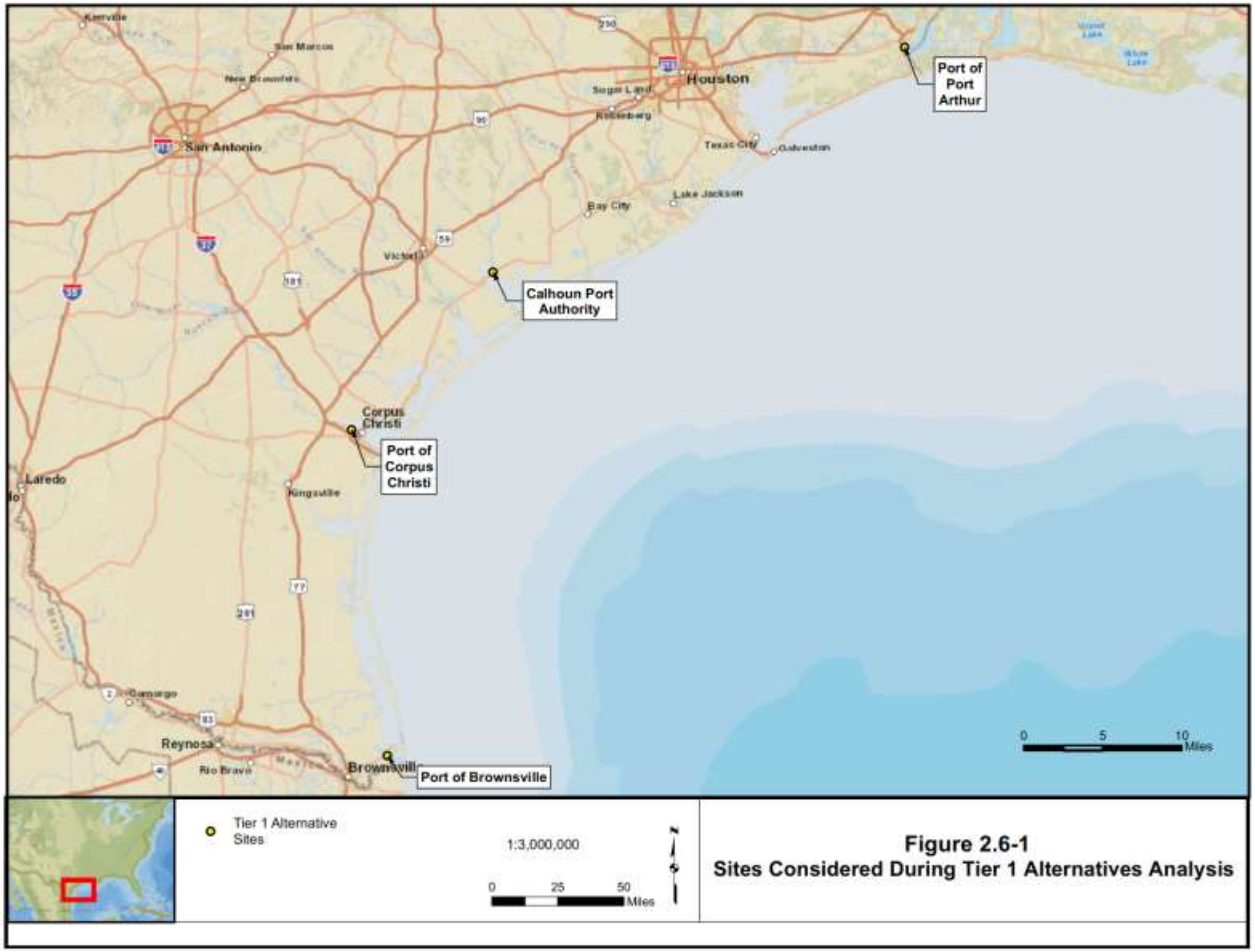

Figure 2.6-1 Sites Considered During Tier 1 Alternative Analysis

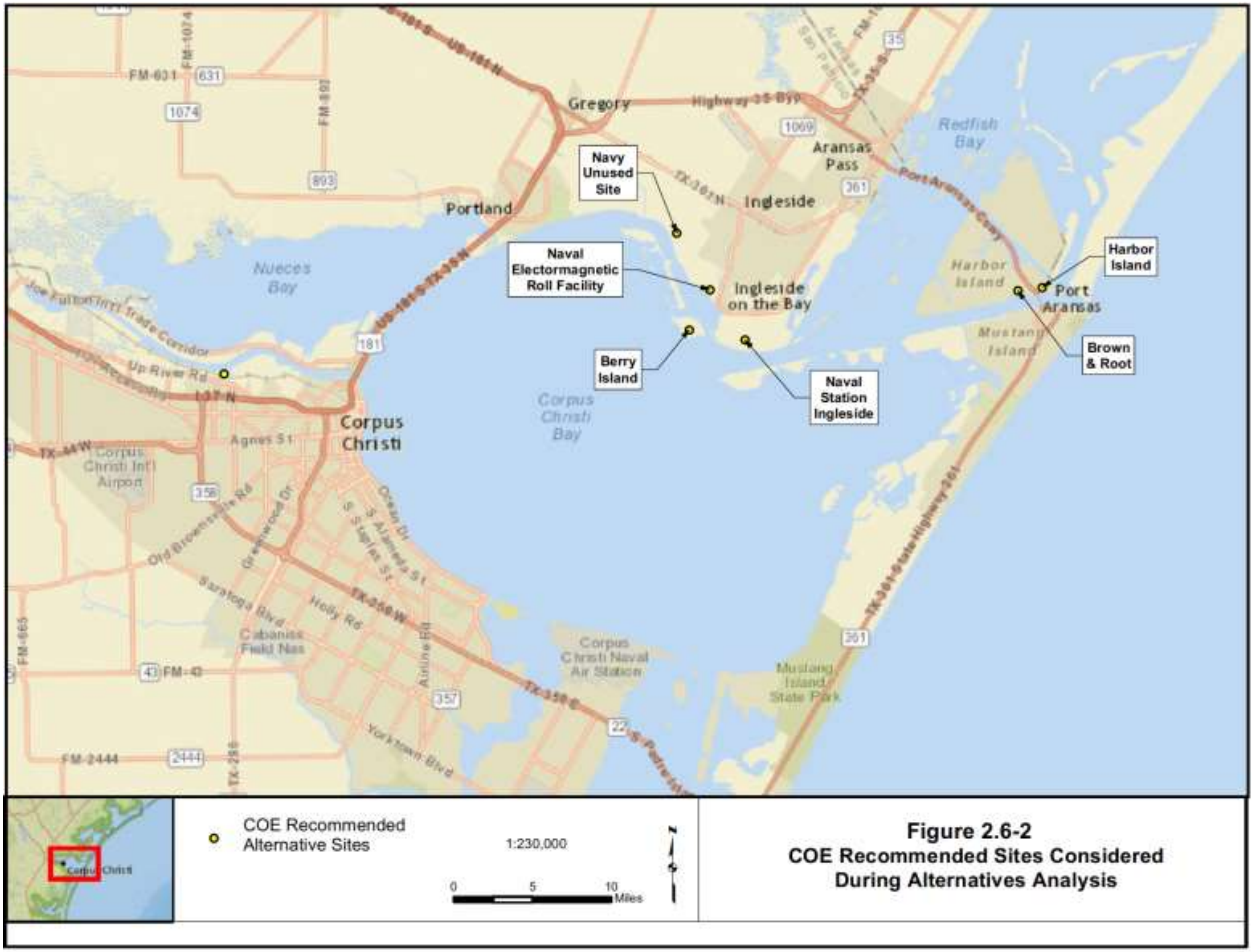

Figure 2.6-2 COE Recommended Sites Considered During Alternatives Analysis

Figure 2.6-3 Sites Considered During Tier 2 Alternative Analysis

TABLE 2.6-1 Comparison of Alternative Sites for the LNG Terminal				
Site	**1**	**2**	**3**	**4 (Proposed)**
Screening Criteria				
Available Acreage (acres)	111.5	500.0	205.0	625.0
Approximate channel frontage (feet)	2,200	6,000	5,500	3,000
Dredging volumes (cubic feet)	13,591,620	9,028,719	14,950,782	3,900,000
Distance to nearest population area (miles)	5.0	2.3	5.4	1.7
Distance from Gulf of Mexico (miles)	8.7	5.8	9.6	4.8
Natural average elevation above sea level (feet)	+2.1	+8.0	+5.5	+13.2
Wetlands and tidal areas (acres)	17.1	270.8	80.0	248.1
Potential Ocelot and Jaguarundi habitat present	Yes	Yes	Yes	Yes

2.6.3.1 Proposed Site (Alternative 4)

The proposed site is approximately 625 acres and is along the Brownsville Ship Channel, approximately 5.0 miles from the Gulf of Mexico. This site has 3,000 feet of water frontage on the Brownsville Ship Channel. This location has the greatest natural average elevation above sea level and would require the least amount of fill of the alternatives considered. The proposed site would also accommodate a recessed maneuvering basin that would allow for the desired diameter for turning and a berthing dock.

The proposed site is within wetland habitat and potential ocelot and jaguarundi habitat; however, the site is proposed 3.5 miles east of the FWS and BND established wildlife corridor which connects suitable ocelot and jaguarundi habitat. This wildlife corridor is designed to allow threatened and endangered species to move between large tracts of suitable habitat (FWS, 2015a). This location would provide the recommended land area for safety of the maneuvering basin, LNG facilities, and the shortest distance to the Gulf of Mexico. While this site includes a large number of wetlands, the overall impacts from dredging and fill that would be needed for constructing the Project components (see section 4.4.2) are less than the other alternative sites.

2.6.3.2 Alternative Site 2

Alternative Site 2 is adjacent to the southwestern portion of the proposed site and consists of 500 acres, with 6,000 feet of waterfront access along the Brownsville Ship Channel. The northern border of the site is SH 48, and the southern border is the Brownsville Ship Channel. Based off of FWS NWI data, over half of the site is considered tidal wetlands (approximately 270.8 acres). The location of this alternative provides adequate water frontage to accommodate LNG carriers, and provides sufficient land for development of both phases of the Project. The location would also provide enough area to accommodate the maneuvering basin and berth.

Alternative Site 2 is approximately 8.0 feet above sea level and would require more dredge material and/or imported fill to raise the site elevation than the proposed site. In addition, Alternative Site 2 would result in significantly more dredge material than the proposed site. This alternative site is approximately 2.3 miles southwest of the nearest population area. Alternative Site 2 is approximately 2.5 miles northeast of the existing FWS wildlife corridor for ocelot and jaguarundi habitat. While Alternative Site 2 would have an adequate amount of land available for construction of the LNG terminal, it would require a greater amount of fill to raise the site elevation, would require a greater amount of dredging for the turning basin, and would result in greater impacts on wetlands. Due to the reasons listed above, we do not consider Alternative Site 2 to provide a significant environmental advantage to the proposed Project.

2.6.3.3 Conclusion

We conclude that the alternative sites considered do not provide a significant environmental advantage when compared to the proposed site. The proposed site, while having the most land, would require the least amount of fill material to increase the site elevation. The proposed site is located away from residences, with the closest residence located approximately 1.7 miles away. While the proposed site contains a greater amount of NWI-mapped wetlands than two of the other alternative sites considered, Texas LNG has sited its proposed facilities to minimize these impacts to less than the alternative sites (see section 3.3.1 and 4.4). The ability to configure facilities to avoid or minimize impacts would be more limited on the smaller sites considered, thus the impacts on wetlands would likely be greater than the proposed site.

2.6.4 Power Generation Alternatives

Texas LNG considered using gas turbines and electric motors as drivers for the refrigeration compressors. While the use of gas turbines results in greater air impacts, additional electric transmission facilities are typically required to power electric motors. The non-jurisdictional electric transmission line that would be constructed for the Project (see section 1.4) would be necessary to deliver power to the LNG terminal regardless of the type of refrigeration compressors that are used. However, the use of gas turbines would result in greater operation emissions. Texas LNG ultimately decided to use electric motors because they would provide the required power and significantly reduce air emissions compared to gas turbines at the facility. Therefore, the use of the electric motors as drivers for the refrigeration compressors provides a significant environmental advantage over gas turbines.

2.6.5 Flaring Systems

The use of ground flares as an alternative to the proposed elevated flares was also examined for the Project. Due to the location of the site, Texas LNG considered the prevailing winds, which for two thirds of the year, travel south to north and come off the Gulf of Mexico to travel further landward. Use of a ground flare would require a continuous open flame creating an easy ignition source for vapor release compared to the use of an elevated flare at the facility. Additionally, for a ground flare to have the proper distance from potential vapor sources, a larger area would be required. Alternatively, an elevated flare would minimize the potential for ignition of released vapor and would require less land. However, elevated flares result in greater impacts on visual resources and birds. Both the ground flare and the elevated flare would adversely impact environmental resources; therefore, there would not be a significant environmental advantage to either flare system.

3.0 LISTED SPECIES AND DESIGNATED CRITICAL HABITATS

3.1 OVERVIEW OF HABITAT TYPES AND CONDITIONS IN THE PROJECT AREA

The Project facilities would be constructed within a 651.5-acre area located between SH 48 and the Brownsville Ship Channel, approximately 5 miles southwest of the Gulf of Mexico in Cameron County, Texas. The Project is located entirely within the Laguna Madre Barrier Islands and Coastal Marshes Level IV Ecoregion within the larger Western Gulf Coastal Plain. The lagoon system of this region is hypersaline from the lack of streams draining into the area, and combined with the Laguna Madre, is one of the largest hypersaline systems in the world (Griffith et al., 2007). Uniformly distributed annual rainfall of the region, along with warm and humid temperatures, allow the growing season to extend to more than 300 days per year (TPWD, 2018).

The area immediately surrounding the Project Site includes the Laguna Atascosa NWR to the north and west across SH 48, undeveloped land owned by the BND to the west, and dredged material PAs to the east and to the south across the Brownsville Ship Channel (see figure 3.1-1).[7] Beyond the immediate area, the City of Port Isabel is located 1.2 miles east of the Project Site and a NWR leased area is approximately 1 mile south of the Site, which borders the Lower Rio Grande Valley NWR (depicted on figure 3.3-1). The Laguna Atascosa NWR and Lower Rio Grande Valley NWR are part of the FWS-managed South Texas Refuges Complex that also includes the Santa Ana NWR. This refuge complex encompasses approximately 180,000 acres and provides important habitat for many species that can only be found in the southern-most extremities of Texas.

The Brownsville Ship Channel is an artificial, man-made channel that was constructed in the 1930s to facilitate deepwater vessel access to the Port of Brownsville (Texas State Historical Association, 2018). The channel is currently maintained to a depth of 42 feet (MLLW) and width of 250 feet; however, the COE recently authorized deepening the channel to 52 feet (2014). The existing channel has no bridges or other obstructions for its entire 19-mile length, from the Gulf of Mexico, upstream to the Port of Brownsville. A series of construction projects modified the topography surrounding the channel in the 1930s and 1950s, placing dredged material along the banks of the Brownsville Ship Channel, which cut off the natural tidal flow between Bahia Grande and the Laguna Madre. Visible today are the dredged spoil banks that were deposited along the banks of the Brownsville Ship Channel, which separate it from the surrounding bays and estuaries. The spoil banks severed natural tidal flow to adjacent bays and estuaries, causing large areas of tidal mudflats and wetlands to dry up (COE, 2014).

Texas LNG is currently negotiating with the COE and BND to use PA 5A as its preferred location for placement of dredged material generated by the Project. PA 5A is an existing confined PA owned by the BND and located adjacent to the Brownsville Ship Channel, about 4 miles west of the Project Site. The PA occupies 704 acres, which is filled with relic hydric soil (previously placed dredged material), which does not meet the criteria of a wetland. PA 5A is bounded to the north by the Brownsville Ship Channel and to the west, south, and east by undeveloped land, as depicted in figure 3.1-3.

[7] Dredged material PAs south of the proposed Site, across the Brownsville Ship Channel, are within Designated Critical Habitat Unit TX-1 for the piping plover. This designated critical habitat unit is discussed in detail in section 3.3.1.2.

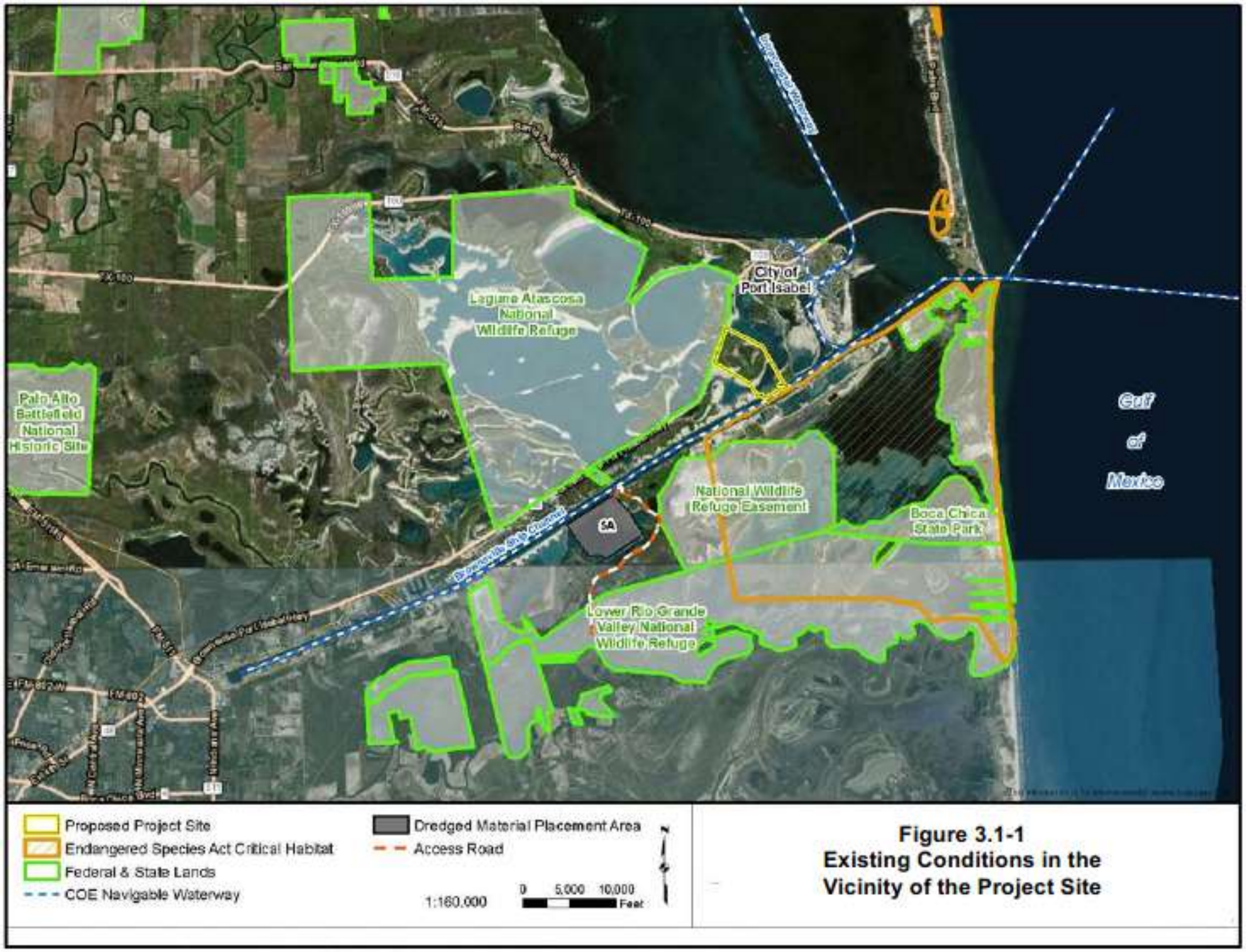

Figure 3.1-1 **Existing Conditions in the Vicinity of the Project Site**

As described in detail in table 3.1-1, habitat types present within the Project Site were defined using the TPWD's Ecological Systems Classification Project, which describes vegetation types in support of the Texas Comprehensive Wildlife Conservation Strategy. The TPWD (2018) indicated that the accuracy of its land classification distribution map is lower in the vicinity of the Project Site and because of the wide variety of cover types and the difficulty of differentiating deciduous and evergreen shrublands remotely. Therefore, field surveys were conducted in October 2015 that included a habitat assessment, which classified and mapped nine vegetation communities, or habitats, within the Site using the Ecological Systems defined by the TPWD. In addition, habitat quality was ranked from poor to high quality based on the level of human disturbance, fire suppression, and species diversity. Table 3.1-1 summarizes these habitats and identifies the acreage occupied by each within the Project Site. Figures 3.1-2 and 3.1-3 depict the distribution and the extent of the habitats at the Project Site and PA 5A, respectfully.

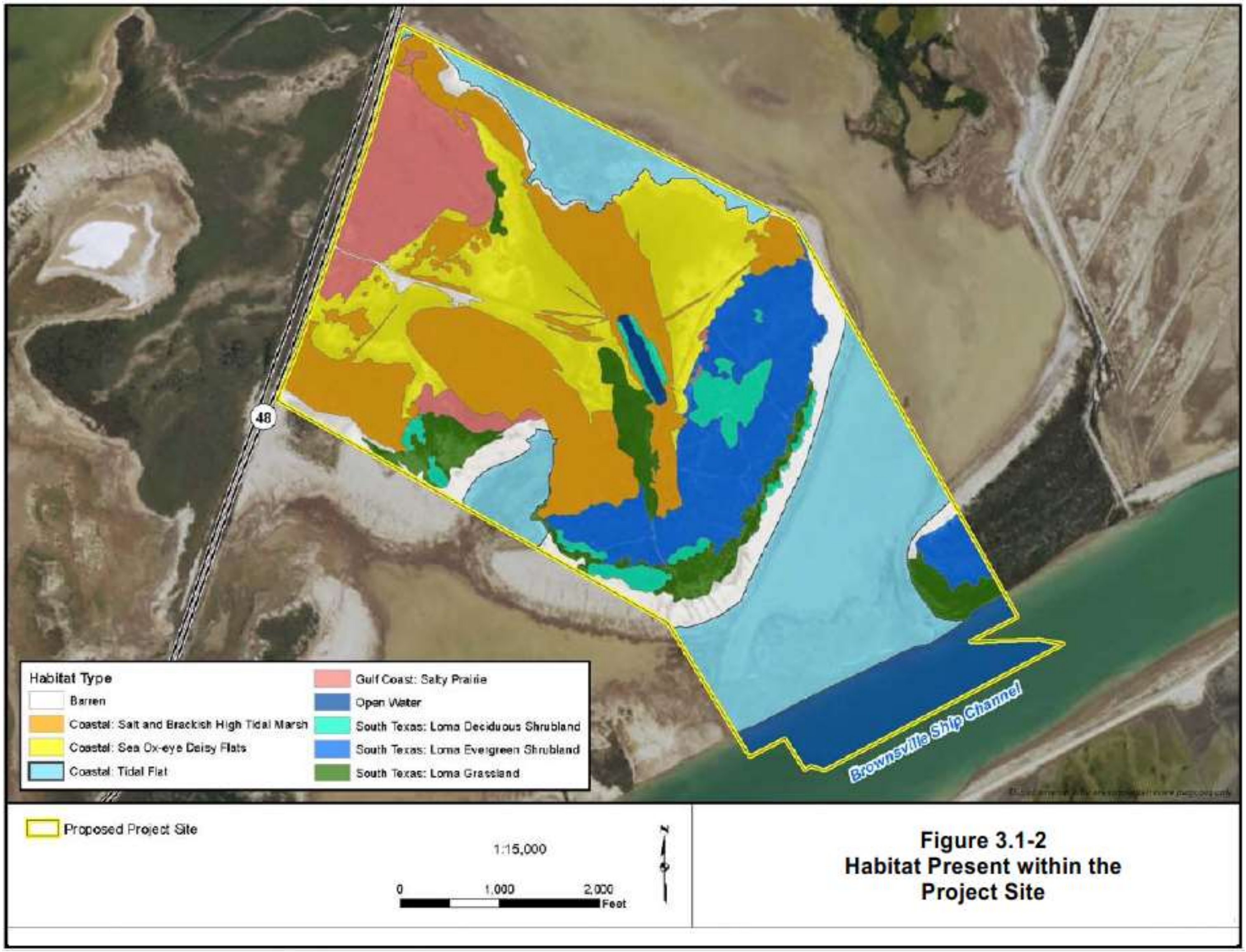

Figure 3.1-2 **Habitat Present within the Project Site**

Figure 3.1-3 **Habitat Present within Dredge Material Placement Area 5A**

TABLE 3.1-1
Texas LNG Project
Habitat Types Documented within the Project Site

Habitat Type	Acreage	Quality	Habitat Description
Barren	743.8 [a]	Poor to Moderate	Barren habitat includes the windblown unvegetated slopes of the lomas on the Project Site as well as areas that have been cleared and not revegetated previously. Barren areas are either of poor quality (continuous disturbance) or of moderate quality (undisturbed but little value to wildlife).
Coastal			
Tidal Flat	164.4	Moderate	Tidal flats are unvegetated mud flats that are frequently inundated by water. Inundation events may be caused by tides or rain events. Within the Project Site, these areas are of moderate quality with evidence of a reduced hydrologic connection to tides.
Salt and Brackish High Tidal Marsh	119.6	Moderate	Salt and brackish high tidal marsh consists of large areas dominated almost exclusively by cordgrass (*Spartina* spp.). Within the Project Site, these areas are not currently connected to high tides, but may be occasionally flooded by storm and other rain events. There is some encroachment of woody species that may suggest an altered hydrologic connection to tides and fire suppression.
Sea Ox-eye Daisy Flats	98.5	Moderate	Sea ox-eye daisy flats consist of large areas dominated by sea ox-eye daisies (*Borrichia frutescens*) with glasswort (*Salicornia bigelovii*) and annual seepweed (*Suaeda linearisI*) throughout. Sea ox-eye daisy flats within the Project Site are of moderate quality due to changes to the hydrologic connection to tides and some ditching that presumably drains water from the habitats.
Gulf Coast			
Salty Prairie	51.1	Moderate	Salty prairie contains dense stands of cordgrass with areas of other grasses such as switchgrass (*Panicum virgatum*), shoregrass (*Monanthochloe littoralis*), and bushy bluestem (*Andropogon glomeratus*) in areas with higher elevation. This community dominates the western third of the Project Site. Shrub encroachment is common throughout the salty prairie, with honey mesquite (*Prosopis glandulosa*), Spanish dagger (*Yucca teculeana*), and screwbean mesquite (*Prosopis pubescens*) dominating the shrub layer. Salty prairie habitats at the Project Site are of moderate quality due to the encroachment of woody species.
Open Water	45.7	Moderate	Open water habitat within the Project Site includes the Brownsville Ship channel and one pond. The pond is not a natural waterbody and is of moderate quality.
South Texas			
Loma Evergreen Shrubland	73.3	High	Loma evergreen shrubland is composed mainly of dense, relatively short thornscrub with areas of open grassland intermixed. Dominant shrub species include spiny hackberry (*Celits pallida*), lotebush (*Ziziphus obtusifolia*), fiddlewood (*Citharexylum berlandieri*), and creeping mesquite (*Prosperis strombulifera*). The herbaceous layer is composed of Texas snakeweed (*Gutierrezia texana*), blue boneset (*Tamaulipa azurea*), giant cutgrass (*Zizaniopsis maliacia*), and mangle duce (*Maytenus phyllanthoides*). The loma evergreen shrublands at the Project Site are high quality with high species diversity and limited areas of non-native species encroachment.
Loma Grassland	39.1	High	Loma grasslands within the Project Site contain buffalo grass, shoregrass, giant cutgrass, and in some areas, the non-native buffelgrass. Lindheimer pricklypear also occurs throughout this community at the Project Site. The loma grasslands within the Project Site are high quality with high species diversity and limited areas of non-native species encroachment.

TABLE 3.1-1 Texas LNG Project Habitat Types Documented within the Project Site			
Habitat Type	**Acreage**	**Quality**	**Habitat Description**
Loma Deciduous Shrubland	20.1	High	Loma deciduous shrublands within the Project Site are composed of a dense impenetrable ticket of honey mesquite, Texas ebony (*Ebenopsis ebano*), brazilwood (*Caesalpinia echinata*), and lime pricklyash (*Zanthoxylum fagara*). Very little understory is present. The loma deciduous shrublands at the Project Site are high quality with high species diversity and limited areas of non-native species encroachment.

[a] Includes all 704 acres associated with PA 5A.

3.2 OVERVIEW OF FEDERALLY LISTED SPECIES AND CRITICAL HABITATS POTENTIALLY PRESENT WITHIN THE ACTION AREA

As described in section 1.4, early coordination with the FWS' Corpus Christi Ecological Services Field Office and the NMFS's Protected Resources Division as well as review of the IPaC System identified a total of 18 federally listed species and one species proposed for listing potentially present within Cameron County, Texas. In addition, critical habitat has been designated for two species within or off the Gulf Coast of Cameron County, Texas. Table 3.2-1 summarizes key information regarding the federally listed species with potential to occur within the Action Area. As described in section 1.3, the Action Area is defined as the area encompassed by the Project Site as well as the Project Site Buffer (the area where sound levels may be greater than 55 decibels on the A-weighted scale during construction), dredged material PA 5A, and the marine vessel transit route through the Brownsville Ship Channel and portions of the Gulf of Mexico within the EEZ.

Section 7 of the ESA only applies to federally listed or proposed species; therefore, candidate species are not required to be included in this BA. Further, given the absence of potentially suitable habitat for one candidate species (red-crowned parrot) within the Action Area, this species is not assessed in this BA. The remaining 19 species are discussed in additional detail in section 3.3.

TABLE 3.2-1
Federally Listed Species and Species Proposed for Listing with Potential to Occur Within the Action Area

Common Name *Scientific Name*	**Listing Status**	**Critical Habitat Designated (Yes/No)**	**Range and Distribution**	**Seasonality and Habitat Association**	**Suitable Habitat Within the Project Site**
Birds					
Northern aplomado falcon *Falco femoralis septentrionalis*	E	No	Breeds in southeastern Arizona, southern New Mexico, and southern Texas south through Mexico. Within Texas, documented breeding occurs in Cameron and Duval Counties.	Occurs in Texas year-round. Habitat includes open rangeland, savanna, and semiarid grasslands that contain scattered trees and shrubs.	Salty prairie, salt and brackish high tidal marsh, sea ox-eye daisy flats, loma grassland
Piping plover *Charadrius melodus*	T	Yes	Breeds in the U.S. and Canada, generally in the northern Great Plains region, with approximately 35 percent of the total breeding population wintering along the Gulf Coast from Florida to Texas. The current known species distribution covers 12 counties in Texas, including Cameron County.	Occurs in Texas during the winter. Wintering habitat includes beaches, mud flats, sand flats, algal flats, and washover passes.	Tidal flats and adjacent upland habitats.
Red knot *Calidris canutus rufa*	T	No	Breeds in the central Canadian arctic but can be found on the Texas coast during migration and winter. Occurs in 13 of the southernmost counties in Texas, including Cameron County.	Occurs in Texas during migration and winter. Foraging habitat includes beaches, oyster reefs, and exposed bay bottoms. Winter roosting habitat includes high sand flats, reefs, and other sites protected from high tides.	Tidal flats
Whooping Crane *Grus americana*	E	Yes; however, none in Action Area	Migrates from nesting habitat in Wood Buffalo National Park in Canada to wintering habitat along the Texas coast primarily in the Aransas NWR located approximately 145 miles north of the Project Site	Occurs in Texas during winter. Foraging habitat includes salt flats, brackish bays, and marshes along the coastal mainland and on barrier islands	Tidal flats, salty prairie, salt and brackish high tidal marsh, and sea ox-eye daisy flats

TABLE 3.2-1 Federally Listed Species and Species Proposed for Listing with Potential to Occur Within the Action Area					
Common Name ***Scientific Name***	**Listing Status**	**Critical Habitat Designated (Yes/No)**	**Range and Distribution**	**Seasonality and Habitat Association**	**Suitable Habitat Within the Project Site**
Mammals					
Gulf Coast jaguarundi *Herpailurus (=felis) yagouaroundi cacomitli*	E	No	Lower Rio Grande Valley in south Texas and eastern Mexico.	Occurs in Texas year-round in dense brush and thorny shrublands that are located near water.	Lomas (deciduous shrubland, evergreen shrubland, and grasslands)
Ocelot *Leopardus (=felis) pardalis*	E	No	Extreme south Texas, northeastern Mexico, and every country south of the United States except Chile.	Occurs in Texas year-round in dense, thorny shrublands.	Lomas (deciduous shrubland, evergreen shrubland, and grasslands)
West Indian manatee *Trichechus manatus*	E [a]	Yes; however, none in Texas	Tropical and subtropical Western Atlantic coastal zone.	Can occur in Texas year-round in shallow, slow moving estuaries, bays, rivers, and lakes near the water surface.	Vessel transit routes
Sperm whale *Physeter macrophalus*	E	No	Circumglobal	Inhabits all oceans of the world, occurring from the edge of pack ice in both hemispheres to the equator, especially in the Pacific. Prefers deep waters.	Vessel transit routes
Fin whale *Balaenoptera physalus*	E	No	Circumglobal	Inhabits all oceans of the world. Commonly occur in the Northern Atlantic, from the Gulf of Mexico and Mediterranean Sea, extending northward to the arctic. Prefer deep, open waters, primarily within the temperate and polar latitudes.	Vessel transit routes
Sei whale *Balaenoptera borealis*	E	No	Circumglobal	Inhabits all oceans of the world. Prefers deep waters near the continental shelf edge, far from the coast.	Vessel transit routes
Blue whale *Balaenoptera musculus*	E	No	Circumglobal	Inhabits open oceans throughout the world. Primarily occurs offshore.	Vessel transit routes
Gulf of Mexico Bryde's whale *Balaenoptera edeni (GOM subspecies)*	P	No	Gulf of Mexico	Inhabits the Gulf of Mexico year-round. Consistently present in northeastern Gulf of Mexico and prefers waters less than 1,600 feet deep.	Vessel transit routes
Flowering Plants					
South Texas ambrosia *Ambrosia cheiranthifolia*	E	No	Kleberg and Nueces Counties. Last documented in Cameron County in 1940.	Upland, terrestrial grasslands and prairies. May also occur on mesquite-dominated shrublands.	Lomas (deciduous shrubland, evergreen shrubland, and grasslands)

TABLE 3.2-1 Federally Listed Species and Species Proposed for Listing with Potential to Occur Within the Action Area					
Common Name ***Scientific Name***	**Listing Status**	**Critical Habitat Designated (Yes/No)**	**Range and Distribution**	**Seasonality and Habitat Association**	**Suitable Habitat Within the Project Site**
Texas ayenia *Ayenia limitaris*	E	No	Three southernmost counties in Texas, including Cameron County	Upland, terrestrial grasslands and prairies. May also occur on mesquite-dominated shrublands.	Lomas (deciduous shrubland, evergreen shrubland, and grasslands)
Sea Turtles					
Green sea turtle *Chelonia mydas*	T	Yes; however, none in Action Area	Circumglobal	Could occur in Texas year-round within marine and estuarine habitats. Nests on sandy coastal beaches.	Vessel transit routes
Hawksbill sea turtle *Eretmochelys imbricate*	E	Yes; however, none in Action Area	Circumglobal	Could occur in Texas year-round within marine and estuarine habitats. Nests on sandy coastal beaches.	Vessel transit routes
Kemp's ridley sea turtle *Lepidochelys kempii*	E	No	Circumglobal	Could occur in Texas year-round within marine and estuarine habitats. Nests on sandy coastal beaches.	Vessel transit routes
Loggerhead sea turtle *Caretta caretta*	T	Yes	Circumglobal	Could occur in Texas year-round within marine and estuarine habitats. Nests on sandy coastal beaches.	Vessel transit routes
Leatherback sea turtle *Dermochelys coriácea*	E	Yes; however, none in Action Area	Circumglobal	Could occur in Texas year-round within marine habitats (open ocean). Nests on sandy coastal beaches.	Vessel transit routes

Source: FWS, 2016; NMFS, 2016
Listing Status: E = endangered; T = threatened; P = species proposed for listing
[a] On January 8, 2016, the FWS proposed reclassification of the West Indian manatee under the ESA from endangered to threatened due to substantial improvements in the species' overall status since the original listing in 1967.

3.3 DETAILED SPECIES ACCOUNTS

The following sections provide detailed information on the species identified in table 3.2-1, including their population status, range and distribution, habitat requirements, threats, and known or potential occurrence within the Project Site. Also included for each species is a description of designated critical habitat, if any, and a summary of elements of recovery plans or other ongoing conservation activities that are relevant to this BA. The information contained herein was derived from publicly available or agency-provided data; scientific resources; technical documents; consultation with the FWS and NMFS and other species experts; and field surveys. Site visits were conducted in May and September 2015, and field surveys were conducted by the Natural Resources Group, LLC (NRG) on behalf of Texas LNG in October 2015.

3.3.1 Birds

3.3.1.1 Northern Aplomado Falcon

Status, Distribution, Habitat Requirements, and Threats

The northern aplomado falcon was federally listed as endangered in 1986 and is also state listed as endangered. Historically, it was found throughout southeastern Arizona, southern New Mexico, and southern Texas south into Mexico. Within the Lower Rio Grande Valley, northern aplomado falcons primarily occurred on the salt prairies between Brownsville and Port Isabel (FWS, 2014a). U.S. populations declined in the early to mid-1900s and the species was considered extirpated from the U.S. by the 1950s (FWS, 2007). In an effort to re-establish the population in Texas, a reintroduction program was initiated in 1978 to release captive-bred young into the historical range (FWS, 2014a). As of 2018, the FWS lists 24 counties in Texas where the species is known or believed to occur and two counties where breeding has been confirmed, including Cameron County (FWS, 2018a). The nearest documented occurrence of a nesting pair to the Project Site is 1.4 miles west within the Laguna Atascosa NWR (FWS, 2015b).

Northern aplomado falcons are year-round residents of the Lower Rio Grande Valley and utilize open grassland habitat with scattered islands of shrubs or trees, or woodland and forest edge habitat (Campbell, 2003). Preferred nesting habitat includes yucca-covered sand ridges in coastal prairies, riparian woodlands in grasslands, and desert grasslands with sporadic mesquite and yucca (FWS, 2014a). Northern aplomado falcons utilize abandoned stick nests made by other raptor or corvid (e.g., crows) species, rather than building their own nests (FWS, 2015b).

Northern aplomado falcons are sensitive to human disturbance, particularly during the breeding season when they are securing nest sites, incubating eggs, and rearing young (TPWD, 2016b). They are less sensitive during foraging activities and forage widely within suitable habitats (Keddy-Hector, 2000). The greatest threat to the northern aplomado falcon is the loss of suitable nesting and foraging habitats through natural succession of grassland habitats (shrub encroachment), conversion of habitat to agriculture, and long-term drought, all of which can also adversely affect prey populations. Population increases of the primary predator of northern aplomado falcons, the great horned owl (*Bubo virginianus*), is another threat to recovery of the species (FWS, 2007).

Lastly, because the northern aplomado falcon is an upper trophic level predator, toxins in the environment may bioaccumulate and have deleterious effects on individuals that ingest contaminated prey. Nesting pairs were present in the United States and Mexico during the dichlorodiphenyltrichloroethane (DDT) era of pesticide application and bioaccumulation of DDT in the food chain likely caused a reduction in the nesting success of this species. Because of the preponderance of agriculture in south Texas, the use of organophosphate insecticides is a threat to falcons because insects and small insectivorous birds are the species' preferred prey. Large-scale agricultural applications of organophosphate pesticides have been linked to waterfowl, raptor, and other bird deaths in Mexico and the United States (Keddy-Hector, 2000).

Critical Habitat and Recovery Plans

Critical habitat has not been designated for the northern aplomado falcon. The FWS developed a recovery plan for the northern aplomado falcon in 1990 (FWS, 1990). No updates to that plan have been published, but a five-year review for the species was conducted by the FWS in 2014 (FWS, 2014b). The five-year review and recovery plan both identified six conservation initiatives intended to increase the recovery of the species: evaluate, monitor, and minimize all threats including pesticides and contaminants to extant populations; identify, maintain, and improve habitat; reestablish sufficient, self-sustaining populations in the United States and Mexico; study habitat requirements, physiological ecology, and behavior of wild populations; enhance public support for recovery through education programs; and encourage national and international cooperation in the recovery of northern aplomado falcons (FWS, 1990, 2014).

As part of the implementation of northern aplomado falcon recovery efforts, the Laguna Atascosa NWR's Bahia Grande Unit has been and continues to be active in habitat restoration activities targeting the species. Habitat restoration for this species focuses on maintenance of early successional open prairie habitats through prescribed fire and shrub removal. In fall and winter, NWR managed prairie is burned and herbicides are applied to manage invasive brush (FWS, 2014b). Recent brush removal projects at the refuge's Bahia Grande Unit have restored nearly 3,000 acres of coastal prairie habitat. The refuge intends to continue restoration efforts over the next few years and restore an additional 1,000 to 1,500 acres of coastal prairie in the Bahia Grande area. The Laguna Atascosa NWR also conducts ongoing monitoring for aplomado falcons within the refuge to document population size, nesting and fledging success, and contaminant levels.

Species Occurrence Within the Project Site

Potentially suitable foraging habitat for the northern aplomado falcon within the Project Site includes salty prairie, salt and brackish high tidal marsh, sea ox-eye daisy flats, and loma grassland (see figure 3.3-1). During a visit to the Project Site in September 2015, FWS noted that yucca within the site could provide nesting habitat for this species, and recommended that in lieu of species-specific surveys for the northern aplomado falcon, an effort should be made during field surveys to record the presence of existing stick nests within the Project Site, as these may indicate potentially suitable nesting habitat for this species.

Based on this recommendation, Texas LNG conducted field surveys in October 2015 included targeted habitat surveys within salty prairies for the northern aplomado falcon, and any raptor or corvid stick nests observed within the Project Site were recorded. In addition, wintering bird surveys were conducted at the Project Site in March 2016. Neither the northern aplomado falcon nor suitable stick nests were observed within the Project Site during surveys (see appendices A and B of this BA).

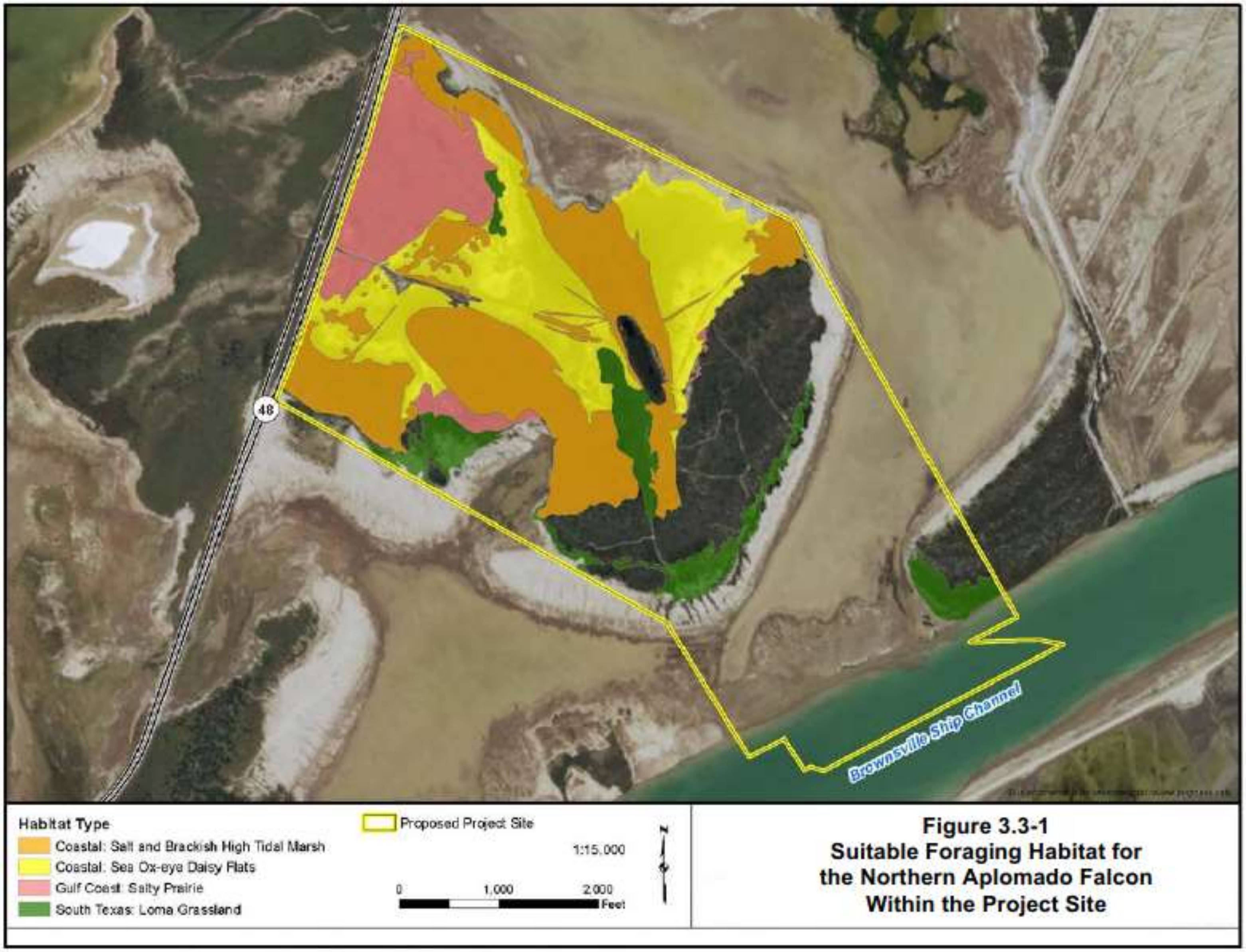

Figure 3.3-1 **Suitable Foraging Habitat for the Northern Aplomado Falcon Within the Project Site**

3.3.1.2 Piping Plover

Status, Distribution, Habitat Requirements, and Threats

The piping plover was federally listed as threatened in 1985 with critical habitat designated for the wintering population in south Texas in 2001. The species breeds in the United States and Canada, generally in the northern Great Plains region, with approximately 35 percent of the total breeding population wintering along the Gulf Coast from Florida to Texas. Results of the 1991, 1996, 2001, and 2006 International Piping Plover Winter Census indicate that roughly 2,000 piping plovers winter in Texas, distributed over 12 counties, including Cameron County (Haig et al., 2005; Elliott-Smith et al., 2009; FWS, 2009). Piping plovers begin arriving on wintering grounds in July, with some late nesting birds arriving in September. Although individuals may occur on the wintering grounds throughout the year, sightings are rare in late May, June, and early July (FWS, 2001). Behavioral observation of piping plovers on wintering grounds suggests that they spend the majority of their time foraging for marine worms, crustaceans, insects, and mollusks.

Piping plovers exhibit a high degree of fidelity to wintering areas, which often include several suitable areas located in close proximity (FWS, 2001, 2009, 2012). Wintering habitats typically include beaches, mud flats, sand flats, algal flats, and washover passes (areas where breaks in the sand dunes result in an inlet). Wintering piping plovers use intertidal flats for foraging and adjacent sparsely vegetated mud, sand, or algal flats above the high tide line for roosting and sheltering. Wrack (organic material including seagrass debris, seashells, driftwood, and other materials deposited on beaches by tidal action) is an important component of winter roost habitat. Piping plover wintering habitat use patterns in Texas are complex, with individuals moving among different nearby habitat types depending on tides, weather conditions, and other factors. Washover passes are commonly used by piping plovers during periods of high bayshore tides, while exposed seagrass beds and oyster reefs are often used during seasonal low water periods (FWS, 2009).

The FWS' Five-Year Review (2009) states that the key threats to the species within the winter range include shoreline development; beach maintenance, clearing (wrack removal), nourishment, and stabilization; inlet dredging; and creation of artificial structures such as jetties and groins; all of which alter naturally dynamic coastal processes and thus affect habitat conditions for wintering plovers. The spread of coastal invasive plants into suitable piping plover habitat, recreational disturbance, exposure to contaminants, and loss of habitat from climate change induced sea level rise are also threats to the species on both wintering and breeding grounds.

Critical Habitat and Recovery Plans

Critical habitat for the wintering population of piping plover was designated within Texas in 2001 (66 Federal Register [FR] 36038-36086). Suitable foraging and mapped designated critical wintering habitat (Unit TX-1-South Bay and Boca Chica Complex) for the piping plover occur approximately 950 feet south of the Project Site (figure 3.3-2).

In designating areas of critical habitat, the FWS defines primary constituent elements, which are features essential to the conservation of a given species and that may require special management considerations or protection. The primary constituent elements (PCEs) of designated critical habitat for wintering piping plovers are those habitat components that are essential for foraging, sheltering, and roosting, which include intertidal flats that are unvegetated or very sparsely vegetated. In some cases, these flats may be covered or partially covered by a mat of blue-green algae. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above the high tide line are also important components for piping plover critical wintering habitat (66 FR 36075). Important components of the beach/dune ecosystem include surf-cast algae for feeding of prey animals, sparsely vegetated beach areas for roosting and refuge during storms, spits (a small point of land, especially sand, running into water) for feeding and roosting, and salterns and washover areas for feeding and roosting. Several of these components (sparse vegetation, little or no topographic relief) are mimicked in artificial habitat types used less commonly by piping plovers, but that are considered critical habitat (e.g., dredged material PAs) (66 FR 36137).

Within Designated Critical Habitat Unit TX-1 (South Bay and Boca Chica Complex), critical habitat includes those areas containing the PCEs described above, but does not include areas of dense vegetation (66 FR 36075). Based on communication with the FWS during the September 2015 site visit, the dredge material PAs along the south side of the Brownsville Ship Channel, no longer contain the PCEs for wintering piping plover habitat because the dredge material has raised the ground level and effectively cut off water flow that is required for a tidal flat. Although the PAs no longer function as critical habitat for the piping plover, sparsely vegetated areas provide suitable wintering habitat that may be used by the species.

The FWS published a revised recovery plan for the piping plover in 1996, which identified multiple conservation efforts that have been established since the species was first listed, including numerous protective federal and state regulatory mechanisms, the protection and management of breeding sites and wintering locations, and the coordination and cooperation between federal and state regulatory and management partners. The most recent five-year review published by FWS (2009) outlined multiple conservation efforts focused on piping plover wintering grounds to increase the recovery potential of this species including the need to develop the following: 1) a comprehensive conservation plan for the species; 2) management plans for designated critical habitat; and 2) a consistent approach towards conservation and management recommendations in relation to Section 7 ESA consultations and Coastal Barrier Resources Act reviews.

Species Occurrence Within the Project Site and at the Dredged Material Placement Area

Within the Project Site, suitable foraging, roosting, and sheltering habitats for wintering piping plovers occur within the tidal flats and adjacent upland areas. Habitat suitability surveys conducted in October 2015 determined that tidal flats within the Project Site are of moderate quality due to evidence of a reduced hydrologic connection to tides as a result of the construction and maintenance of the Brownsville Ship Channel (as described in section 3.1). Per FWS recommendations, Texas LNG conducted wintering bird surveys in March 2016 to determine if the Project Site is used by piping plovers; however, no individuals were observed.

As discussed above, the piping plover may utilize sparsely vegetated areas following dredged material placement activities. However, because the tidal flats are no longer present in the dredged material PAs on the south side of the Brownsville Ship Channel, this area is considered marginally suitable for the piping plover.

Figure 3.3-2 **Suitable Wintering Habitat for the Piping Plover and Red Knot Within the Project Site**

3.3.1.3 Red Knot

Status, Distribution, Habitat Requirements, and Threats

The red knot was federally listed as threatened in 2015. The red knot breeds in the Canadian arctic and winters along shorelines of the southern U.S., Caribbean, and South America. During migration, the red knot primarily uses stopover habitat along the Atlantic Coast, but is occasionally documented along the Gulf Coast of Texas. The red knot is known or believed to occur in 13 of the southernmost counties in Texas, including Cameron County (Baker et al., 2013).

Observations along the Gulf Coast of Texas indicate that red knots forage on beaches, oyster reefs, and exposed bay bottoms, and they roost on high sand flats, reefs, and other sites protected from high tides. Within wintering habitat, the red knot commonly forages on bivalves, gastropods, and crustaceans. Coquina clams (*Donax varibilis*), a frequent and important food source for red knots, are common along many Texas beaches (Baker et al., 2013).

The red knot faces multiple threats, including habitat loss and degradation resulting from the overfishing of horseshoe crabs (FWS, 2011a; Baker et al., 2013). The red knot is threatened by the loss of suitable habitat from the conversion of available coastal habitat to other land uses and development. Red knot feed almost exclusively on horseshoe crab (*Limulus polyphemus*) eggs during the spring migration. For this reason, overharvesting of horseshoe crabs has led to a drastic reduction of the available food sources for the red knot during spring migration. Additional threats include invasive species and global climate change; however, these secondary threats are of a lesser concern than the lack of available food and the loss of suitable habitat (FWS, 2011a).

Critical Habitat and Recovery Plans

There is currently no critical habitat designated for the red knot. Additionally, no recovery plan has been issued for the red knot.

Species Occurrence Within the Project Site and at the Dredged Material Placement Area

Suitable foraging, roosting, and sheltering habitats for migrating and wintering red knots occur within the tidal flat habitats at the Project Site (see figure 3.3-2). Tidal flats are located in three areas along the north, south, and east boundaries of the Project Site; the largest of these forms the boundary between the Brownsville Ship Channel and upland portions of the Project Site. Surveys conducted during October 2015 determined that tidal flats within the Project Site are of moderate quality due to evidence of a reduced hydrologic connection to tides as a result of construction projects in the 1930s and 1950s (as described in section 3.1). Although suitable habitat for the red knot is present within the Project Site, this species was not observed during field visits conducted in May, September, and October 2015. Based on a request from the FWS, Texas LNG conducted wintering bird surveys at the Site in March 2016 to establish a baseline of seasonal habitat use. There were no red knots observed during these surveys. As described above for the piping plover, suitable habitat may also be present within PA 5A in sparsely vegetated areas. However, because the PA has been elevated, which removed the tidal flats that were once present, this area is considered marginally suitable for the red knot.

3.3.1.4 Whooping Crane

Status, Distribution, Habitat Requirements, and Threats

The whooping crane is federally listed as endangered. Whooping cranes winter along the Texas coast, primarily in the Aransas NWR located approximately 145 miles north of the Project Site; however, there have been documented sightings within Cameron County as recent as 2015 (eBird, 2018). Whooping cranes arrive on their wintering grounds October to mid-November; however, some individuals do not arrive until December. Wintering habitat for whooping cranes includes coastal marshes and estuaries dominated by saltgrass (*Distichlis spicata*), saltwort (*Batis maritima*), smooth cordgrass (*Spartina alterniflora*), glasswort (*Salicornia* spp.), and sea ox-eye (*Borrichia frutescens*). Although the whooping crane is omnivorous, consuming a variety of insects, berries, minnows, and frogs during the summer and migration, during the winter, their diet primarily consists if blue crab (*Callinectes sapidus*). Whooping cranes forage in salt flats, brackish bays, and marshes along the coastal mainland and on barrier islands (FWS, 2006).

As of 2011 there are an estimated 279 wild whooping cranes, not including experimental reintroductions (FWS, 2012). The historic decline in whooping crane populations were the result of hunting, habitat loss, and displacement by human activities. Currently, the greatest threats to whooping crane recovery include low genetic diversity, loss of migratory stopover habitat, degradation of coastal marshes, construction of powerlines, and chemical spills (FWS, 2006).

Critical Habitat and Recovery Plans

Critical habitat for the whooping crane was designated in 1978 (43 FR 20938-942). Designated critical habitat of wintering grounds for whooping cranes occurs in the Aransas NWR, approximately 145 miles north of the Project Site. The designation of this critical habitat was crucial in the protection of suitable habitat for the whooping crane along the Gulf Intracoastal Waterway (FWS, 2006).

The FWS developed a recovery plan under the ESA in 1973 and published the most recent revision to the recovery plan in 2007. The whooping crane recovery plan identifies two primary objectives aimed at the recovery of whooping crane populations and subsequent downlisting of the species: establish and maintain self-sustaining populations of genetically stable, resilient whooping cranes in the wild; maintain a genetically stable captive population to ensure against extinction of the species. The FWS anticipates new threats to arise that could challenge the recovery. In addition, due to the status and biology of this species, a considerable amount of time and information is needed to justify downlisting the whooping crane. For example, more information is needed to determine the effective population size in order to maintain genetic viability to overcome catastrophic events or new threats (FWS, 2006).

Species Occurrence Within the Project Site

Suitable wintering habitat is present at the Project Site within the salt and brackish high tidal marsh, sea ox-eye daisy flats, tidal flat, and salty prairie. Whooping cranes have been observed within the Laguna Atascosa NWR (approximately 0.5 miles west of the Project Site).

3.3.2 Mammals

3.3.2.1 Ocelot

Status, Distribution, Habitat Requirements, and Threats

The ocelot was federally listed as endangered in 1972. The species' range covers a vast region from southern Texas and southern Arizona through central and South America to northern Argentina and Uruguay (FWS, 2010a). The United States contains a very small proportion of the species' range and the ocelot population in Texas is very small. In the 2010 recovery plan, the FWS estimated that the Texas population of ocelots consisted of fewer than 25 individuals, included two populations in the southern part of the state: one located in and around the Laguna Atascosa NWR in Cameron County and the other located approximately 20 miles north on private land in Willacy and Kennedy Counties (FWS, 2010a). More recent data suggest that the two populations contain approximately 55 ocelots; there are currently 17 ocelots with tracking collars in the Laguna Atascosa NWR population (FWS, 2016). Both populations occupy remnant habitat fragments and are isolated from each other by roughly 20 miles. No evidence of breeding between the two populations exists, although the possibility cannot be excluded because at least one male ocelot has been documented moving back and forth between the two populations (FWS, 2010a).

In Texas, dense vegetation, including canopy cover of at least 75 percent and 95 percent cover in the shrub layer are key elements of suitable habitat (FWS, 2010a). In addition, ocelots require contiguous dense brush habitat for home range consisting of 100 acres or 75-acre areas interconnected with other habitat tracts by dense brush corridors. Smaller tracts of at least 5 acres may also be used by ocelots, if they are adjacent to larger suitable habitat areas. Small passages such as roads, waterbodies, and rights-of-way are not barriers to ocelot movement (TPWD, 2017a); however, road mortality is considered to be a leading cause of mortality for the ocelot, with natural causes of mortality being second (Haines et al., 2005b). Additionally, the ocelot is known to swim across relatively narrow bodies of water, including the Brownsville Ship Channel. Ocelots normally begin their activities at dusk, foraging for prey, including rabbits, rodents, birds, and lizards (FWS, 2010a).

The mean home range size for ocelots has been estimated from between 2.5 square miles to 5 square miles (Navarro-Lopez, 1985; Tewes, 1986; Laack, 1991) with males typically travelling farther than females. Studies at the Laguna Atascosa NWR documented that the ocelot's home range was significantly larger during winter than summer (FWS, 1990). Radio telemetry studies of a single adult female during 1992 and 1993 and again in 1995 and 1996 estimated the home range of that individual to be 3 square miles (Fisher and Tewes, 1996). The FWS estimated that the amount of suitable ocelot habitat available in the Laguna Atascosa NWR and the surrounding area (within a 13.7-mile buffer around the refuge, which includes the Project Site) is 19,200 acres (FWS, 2010a).

The primary threats to ocelot are habitat loss and fragmentation, and vehicle collisions. In south Texas, more than 95 percent of the dense thornscrub habitat in the Lower Rio Grande Valley has been converted to agriculture, rangelands, or urban land uses. Border security activities (e.g., erection of lighting, development of roads and fences, brush clearing, and human activity) have also contributed to the loss, degradation, and fragmentation of ocelot habitat. The two populations of ocelot within Texas face a growing threat of genetic inbreeding due to the small population size and genetic isolation (including genetic isolation between the two populations in Texas, as well as from nearby ocelot populations in Mexico) due to habitat fragmentation and loss of connectivity. Moreover, the construction of roads through suitable ocelot habitat has resulted in high rates of road mortality, further inhibiting population growth and connectivity with adjacent populations (FWS, 2010a).

Critical Habitat and Recovery Plans

Critical habitat has not been designated for the ocelot. The strategy described in the FWS' draft recovery plan (2010) includes the assessment, protection, reconnection, and restoration of sufficient habitat to support viable ocelot populations in the United States and Mexico.

As described above, efforts have been underway for decades to create a habitat corridor along the Laguna Madre coast into Mexico, connecting the Lower Rio Grande Valley NWR, the Laguna Atascosa NWR, and areas of suitable habitat in Mexico (FWS, 2015a). The Laguna Atascosa NWR and Lower Rio Grande Valley NWR have active programs focused on restoring native thornscrub habitat, including the Ocelot Habitat Restoration Plan and the Burned Area Emergency Response program (FWS, 2013). The FWS is also working with its counterparts in Mexico to connect the portions of the habitat corridor in south Texas with suitable habitat in Mexico (FWS, 2015a).

In 1998, an ocelot was captured, radio-collared, and tracked to determine movement patterns and habitat utilization. During tracking, the ocelot spent most days on lomas along SH 4, located south of the Brownsville Ship Channel. Tracking data indicated that the ocelot used an area approximately 3 miles southwest of the Project Site to cross to the south side of the Brownsville Ship Channel. As part of the effort to create a habitat corridor for the ocelot, the FWS and BND established a wildlife corridor between SH 48 and the Brownsville Ship Channel (see figure 3.3-4) (FWS, 2015c). This wildlife corridor connects areas of suitable ocelot and jaguarundi (see discussion below) habitat within the Laguna Atascosa NWR with suitable habitat south of the Brownsville Ship Channel. The FWS is also working with TXDOT to reduce road mortality by installing underpasses under roads (see discussion below) where ocelots are known to frequently cross. To date, one underpass has been installed beneath SH 48 and four have been installed beneath SH 100. Based on consultations between Texas LNG and the FWS, it is anticipated that additional underpasses will be installed beneath roadways in the Laguna Atascosa NWR including Highway 77 and Interstate 69 within the next few years.

Species Occurrence Within the Project Site

Potentially suitable habitat for the ocelot within the Project Site includes loma deciduous shrubland, loma evergreen shrubland, and loma grassland vegetation communities. Although suitable loma habitats within the Project Site are high quality ocelot habitat, they are fragmented and isolated from nearby large blocks of intact habitats on all sides by SH 48, tidal flats, dredge material PAs, and the Brownsville Ship Channel. During consultations with Texas LNG, the FWS confirmed that the Project Site is likely too small to support a reproducing pair of ocelots; however, dense thornscrub habitat within the Project Site could provide habitat for a transient ocelots.

Ocelots have not been documented within the Project Site; however, during field surveys conducted in October 2015, Texas LNG documented feline tracks typical of an ocelot, based on the shape of a metacarpal pad and overstep. Positive identification of the tracks was not possible due to the condition of the tracks and known occurrence of bobcats in the area, which have similar tracks. Given that the ocelot has been documented in the vicinity of the Project Site, the mobility of the species, and presence of potentially suitable loma habitat, it is anticipated that ocelots may utilize the Project Site for foraging and movement between preferred habitats. The Project Site is not contiguous with other tracts of suitable habitat or connected to other suitable habitat by brush corridors; therefore, use of the Project Site by ocelots would be rare and limited to transient individuals.

3.3.2.2 Gulf Coast Jaguarundi

Status, Distribution, Habitat Requirements, and Threats

The Gulf Coast jaguarundi was federally listed as endangered in 1976. The species historically occurred from the Lower Rio Grande Valley in south Texas through eastern Mexico in the states of Coahuila, Nuevo Leon, Tamaulipas, San Luis Potosi, and Veracruz (FWS, 2013a). The closest, most recent documented occurrences of the jaguarundi to the Project Site are approximately 100 miles southwest in Nuevo Leon, Mexico where the jaguarundi was documented in 2000 (Carvajal et al., 2004; FWS, 2013a). The Gulf Coast jaguarundi was last documented in the United States in 1986 (FWS, 2013a), although unconfirmed sightings of the species within the Laguna Atascosa NWR have occurred more recently. Camera traps and live traps have been used within the South Texas Refuge Complex, including the Laguna Atascosa NWR, since 1982, resulting in data from over 96,000 camera trap-nights and over 36,000 live trap-nights, none of which have documented the presence of Gulf Coast jaguarundi. Similar camera trap efforts in Mexico have documented individuals from the Nuevo Leon population near Tamaulipas, Mexico as recently as 2012. Based on successful documentation of this species using camera traps in Mexico, if a population of jaguarundi were present in south Texas, it likely would have been documented using camera traps and/or live traps. Therefore, although the Gulf Coast jaguarundi may occur in the vicinity of the Project Site, it is expected to be extremely rare.

Similar to the ocelot, the jaguarundi prefers dense brush and thorny shrublands that are located near water. Tracts of at least 100 acres of isolated dense brush or 75 acres of brush interconnected with other brush habitats by brush corridors are considered important habitat for this species (Campbell, 2003). Their home range size varies considerably, from as low as 3.3 square miles to over 38 square miles (FWS, 2013a). In contrast to the ocelot, the jaguarundi is primarily active during the day. However they hunt similar prey as the ocelot such as birds, rabbits, reptiles, and small rodents (TPWD, 2015b). The primary threat to the recovery of the jaguarundi is the loss of habitat through destruction, degradation, and fragmentation typically associated with conversion of natural habitats to agriculture and urban development and border security activities involving erection of lighting, development of roads and fences, brush clearing, and human activity (FWS, 2013a). Other threats include competition with bobcats (*Lynx rufus*) in the northern portion of the species' range and habitat-related impacts from climate change.

Critical Habitat and Recovery Plans

Critical habitat has not been designated for the Gulf Coast jaguarundi. The current recovery strategy for this species centers on the need for assessing, protecting, restoring, and reconnecting sufficient suitable habitats to support a viable United States breeding population of the jaguarundi (FWS, 2013a). Other efforts described in the recovery plan include evaluating the merits of reintroductions, using adaptive management strategies, reducing the risk of road mortality, conducting in-depth studies of the existing population within the United States, and studying the interrelationships between jaguarundi and bobcats, coyotes (*Canis latrans*), and ocelots.

The Lower Rio Grande Valley NWR and partners in both the United States and Mexico have been collaborating since 1979 to create a habitat corridor along the Laguna Madre coast into Mexico, connecting the Lower Rio Grande Valley NWR, the Laguna Atascosa NWR, and areas of suitable habitat within Mexico as shown on figure 3.3-3. The habitat corridor is not yet complete and efforts to incorporate more lands into the corridor and to restore degraded lands within the corridor are ongoing (FWS, 2015f). As part of this habitat corridor initiative, the FWS and BND have worked together to establish an approximately 1,000-foot-wide habitat corridor between SH 48 and the Brownsville Ship Channel, which is 3.8 miles west of the Project Site (figure 3.3-4). To further facilitate safe movement of the jaguarundi and ocelot between areas of suitable habitat, underpasses have been constructed under SH 48 and SH 100 to connect the 100-foot-wide wildlife corridor to the Laguna Atascosa NWR.

Species Occurrence Within the Project Site

Potentially suitable habitat for the Gulf Coast jaguarundi within the Project Site includes loma deciduous shrubland, loma evergreen shrubland, and loma grassland habitats (see figure 3.3-5). Based on the presence of high quality loma habitats at the Project Site, unconfirmed sightings of the jaguarundi within the Laguna Atascosa NWR, and confirmed presence of the ocelot (which has a similar life history and utilizes similar habitat, see section 3.3.2.1) in the vicinity, there is potential for the Gulf Coast jaguarundi to occur within the Project Site. However, given the overall rarity of the species and the lack of contiguous habitat or habitat connected by brush corridors, use of the Project Site by the Gulf Coast jaguarundi would likely be very rare and limited to transient individuals.

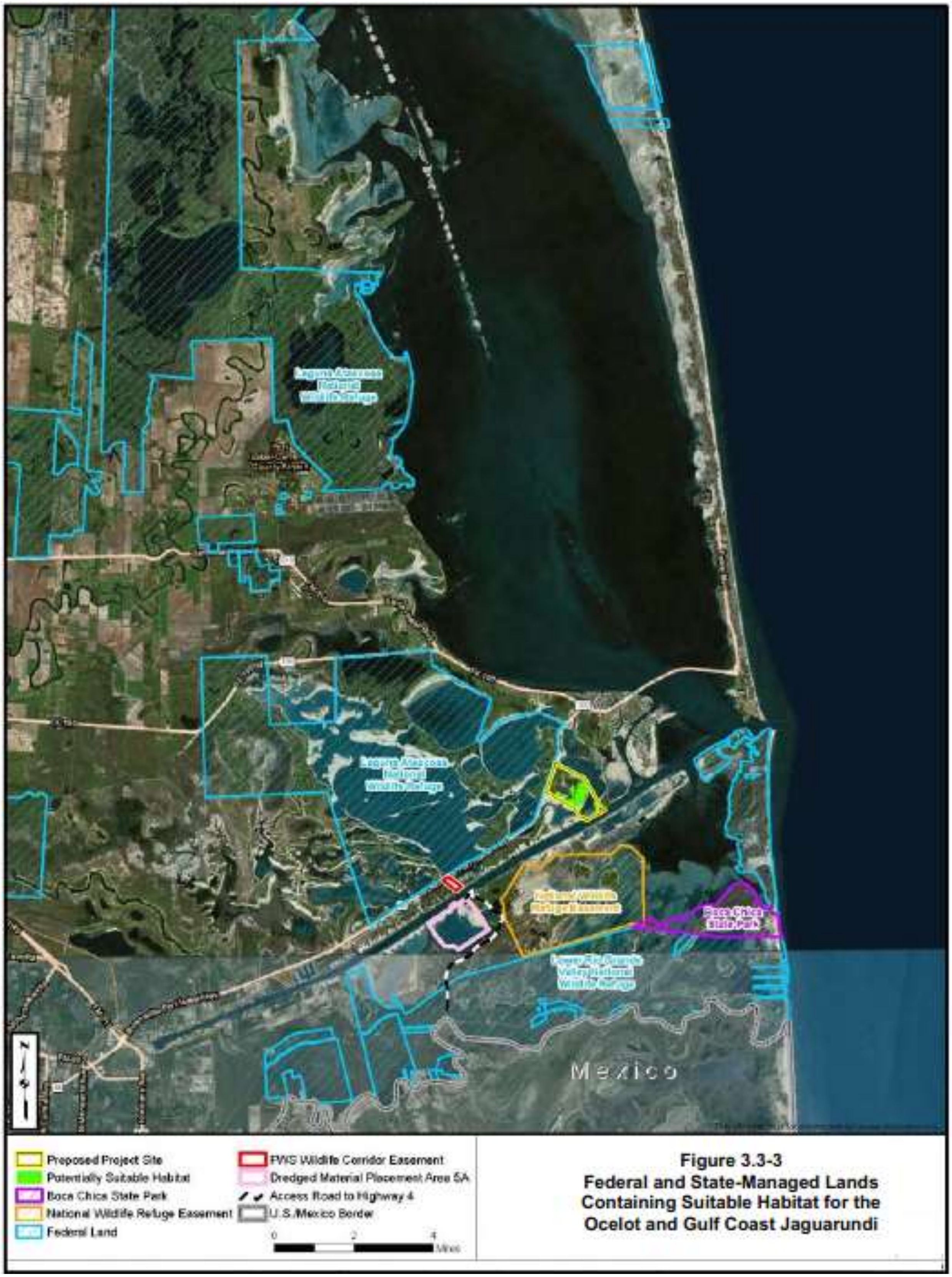

Figure 3.3-3 Federal and State-Managed Lands Containing Suitable Habitat for the Ocelot and Gulf Coast Jaguarundi

Figure 3.3-4 **Ocelot Habitat in the Vicinity of the Project**

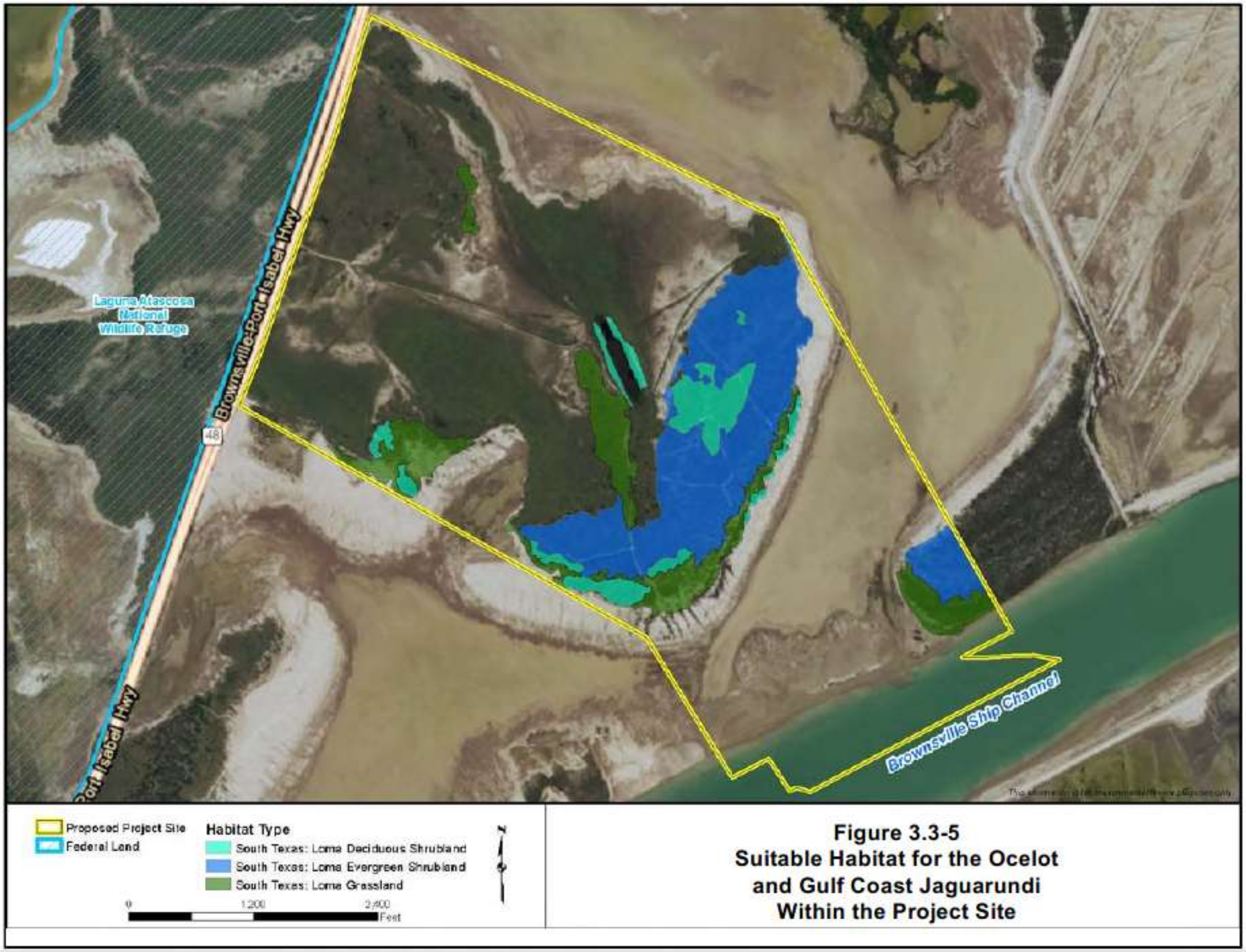

Figure 3.3-5 **Suitable Habitat for the Ocelot and Gulf Coast Jaguarundi Within the Project Site**

3.3.2.3 Sperm Whale

Status, Distribution, Habitat Requirements, and Threats

The sperm whale was federally listed as endangered in 1970 under the law that preceded the ESA and is also protected under the Marine Mammal Protection Act (MMPA). Sperm whales have a global distribution and can be found within the Atlantic, Indian, and Pacific Oceans, as well as partially enclosed seas. Sperm whales are deep divers and have the ability to use the entire water column for feeding. In the Gulf of Mexico, the sperm whale is typically found in waters along and seaward of the 3,000-foot-depth contour, as its occurrence correlates with the Loop Current eddies that locally increase prey availability (NMFS, 2010). In the north-central portion of the Gulf of Mexico, sperm whales inhabit the Mississippi Canyon year-round, which is an area south of mouth of the Mississippi River off the coast of Louisiana. The primary threats to sperm whales are entanglement in fishing gear, particularly gillnets and long-line gear, and collisions with vessels. Other threats include ingestion of marine debris and noise resulting in short-term behavioral effects (NMFS, 2018a).

Critical Habitat and Recovery Plans

Critical habitat has not been designated for the sperm whale. The most recent sperm whale recovery plan identified the following nine actions needed to achieve recovery of the species: 1) coordinate with state, federal, and international actions to implement recovery action and maintain international regulation of whaling for sperm whales; 2) develop and apply methods to estimate population size and trends in abundance; 3) determine population discreteness and population structure of the species; 4) conduct risk analysis; 5) identify, characterize, protect, and monitor habitat important to sperm whale populations; 6) investigate causes of and reduce the frequency and severity of human-caused injury and mortality; 7) determine and minimize any detrimental effects of anthropogenic noise in the oceans; 8) maximize efforts to acquire scientific information from dead, stranded, and entangled sperm whales; and 9) develop a post-delisting monitoring plan (NMFS, 2010).

Species Occurrence Along the Vessel Transit Routes

Between 1994 and 2014, there were several sperm whale sightings off the coast of South Padre Island, Texas in locations with depths greater than 2,000 feet (Hodne, 2015). Although sperm whales occur regularly within oceanic portions of the Gulf of Mexico, this species is less frequently documented within the EEZ, and the most recent sightings within waters off the Texas coast were located along the continental slope or seaward (i.e., greater than 50 miles from shore) (Jefferson et al., 2008; NMFS, 2015; Hodne, 2015).

3.3.2.4 Fin Whale

Status, Distribution, Habitat Requirements, and Threats

The fin whale was federally listed as endangered in 1970 under the law that preceded the ESA and is also protected under the MMPA. Fin whales have a global distribution; however, their occurrence is most extensive in the Northern Atlantic, from the Gulf of Mexico and Mediterranean Sea, extending northward to the arctic. Fin whales are a migratory species and prefer deep, open waters, primarily within the temperate and polar latitudes. This species generally migrates from the Arctic and Antarctic in the summer to subtropical and tropical areas in the winter (NMFS, 2010b). Fin whales are baleen whales, considered fast swimmers, and are commonly found in groups of two to seven whales. The primary threat to fin whales is injury or mortality resulting from inadvertent vessel strikes. Other threats include reduced prey abundance due to overfishing and climate change, entanglement in various fishing gear types, such as traps or gillnets, and underwater low-frequency noise (NMFS, 2018b).

Critical Habitat and Recovery Plans

Critical habitat has not been designated for the fin whale. The most recent fin whale recovery plan identified the same nine actions needed to achieve recovery of the sperm whale, outlined in section 3.3.2.3.

Species Occurrence Along the Vessel Transit Routes

While fin whales have a global distribution, their occurrence within the Gulf of Mexico is rare. The only recorded Texas sighting occurred in 1951 where one young individual was stranded on the beach in Chambers County (The Mammals of Texas – Online Edition, 2018).

3.3.2.5 Sei Whale

Status, Distribution, Habitat Requirements, and Threats

The sei whale was federally listed as endangered in 1970 under the law that preceded the ESA and is also protected under the MMPA. Similar to the sperm and fin whales, sei whales have a global distribution, and can be found in the Atlantic, Indian, and Pacific oceans. This species prefers deep waters near the continental shelf edge, far from the coast. During the summer months, sei whales generally migrate to higher latitudes, in areas such as western North Atlantic. Sei whales and fin whales are generally found within the same regions and have a close resemblance in appearance. These similarities create ambiguity in establishing and distinguishing the entire distribution and migratory patterns of the two species. This species tends to unpredictably occur in a certain area, sometimes in large groups (NMFS, 2011; Schmidly and Bradley, 2016). However, sei whales usually appear alone or in small groups of two to five. Sei whales are also baleen whales and commonly feed on plankton, cephalopods (such as squid), and small schooling fish. The primary threats to fin whales are injury or mortality resulting from inadvertent vessel strikes and entanglement in fishing traps (NMFS, 2011).

Critical Habitat and Recovery Plans

Critical habitat has not been designated for the sei whale. The most recent sei whale recovery plan identified an adaptive management strategy that divides recovery actions into three tiers (NMFS, 2011). Tier I involves: 1) continued international regulation of whaling (i.e., a moratorium on commercial sei whaling); 2) determining population size, trends, and structure using opportunistic data collection in conjunction with passive acoustic monitoring, if determined to be feasible; and 3) continued stranding response and associated data collection. Following 10 years of implementation of these actions under Tier I, NMFS will reevaluate these actions to ensure they are still providing the most sufficient data, or if other actions are warranted, to accurately assess recovery of the sei whale. Tier I methods are considered sufficient if they provide the appropriate information to estimate population size, trends, and structure in order clearly identify factors that are limiting the recovery of the species (NMFS, 2011).

Once the appropriate data is collected in Tier I, NMFS will move on to Tier II, which is an extensive, comprehensive approach to determining abundance and distribution of the sei whale. Some Tier I actions may occur simultaneously with Tier II. Tier III recovery actions are dependent upon the data collected in tiers I and II, and will be carried out as feasible (NMFS, 2011).

Species Occurrence Along the Vessel Transit Routes

As described above, sei whales are known to occur in the western North Atlantic, as far south as the Gulf of Mexico and Caribbean Sea. Along the Texas coast, one stranding was documented in November 2002 approximately 19 miles from Freeport, Brazoria County (Schmidly and Bradley, 2016).

3.3.2.6 Blue Whale

Status, Distribution, Habitat Requirements, and Threats

The blue whale was federally listed as endangered in 1970 under the law that preceded the ESA and is also protected under the MMPA. Similar to the other whales discussed, blue whales have a global distribution, and can be found in the Atlantic, Indian, and Pacific oceans. This species is found in coastal waters but is more common further offshore. Blue whales are seasonally migratory. During the summer months, blue whales generally migrate to higher latitudes, where zooplankton productivity is high in the summer months. In the fall, blue whales begin to migrate back to warmer sub-tropic waters where reproduction occurs. Due to its occurrence offshore, blue whales are less susceptible to vessel strikes and entanglement with fishing gear than other nearshore whale species. In addition, euphausiids, the primary food source for blue whales, are not commercially exploited by humans. Nevertheless, the primary threats to blue whales are Collisions with vessels, entanglement in fishing gear, reduced zooplankton production due to habitat degradation, and disturbance from low-frequency noise (NMFS, 1998).

Critical Habitat and Recovery Plans

The blue whale recovery plan evaluates two separate populations; the North Atlantic Population and the North Pacific Population. For the purposes of this BA, only the North Atlantic Population is discussed. Critical habitat has not been designated for the blue whale. The most recent blue whale recovery plan identifies seven key recommended actions to protect and monitor the recovery of blue whale populations (NMFS, 1998). These actions include: 1) determination of population structure of blue whales; 2) estimation of population size and monitoring trends in abundance, 3) identification and protection of essential habitats; 4) minimization or elimination of human-caused injury and mortality; 5) coordination of state, federal, and international actions to implement recovery efforts; 6) determination and minimization of any detrimental effects of directed vessel and aircraft interactions; and 7) maximization of efforts to acquire scientific information from dead, stranded, and entangled animals.

Species Occurrence Along the Vessel Transit Routes

Blue whales are known to occur in the western North Atlantic and within the Gulf of Mexico. Along the Texas coast, one stranding was documented in 1940 approximately between Freeport and San Luis Pass. More recently, a blue whale was stranded near Veracruz, Mexico (Schmidly and Bradley, 2016).

3.3.2.7 Gulf of Mexico Bryde's Whale

Status, Distribution, Habitat Requirements, and Threats

The Gulf of Mexico Bryde's whale was proposed for listing as endangered under the ESA in 2016 and is protected under the MMPA. The Gulf of Mexico Bryde's whale is a distinct subspecies of the Bryde's whale and is the only resident baleen whale in the Gulf of Mexico. This whale subspecies was once thought to inhabit the north-central and southern Gulf of Mexico, however, has consistently occurred in the northeastern Gulf of Mexico for the past two decades. In addition, the Gulf of Mexico

Bryde's whale tends to prefer waters between 300 feet to 1,300 feet in depth. Although similar in appearance to sei whales, Gulf of Mexico Bryde's whale is smaller and prefers warmer waters. Gulf of Mexico Bryde's whales have been documented approaching ships and vessels, a behavior that increases the species' exposure to one of its main threats – vessel strikes. Other threats to the Gulf of Mexico Bryde's whale include ocean noise, energy exploration and developments, and oil spills and responses (NMFS, 2018c).

Critical Habitat and Recovery Plans

Critical habitat has not been designated for the Gulf of Mexico Bryde's whale. However, LeBrecque et al. (2015) identified an area in the waters of northeastern Gulf of Mexico between depths of 300 feet to 1,300 feet along the continental shelf break, as the species' Biologically Important Area (NMFS, 2016).

There is no recovery plan for the Gulf of Mexico Bryde's whale as it has not been listed under the ESA.

Species Occurrence Along the Vessel Transit Routes

A total of 22 strandings have been documented for the Bryde's whale in the Gulf of Mexico from 1954 to 2012. While a majority of the strandings has been recorded from eastern Louisiana to west central Florida, two strandings have been recorded along western Louisiana beaches (NMFS, 2016).

3.3.2.8 West Indian Manatee

Status, Distribution, Habitat Requirements, and Threats

The West Indian manatee was federally listed as endangered in 1967. Manatees occur in rivers, estuaries, and coastal areas of the tropical and subtropical New World (Deutsch et al., 2008). In 2017, the West Indian manatee was reclassified as threatened under the ESA. In addition, the West Indian manatee is federally protected under the MMPA which prohibits the take (i.e., harass, hunt, capture, or kill) of all marine mammals. West Indian manatees occur in rivers, estuaries, and coastal areas of the tropical and subtropical western hemisphere. In the United States, the West Indian manatee occurs primarily in Florida and occasionally from Texas to North Carolina during the summer. In Texas, the West Indian manatee historically inhabited the Laguna Madre, Gulf of Mexico, and tidally influenced portions of adjacent rivers. Other historical records from Texas waters include sightings from Cow Bayou, Sabine Lake, Copano Bay, the Bolivar Peninsula, and the mouth of the Rio Grande River. Currently, manatees are extremely rare in south Texas waters, and sightings are thought to be individuals migrating or wandering to or from Mexico or Florida waters (Deutsch et al., 2008; COE, 2013). The most recent sighting in south Texas was in 2012 in Corpus Christi Bay, approximately 110 miles north of the Project (NBC 5-KXAS, 2012).

West Indian manatees occur primarily within shallow, slow moving estuaries, bays, rivers, and lakes where they inhabit water that is at least 3 feet deep but no more than 15 feet deep (FWS, 2001b). They forage on submerged, emergent, and floating vegetation, although they also could consume other available food items if they are presented, including acorns and fish, although this is rare (FWS, 2001b). West Indian manatees are extremely sensitive to cold temperatures and sudden changes in temperature can cause mortality. They travel widely throughout their range during most of the year, although during winter their distribution contracts considerably to warm waters near natural springs and power plant outfalls (Deutsch et al., 2008).

The primary threat to the West Indian manatee is collision with vessels as well as a reduction in the number and availability of coastal warm water refuges (e.g., warm springs), which provide important winter habitat. Other threats include poaching, entanglement in fishing gear or debris, entrapment in water-control structures such as pipes, exposure to contaminants, and incidental digestion of debris (Deutsch et al., 2008).

Critical Habitat and Recovery Plans

Critical habitat was designated for the West Indian manatee in 1976, which encompasses coastal habitats of southern Florida. Critical habitat has not been designated for this species within or along the Gulf Coast of Texas. The most recent recovery plan for the West Indian manatee (FWS, 2001b) outlines four recommended conservation actions, including: 1) minimizing causes of manatee disturbance, harassment, injury, and mortality; 2) determining and monitoring the status of the manatee population; 3) protecting, identifying, evaluating and monitoring suitable manatee habitat; and 4) implementing public awareness and education initiatives to increase the public's knowledge about the species.

Species Occurrence Within the Project Site and Along the Vessel Transit Routes

Due to the extreme rarity of West Indian manatee sightings within south Texas and the absence of seagrass habitat in the Project area, the West Indian manatee is not expected to occur within the Project Site. Small areas of seagrass habitat are present approximately 2.0 miles northeast of the Project Site along the northern shoreline of the Brownsville Ship Channel with larger areas of seagrass present adjacent to the Intracoastal Waterway in the Laguna Madre and near the South Bay (see figure 3.3-6 for the location of seagrass beds relative to the Project Site) (TPWD, 2017c). Although unlikely, seagrass habitats adjacent to these portions of the vessel transit routes could support transient manatees.

Figure 3.3-6 Suitable Habitat for the West Indian Manatee in the Vicinity of the Project

3.3.3 Flowering Plants

3.3.3.1 South Texas Ambrosia

Status, Distribution, Habitat Requirements, and Threats

The South Texas ambrosia was federally listed as endangered in 1994. Historically, the species occurred in Cameron, Jim Wells, Kleberg, and Nueces Counties in South Texas and the State of Tamaulipas in Mexico (FWS, 2010b). According to the latest five-year review (FWS, 2010b), there are six verified sites that contain South Texas ambrosia in Nueces and Kleberg Counties. South Texas ambrosia has been documented at one location in Cameron County: the record consists of a specimen documented in 1941, which was found growing in clayey soils in association with drought-resistant vegetation typical of open plains (FWS, 2010b). The FWS' five-year review of the species lists this as a historical site as the species has not been documented since 1941. The current status of this species in Mexico is unknown.

Suitable habitat for South Texas ambrosia consists of grasslands and mesquite shrublands on various soils, from heavy clays to lighter-textured sandy loams, mostly of the Beaumont and Victoria clay series. South Texas ambrosia grows at low elevations, typically on well-drained, heavy soils associated with subtropical woodland communities in openings of coastal prairies and savannas.

The greatest threat to South Texas ambrosia is from introduction and spread of non-native, invasive plant species, particularly invasive grasses (FWS, 2010b). Habitat conversion and loss; agricultural chemicals; and climate change-induced environmental changes including higher temperatures, a decrease in the amount and frequency of precipitation, and more intense and frequent storm events are also threats to the recovery of the species. Nevertheless, the FWS considers the species to have a high potential for recovery because efforts to propagate and transplant the species into suitable habitats have been successful (FWS, 2010b). The species was propagated by the San Antonio Botanical Garden in 2006 and these propagules were successfully introduced in a Nueces County park located in Robstown, Texas. The population grew by 50 percent after its first year with ongoing maintenance to eradicate invasive species (FWS, 2010b).

Critical Habitat and Recovery Plans

Critical habitat has not been designated for this species. A recovery plan is currently being developed by the South Texas Plant Recovery Team for the South Texas ambrosia (FWS, 2011). Recovery actions have been implemented and continue to occur, including the propagation of transplant individuals, protection of suitable habitat from conversion to agriculture or developed land uses, invasive species control and reduction in cattle grazing, and implementation of public outreach and education programs (FWS, 2010b).

Species Occurrence Within the Project Site

During a visit to the Project Site in September 2015, the FWS determined that although soil series most likely to support South Texas ambrosia (Beaumont and Victoria clay series) are not present within the Project Site, loma deciduous shrubland, loma evergreen shrubland, and loma grassland vegetation communities within the Project Site are potentially suitable for the species (see figure 3.3-7).

Species-specific surveys were conducted for South Texas ambrosia within loma deciduous shrubland, loma evergreen shrubland, and loma grassland habitats at the Project Site between October 5 and 8, 2015. South Texas ambrosia was not documented during the survey effort. However, plant community associates for this species were documented in the Project Site; these include, but are not limited to, brasil (*Condalia hookeri*), honey mesquite, lotebush, and snake eyes (*Phaulothamnus spinescens*). Based on the overall rarity of the species, the last documented occurrence within Cameron County occurring in the 1940s, and the negative survey results; it is highly unlikely that South Texas ambrosia is present within the Project Site.

3.3.3.2 Texas Ayenia

Status, Distribution, Habitat Requirements, and Threats

Texas ayenia was federally listed as endangered in 1994. The range of the species includes south Texas and northern Mexico. There are currently five documented populations of Texas ayenia within the three southernmost Texas counties, including Willacy, Hidalgo, and Cameron counties; these populations range from about 100 to 1,000 individuals. In addition, the FWS has received credible, confidential reports of the species within several areas, including near Brownsville (FWS, 2014c). Publicly available information on the two populations of Texas ayenia in Cameron County indicates that both populations are located over 25 miles northwest of the Site along the Arroyo Colorado (FWS, 2014).

Texas ayenia is a small shrub species that occurs within a range of alluvial soil types, from fine sandy loam to heavy clay. The species occurs in association with other shrub species and native grasses and forbs on open ground, along the edges of thickets, or within thickets, on dry, alluvial clay soils, and appears to require at least some direct sunlight for successful reproduction (FWS, 2014c).

The primary threat to Texas ayenia is habitat loss due to conversion of natural habitats to agricultural production or urban development. The introduction of and competition with nonnative invasive species also poses a threat to the continued existence of the Texas ayenia (FWS, 2014c).

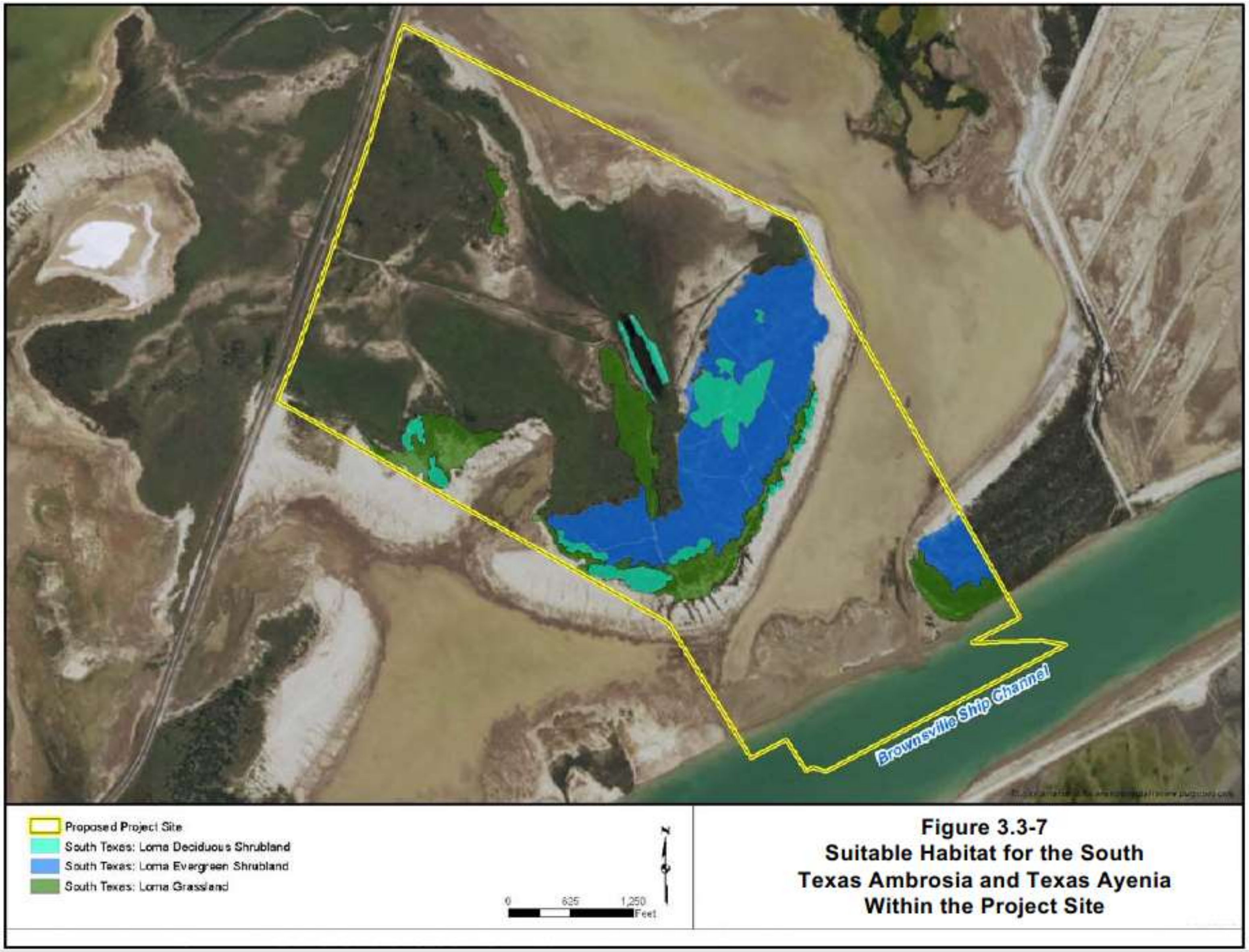

Figure 3.3-7 **Suitable Habitat for the South Texas Ayenia Within the Project Site**

Critical Habitat and Recovery Plans

Critical habitat has not been designated for Texas ayenia. The FWS released a draft recovery plan for the Texas ayenia in June 2014, which describes multiple conservation efforts including protection, conservation, and improved management of extant populations; habitat restoration; reintroduction; and establishment of ecological corridors necessary for gene flow between and among populations (FWS, 2014c).

Species Occurrence Within the Project Site

NRG and FWS staff participated in a visit to the Project Site on September 16, 2015. During the site visit, staff determined that potentially suitable habitat for Texas ayenia is present within loma deciduous shrubland, loma evergreen shrubland, and loma grassland habitats at the Project Site (see figure 3.3-7).

Species-specific surveys were conducted for Texas ayenia within loma habitats at the Project Site between October 5 and 8, 2015. Prior to beginning surveys within the Site, NRG and FWS staff visited a local reference site on October 5, 2015, to confirm the species was flowering, to aid visual identification, and to observe local habitat and plant associates. No occurrences of Texas ayenia were documented during the survey effort. However, plant community associates for this species were documented in the Project Site; these include Texas ebony, snake eyes, arrow leaf elbow bush (*Forestiera angustifolia*), and silver bluestem (*Bothriochloa laguroides*). Based on the overall rarity of the species and the negative findings for species-specific surveys conducted within the Project Site, it is highly unlikely that Texas ayenia is present within the Project Site.

3.3.4 Sea Turtles

The FWS and NMFS share jurisdiction under the ESA for sea turtles; the FWS has jurisdiction over sea turtles on land (terrestrial habitat) and the NMFS has jurisdiction over sea turtles in marine and estuarine waters. Sea turtles are almost exclusively aquatic (occurring within marine and estuarine waters), with terrestrial habitat use only occurring when adult females come to shore to lay eggs. Of the five federally listed sea turtles that occur in Texas, three (green, Kemp's ridley, and loggerhead) nest along the Gulf Coast of Texas. However, these species are not known to nest along the shorelines of inland waterways, such as the Brownsville Ship Channel. Therefore, the Action Area is limited to marine and estuarine waters, which are under the jurisdiction of the NMFS.

3.3.4.1 Green Sea Turtle

Status, Distribution, Habitat Requirements, and Threats

The green sea turtle was federally listed as threatened in 1978, except where it is listed as endangered, and is also state listed as threatened. On April 6, 2016, the FWS and NMFS published a final rule to list the green sea turtle population as 11 distinct population segments (DPS) that qualify as unique species for the purposes of listing under the ESA (80 FR 34594). As a result, the FWS and NMFS removed the range-wide listing status and, in its place, list eight DPSs as threatened and three DPSs as endangered. Green sea turtles off the coast of Texas are part of the North Atlantic DPS, which is listed as threatened (80 FR 34594). The highest density of green sea turtles in the North America DPS are located around Costa Rica, Mexico (Campeche Yucatan and Quintana Roo), Florida, and Cuba but green turtles also frequently occur in Texas waters (80 FR 15271).

In the continental United States, green sea turtles occur in coastal waters from Texas to Massachusetts (NMFS, 2015b). This species frequently occurs within the coastal and offshore waters of southern Texas throughout the year, where the population is increasing (Fuller et al., 1987; NPS, 2013). Most of the green sea turtles in the coastal waters of Texas are juveniles, which occur off the Gulf Coast of the eight southernmost counties, including Cameron County (NMFS, 2009; NPS, 2013). Within Texas, green sea turtles are most prevalent in the vicinity of South Padre Island (approximately 5 miles east of the Project Site), where one to five green sea turtles have nested in recent years (NPS, 2013).

Except during migration, the species is often found in fairly shallow estuarine and marine waters including reefs, bays, and inlets, where they feed on seagrass and algae. Hatchlings are known to eat a variety of plants and animals (FWS, 2015a).

The 2015 five-year review states that green sea turtles continue to face recovery challenges, most significantly from habitat loss and degradation, disease caused by fibropapillomatosis, fishery bycatch, boat strikes, climate change, and marine contaminants and debris (NMFS, 2015b).

Critical Habitat and Recovery Plans

Critical habitat has not been designated for the green sea turtle within the Action Area; designated critical habitat includes the coastal waters of Culebra Island, Puerto Rico. The FWS and NMFS published a recovery plan for the Atlantic green sea turtle population in 1991 that established the necessary actions to achieve successful recovery of the green sea turtle population, including long-term protection of nesting beaches, at least a 60 percent hatch success rate, implementation of effective lighting ordinances on nesting beaches, determination of distribution and seasonal movements for all life stages, minimizing mortality from commercial fishing, and reducing marine pollution (FWS and NMFS, 1991).

Species Occurrence Within the Project Site and Along the Vessel Transit Routes

As described above, juvenile green sea turtles frequently occur within coastal and offshore waters off of southern Texas throughout the year. Green sea turtles have been documented during maintenance dredging of the outer portions of the Brownsville Ship Channel on numerous occasions since 1995, and incidental take has occurred near the entrance to the channel from the use of hopper dredges (COE, 2013). A NMFS telemetry tracking study (Renaud, 1992) determined that use of the ship channel by green sea turtles is rare, and likely limited to use as an escape route when turtles are disturbed. The study also determined that transient use of the ship channel may occur when a green sea turtle crosses the channel from one jetty to another at Brazos Santiago Pass or when the channel is used for passage to enter the Laguna Madre.

Due to the absence of suitable foraging habitat (seagrass) and given the use of the Brownsville Ship Channel by green sea turtles is rare and likely limited to transient individuals, green sea turtle occurrence within the Project Site is anticipated to be infrequent. However, green sea turtles may occur along portions of the vessel transit routes near the entrance to the Brownsville Ship Channel and the portion of the Intracoastal Waterway transiting through seagrass habitat within Laguna Madre (see figure 3.3-6).

3.3.4.2 Hawksbill Sea Turtle

Status, Distribution, Habitat Requirements, and Threats

The hawksbill sea turtle was federally listed as endangered in 1970. Hawksbill sea turtles are circumtropical, distributed in the Atlantic, Pacific, and Indian oceans. In the continental U.S., this species is found primarily in Florida and Texas, although they have been recorded in all Gulf States and along the Atlantic Coast as far north as Massachusetts (NMFS, 2014). The current known species distribution in Texas extends across the eight southernmost counties, including Cameron County. Nesting in the continental U.S. is mostly limited to the southeastern coast of Florida and the Florida Keys; however, one hawksbill sea turtle nest has been documented within the last 10 years on South Padre Island approximately 25 miles north of the Project Site (NPS, 2013).

Threats to the hawksbill sea turtle include foraging and nesting habitat loss and degradation, fishing bycatch, marine pollution and debris, and overutilization for anthropogenic purposes (NMFS and FWS, 2013a). Habitat loss and degradation continues to be the main cause of the continued decline of this species as suitable available habitat is lost to land conversion, development, erosion, and other factors.

Critical Habitat and Recovery Plans

Critical habitat has not been designated for the hawksbill sea turtle within the Action Area; however, critical habitat has been designated for this species on Isla Mona, Isla Monita, Culebra Island, Cayo Norte, and Island Culebrita in Puerto Rico (FWS, 2018b).

The FWS and NMFS developed a recovery plan for the hawksbill sea turtle in 1993 that established the necessary actions to achieve successful recovery of the hawksbill sea turtle population, including the long-term protection of important nesting beaches, in conjunction with ensuring 75 percent hatching success rate; understanding of the distribution and seasonal movements of all life stages; reduction in the illegal exploitation of this species; and long-term protection of important foraging habitats (FWS and NMFS, 1993). The five-year review conducted in 2013 documented that substantial progress has been made towards achieving the restoration goals for this species; however, this species continues to experience a precipitous decline in its population, and therefore, its listing status remains unchanged (NMFS and FWS, 2013a).

Species Occurrence Within the Project Site and Along the Vessel Transit Routes

Although hawksbill sea turtles have been commonly observed in Texas, they have never been documented during maintenance dredging of the Brownsville Ship Channel (FWS and NMFS, 1993; COE, 2013). Suitable habitat for this species does not occur within the ship channel, although mangrove bordered bays are present within Laguna Madre and South Bay, approximately 2 miles east of the Project Site. Therefore, it is highly unlikely that this species occurs in or near the Project Site, although it may occur along offshore portions of the vessel transit routes.

3.3.4.3 Kemp’s Ridley Sea Turtle

Status, Distribution, Habitat Requirements, and Threats

Kemp’s ridley sea turtle was federally listed as endangered in 1970. Adult Kemp’s ridley sea turtles occur primarily within the Gulf of Mexico, although juveniles also occur along the Atlantic Coast north to Long Island Sound. The current known species distribution in Texas covers the eight southernmost counties in Texas, including Cameron County (NMFS, 2007). Kemp’s ridley sea turtles nest on beaches along South Padre Island and Boca Chica Beach, each of which is approximately 4 miles from the Project Site. Post nesting migration of females from Texas beaches indicate that turtles move along migratory corridors that appear to extend through the coastal areas of the Gulf of Mexico, and most adult females appear to travel in waters less than 150 feet in depth (FWS, 2015c).

Kemp's ridley sea turtle is the smallest of the sea turtles that occur in Texas; adults may reach a length of about 2 feet and weight of up to 100 pounds (FWS, 2015b). Kemp's ridley sea turtles often live in the open ocean and Gulf waters but are also known to inhabit shallow coastal waters and estuarine habitats. Preferred habitats include calm waters over sandy or muddy substrates where prey, which consists of crabs and other invertebrates, are plentiful. Juvenile sea turtles float on large mats of *Sargassum* (accumulations of floating seaweed) in the Gulf of Mexico and Atlantic Ocean (TPWD, 2015c).

Kemp's ridley sea turtles face three major threats, including: 1) loss of habitat and habitat degradation; 2) incidental capture in fishing gear; and 3) egg collection. Loss of nesting habitat resultant from both anthropogenic impacts (e.g., development, habitat conversion) and from natural causes (e.g., severe storms, erosion) has reduced available lands for Kemp's ridley sea turtle to successfully nest. Bottom trawling, dredge fishing, and channel dredging have resulted in loss or degradation of this species' foraging habitats. Incidental capture by commercial fishing gear continues to be a leading cause of Kemp's ridley sea turtle mortality: this species of sea turtle is encountered more often by commercial fishing vessels than all other sea turtle species, mostly as a result of shrimp fishing. Proper implementation of turtle exclusion devices on commercial fishing gear has reduced turtle mortality related to commercial fishing but interactions with fishing vessels and equipment remain a significant cause of injury and death in this species. Harvesting of eggs and/or adults for commercial, recreational, scientific, or educational purposes was identified as a potential threat for the species; however, conservation efforts by both the United States and Mexico have reduced this threat (NMFS and FWS, 2015).

Critical Habitat and Recovery Plans

Critical habitat has not been designated for the Kemp's ridley sea turtle; however, the FWS and NMFS have recently been petitioned by WorldEarth Guardians to classify nesting beaches along the Texas coast as well as suitable marine habitats in the Gulf of Mexico and Atlantic Ocean as critical habitat (NMFS and FWS, 2015).

A bi-national recovery plan for the Kemp's ridley sea turtle was published by the NMFS, FWS, and Mexico's Secretary of Environment and Natural Resources in 2011. That plan noted that the nesting population of this species appears to be rebounding. However, even though the population appears to be increasing, the plan also notes that the protection of nesting females and suitable nesting habitat is critical for the successful recovery of Kemp's ridley sea turtles. In 2015, the NMFS and FWS published a five-year review for this species, which noted that the number of nesting Kemp's ridley sea turtles has increased in Texas over the last 30 years. In 1985, only one nest was observed, but following intensive conservation efforts, that number increased to between 100 and 200 in 2006. However, the five-year review documented a 40 percent decrease in nesting activity since 2008. Much of this reduction in nesting activity appears to be related to increasing anthropogenic impacts (e.g., habitat conversion, lighting, boat traffic (NMFS and FWS, 2015).

Species Occurrence Within the Project Site and Along the Vessel Transit Routes

Kemp's ridley sea turtles have been documented during dredging operations along the outer portions of the Brownsville Ship Channel on three occasions since 1995 (COE, 2013). As previously discussed, this species is known to nest along the beaches north and south of the Brazos Santiago Pass (entrance to the Brownsville Ship Channel). Although Kemp's ridley sea turtle occurrence within the Project Site or along vessel transit routes is anticipated to be rare, it is possible due to the presence of known nesting areas in the Project vicinity.

3.3.4.4 Leatherback Sea Turtle

Status, Distribution, Habitat Requirements, and Threats

The leatherback sea turtle was federally listed as endangered in 1970. The leatherback sea turtle is a circumglobal species that is known to occur farther north and south than other sea turtles. The leatherback sea turtle rarely leaves the deep waters of the Gulf of Mexico but occasionally occurs along the Texas coast; sightings have been documented in all the coastal counties of Texas (NMFS, 2009). With the exception of one nest at Padre Island National Seashore in 2008 (approximately 40 miles north of the Project Site at its nearest point), the leatherback sea turtle has not nested in Texas since the 1930's (NPS, 2013).

Leatherback sea turtles are the most migratory and wide ranging species of all sea turtles. Leatherback sea turtles primarily live in the open ocean and move into coastal waters only during the reproductive season (TPWD, 2015d). The leatherback sea turtle prefers deep waters up to 4,200 feet in depth (NPS, 2015). Individuals undergo long distance migrations between foraging and breeding grounds. Leatherback sea turtles feed primarily on soft-bodied animals such as jellyfish and sea squirts; however, they have also been known to consume urchins, crustaceans, fish, and floating seaweed (TPWD, 2015d).

Similar to the other species of sea turtles, the loss of habitat through land conversion, degradation, and fragmentation presents the most pressing threat to the recovery of this species. Egg collection for commercial, recreational, scientific, and educational purposes poses a significant risk to leatherback recovery at the global level although the impact from egg collection in the United States is minimal. Disease and predation also pose a threat to the recovery of leatherbacks. Similar to other species of sea turtle, fibropapillomatosis has been documented in this species; however, it is not as common in leatherbacks as in other sea turtle species (NMFS and FWS, 2013b).

Critical Habitat and Recovery Plans

Critical habitat has not been designated for the leatherback sea turtle within the Action Area; the closest designated critical habitat for this species includes the western portion of Saint Croix in the U.S. Virgin Islands. The NMFS published a recovery plan for the Atlantic population of leatherback sea turtle in 1992. The scope of the plan does not include recovery efforts for nesting beaches, but rather focuses on efforts to reduce foraging and migratory habitat loss and degradation and to reduce fishing-related mortality (NMFS, 1992). Multiple conservation efforts have been implemented since the leatherback was first listed under the ESA in 1970. As a result, within the Gulf of Mexico, leatherback populations have been steadily increasing (NMFS and FWS, 2013b). Increased nest surveys have effectively reduced poaching, particularly in the U.S. Virgin Islands and other Caribbean nesting sites. Additionally, local lighting ordinances aimed at controlling lights from coastal developments have helped to increase nesting activity and reduce mortality of hatchlings. Moreover, use of more environmentally friendly engineering procedures has reduced the use of hard beach armoring, thereby increasing available nesting habitat for this species.

Species Occurrence Within the Project Site and Along the Vessel Transit Routes

Because of this species' preference for open ocean habitat outside of the reproductive season, and the lack of documented nesting sites in Texas for many years, it is unlikely that this species occurs within the Project Site or within the Brownsville Ship Channel. The leatherback sea turtle may, however, occur along vessel transit routes within the Gulf of Mexico.

3.3.4.5 Loggerhead Sea Turtle

Status, Distribution, Habitat Requirements, and Threats

The Northwest Atlantic Ocean DPS of loggerhead sea turtle was federally listed as threatened in 2011, and is also state listed as threatened. The loggerhead sea turtle regularly occurs in the warmer waters of the Atlantic, Pacific, and Indian oceans, as well as the Mediterranean and Caribbean seas. The current known species distribution in Texas covers the eight southernmost counties, including Cameron County. The majority of nesting activity in the U.S. occurs in Florida, with only occasional nesting activity in Texas (about six documented nests per year) (NMFS and FWS, 2008; NPS, 2013).

Loggerhead sea turtles use a wide variety of habitats including open marine habitats up to 300 miles from shore, estuarine waters of coastal lagoons, mouths of large rivers, inshore bays, and ship channels within tropical and temperate waters. Coral reefs and rocky habitats are often used as feeding areas (TPWD, 2015e). Loggerhead sea turtles are benthic feeders, primarily eating mollusks, crustaceans, fish, and other marine animals (FWS, 2015f).

Within the continental U.S, loggerhead sea turtles are known to nest from Texas to Virginia. Similar to the other sea turtle species that occur in Texas, the loss and degradation of nesting and foraging habitat are the primary threats to this species. In addition, anthropogenic impacts resulting from development (e.g., lighting), boat strikes, commercial fishing, pollution, and climate change all contribute to the continued decline of this species. Further, the overutilization (egg or adult harvest) of loggerhead sea turtles for commercial, recreational, scientific, or education purposes has had an adverse impact on the species. However, this impact is less significant in the United States than in the Caribbean and Mediterranean regions.

Critical Habitat and Recovery Plans

In 2014, critical habitat was designated for the loggerhead sea turtle, which includes both marine and terrestrial environments (79 FR 39855-39912). Designated critical habitat includes terrestrial coastal areas that support loggerhead nesting populations as well as marine foraging habitat. A significant portion of the Gulf of Mexico is designated critical habitat for the loggerhead sea turtle, including the entire Texas state coastline (see figure 3.3-8). The designated critical habitat in the Gulf of Mexico (Unit LOGG-S-02) consists of offshore *Sargassum* habitat, which provides essential forage, cover, and transport habitat for post-hatchlings and early juveniles (see figure 3.3-8).

The most recent recovery plan for loggerhead sea turtles was published by the NMFS and FWS in 2008. The population of loggerheads that occurs closest to the Project Site is part of the Northern Gulf of Mexico Recovery Unit. Available data for this population is limited and mostly focused on the extensive breeding populations that occur in Florida. Although the loggerhead does occur in Texas, nesting is very infrequent. The 2008 recovery plan describes multiple conservation efforts that have been enacted or are proposed, primarily in the United States, including protection of nesting habitat, minimizing the adverse effects of beach nourishment and beach cleaning on nesting habitats, reducing light pollution on nesting beaches, reducing nest predation, reducing the effects of vehicular travel on beaches, and eradicating exotic plants on nesting beaches. In addition, efforts to remove physical barriers (e.g., hard armoring, fences) to suitable nesting locations have allowed loggerhead sea turtles access to habitats that would otherwise not be utilized (NMFS and FWS, 2008).

Species Occurrence Within the Project Site and Along the Vessel Transit Routes

Loggerhead sea turtles have been documented during maintenance dredging along the outer portions of the Brownsville Ship Channel on five occasions since 1995 (COE, 2013). Therefore, there is potential for loggerhead sea turtles to occur within the Brownsville Ship Channel and along vessel transit routes in the Gulf of Mexico.

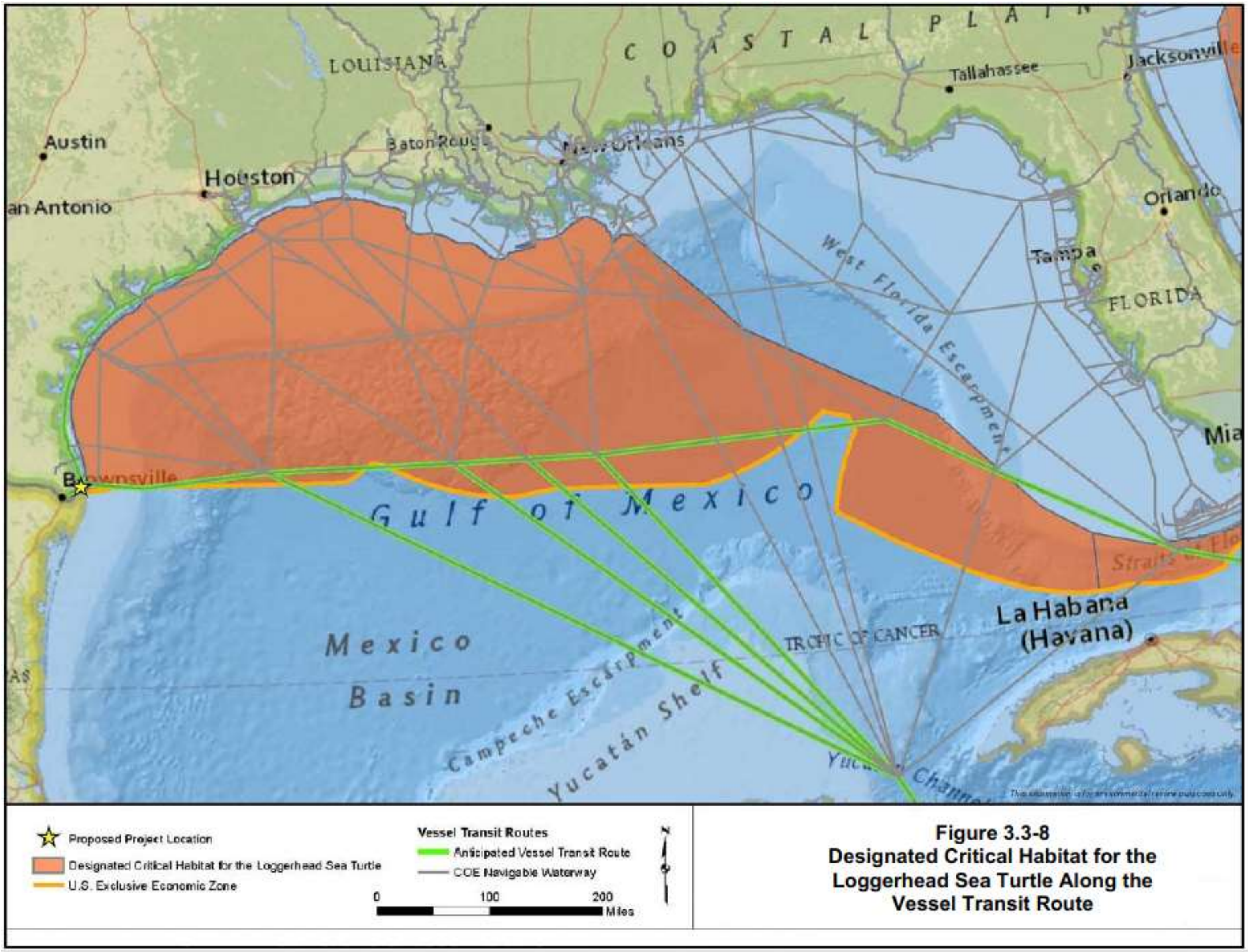

Figure 3.3-8 **Designated Critical Habitat for the Loggerhead Sea Turtle Along the Vessel Transit Route**

4.0 EFFECT ANALYSIS

Based on the information presented in section 2 of this BA, construction and operation of the Project would involve several activities that have the potential to affect listed species, including:

- clearing vegetation during site preparation;
- constructing plant facilities and access roads;
- dredging the proposed berth and maneuvering basin;
- installing piles to support LNG terminal structures;
- lighting associated with construction and operation of the Project;
- increasing roadway traffic during construction and operation;
- increasing marine vessel traffic during construction and operation; and
- operating and maintaining the LNG terminal.

The primary mechanisms by which these activities could potentially impact federally listed species include aquatic and terrestrial habitat loss and/or degradation; generation of underwater and terrestrial noise and vibration; marine vessel or terrestrial vehicle strikes; and introduction of exotic and invasive terrestrial and marine species. These activities could have the following types of direct and indirect effects on federally listed species:

- Direct injury or mortality. The taking[8] of either an individual or population of a federally listed species due to physical injury, extreme stress, or death of an individual.
- Indirect effects from disturbance or displacement. Changing an individual's or population's habitat use or life history pattern due to disturbance from increased noise, vibration, lighting, human activity, visual disturbance, and/or transportation activity; increasing competition for resources or habitat due to displacement of individuals from the Project Site into the territory of other animals; or other indirect effects ultimately causing mortality, decreased fitness, or reduced breeding and recruitment in the future population.
- Direct or indirect effects on habitat for listed species (including but not limited to designated critical habitat). Physical disturbances to habitat that result in alterations in the amount or quality of a habitat. Indirect impacts on habitat can occur through preventing an animal from accessing an optimal habitat (e.g., breeding, forage, or refuge), either by physically preventing use of a habitat or by causing an animal to avoid a habitat.

[8] The ESA defines take as "to harass, harm, pursue, hunt, shoot, wound, trap, capture, collect or attempt to engage in any such conduct." The ESA further defines "harass" as "actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering," and defines "harm" as "significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering."

Permanent and temporary impacts on habitat types within the Project Site are provided in table 4.0-1.

The following section describes how each of the listed species with the potential to occur in the Action Area could be exposed to Project activities and their anticipated response from potential exposure. Impact avoidance and mitigation measures Texas LNG would implement are also considered in determining the likelihood, magnitude, and significance of the potential impacts described above for each federally listed species.

TABLE 4.0-1
Impacts on Habitat Types Within the Project Site

Habitat Type	Barrow (acres)	Temporary Workspace (acres)	Permanent Footprint (acres)	Total Impacted Area (acres)
Barren	1.1	3.5	9.9	14.5
Coastal				
Salt and Brackish High Tidal Marsh	0.0	3.8	31.9	35.7
Sea Ox-eye Daisy Flat	0.0	9.6	54.0	63.6
Tidal Flat	0.0	1.8	42.0	43.8
Gulf Coast				
Salty Prairie	0.0	3.7	13.0	16.7
Open Water	0.0	1.1	32.7	33.8
South Texas				
Loma Evergreen Shrubland	0.0	0.8	63.6	64.4
Loma Deciduous Shrubland	0.3	0.4	14.7	15.4
Loma Grassland	0.5	2.9	20.2	23.6
Project Total [a]	**2.0**	**27.6**	**282.0**	**311.5**

Source: TPWD, 2013
[a] Due to rounding the totals may not equal the sum of the addends.

4.1 BIRDS

4.1.1 Northern Aplomado Falcon

Field surveys indicated, and the FWS concurred, that suitable foraging habitat for the northern aplomado falcon is present within the Project Site (see figures 3.3-1 and 4.1-1). Specifically, the salt and brackish high tidal marsh, sea ox-eye daisy flat, salty prairie, and loma grassland habitats provide suitable foraging habitat for the northern aplomado falcon. As discussed in section 3.3, the FWS determined that yucca trees within the northwestern portion of the Project Site could provide potentially suitable nesting habitat for this species; however, field surveys conducted in October 2015 determined that the habitat is suboptimal for nesting due to the encroachment of honey mesquite. In addition, wintering bird surveys were conducted at the Project Site in March 2016. Neither the northern aplomado falcon nor suitable stick nests were observed within the Project Site during surveys.

4.1.1.1 Potential Impacts

Based on the presence of foraging habitat and potentially suitable nesting habitat in the Project area, as well as documented occurrences of northern aplomado falcon in the Project vicinity, northern aplomado falcons may occur within the Project Site. Northern aplomado falcons foraging within the Project Site could be affected by impacts on foraging habitat as well as increased noise, lighting, and human activity during construction and operation of the Project. Impacts on foraging habitat for the northern aplomado falcon would primarily be within the northeastern portion of the Project Site. Northern aplomado falcons are known to forage widely throughout the year and high quality foraging habitat for this species occurs nearby, including within the Laguna Atascosa NWR, where there is ongoing management to promote recovery of the species (FWS, 2014a).

Construction-related activities are likely to deter individuals from foraging in the immediate vicinity of the Project Site; however, this effect is anticipated to be temporary and once the Project begins operation (noise and traffic levels would be reduced during operation; refer to draft EIS) some individuals may return to forage within the undisturbed areas within the Project Site.

Flaring typically occurs during startup, shutdown, and in the event of a process upset of an LNG terminal. During operation of the Project, the main flare would be active intermittently, totaling an estimated 15 days per year. Given the infrequency of flaring, impacts on the northern aplomado falcon from flaring are unlikely.

Texas LNG would require artificial lighting during construction and operation of the Project for both safety and to comply with Federal Aviation Administration regulations, which could adversely affect northern aplomado falcons during foraging. Artificial lighting may mask natural light sources (e.g., star or moon light) or result in attraction of avian species, especially in low light, fog, and when there is a low cloud ceiling (Orr et al., 2013). Northern aplomado falcons are largely diurnal, with 90 percent of their active foraging and flying activities occurring between dawn and dusk. However, some individuals may forage in the pre-dawn and post-dusk hours, when artificial lighting could act as an attractant to insects that the species forages on (Keddy-Hector and Dean, 2000). Attraction to artificial lighting could impact individuals if they collide with lighting structures or nearby Project facilities (e.g., storage tanks or communication tower). To minimize the potential effects of lighting on aplomado falcons, Texas LNG has developed a *Facility Lighting Plan*, which would implement measures such as shielding and down-facing lights, as discussed below.

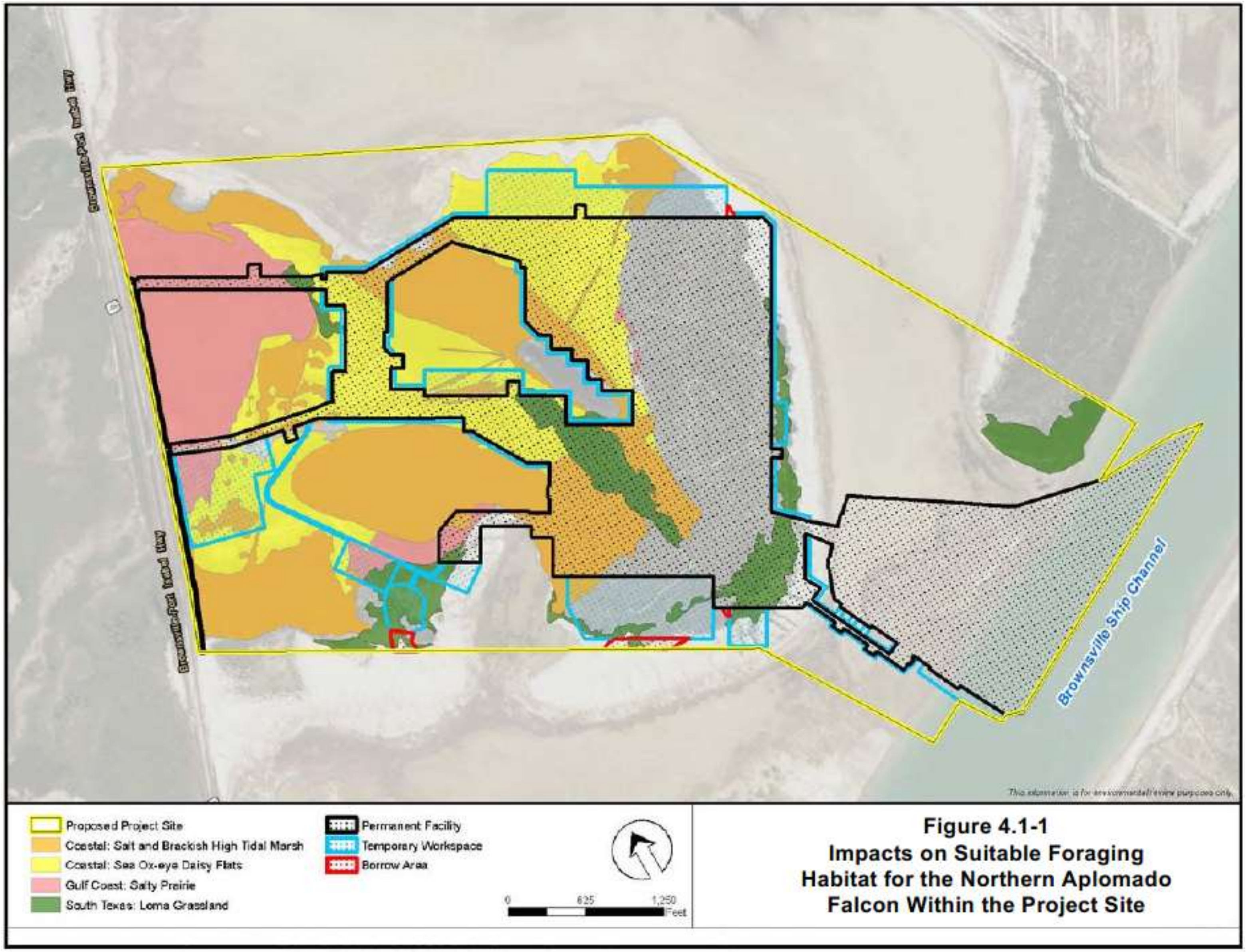

Figure 4.1-1 **Impacts on Suitable Foraging Habitat for the Northern Aplomado Falcon Within the Project Site**

4.1.1.2 Mitigation Measures

Texas LNG has indicated that it would conduct clearing activities outside the nesting season or, if clearing would occur during the nesting season, it would conduct surveys for active nests prior to commencing construction activities. If a Northern aplomado falcon is found, Texas LNG would notify the FWS for recommendations for avoidance. In addition, Texas LNG has proposed general mitigation measures to reduce the potential impacts from construction on wildlife in the area that would apply to this species as well. Measures implemented by Texas LNG include the following:

- Texas LNG modified the location of the administration building, moving the area away from SH 48, based on coordination with the FWS.

- During preliminary Project planning, Texas LNG concentrated and collected Project facilities to minimize the Project footprint to the maximum extent practicable.

- Approximately 168.7 acres of potentially suitable habitat for the northern aplomado falcon within the Project Site would not be physically disturbed by construction activities, including salt and brackish high tidal marsh (83.9 acres), sea ox-eye daisy flat (34.9 acres), salty prairie (34.4 acres), and loma grassland (15.5 acres) habitats.

- During construction, Texas LNG would direct nighttime lighting towards construction activity and use the minimum light level necessary to ensure site safety and security.

- The *Facility Lighting Plan* for operation of the LNG terminal[9] outlines the lighting that would be installed at the facility including down-facing lights with shielding needed to meet regulatory standards and minimize fugitive lighting. Facility lighting would be chosen to minimize the horizontal emission of light away from intended areas, and shielding would help minimize impacts on birds (e.g., northern aplomado falcon) and other wildlife while providing the illumination needed to ensure security and safe operation of the facility. In addition, for structures that are greater than 200 feet and require aviation safety lights in accordance with FAA regulations, Texas LNG would minimize potential impacts on birds (e.g., northern aplomado falcon) from collisions with structures at night by utilizing flashing lights rather than non-flashing lights.

4.1.1.3 Determination of Effect

Construction of the Project would impact 139.6 acres of potentially suitable foraging habitat for the northern aplomado falcon. However, we determined that through implementation of measures, including minimization of impacts on suitable nesting habitat as well as clearing outside the nesting season or otherwise conducting nest surveys prior to construction, the Project *is not likely to adversely affect* the northern aplomado falcon.

4.1.2 Piping Plover

Field surveys conducted by Texas LNG indicated that suitable wintering habitat for the piping plover is present within tidal flats and adjacent upland habitat at the Project Site (see figures 3.3-2 and 4.1-2). However, no piping plovers were observed at the Project Site during surveys conducted in October 2015 and March 2016.

[9] Texas LNG's Facility Lighting Plan is available on eLibrary under Accession No. 20160511-5281.

4.1.2.1 Potential Impacts

Piping plovers within the Action Area could be affected by modification of wintering habitat within the Project Site; increased noise, flaring and artificial lighting, and human activity; mortality due to interaction with construction activities; and the introduction of invasive species due to ballast water discharges. The potential impacts are described below.

A total of 43.8 acres of potentially suitable wintering habitat within tidal flats and adjacent upland areas would be affected by construction and operation of the Project. The majority of the impacted habitat (42.0 acres) would be permanently modified by the operation of the berth and maneuvering basin. The remaining 1.8 acres of tidal flat habitat would be used for temporary workspace. The remaining 120.6 acres of suitable tidal flat habitat within the Project Site for wintering piping plovers would be undisturbed by construction activities, as depicted on figure 4.1-2. To minimize the potential for construction activities to increase erosion and sedimentation to adjacent tidal flat habitat, Texas LNG would install erosion control structures in accordance with its ECP. Temporary erosion and sediment control devices include, but are not limited to, sediment barriers (e.g., silt fence, straw bales, biologs), stormwater diversions, mulch, and revegetation. Where tidal flats are adjacent to and downslope of construction work areas, sediment barriers would be installed along the edge of these areas, as necessary to prevent sediment flow into the tidal flat. If sediment barriers are in use, when the depth of sediment reaches about one-third of the height, the sediment must be removed. Erosion and sediment control structures would be maintained at all times, as required in the Project construction documents and as required by all applicable permits.

Tidal flats within the Project Site are composed of unvegetated mud flats that under normal conditions would be frequently inundated by water, although surveys indicate that flats within the Project Site have a reduced hydrologic connection to tidal waters due to a series of construction projects surrounding channel in the 1930s and 1950s. Periodic tidal inundation is important for replenishing invertebrate prey, reducing salinity, and providing nutrients to tidal flat systems; flats without such inundation may be ecologically impoverished and hypersaline, as is the case within tidal flats at the Project Site. For this reason, tidal flats within the Project Site are considered to be of moderate quality.

In addition, disturbance and displacement from foraging habitats within the Action Area could occur as a result of Project-related noise, flaring and other artificial lighting, and human activity, which would deter individuals from foraging in undeveloped portions of the Project Site and nearby suitable habitats but not completely preclude it. Studies of wintering piping plovers have documented that disturbance reduces time spent foraging and increases energy expenditure (Burger, 1991; Zonick and Ryan, 1995), but individuals readily move to nearby suitable and available habitats following disturbance and resume normal activity quickly, usually without suffering reduced survivorship unless disturbance is frequent, long term, and unpredictable, which limit individuals' ability to habituate to or tolerate the disturbance. Disturbance that occurs during periods of poor food abundance or availability and/or adverse weather conditions (e.g., cold weather, wind, and precipitation) is more stressful on individuals, to the degree of affecting survivorship, than disturbance that occurs during mild conditions (Smit and Visser, 1993; Goss- Custard et al., 2006).

Because piping plovers exhibit a high degree of fidelity to wintering areas, which often include several suitable areas in close proximity to the proposed Project, and construction-related disturbances would be relatively continuous, it is expected that piping plovers in the vicinity of the Project Site would be permanently displaced into nearby areas of suitable habitat. Although this could increase density within neighboring areas of suitable habitat, normal behavior is expected to resume quickly. Further, winters in south Texas are relatively mild; thus further reducing the potential for displacement to adversely affect the survivorship of wintering piping plovers.

Individuals displaced as a result of habitat modification and activity within the Project Site would likely easily relocate to nearby suitable habitats. Tidal flats are a naturally dynamic environment, changing over time due to natural and anthropogenic changes including, but not limited to, sedimentation and sand deposition patterns, encroachment of vegetation, and storms. As such, plovers are adapted to changing conditions and exhibit low fidelity to specific wintering sites, but instead return each year to a general area (e.g., Gulf Coast of south Texas) where they select specific sites that contain suitable foraging, roosting, and sheltering habitat components. High quality wintering habitat for the piping plover occurs at nearby offsite locations including the Laguna Atascosa NWR and Designated Critical Habitat Unit TX-1 (see additional discussion below). These habitats are not expected to be at or near carrying capacity for wintering shorebirds given the extent of suitable habitats in the region so Project-related displacement is not expected to adversely affect the species.

Further, individuals displaced from the Action Area would likely return to the tidal flat habitat adjacent to the Project Site once operation begins, given that operation of the Project would generally have a much lower activity and noise level. Creation of the maneuvering basin would reintroduce tidal inundation of the tidal flats adjacent to the Project Site, which would likely increase invertebrate prey diversity and abundance within months after inundation. This could significantly improve the quality of foraging habitat for plovers within the Action Area following construction.

Mortality of piping plovers from interaction with Project activities is unlikely. Wintering plovers are highly vigilant and very mobile so they would likely be displaced from the Project Site when construction activities commence. Nevertheless, per FWS request, Texas LNG would conduct pre-construction surveys within tidal flats in the vicinity of the berth and maneuvering basin to confirm that piping plovers are not present when marine pile driving and dredging activities commence.

During operation of the Project, there is potential for wintering piping plovers to be injured or killed during operation of the flares and/or due to collision with LNG terminal facilities. The flares would be used during start up, shutdown, and non-routine venting of excess pressure. Texas LNG estimates that each train would have one shutdown/start up per year requiring a total of 372 hours of flaring with the main flare and 264 hours of flaring with the marine flare, annually. Use of the flares for planned maintenance activities would be limited to daylight hours to the extent practical; thereby limiting potential impacts on birds. Further, start-up and maintenance events would be planned by Texas LNG to avoid inclement weather and during migration when the risk of bird mortalities from attraction to the flares would be the highest. The infrequency of flaring makes it highly unlikely to result in injury or take of the piping plover, which is a diurnal species that is present in south Texas during the winter months (Bourne, 1979; Russell, 2005). Similarly, research indicates that the potential for a piping plover to be injured or killed due to collision with terminal facilities is low, and is most likely to occur during migration (Russell, 2005). As with flaring, poor weather (e.g., fog, storms, and low cloud cover) can exacerbate the effect of bird attraction to lights (Ronconi et al., 2015). Texas LNG would minimize the potential for bird strikes by implementing its *Facility Lighting Plan*, which would minimize the occurrence of stray light and thus reduce the potential for collision.

Suitable habitat for the piping plover within the Project Site could be impacted during construction and operation of the Project through the accidental release of hazardous substances, such as lubricants or fuel. To counteract this potential, Texas LNG would adhere to its SPRP, which addresses personnel training, secondary containment design, hazardous substance storage and disposal procedures, refueling areas, spill response procedures, mitigation measures, and the Best Management Practices designed to reduce or eliminate potential adverse impacts on sensitive resources.

LNG carriers would discharge ballast water while berthed at the LNG terminal, which could introduce invasive plant or animal species to the Brownsville Ship Channel and related tidally influenced habitats. Invasive species compete with native species for food and space and can quickly cause a reduction in native species diversity and abundance and degrade the overall health of ecosystems. They can also cause algal blooms and hypoxic conditions, affecting all trophic levels of the aquatic ecosystem. Transport in ships' ballast water and ballast sediments is the leading means of unintentionally moving a broad range of aquatic species throughout the world and from state to state (U.S. Geological Survey, 2013). Introduction of invasive marine invertebrates, such as snails, could adversely affect forage quality for wintering piping plovers that forage on the tidal flats.

U.S. regulations require that all vessels equipped with ballast water tanks that enter or operate in U.S. waters maintain a vessel-specific ballast water management plan and assign responsibility to the master or appropriate official to understand and execute the ballast water management strategy for that vessel (33 CFR 151.2026). All LNG carriers calling at the terminal would be required to adhere to federal requirements that govern ballast water discharges into U.S. waters. Further, best management practices would be applied prior to allowing any ballast water to be discharged into the maneuvering basin. As such, introduction of aquatic invasive species through ballast water exchange is not anticipated.

4.1.2.2 Mitigation Measures

Texas LNG has committed to conducting pre-construction surveys to ensure that federally listed species (e.g., piping plover) are not present within the berth, maneuvering basin, and/or dredge disposal area prior to the start of marine pile driving and dredging activities. In addition, several measures have been proposed by Texas LNG to avoid or minimize Project related impacts on wintering piping plovers, including the following:

- During preliminary Project planning, Texas LNG concentrated and collocated Project facilities to minimize the Project footprint to the maximum extent practicable and concentrate the development in upland locations outside of piping plover habitat.

- Approximately 120.6 acres of tidal flat habitat for the piping plover would be undisturbed within the Project Site.

- Texas LNG designed the maneuvering basin to allow tidal exchange to nearby low elevation areas. Areas connected to the maneuvering basin lower than the tide level would receive unrestricted tidal exchange. This design feature would likely cause increased sediment transfer into the maneuvering basin and increased maintenance dredging cost and frequency; however, it would improve the functional quality of the nearby tidal flats.

- Texas LNG would adhere to federal regulations and best management practices relating to ballast water exchange.

- The Project-specific ECP and SWPPP would be implemented to avoid impacts on suitable wintering habitat for the piping plover beyond the approved construction footprint.

- During construction, Texas LNG would direct nighttime lighting towards construction activity and use the minimum light level necessary to ensure site safety and security.

- The *Facility Lighting Plan* for operation of the LNG terminal outlines the lighting to be installed at the facility, including down facing lights with shielding needed to meet regulatory standards and minimize fugitive lighting. Facility lighting would be chosen to minimize the horizontal emission of light away from intended areas, and shielding would help minimize impacts on birds (e.g., piping plover) and other wildlife while providing the illumination needed to ensure security and safe operation of the facility. In addition, for structures that are greater than 200 feet and require aviation safety lights in accordance with FAA regulations, Texas LNG would minimize potential impacts on birds (e.g., piping plover) from collisions with structures at night by utilizing flashing lights rather than non-flashing lights.

4.1.2.3 Determination of Effect

Construction and operation of the Project would impact 43.8 acres of suitable wintering habitat for the piping plover. However, given that the piping plover has not been observed within the Project Site during surveys in 2015 and 2016, that suitable wintering habitat impacted by construction of the Project is common in the region, and that 120.6 acres of suitable wintering habitat would be undisturbed within the Project Site, impacts from the Project are not expected to have a measurable effect on the species. Further, the Project has the potential to increase tidal inundation of the tidal flats following creation of the maneuvering basin. With implementation of Texas LNG’s proposed measures, we have determined that the Project *is not likely to adversely affect* the piping plover.

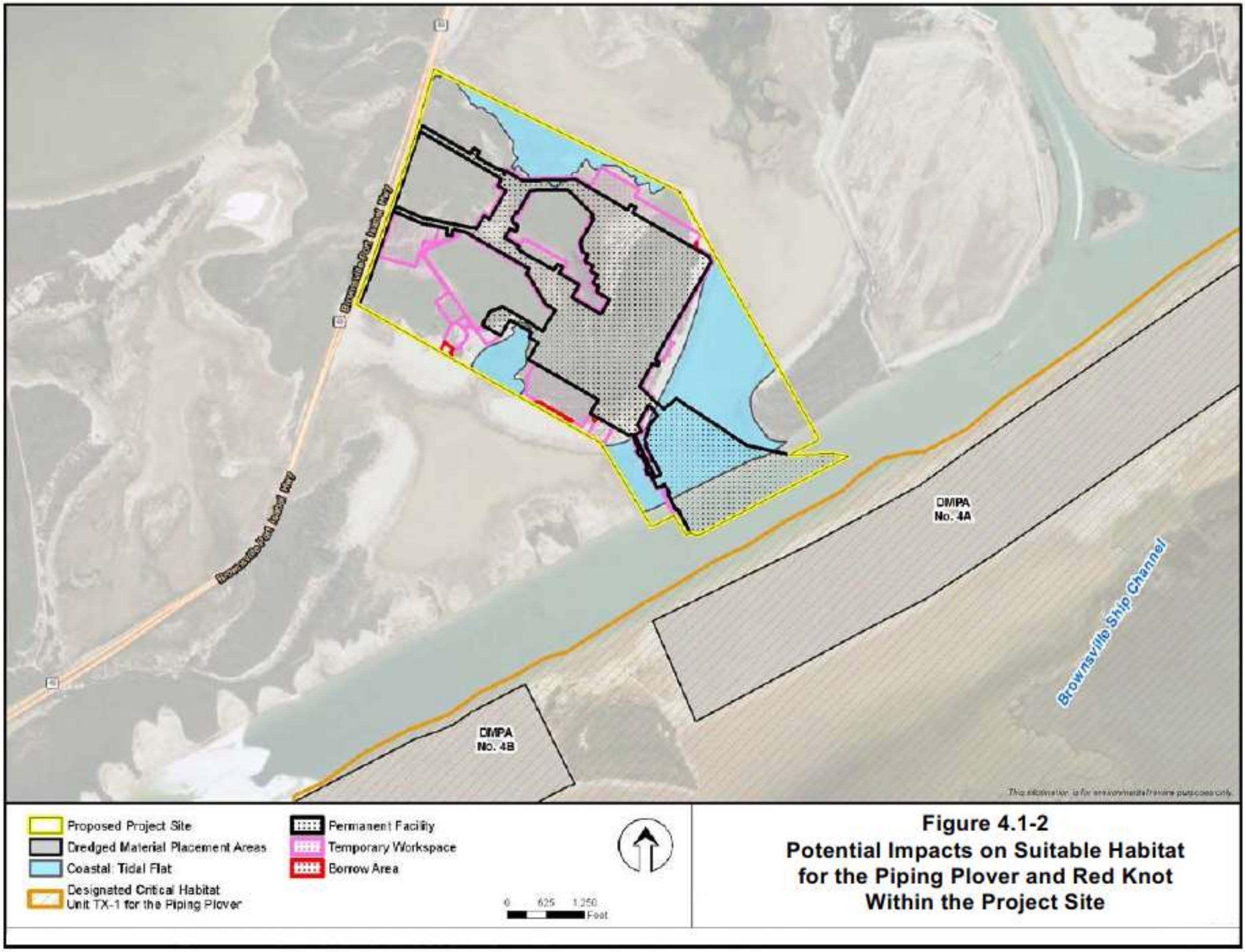

Figure 4.1-2 **Potential Impacts on Suitable Habitat for the Piping Plover and Red Knot Within the Project Site**

4.1.2.4 Designated Critical Habitat

As discussed in section 3.3.1.2, designated critical habitat for wintering piping plovers (Unit TX-1: South Bay and Boca Chica), occurs approximately 950 feet south of the Project Site, across the Brownsville Ship Channel. Potential impacts on designated critical habitat for the piping plover include modification due to dredged material placement and increased shoreline erosion as a result of vessel transit along the Brownsville Ship Channel and within the maneuvering basin.

One of the alternatives being considered by Texas LNG for the placement of up to approximately 3.9 million cubic yards of dredged material is the use of PA 4A, which is within Unit TX-1. However, as described in section 3.3.1.2, PA 4A no longer contains the PCEs for wintering habitat because the dredged materials have raised the ground level and effectively cut off water flow that is required for a tidal flat.

Construction and operation of the Project would result in increased vessel traffic within the Brownsville Ship Channel, including the proposed maneuvering basin. Up to 74 LNG carriers are expected to call on the LNG terminal annually during operation of the Project, which could increase wave activity and resulting shoreline erosion along the shoreline of Unit TX-1. However, the shoreline adjacent to Unit TX-1 has been substantially modified to accommodate PA 4A. In addition, LNG carriers and other support vessels are anticipated to travel at a low vessel speed (less than 8 knots per hour within the channel [NMFS, 2013]). Further, the Brownsville Ship Channel was specifically constructed to provide access for maritime commerce and to support high levels of deep-draft vessel traffic. As such, potential impacts on designated critical habitat for the piping plover would be negligible.

Because designated critical habitat along the Brownsville Ship Channel has been modified by previous and ongoing use for dredged material placement, and considering the low vessel speed of LNG carriers and other support vessels, construction and operation of the Texas LNG Project would result in *no adverse modification of designated critical habitat* for the piping plover.

4.1.3 Red Knot

Field surveys identified potentially suitable migratory stopover and wintering habitats for the red knot within tidal flats at the Project Site (see figures 3.3-2 and 4.1-2). There were no red knots observed at the Project Site during surveys conducted in October 2015 and March 2016.

4.1.3.1 Potential Impacts

Red knots within the Action Area could be affected by modifications to migratory stopover and wintering habitats within the Project Site; increased noise, flaring and artificial lighting, and human activity; mortality due to interaction with construction activities; accidental spills or leaks of hazardous materials, and the introduction of invasive species due to ballast water discharges. Given similar life histories, seasonal occurrence, and habitat requirements, the majority of these impacts would be similar to those described above for the piping plover (see section 4.1.2.1). However, the red knot has a higher sensitivity to human disturbance than the piping plover. Therefore, potential impacts on the red knot due to increased noise, artificial lighting, and human activity associated with construction and operation of the Project are discussed in additional detail below.

Based on foraging data from multiple species of shorebirds and gulls, red knots spent significantly less time foraging than did the other species, largely because they devoted more time to being vigilant (Burger et al., 2007). This same study documented that foraging red knots left beaches when disturbed by anthropogenic activity and did not return to pre-disturbance abundance within the 10-

minute study observation period. The results of this study indicate that red knots are sensitive to disturbance. Red knots that are present at or in the immediate vicinity of the Project during construction activities (in particular, dredging and pile driving activities) would likely be displaced from the Action Area. However, suitable red knot wintering habitat is common in the vicinity of the Project Site, so displaced individuals would likely easily relocate to nearby suitable habitats. These habitats are not expected to be at or near carrying capacity for wintering shorebirds given the extent of suitable habitats in the region so displacement is not expected to adversely affect the species.

Approximately 120.6 acres of migratory stopover and wintering habitats for the red knot within the Project Site would remain undisturbed following development of the Project. Although it is likely that this species would avoid the Project Site during more active periods of operation (e.g., when an LNG carrier is docked at the terminal and there is increased human activity within the Project Site), the red knot may utilize tidal flat habitats within the Project Site during operation when human activity levels are low.

4.1.3.2 Mitigation Measures

Texas LNG would conduct pre-construction surveys to ensure that federally listed species (e.g., red knot) are not present within the berth, maneuvering basin, and/or dredge disposal area prior to the start of marine pile driving and dredging activities.

Additionally, Texas LNG would implement the following mitigation measures to reduce the potential impacts from construction on piping plover and this species including the following:

- During preliminary Project planning, Texas LNG concentrated and collocated Project facilities to minimize the Project footprint to the maximum extent practicable and concentrate the development in upland locations outside of red knot habitat.

- Approximately 120.6 acres of tidal flat habitat for the red knot would be undisturbed within the Project Site.

- Texas LNG would adhere to federal regulations and best management practices relating to ballast water exchange.

- The Project-specific ECP and SWPPP would be implemented to avoid impacts on suitable migratory stopover and wintering habitats for the red knot beyond the approved construction footprint.

- During construction, Texas would direct nighttime lighting towards construction activity and use the minimum light level necessary to ensure site safety and security.

- The *Facility Lighting Plan* for operation of the LNG terminal outlines the lighting to be installed at the facility including down facing lights with shielding needed to meet regulatory standards and minimize fugitive lighting. Facility lighting would be chosen to minimize the horizontal emission of light away from intended areas, and shielding would help minimize impacts on birds (e.g., red knot) and other wildlife while providing the illumination needed to ensure security and safe operation of the facility.

4.1.3.3 Determination of Effect

Construction and operation of the Project would impact 40.8 acres of suitable migratory and wintering habitat for the red knot. However, given that the red knot has not been observed within the Site during surveys in 2015 and 2016, that suitable habitat impacted by construction of the Project is common in the region, and that approximately 120.6 acres suitable habitat would be undisturbed within the Project Site, impacts from the Project are not expected to have a measurable effect on the species. With implementation of Texas LNG's proposed measures, we have determined that the Project *is not likely to adversely affect* the red knot.

4.1.4 Whooping Crane

Suitable wintering habitat is present at the Project Site within the salt and brackish high tidal marsh, sea ox-eye daisy flats, tidal flat, and salty prairie. Whooping cranes winter along the Texas coast, primarily in the Aransas NWR located approximately 145 miles north of the Project site; however, there have been documented sightings within Cameron County as recent as 2015 (eBird, 2018).

4.1.4.1 Potential Impacts

Based on the presence of suitable wintering habitat in the Project area, as well as documented occurrences of whooping cranes in the Project vicinity, whooping cranes may occur within the Project Site. Whooping cranes within the Project Site could be affected by modifications to wintering habitats within the Project Site; increased noise, flaring and artificial lighting, and human activity; mortality due to interaction with construction activities; accidental spills or leaks of hazardous materials, and the introduction of invasive species due to ballast water discharges.

The majority of the sea ox-eye daisy flats within the Project Site are in the central portion of the Site between salty prairie and salt and brackish high tidal marsh habitats, all partially bounded by tidal flats on the northeast, southwest, and southeast portions of the Site. A total of 159.8 acres of suitable habitat for the whooping crane would be impacted by construction of the Project, including 140.9 acres that would be permanently impacted during operation or would not be restored to preconstruction contours. To minimize the potential for construction activities to increase erosion and sedimentation to adjacent suitable habitat, Texas LNG would install erosion control structures in accordance with its ECP. Temporary erosion and sediment control devices include, but are not limited to, sediment barriers (e.g., silt fence, straw bales, biologs), stormwater diversions, mulch, and revegetation. Where suitable habitat is adjacent to and downslope of construction work areas, sediment barriers would be installed along the edge of these areas, as necessary to prevent sediment flow into the tidal flat. If sediment barriers are in use, when the depth of sediment reaches about one-third of the height, the sediment must be removed. Erosion and sediment control structures would be maintained at all times, as required in the Project construction documents and as required by all applicable permits.

As discussed in section 4.1.2 and presented in table 3.1-1, tidal flats within the Project Site are composed of unvegetated mud flats that under normal conditions would be frequently inundated by water, although surveys indicate that flats within the Project Site have a reduced hydrologic connection to tidal waters. For this reason, tidal flats within the Project Site are considered to be of moderate quality. Tidal flats are a naturally dynamic environment, changing over time due to natural and anthropogenic changes including, but not limited to, sedimentation and sand deposition patterns, encroachment of vegetation, and storms. Similarly, sea ox-eye daisy flats, salty prairie, and salt and brackish high tidal marsh within the Project Site are all considered to be of moderate quality due to reduced hydrologic connection to tides (sea ox-eye daisy flats and salt and brackish high tidal marsh) and encroachment of woody species (salty prairie and salt and brackish high tidal marsh). Nevertheless, individuals displaced as a result of habitat modification and activity within the Project Site would likely easily relocate to nearby suitable habitats.

4.1.4.2 Mitigation Measures

Texas LNG has not proposed any mitigation measures specific to the whooping crane; however, general mitigation measures to reduce the potential impacts from construction on wildlife in the area apply to this species as well. Measures implemented by Texas LNG include the following:

- During preliminary Project planning, Texas LNG concentrated and collocated Project facilities to minimize the Project footprint to the maximum extent practicable and concentrate the development in upland locations outside of whooping crane habitat.

- Approximately 273.8 acres of potentially suitable habitat for the whooping crane within the Project Site would not be physically disturbed by construction activities, including salt and brackish high tidal marsh (83.9 acres), sea ox-eye daisy flat (34.9 acres), salty prairie (34.4 acres), and tidal flat (120.6 acres) habitats.

- The Project-specific ECP and SWPPP would be implemented to avoid impacts on suitable wintering habitats for the whooping crane beyond the approved construction footprint.

- Texas LNG would adhere to federal regulations and best management practices relating to ballast water exchange.

- During construction, Texas LNG would direct nighttime lighting towards construction activity and use the minimum light level necessary to ensure site safety and security.

- The *Facility Lighting Plan* for operation of the LNG terminal outlines the lighting that would be installed at the facility including down-facing lights with shielding needed to meet regulatory standards and minimize fugitive lighting. Facility lighting would be chosen to minimize the horizontal emission of light away from intended areas, and shielding would help minimize impacts on birds (e.g., whooping crane) and other wildlife while providing the illumination needed to ensure security and safe operation of the facility.

4.1.4.3 Determination of Effect

As discussed in section 3.3.1.4, suitable wintering habitat is present at the Project Site and whooping cranes have been observed within the Laguna Atascosa NWR. If whooping cranes are present within the Project area at the time of Project construction, they would likely relocate to nearby suitable habitat. Operation of the Project would permanently remove suitable wintering habitat from the Project area. However, abundant suitable habitat exists in the Project area, such as that present in the Laguna Atascosa NWR. Due to the potential presence of whooping cranes within the Project area we have determined that the Project *is not likely to adversely affect* the whooping crane.

4.2 MAMMALS

4.2.1 Ocelot

Suitable habitat for the ocelot within the Project Site includes areas of loma deciduous shrubland, loma evergreen shrubland, and loma grassland habitats, as depicted on figures 3.3-5 and 4.2-1. However, areas of potentially suitable habitat within the Site are fragmented and isolated from nearby large blocks of intact habitats on all sides by SH 48, tidal flats, dredged material PAs, and the Brownsville Ship Channel. The Laguna Atascosa NWR, part of the South Texas Refuge Complex, is located across SH 48 from the Project Site. Although the exact number of ocelots is unknown (due to ongoing changes in population size and the elusive nature of the species), there are currently 15 ocelots with tracking collars in the Laguna Atascosa NWR population (FWS, 2016). The FWS confirmed that the Project Site is neither considered to contain or be part of a larger block of suitable breeding habitat for ocelots, nor have collared ocelots have been tracked on the Project Site. However, the ocelot may use the Project Site for foraging and movement between preferred habitats. Biological surveys conducted in October 2015 documented feline tracks within the Site that are typical of ocelot, based on the shape of the metacarpal pad and overstep. Positive identification of the tracks was not possible due to the condition of the tracks and known occurrence of bobcats within the Project Site, which have similar tracks.

4.2.1.1 Potential Impacts

If present within the Action Area, ocelot could be affected by a reduction in foraging/transient habitats within the Project Site; increased noise, lighting, and human activity; and mortality due to interaction with roadway traffic. These potential impacts are described below.

A total of 132.5 acres of potentially suitable loma habitats are present within the Project Site, of which 103.4 acres would be impacted by construction of the Project. As depicted on figure 4.2-1, the majority of the impacted habitat within the Project Site (63.6 acres of loma evergreen shrubland, 20.2 acres of loma grassland, and 14.7 acres of loma deciduous shrubland) would be permanently impacted by operation of the Project. An additional 4.9 acres of habitat would be used for temporary workspace and laydown areas, which would be seeded, and allowed to revegetate following construction activities. The remaining 29.1 acres of loma habitats within the Site would be undisturbed by construction activities. Although 34.0 acres of loma habitats within the Site would be either undisturbed or allowed to revegetate, these areas would no longer provide potentially suitable foraging/transient habitats for the ocelot and Gulf Coast jaguarundi (see section 4.2.2) due to their small size and isolation from other tracts of suitable habitat. The loss of 132.5 acres of potentially suitable foraging/transient habitats within the Project Site represents less than 1 percent of the approximately 19,200 acres of dense thornscrub habitat within a 13.7-mile radius around the Laguna Atascosa NWR (FWS, 2010a). In addition, the Lower Rio Grande Valley NWR, located south of the Project Site (see figure 3.3-3), encompasses almost 80,000 acres of federally protected land, including thornscrub and dense bunchgrass habitats that are suitable for and ocelot and jaguarondi (FWS, 2013b). Further, there are several programs underway focused on restoring suitable habitat for the jaguarundi and ocelot, including the following:

- The Ocelot Habitat Restoration Plan was finalized by the Laguna Atascosa NWR in 2012, which targets areas for habitat restoration within the refuge (FWS, 2012).
- The Burned Area Emergency Response program operated by the South Texas Refuge Complex provides funding for restoration of wildfire-affected areas involving invasive grass control and revegetation with native brush species in an effort to increase the amount of suitable jaguarundi and ocelot habitat on NWR managed lands.

- The Lower Rio Grande Valley NWR and partners have been collaborating since 1979 to create a wildlife corridor that connects the Lower Rio Grande Valley NWR with the Laguna Atascosa NWR (FWS, 2015f). A key purpose of the corridor is to connect habitats within the two refuges to facilitate the safe movement of ocelot, jaguarundi, and other wide-ranging wildlife species. The corridor is not yet complete and efforts to incorporate more lands into the corridor and to restore degraded lands within the corridor are ongoing (FWS, 2015f).

Ocelots exhibit significant habitat plasticity, successfully adapting to agricultural or otherwise disturbed landscapes and dispersing widely in search of prey and/or undisturbed habitats (de Oliveira, 1998; Nowak, 1999). As such, avoidance of, or displacement from the Project Site would not have a measureable effect on the ocelot.

Although the ocelot is less sensitive to elevated noise and human activity than the jaguarundi (see section 4.2.2.1), it is expected that if an ocelot is present within the Action Area when construction activities commence, it would likely be permanently displaced to nearby areas of suitable habitat within the Laguna Atascosa NWR. However, because potential use of the Project Site is currently limited to transient individuals, permanent displacement from the Project Site is not expected to have an adverse effect on the species.

The three major threats to the ocelot population include loss of habitat, road mortalities, and genetic isolation (Haines et al., 2005a). There is potential for increased vehicle traffic along SH 48 to result in the injury of ocelot. Collisions with motor vehicles account for approximately 45 percent of ocelot mortality followed by 35 percent from natural causes, and the remaining 20 percent are unknown (Haines et al., 2005b). However, traffic associated with construction and operation of the Project would largely occur during daytime hours, when the ocelot is inactive. In addition, the conversion of suitable foraging/transient habitat within the Project Site would further reduce the likelihood of ocelot crossing SH 48, thereby minimizing the potential for vehicle strike. Further, the facility fence would not extend all the way to SH 48; therefore, it is possible for transient individuals to get around the Project Site without having to cross SH 48. Finally, ocelot moving between areas of suitable habitat may utilize an existing underpass beneath SH 48, which was constructed at a known ocelot crossing of the Brownsville Ship Channel 3.8 miles west of the Project Site, thereby avoiding the potential for collision with Project-related traffic. Therefore, the Project would not further contribute to ocelot population declines through increased genetic isolation.

4.2.1.2 Mitigation Measures

Texas LNG has proposed the following measures to avoid or minimize project-related impacts on wildlife, including the ocelot:

- During preliminary Project planning, Texas LNG concentrated and collocated Project facilities to minimize the Project footprint to the maximum extent practicable.

- Texas LNG would implement a training and awareness program for all personnel constructing or accessing the LNG terminal, which would teach personnel about the natural history and endangerment factors for the ocelot, and the responsibilities of personnel in preventing vehicular impacts on the species.

- The *Facility Lighting Plan* for operation of the LNG terminal outlines the lighting to be installed at the facility, including downfacing lights with shielding needed to meet regulatory standards and minimize fugitive lighting. Facility lighting would be chosen to minimize the horizontal emission of light away from intended areas, and shielding would help minimize impacts on nocturnal wildlife (e.g., ocelot) while providing the illumination needed to ensure security and safe operation of the facility.

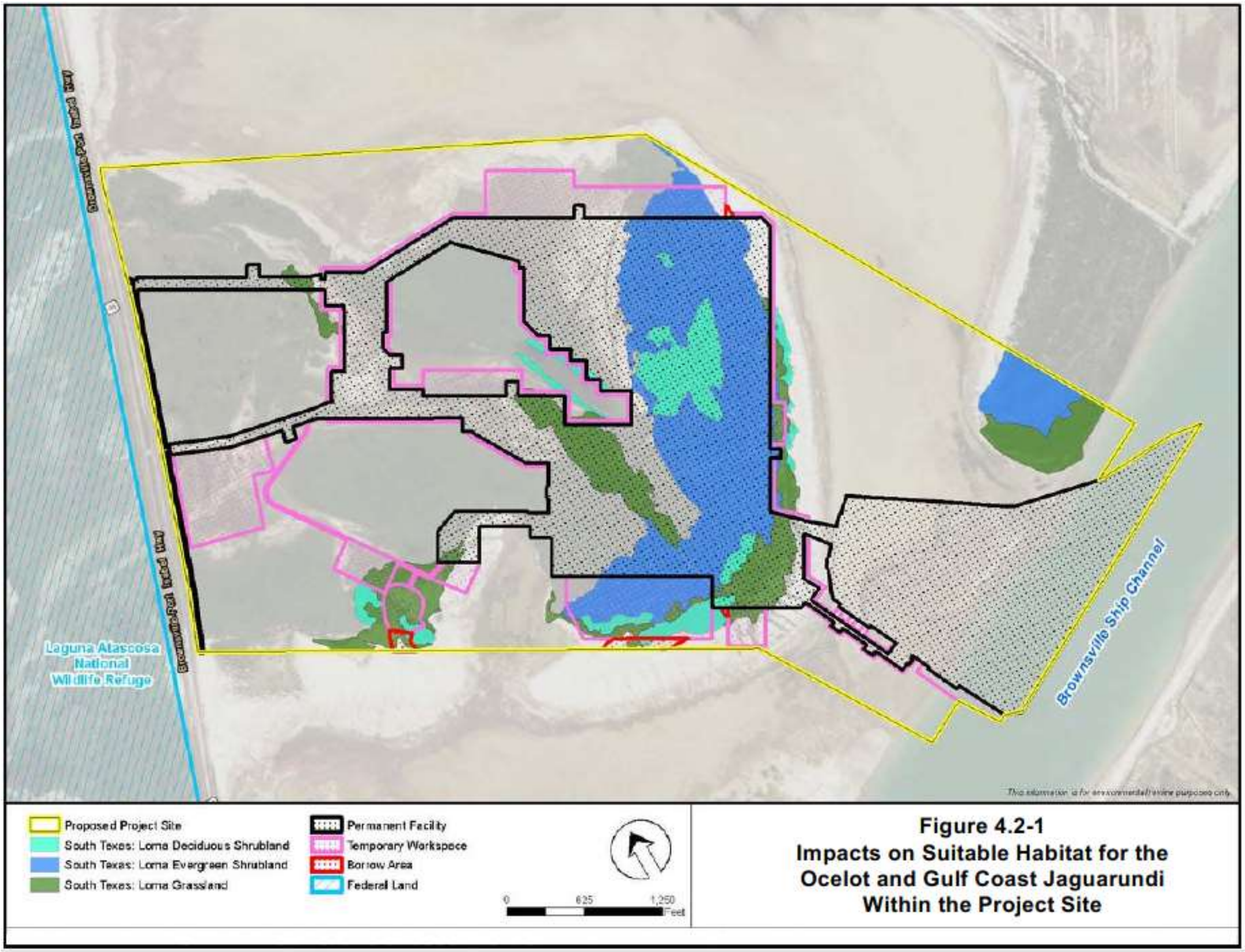

Figure 4.2-1 **Impacts on Suitable Habitat for the Ocelot and Gulf Coast Jaguarundi Within the Project Site**

4.2.1.3 Determination of Effect

Habitats that would be impacted by the Project are limited to supporting foraging or transient ocelots due to isolation from larger areas of suitable habitat. Habitat modification due to the Project would result in a reduction in suitable habitat of less than 1 percent within the region, which is not expected have a measurable effect on the species because the ocelot exhibits a high level of habitat plasticity and is able to traverse long distances in search of suitable habitat and prey.

Texas LNG would implement a training and awareness program for all personnel accessing the Project Site, which would teach personnel about the natural history and endangerment factors for the ocelot and the responsibilities of personnel in preventing vehicular impacts.

While the ocelot may occur within the Project Site, it is likely rare and limited to transient individuals. Based on the impact minimization measures that Texas LNG would implement as well as the rarity of the species, we have determined that the Project *is not likely to adversely affect* the ocelot.

4.2.2 Gulf Coast Jaguarundi

Field surveys identified potentially suitable foraging and transient habitat for the Gulf Coast jaguarundi within lomas (loma deciduous shrubland, loma evergreen shrubland, and loma grassland habitats) at the Project Site (figure 3.3-5). The Gulf Coast jaguarundi is exceedingly rare in south Texas and the last confirmed sighting of the species in the area was in 1986. Staff from the Laguna Atascosa NWR acknowledge that confirmed sightings of the jaguarundi are rare; however, the species has been detected on the refuge in the past and is still considered to occur in the area.

4.2.2.1 Potential Impacts

If present within the Action Area, Gulf Coast jaguarundi could be affected by a reduction in foraging/transient habitats within the Project Site, increased noise and human activity, and mortality due to increased interaction with roadway traffic. These potential impacts are described below.

As discussed in section 4.2.1.1, the loss of 132.5 acres of potentially suitable foraging/transient habitats within Project Site represents less than 1 percent of the approximately 19,200 acres of dense thornscrub habitat within a 13.7-mile radius around the Laguna Atascosa NWR and approximately 0.1 percent of the federally protected land associated with the South Texas Refuge Complex. In addition, several programs underway are focused on restoring suitable habitat for the jaguarundi and ocelot (section 4.2.1.1).

Because of the availability of large tracts of suitable (and in some cases higher quality) habitat in nearby protected areas and on other privately owned sites, it is expected that the loss of foraging/transient habitat at the Project Site would not adversely impact the Gulf Coast jaguarundi. The jaguarundi is more sensitive to disturbance and more specific in its habitat preferences than other cat species in Texas, such as ocelot (FWS, 2013). As a result, it is expected that if a jaguarundi is present within the Action Area when construction activities commence, it would likely be permanently displaced to nearby areas of suitable habitat within the Laguna Atascosa NWR due to increased noise and human activity. However, because potential use of the Project Site is currently limited to transient individuals, permanent displacement from the Site is not expected to have a measurable effect on the species. There is potential for increased vehicle traffic along SH 48 to result in the injury of Gulf Coast jaguarundi. Collisions with motor vehicles are a known cause of mortality for jaguarundi in Texas (FWS, 2013). However, because the species is primarily active during the day, the risk of road mortality is lower for jaguarundi than for nocturnal species. An underpass has been constructed under SH 48, 3.8 miles west of the Project Site, to facilitate safe road crossing by jaguarundi and other species. Further, as mentioned above for the ocelot, the facility fence would not extend all the way to SH 48; therefore, it is possible for transient individuals to get around the Project Site without having to cross SH 48. The conversion of suitable foraging/transient habitat within the Project Site and absence of suitable habitat for this species adjacent to the Project Site would further reduce the likelihood of jaguarundi crossing SH 48, thereby minimizing the potential for vehicle strike.

4.2.2.2 Mitigation Measures

Texas LNG has proposed the following measures (similar to those measures proposed for the ocelot) to avoid or minimize Project-related impacts on the Gulf Coast jaguarundi:

- During preliminary Project planning, Texas LNG concentrated and collocated Project facilities to minimize the Project footprint to the maximum extent practicable.

- Texas LNG would implement a training and awareness program for all personnel constructing or accessing the LNG terminal, which would teach personnel about the natural history and endangerment factors for the Gulf Coast jaguarundi, and the responsibilities of personnel in preventing vehicular impacts on the species.

4.2.2.3 Determination of Effect

While Gulf Coast jaguarundi are more sensitive than the ocelot to human activity and typically more active during the day, it is rare in the Project area and the Project Site would be likely limited for use by transient individuals. Thus, potential impacts on Gulf Coast jaguarundi and the measures that Texas LNG would implement to minimize those impacts would be the same as discussed above for the ocelot. Therefore, we have determined that the Project *is not likely to adversely affect* the Gulf Coast jaguarundi.

4.2.3 Sperm Whale

Due to their preference for deep, offshore waters and their relative rarity in Texas waters, the occurrence of sperm whales within the Action Area is limited to the portion of the LNG carrier transit route through the Gulf of Mexico between the Brownsville Ship Channel and the EEZ. Potential impacts on the sperm whale from increased vessel transit through the Gulf of Mexico (74 LNG carriers are expected to call on the LNG terminal annually during operation of the Project) include vessel-whale strikes and spills or leaks of hazardous materials.

When in the ocean, LNG carriers would travel at approximately 20 knots. Although interaction with sperm whales is highly unlikely due to the limited amount of time this species spends near the surface, it is possible that a vessel could strike a whale resulting in injury or mortality. To minimize the likelihood of a whale strike, Texas LNG would provide ship captains with the NMFS *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008) and would advocate compliance with the measures identified in the document, such as:

- Vessel operators and crews shall maintain a vigilant watch for marine mammals to avoid striking sighted protected species.
- When whales are sighted, maintain a distance of 100 yards or greater between the whale and the vessel.

- When small cetaceans are sighted while a vessel is underway (e.g., bow-riding), attempt to remain parallel to the animal's course. Avoid excessive speed or abrupt changes in direction until the cetacean has left the area.
- Reduce vessel speed to 10 knots or less when mother/calf pairs, groups, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. A single cetacean at the surface may indicate the presence of submerged animals in the vicinity; therefore, prudent precautionary measures should always be exercised. The vessel shall attempt to route around the animals, maintaining a minimum distance of 100 yards whenever possible.

Spills, leaks, or accidental releases of fuels, lubricants, or other hazardous substances could potentially occur during vessel transit. The sperm whale could be susceptible to the effects of spills either by direct encounter or ingestion of contaminated prey. Fuel (e.g., diesel) used for vessel propulsion or auxiliary/emergency generators could potentially spill or leak. However, fuel on each ship is protected by the vessel's double hull. Furthermore, every oil tanker of 150 gross tons and above, and all vessels of 400 gross tons and above are required to maintain a Shipboard Oil Pollution Emergency Plan (SOPEP), in compliance with MARPOL 73/78 Consolidated Edition 2002 Annex 1 Regulation 26. The SOPEP would contain measures to be implemented in the event of a petroleum release.

Based on the limited occurrence of sperm whales in the Gulf of Mexico waters, the implementation of *Vessel Strike Avoidance Measures and Reporting for Mariners*, and maintenance of a SOPEP on each LNG carrier, we have determined that the Project *may affect, but is not likely to adversely affect* the sperm whale.

4.2.4 Fin Whale

Due to their preference for deep, offshore waters and their relative rarity in Texas waters, the occurrence of fin whales within the Action Area is limited to the portion of the LNG carrier transit route through the Gulf of Mexico between the Brownsville Ship Channel and the EEZ. Potential impacts on the fin whale and measures that Texas LNG would take to minimize those impacts would be the same as described above for the sperm whale.

Based on the limited occurrence of fin whales in the Gulf of Mexico waters, the implementation of *Vessel Strike Avoidance Measures and Reporting for Mariners*, and maintenance of a SOPEP on each LNG carrier, we have determined that the Project *is not likely to adversely affect* the fin whale.

4.2.5 Sei Whale

Due to their preference for deep, offshore waters and their relative rarity in Texas waters, the occurrence of sei whales within the Action Area is limited to the portion of the LNG carrier transit route through the Gulf of Mexico between the Brownsville Ship Channel and the EEZ. Potential impacts on the sei whale and measures that Texas LNG would take to minimize those impacts would be the same as described above for the sperm and fin whales.

Based on the limited occurrence of sei whales in the Gulf of Mexico waters, the implementation of *Vessel Strike Avoidance Measures and Reporting for Mariners*, and maintenance of a SOPEP on each LNG carrier, we have determined that the Project *is not likely to adversely affect* the sei whale.

4.2.6 Blue Whale

Due to their preference for deep, offshore waters and their relative rarity in Texas waters, the occurrence of blue whales within the Action Area is limited to the portion of the LNG carrier transit route through the Gulf of Mexico between the Brownsville Ship Channel and the EEZ. Potential impacts on the blue whale and measures that Texas LNG would take to minimize those impacts would be the same as described above for the sperm, fin, and sei whales.

Based on the limited occurrence of blue whales in the Gulf of Mexico waters, the implementation of *Vessel Strike Avoidance Measures and Reporting for Mariners*, and maintenance of a SOPEP on each LNG carrier, we have determined that the Project *is not likely to adversely affect* the blue whale.

4.2.7 Gulf of Mexico Bryde's Whale

As discussed in section 3.3.2.6, the Gulf of Mexico Bryde's whale prefers warmer waters than the other listed whales and is also known to approach vessels, increasing their risk of vessel strikes. However, a majority of the documented occurrences are in northeastern Gulf of Mexico and no occurrences have been documented west of Louisiana's coast. Due to their preference for deep, offshore waters and relative rarity in Texas waters, the potential occurrence of Gulf of Mexico Bryde's whale within the Action Area is limited to the portion of the LNG carrier transit route through the Gulf of Mexico between the Brownsville Ship Channel and the EEZ. Potential impacts on the Gulf of Mexico Bryde's whale and measures that Texas LNG would take to minimize those impacts would be the same as described above for the other listed whales.

Based on the limited occurrence of Gulf of Mexico Bryde's whales in the Gulf of Mexico waters along the Texas coast, the implementation of *Vessel Strike Avoidance Measures and Reporting for Mariners* and maintenance of a SOPEP on each LNG carrier, we have determined that the Project *is not likely to adversely affect* the Gulf of Mexico Bryde's whale.

4.2.8 West Indian Manatee

Potential for the West Indian manatee to occur within the Action Area is limited to the portion of the vessel transit routes through the Brownsville Ship Channel between Laguna Madre and South Bay, as depicted in figure 3.3-6. This portion of the transit area is between suitable areas of seagrass habitats that could be utilized by the manatee.

However, given the limited and transient occurrence of West Indian manatees in Texas coastal waters, the presence of the West Indian manatee is expected to be extremely rare. Although unlikely, seagrass habitats adjacent to vessel transit routes could support transient manatees. During construction and operation of the Project, barges, support vessels, and LNG carriers would call on the LNG terminal, increasing ship traffic within the Brownsville Ship Channel and Gulf of Mexico. Potential impacts on West Indian manatees from increased vessel traffic through these areas include vessel strikes, increased turbidity levels, accidental spills or leaks of hazardous materials, and pile driving.

Texas LNG estimates that construction of the Project would result in a total of approximately 109 barge deliveries to the MOF. During operation, 74 LNG carriers are expected to call on the LNG terminal per year.

As discussed further detail the draft EIS, based on Texas Commission on Environmental Quality water quality standards for total suspended solids (TSS), the target maximum suspended sediment concentrations was determined to be 300 mg/l. TSS levels for clays are anticipated to reach the Texas Commission on Environmental Quality level of 300 mg/l approximately 460 feet from the dredging activity. Based on the results of the dredge plume propagation study conducted for the Project, turbidity is anticipated to be greatest during dredging of clays with moderate impacts in the immediate vicinity of dredge activities; however, TSS levels are anticipated to dissipate to acceptable levels within a relatively short distance (460 feet). Based on the anticipated dissipation of TSS approximately 460 feet from dredging activities and the limited occurrence of the West Indian manatee in the Action Area, impacts on manatees are not anticipated to result from dredging activities.

When transiting the Brownsville Ship Channel, vessels (barges, support vessels, and LNG carriers) would travel at a speed no greater than 8 knots (NMFS, 2013). Manatees have relatively poor hearing sensitivity in the low frequency ranges associated with boat noise, so they often cannot hear boats approaching until they are too close to avoid an interaction (Gerstein, 2002). To minimize the potential for interactions with manatees (and other federally listed species) and LNG carriers, Texas LNG would provide ship captains with the NMFS, Southeast Region's *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008) and would advocate compliance with the measures identified in the document.

As discussed further in section 4.4.1.1, pile driving activities would take place 10 hours per day, six days per week. Onshore pile driving would be conducted over approximately 13 months. Driving piles in aquatic environments creates sound waves that can adversely impact marine life. Most piles associated with construction of the LNG carrier dock and all of the MOF would be installed prior to dredging the maneuvering basin to reduce potential acoustic impacts on aquatic resources; however, 12, 48-inch-diameter steel piles associated with the three southernmost mooring dolphins closest to the Brownsville Ship Channel would be installed in-water over an anticipated 12 days. Texas LNG has proposed general measures to reduce potential impacts on sea turtles and marine mammals as a result from pile driving (e.g., the West Indian manatee) (see section 4.4.1.2). Based on the relatively short duration of the installation of the three southernmost mooring dolphins closest to the Brownsville Ship Channel and the implementation of the measures listed in section 4.4.1.2, impacts on the West Indian manatee are not anticipated to result from pile driving activities.

Spills, leaks, or accidental releases of fuels, lubricants, or other hazardous substances could potentially occur during vessel transit. The West Indian manatee could be susceptible to the effects of spills either by direct encounter or ingestion of contaminated seagrass. Fuel used for vessel propulsion or auxiliary/emergency generators could potentially spill or leak. However, fuel on each LNG carrier will be protected by the vessel's double hull. Furthermore, each LNG carrier would maintain a SOPEP, which contains measures to be implemented in the event of a petroleum release.

Based on the limited and transient occurrence of West Indian manatees in Texas coastal waters, the lack of suitable seagrass habitat within the Action Area, and with the implementation of the *Vessel Strike Avoidance Measures and Reporting for Mariners* and maintenance of a SOPEP on each LNG carrier, the likelihood of construction or operation of the Project impacting the manatee is negligible. Therefore, we have determined that the Project *is not likely to adversely affect* the West Indian manatee.

4.3 FLOWERING PLANTS

4.3.1 South Texas Ambrosia

Species-specific surveys were conducted for South Texas ambrosia during the species' flowering season within loma habitats at the Project Site in October 2015 (as described in section 3.3.3.1). South Texas ambrosia was not documented during the survey effort, although plant community associates for this species were documented within the Project Site, which indicates potential suitability of habitat within the Project Site to support South Texas ambrosia.

4.3.1.1 Potential Impacts

If present within the Project Site, South Texas ambrosia could be affected by clearing associated with construction activities, stormwater discharges, and spills or leaks of hazardous materials. These potential impacts are described below.

Construction and operation of the Project would directly impact 103.4 acres of loma habitats within the Project Site. As depicted on figure 4.3.1-1, the majority of the impacted habitat (53.9 acres of loma evergreen shrubland, 16.0 acres of loma grassland, and 10.9 acres of loma deciduous shrubland) would be permanently converted to industrial use associated with the LNG terminal, respectively. An additional 4.9 acres of habitat would be used for temporary workspace and laydown areas, which would be seeded, and allowed to revegetate following construction activities. The remaining 29.1 acres of potentially suitable loma habitats for South Texas ambrosia within the Project Site would be undisturbed.

Stormwater discharges associated with construction and operation of the Project could result in the introduction of soils from within the construction footprint to adjacent areas of potentially suitable habitat for South Texas ambrosia. To minimize the potential for erosion and sedimentation impacts on adjacent loma habitats, land disturbing activities would be conducted in compliance with the EPA's National Pollution Discharge Elimination System Construction General Permit for stormwater discharges and a Project–specific SWPPP, as required under the Clean Water Act.

Suitable habitat for South Texas ambrosia within the Project Site could be impacted during construction and operation of the Project through the accidental release of hazardous substances, such as lubricants or fuel. To minimize this potential, Texas LNG would adhere to its SPRP, which addresses personnel training, secondary containment design, hazardous substance storage and disposal procedures, refueling areas, spill response procedures, mitigation measures, and the Best Management Practices designed to reduce or eliminate potential adverse impacts on sensitive resources resulting from a spill.

4.3.1.2 Mitigation Measures

Texas LNG has not proposed any mitigation measures specific to South Texas ambrosia, as species-specific surveys for the plant indicated it was not present on the Project Site (see section 3.3.3.1); however, general mitigation measures to reduce the potential impacts from construction on sensitive resources apply to this species as well. Measures to be implemented by Texas LNG include the following:

- During preliminary Project planning, Texas LNG concentrated and collocated Project facilities to minimize the Project footprint to the maximum extent practicable.
- Approximately 29.1 acres of suitable habitat for South Texas ambrosia within loma grassland (15.5 acres), loma evergreen shrubland (8.9 acres), and loma deciduous shrubland (4.7 acres) habitats would be undisturbed within the Project Site.
- The Project-specific ECP and SWPPP would be implemented to avoid impacts on suitable loma habitats for South Texas ambrosia beyond the approved construction footprint.
- The Project-specific SPRP would be implemented to minimize the potential for an accidental release of hazardous materials and ensure adequate spill response procedures are in place in the event of a release.

4.3.1.3 Determination of Effect

As described in section 3.3.3.1, South Texas ambrosia is not present within the Project Site. As such, we have determined that the Project would have *no effect* South Texas ambrosia.

4.3.2 Texas Ayenia

Species-specific surveys were conducted for Texas ayenia during the species' flowering season within loma habitats at the Project Site in October 2015. Texas ayenia was not documented during the survey effort, although plant community associates for this species were documented in the Project Site, which indicates suitability of habitat within the Project Site to support Texas ayenia.

4.3.2.1 Potential Impacts and Mitigation Measures

If present within the Project Site, Texas ayenia could be affected by clearing associated with construction activities, stormwater discharges, and spills or leaks of hazardous materials. These potential impacts would be similar to those described in section 4.3.1.1 for South Texas ambrosia. Texas LNG has not proposed any mitigation measures specific to Texas ayenia; however, the mitigation measures described in section 4.3.1.2 that apply to South Texas ambrosia would apply to this species as well.

4.3.2.2 Determination of Effect

Based on the overall rarity of the species, documented occurrence of Texas ayenia within Cameron County being limited to one population on private property and isolated individuals along the Arroyo Colorado (FWS, 2014c), and the negative findings for species-specific surveys conducted within the Project Site, Texas ayenia is not anticipated to be present within the Project Site. Therefore, we have determined that the Project would have *no effect* on the Texas ayenia.

4.4 SEA TURTLES

4.4.1 Species

Of the five species of sea turtles known to occur within the Action Area, four are relatively common in Texas waters (green, hawksbill, Kemp's ridley, and loggerhead sea turtles), where they primarily inhabit shallow, inner continental shelf waters of the Gulf of Mexico, close to the coast (COE, 2013). Of these four species, hawksbill sea turtles occur the least frequently. Sighted individuals are usually post-hatchlings and juveniles that come to Texas from nesting beaches in Mexico and are often found in association with stone jetties (NMFS and FWS, 2013a). Leatherback turtles are rare in Texas and when they do occur, they are found in deep offshore waters in the Gulf of Mexico. As described in section 3.3.4, no nesting habitat for any of the five sea turtles is present within the Action Area.

In contrast with the regular occurrence of sea turtles within coastal portions of the Gulf of Mexico, sea turtles are occasionally documented near the entrance to the Brownsville Ship Channel and are very rarely documented further inland than the Laguna Madre and South Bay within the Brownsville Ship Channel, due to a lack of seagrass or other preferred habitats (seagrass habitat is depicted on figure 3.3-6). It is thought that sea turtles within the waterway are transients avoiding disturbance or en route to preferred habitats (COE, 2013; Renaud et al., 1992).

4.4.1.1 Potential Impacts

Due to the potential presence of sea turtles within the Project Site and along vessel transit routes, the Project could directly affect sea turtles as a result of dredging, pile driving, and LNG carrier and other marine vessel transit (e.g., construction barges and tugboats). In addition, Project-related noise, lighting, and human activity could result in disturbance and/or displacement of sea turtles; however, because sea turtle occurrence in the vicinity of the Project Site is rare and likely limited to transient individuals, these impacts would be negligible and are not further discussed.

Potential effects from the Project would primarily be limited to impacts on green, Kemp's ridley, and loggerhead turtles because of their more common presence within coastal portions of the Gulf of Mexico and outer portions of the Brownsville Ship Channel. Potential impacts on sea turtles and measures Texas LNG would implement to avoid and minimize these impacts are described below.

Dredging

As described in additional detail in section 2.4.2.2, construction of the Project would require dredging of approximately 3.9 million cubic yards of material for construction of the maneuvering basin. Dredging would be accomplished over an 11-month period using a hydraulic cutterhead dredge. Dredged materials would be transported to an upland PA on the south side of the Brownsville Ship Channel, where they would be placed and allowed to dewater.

Dredging activities associated with the Project would be geographically limited to the maneuvering basin, approximately 5 miles from the Gulf of Mexico (figure 2.3-2). As described above, sea turtles rarely occur in the portion of the Brownsville Ship Channel near the Project Site due to the disturbed nature of the channel and absence of seagrass and other suitable foraging habitats in the channel.

Although unlikely due to the rarity near the Project Site, sea turtles could be injured or killed during dredging activities through contact with or entrainment in the dredge. The potential for injury of or mortality to sea turtles as a result of dredging is primarily limited to hopper dredging, which entrain turtles and other marine species because of the large suction tubes used to extract bottom sediments. However, sea turtles easily avoid hydraulic cutterhead dredges due to the slow movement of the dredge (COE, 2013). For this reason, the NMFS recommends the use of non-hopper dredges, particularly during sea turtle nesting and hatching periods (COE, 2013; NMFS, 2005). To further minimize the likelihood of injury or mortality to sea turtles as a result of dredging, a monitor trained in the identification of sea turtles and other federally listed marine species would ensure that sea turtles or other protected species are not present prior to the start of dredging activities. Therefore, sea turtle injury or mortality as a result of dredging activities associated with the Project is unlikely.

Another potential impact on sea turtles from dredging could be habitat degradation through a temporary decrease in water quality during and immediately following dredging activities. Dredging activities suspend sediments in the water column, creating increased total suspended solids and turbidity, increased dissolved nutrient levels, and decreased dissolved oxygen levels within the waters surrounding the dredging activity. The magnitude and spatial extent of these water quality effects varies widely depending on site conditions (e.g., background water and sediment quality, tidal exchange) and the dredging method used.

Proposed use of a hydraulic cutterhead dredge would minimize turbidity in the vicinity of the dredge activities because the turbid water is siphoned into the temporary pipeline along with the substrate.

Implementation of the Texas LNG's Project-specific ECP, would reduce the potential for and magnitude of water quality effects related to dredging even further.

Texas LNG anticipates that maintenance dredging of the maneuvering basin would occur once every three to five years. Potential impacts on sea turtles as a result of maintenance dredging would be similar to those described above for construction of the Project, but would be reduced due to a lower volume of material being removed.

Pile Driving

The installation of piles would be required to provide a firm base for the structures comprising the LNG terminal. As discussed in section 2.4.2.2, pile driving activities are anticipated to occur up to 10 hours per day, 6 days per week. Texas LNG would install most piles onshore (uplands and tidal flats) to support the liquefaction trains, LNG storage tanks, LNG carrier berthing dock, MOF, and other process equipment and structures. Onshore piles would be driven by up to 10 impact pile drivers over an estimated 13 months. In-water pile driving would be required to install a total of 12 piles associated with the three southernmost mooring dolphins. In-water pile installation would occur over a 12-day period. In-water piles would be driven with vibratory pile drivers and finished with impact pile drivers, which may include both land-based and floating rigs.

Underwater sound pressure levels generated by pile driving could affect sea turtles by causing decreased auditory sensitivity; loss of hearing; behavioral changes such as avoidance, which can increase energy expenditure, reducing overall fitness; or by masking acoustic cues that are important for evading predators or anthropogenic hazards (e.g., vessels, fishing equipment) (Bureau of Ocean Energy Management, 2012). NMFS has developed guidelines for determining sound pressure level thresholds for sea turtles (NMFS, 2016b). These thresholds are presented in table 4.4-1. Avoidance behavior in response to seismic signals at levels between 166 and 179 dB has been observed (Moein et al., 1995; McCauley et al., 2000).

TABLE 4.4-1
Underwater Sound Thresholds for Sea Turtles

Functional Hearing Group	Underwater Sound Thresholds			
	Vibratory Pile Driving – Behavioral Disturbance [a]	Vibratory Pile Driving – Injury	Impact Pile Driving – Behavioral Disturbance [a]	Impact Pile Driving – Injury
Sea Turtles	166 dB RMS	180 dB RMS	166 dB RMS	180 dB RMS

[a] The root mean square exposure level is the square root of the average sound pressures over the duration of a pulse and represents the effective pressure and intensity produced by a sound source.

Although sea turtles would be expected to largely avoid the Project area during pile driving activities, the potential exists for sea turtles to be injured during the first several strikes of the pile driving hammer, especially if the turtles are cold-stunned from cold weather events. Texas LNG would reduce impacts on sea turtles as well as all marine species from pile driving by implementing the measures outlined in section 4.4.1.2. In addition to pile driving, dredging can also result in increased underwater noise. As discussed in the draft EIS, operation of a hydraulic cutterhead dredge operating in the Project area would have an estimated sound pressure level at 1 meter of 172 dB re 1 μPa. The anticipated distances at which the thresholds presented in table 4.4-1 would be expected to occur are presented in table 4.4-2. Texas LNG would implement measures to reduce underwater sound pressures during pile driving activities, including installation of cushion blocks and bubble curtains. The values presented in table 4.4-2 below are the anticipated distances at which the thresholds would be exceeded with the implementation of the proposed measures to reduce underwater sound pressures.

TABLE 4.4-2
Calculated Distances to Underwater Noise Thresholds for Sea Turtles from Dredging and Mitigated In-water Pile Driving
Texas LNG Project

Activity	Distance from Source in which Threshold would be Exceeded	
	Injury (RMS)	Behavioral Disturbance (RMS)
Impact pile driving	71 feet	606 feet
Vibratory pile driving	3 feet	28 feet
Dredging	1 foot	8.2 feet

[a] Peak = peak sound pressure

As presented in table 4.4-2, injury to sea turtles during pile driving is anticipated to occur within 71 feet and 3 feet for impact and vibratory pile driving, respectively, and within 1 foot during dredging. To minimize impacts on sea turtles and other protected marine species from in-water construction activities we are recommending that Texas LNG utilize biological monitors during all in-water activities (see our recommendation in section 7.0).

Vessel Transit

Potential impacts on sea turtles resulting from increased vessel transit include injury or mortality due to vessel strikes, and accidental leaks or spills of hazardous materials. During construction and operation of the Project, barges, support vessels, and LNG carriers would call on the LNG terminal, increasing ship traffic within the Brownsville Ship Channel and Gulf of Mexico. Increased marine traffic could result in collisions with sea turtles; however, as discussed above for the West Indian manatee, vessel speeds are anticipated to be low and Texas LNG would provide ship captains with NMFS Southeast Region's *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008).

Marine traffic associated with the Project could result in collisions with sea turtles, particularly in the navigation routes in the Gulf of Mexico approaching the Brownsville Ship Channel. Sea turtles are most vulnerable to vessel strikes while foraging, swimming, and resting near the surface. Most vessel strikes to sea turtles are from fast moving, small- to medium-sized vessels (NMFS, 2004). As discussed in section 4.2.7, LNG vessels, barges, and support vessels would transit at speeds no greater than 8 knots within the Brownsville Ship Channel (NMFS, 2013). As such, sea turtles can more readily avoid such vessels. In addition, LNG carriers typically push large bow waves when they are in transit because of their design and large displacement tonnage, which push water and floating objects (including sea turtles) away from the vessel path. Given the lack of known turtle concentration areas along the transit route, the rarity of sea turtles in the Brownsville Ship Channel, the substantial bow wave of the LNG carriers that would push any turtles that are present in the area from the vessel pathway, and the relatively low number of LNG carrier visits per year, Project-related vessel transit is not expected to result in injury or mortality of sea turtles. Nevertheless, to minimize the potential for interactions with sea turtles (and other federally listed species), Texas LNG would provide ship captains with the NMFS, Southeast Region's *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008) and would advocate compliance with the measures identified in the document.

As discussed in section 4.2.7, spills, leaks, or accidental releases of fuels, lubricants, or other hazardous substances could potentially occur during construction and operation of the Project. If a spill or leak were to occur in the maneuvering basin or along the vessel transit route, sea turtles could be susceptible to the effects of spills either by direct encounter or ingestion of contaminated seagrass or prey species. Fuel used for vessel propulsion or auxiliary/emergency generators could potentially spill or leak.

However, Texas LNG would implement its SPRP and Spill Prevention, Containment, and Countermeasure Plans, and the fuel on each ship is protected by the vessel's double hull. Furthermore, every oil tanker of 150 gross tons and above and all vessels over 400 gross tons would maintain a SOPEP, which contains measures to be implemented in the event of a petroleum release.

4.4.1.2 Mitigation Measures

Texas LNG proposes mitigation measures specific to sea turtles as well as general measures to reduce the potential impacts from construction and operation on sea turtles. Measures that will be implemented by Texas LNG include the following:

- Dredging
    - Hopper dredges would not be used during construction or maintenance dredging.
    - A monitor trained in the identification of federally listed species would ensure that sea turtles are not present prior to the start of dredging activities.
- Pile Driving
    - Texas LNG would conduct the majority of pile driving activities from land (prior to dredging the maneuvering basin); driving piles into the substrate, rather than open water would result in sound energy being absorbed by the mudflat and not transmitted directly to the water, which would result in a reduced underwater noise impact.
    - In-water pile driving activities would be limited to the installation of 12 piles associated with the three southernmost mooring dolphins.
    - Soft starts would be used, gradually increasing the intensity of pile driving activities, to allow sea turtles to leave the area.
    - Pile drivers would minimize impact energy to the extent feasible in order to lower underwater sound pressure levels.
    - Cushion blocks and/or bubble curtains would be used during in-water pile installation to minimize underwater sound pressure levels.
- Vessel Transit
    - Texas LNG would provide ship captains with the NMFS, Southeast Region's *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008) and would advocate compliance with the measures identified in the document.
    - Each LNG carrier would maintain a SOPEP, which contains measures to be implemented in the event of a petroleum release.

4.4.1.3 Determination of Effect

Given the rarity of sea turtles to be present within the Project Site as well as the implementation of avoidance and minimization measures described above both during Project construction and operation of the LNG carriers, we have determined that the Project *is not likely to adversely affect* the green, hawksbill, Kemp's ridley, leatherback, or loggerhead sea turtles while in the marine environment. Further, based on habitat present at the Project Site, as well as known nesting locations for these species, we have determined that the Project would have *no effect* on nesting sea turtles.

4.4.2 Designated Critical Habitat

As discussed in section 3.3.4, there is potential for loggerhead sea turtles to occur within the Brownsville Ship Channel and along vessel transit routes in the Gulf of Mexico. Consultations with NMFS also indicated that there is potential for vessels to divide floating *Sargassum* designated as critical habitat for loggerhead sea turtles in the Gulf of Mexico (Designated Critical Habitat Unit LOGG-S-02). However, NMFS also indicated that these impacts would be temporary and the *Sargassum* habitat would continue to serve as developmental and foraging habitat for loggerhead sea turtles.

Although very unlikely, LNG carrier transit could also result in the accidental release of hazardous materials to *Sargassum* habitat. As discussed in previous sections, to minimize the potential for a spill, leak, or accidental release of hazardous substances, each LNG carrier would maintain a SOPEP, which contains measures to be implemented in the event of a petroleum release, as mentioned above in previous sections. Implementation of the SOPEP would substantially reduce the potential for degradation of designated critical habitat for loggerhead sea turtles.

LNG carriers and heavy load carrier shipments would use established shipping lanes through the Gulf of Mexico that are already subject to frequent vessel transit. Furthermore, given the temporary nature of potential damage and maintenance of a SOPEP, vessel transit through designated critical habitat is expected to have negligible impacts on *Sargassum* habitat. Therefore, we have determined that construction and operation of the Texas LNG Project would result in *no adverse modification of designated critical habitat* for the loggerhead sea turtle.

5.0 SUMMARY OF EFFECT DETERMINATIONS

The effects analysis presented in section 4 of this BA resulted in a determination that the Project is not likely to adversely affect 16 of the federally listed species, would have no effect on two species, and that no adverse modification of designated critical habitat would occur. These determinations are based on the implementation of the design controls and mitigation measures that Texas LNG would incorporate during construction and/or operation of the Project. Table 5.0-1 provides the determination of effect for each species and summarizes the rationale for each determination.

TABLE 5.0-1 Texas LNG Project Summary of Effect Determination				
Common Name *Scientific Name*	Listing Status	Agency Jurisdiction	Determination of Effect	Rationale
Birds				
Northern aplomado falcon *Falco femoralis septentrionalis*	E	FWS	NLAA	• Foraging habitat for the northern aplomado falcon occurs at the Project Site within salt and brackish high tidal marsh, sea ox-eye daisy flat, salty prairie, and loma grassland habitats. • No suitable stick nests are present within the Project Site. • The Project would result in the following impacts on suitable foraging habitat for the northern aplomado falcon: ○ Permanent conversion of 119.1 acres. ○ Temporary impacts on 20.0 acres, which would be reseeded and allowed to revegetate. • Approximately 168.7 acres of potentially suitable foraging habitat for this species within the Project Site would remain undisturbed. •
Piping Plover Charadrius melodus	T	FWS	NLAA	• Suitable foraging, roosting, and sheltering habitats for wintering piping plovers occur within the tidal flats and adjacent upland areas at the Project Site. • The Project would result in the following impacts on suitable wintering habitat for the piping plover: ○ Permanent conversion of 42.0 acres to industrial use. ○ Temporary impacts on 1.8 acres, which would be reseeded and allowed to revegetate. • Approximately 120.6 acres of potential piping plover wintering habitat within the Project Site would remain undisturbed. • Indirect impacts of the Project on wintering piping plovers include disturbance and displacement from the Action Area during construction activities due to increased noise, lighting, and human activity. • Wintering habitat for the piping plover is common and plentiful in the vicinity of the Project Site. Although the piping plover could be displaced to nearby similar habitats, construction and operation of the Project would not adversely affect the species in any measurable way.
	CH	FWS	NAM	• Designated Critical Habitat for wintering piping plover (Unit TX-1: South Bay and Boca Chica) occurs across the Brownsville Ship Channel from the Project Site. • Critical Habitat Unit TX-1 is currently used for dredged material placement by the COE. The FWS has verified that the PCEs of designated critical habitat for wintering piping plover are not present within these PAs due to the land being raised as a result of dredged material placement. Therefore, the Project would not result in adverse modification of designated critical habitat.

TABLE 5.0-1 Texas LNG Project Summary of Effect Determination				
Common Name *Scientific Name*	Listing Status	Agency Jurisdiction	Determination of Effect	Rationale
Red knot *Calidris canutus rufa*	T	FWS	NLAA	• Migratory stopover and wintering habitats for the red knot occur within tidal flats at the Project Site. • The Project would result in the following impacts on suitable migratory stopover and wintering habitats for the red knot: ○ Permanent conversion of 42.0 acres to industrial use. ○ Temporary impacts on 1.8 acres, which would be reseeded and allowed to revegetate. • Approximately 120.6 acres of potential red knot habitat within the Project Site would remain undisturbed. • Indirect impacts of the Project on wintering red knots include disturbance and displacement from the Action Area during construction activities due to increased noise, lighting, and human activity. • Red knot migratory stopover and wintering habitats are common and plentiful in the region. Although the red knot could be displaced to nearby similar habitats, construction and operation of the Project would not adversely affect the species in any measurable way.
Whooping Crane *Grus americana*	P	FWS	NLAA	• Wintering habitat for the whooping crane occur within tidal flats, sea ox-eye daisy flats, salt and brackish high tidal marsh, and salty prairie at the Project Site. • The Project would result in the following impacts on suitable wintering habitat for the whooping crane: ○ Permanent conversion of 140.9 acres to industrial use. ○ Temporary impacts on 18.9 acres, which would be reseeded and allowed to revegetate. • Approximately 273.8 acres of potential whooping crane habitat within the Project Site would remain undisturbed. • Indirect impacts of the Project on wintering whooping cranes include disturbance and displacement from the Action Area during construction activities due to increased noise, lighting, and human activity. • Whooping crane wintering habitat is common and plentiful in the region. Although the whooping crane could be displaced to nearby similar habitats, construction and operation of the Project would not adversely affect the species in any measurable way.
Mammals				
Gulf Coast jaguarundi *Herpailurus (=felis) yagouaroundi cacomitli*	E	FWS	NLAA	• Potential foraging and transient habitat for the Gulf Coast jaguarundi at the Project Site occurs in loma habitats (loma deciduous shrublands, loma evergreen shrublands, and loma grasslands). • Jaguarundi are exceedingly rare in south Texas and the last confirmed sighting of the species in the area was in 1986, although unconfirmed sightings of the species within the Laguna Atascosa NWR have occurred. • The Project would result in the following impacts on suitable foraging/transient habitats for the Gulf Coast jaguarundi: ○ Permanent conversion of 98.5 acres. ○ Temporary impacts on 4.9 acres, which would be reseeded and allowed to

TABLE 5.0-1 Texas LNG Project Summary of Effect Determination				
Common Name *Scientific Name*	Listing Status	Agency Jurisdiction	Determination of Effect	Rationale
				revegetate. ○ Roughly 29.1 acres of potential foraging/transient habitat for this species at the Project Site would remain undisturbed. ○ Temporary workspaces and undisturbed areas would no longer provide potentially suitable habitat due to their small size and isolation from other tracts of suitable habitat. • Indirect impacts of the Project on jaguarundi include disturbance and displacement from the Project Site and areas immediately surrounding Project activities due to increased noise and human activities. • Large expanses of thornscrub habitats are present in the immediate vicinity of the Project Site, including at the Laguna Atascosa NWR where habitat management and restoration activities for this species are ongoing. •
Ocelot *Leopardus (=felis) pardalis*	E	FWS	NLAA	• Potential foraging and transient habitat for the ocelot occurs in the loma habitats (loma deciduous shrublands, loma evergreen shrublands, and loma grasslands) at the Project Site. • The Project Site is not considered to contain or be part of a larger block of suitable breeding habitat for ocelot due to the fragmented nature of the habitat at the Project Site and surrounding area. • The Project would result in the following impacts on suitable foraging/transient habitats for the ocelot: ○ Permanent conversion of 98.5 acres. ○ Temporary impacts on 4.9 acres, which would be reseeded and allowed to revegetate. ○ Roughly 29.1 acres of potential foraging/transient habitat for this species at the Project Site would remain undisturbed. ○ Temporary workspaces and undisturbed areas would no longer provide potentially suitable habitat due to their small size and isolation from other tracts of suitable habitat. • Indirect impacts of the Project on ocelot include disturbance and displacement from the Project Site and areas immediately surrounding Project activities due to increased noise and human activities. • Increased truck traffic associated with the Project, particularly during construction and after dusk, could result in vehicle strikes on SH 48. An underpass has been constructed under SH 48 to reduce vehicle strikes of ocelot and other animals and to facilitate safe movement between Refuge properties. • Large expanses of thornscrub habitats are present in the immediate vicinity of the Project Site, including at the Laguna Atascosa NWR where habitat management and restoration activities for this species are ongoing.

TABLE 5.0-1 Texas LNG Project Summary of Effect Determination				
Common Name *Scientific Name*	Listing Status	Agency Jurisdiction	Determination of Effect	Rationale
Sperm whale *Physeter macrophalus*	E	NMFS	NLAA	• The occurrence of sperm whales within the Action Area is expected to be rare and transient in nature due to the species' strong preference for deep water. No suitable habitat for this species occurs in the Brownsville Ship Channel or in nearshore Texas coastal waters. • Texas LNG would provide the NMFS' Vessel Strike Avoidance Measures to LNG carrier captains and would advocate compliance with the measures identified in the document. • Based on the overall rarity of the species within the Action Area and implementation of the NMFS' Vessel Strike Avoidance measures, the Project is not expected to affect the sperm whale in any measurable way.
Fin whale *Balaenoptera physalus*	E	NMFS	NLAA	• The occurrence of fin whales within the Action Area is expected to be rare and transient in nature due to the species' strong preference for deep water. No suitable habitat for this species occurs in the Brownsville Ship Channel or in nearshore Texas coastal waters. • Texas LNG would provide the NMFS' Vessel Strike Avoidance Measures to LNG carrier captains and would advocate compliance with the measures identified in the document. • Based on the overall rarity of the species within the Action Area and implementation of the NMFS' Vessel Strike Avoidance measures, the Project is not expected to affect the fin whale in any measurable way.
Sei whale *Balaenoptera borealis*	E	NMFS	NLAA	• The occurrence of sei whales within the Action Area is expected to be rare and transient in nature due to the species' strong preference for deep water. No suitable habitat for this species occurs in the Brownsville Ship Channel or in nearshore Texas coastal waters. • Texas LNG would provide the NMFS' Vessel Strike Avoidance Measures to LNG carrier captains and would advocate compliance with the measures identified in the document. • Based on the overall rarity of the species within the Action Area and implementation of the NMFS' Vessel Strike Avoidance measures, the Project is not expected to affect the sei whale in any measurable way.
Blue whale *Balaenoptera musculus*	E	NMFS	NLAA	• The occurrence of blue whales within the Action Area is expected to be rare and transient in nature due to the species' strong preference for deep water. No suitable habitat for this species occurs in the Brownsville Ship Channel or in nearshore Texas coastal waters. • Texas LNG would provide the NMFS' Vessel Strike Avoidance Measures to LNG carrier captains and would advocate compliance with the measures identified in the document. • Based on the overall rarity of the species within the Action Area and implementation of the NMFS' Vessel Strike Avoidance measures, the Project is not expected to affect the blue whale in any measurable way.

TABLE 5.0-1
Texas LNG Project Summary of Effect Determination

Common Name *Scientific Name*	Listing Status	Agency Jurisdiction	Determination of Effect	Rationale
Gulf of Mexico Bryde's whale *Balaenoptera edeni (GOM subspecies)*	P	NMFS	NLTJ	• The occurrence of Gulf of Mexico Bryde's whale within the Action Area is expected to be rare and transient in nature due to the species' strong preference for deep water. No suitable habitat for this species occurs in the Brownsville Ship Channel or in nearshore Texas coastal waters. There are no documented occurrences west of Louisiana. • Texas LNG would provide the NMFS' Vessel Strike Avoidance Measures to LNG carrier captains and would advocate compliance with the measures identified in the document. • Based on the overall rarity of the species within the Action Area and implementation of the NMFS' Vessel Strike Avoidance measures, the Project is not expected to affect the Gulf of Mexico Bryde's whale in any measurable way.
West Indian manatee *Trichechus manatus*	E	FWS	NLAA	• The limited and transient occurrence of West Indian manatees in Texas coastal waters and the lack of suitable or accessible habitat at or in the immediate vicinity of the Project Site make it highly unlikely that this species could interact with Project activities. • Seagrass habitats that could be suitable for this species occur near the mouth of the Brownsville Ship Channel so there is potential, although small, for manatees to interact with vessels associated with the Project. • Seagrass habitats adjacent to the LNG carrier transit route near the entrance to the Brownsville Ship Channel could support transient manatees; however, Texas LNG would provide the NMFS' Vessel Strike Avoidance Measures to LNG carrier captains and would advocate compliance with the measures identified in the document. • Based on the overall rarity of the species within the Action Area, because LNG carriers would transit through waters deeper than are used by the manatee, and with the implementation of the NMFS' Vessel Strike Avoidance Measures, the Project is not expected to affect the West Indian manatee in any measurable way.
Flowering Plants				
South Texas ambrosia *Ambrosia cheiranthifolia*	E	FWS	NE	• South Texas ambrosia was last documented within Cameron County in 1941. • Potentially suitable habitat for South Texas ambrosia is present within loma deciduous shrubland, loma evergreen shrubland, and loma grassland habitats at the Project Site. • Species-specific surveys were conducted for South Texas ambrosia within suitable habitats at the Project Site between October 5 and 8, 2015 (during the species' flowering period). South Texas ambrosia was not documented during the survey effort. • Although suitable habitat for this species is present within the Project Site, due to the overall rarity of the species and negative survey results, South Texas ambrosia is not anticipated to be present at the Project Site.

TABLE 5.0-1 Texas LNG Project Summary of Effect Determination				
Common Name *Scientific Name*	Listing Status	Agency Jurisdiction	Determination of Effect	Rationale
Texas ayenia *Ayenia limitaris*	E	FWS	NE	• Potentially suitable habitat for Texas ayenia is present within loma deciduous shrubland, loma evergreen shrubland, and loma grassland habitats at the Project Site. • Species-specific surveys were conducted for Texas ayenia within suitable habitats at the Project Site between October 5 and 8, 2015 (during the species' flowering season). Texas ayenia was not documented during the survey effort. • Although suitable habitat for this species is present within the Project Site, due to the overall rarity of the species and negative survey results, Texas ayenia is not anticipated to be present at the Project Site.
Sea Turtles				
Green sea turtle *Chelonia mydas*	T	NMFS FWS	NLAA NE	• Green sea turtles are known to occur in waters off the Gulf Coast of Texas throughout the year. This species nests within sandy beaches along the coastline of Cameron County in the vicinity of, but not within, the Brownsville Ship Channel. Use of the Brownsville Ship Channel by green sea turtles is rare, and likely limited to use as an escape route when turtles are disturbed. • Dredging activities would be conducted using a hydraulic cutterhead dredge; use of a hopper dredge is not proposed. • Texas LNG would implement the following measures to avoid and/or minimize impacts associated with pile driving activities: ○ conducting the majority of pile installation from land (prior to dredging the maneuvering basin); ○ implementing soft starts to allow sea turtles to leave the area prior to the beginning of pile driving activities; ○ minimizing impact energy to the extent feasible in order to lower underwater sound pressure levels; and/or ○ using cushion blocks and/or bubble curtains during in-water pile installation. • Although the bow wave pushed by LNG carriers during transit is expected to push sea turtles away from the vessel, Texas LNG would provide the NMFS' Vessel Strike Avoidance Measures to LNG carrier captains and would advocate compliance with the measures identified in the document. • Texas LNG would implement its Spill Response and Prevention Plan to avoid and/or minimize impacts on sea turtles during construction and operation of the Project. • With the implementation of the measures described above, impacts on the green sea turtle during construction and operation of the Project are expected to be insignificant.

TABLE 5.0-1 **Texas LNG Project Summary of Effect Determination**				
Common Name *Scientific Name*	Listing Status	Agency Jurisdiction	Determination of Effect	Rationale
Hawksbill sea turtle *Eretmochelys imbricate*	E	NMFS FWS	NLAA NE	• Texas is the only state outside of Florida where hawksbill sea turtles have been observed with regularity. Only one nest has been documented in Texas within the last decade, which was over 25 miles northeast of the Project Site. • Suitable habitat for the hawksbill sea turtle does not occur within the ship channel or adjacent coastal habitats. Therefore, occurrence within the Action Area is expected to be limited to the LNG carrier transit route. • Although the bow wave pushed by LNG carriers during transit is expected to push sea turtles away from the vessel, Texas LNG would provide the NMFS' Vessel Strike Avoidance Measures to LNG carrier captains and would advocate compliance with the measures identified in the document. • Texas LNG would implement its Spill Response and Prevention Plan to avoid and/or minimize impacts on sea turtles during construction and operation of the Project. • With the implementation of the measures described above, impacts on the hawksbill sea turtle during construction and operation of the Project are expected to be insignificant.
Kemp's ridley sea turtle *Lepidochelys kempii*	E	NMFS FWS	NLAA NE	• Kemp's ridley sea turtles are known to occur in waters off the Gulf Coast of Texas throughout the year. This species nests within sandy beaches along the coastline of Cameron County in the vicinity of, but not within, the Brownsville Ship Channel. Use of the Brownsville Ship Channel by Kemp's ridley sea turtles is rare, and likely limited to use as an escape route when turtles are disturbed. • Potential impacts on this species from the Project and avoidance and mitigation measures are similar to those described above for green sea turtles. Therefore, impacts on the Kemp's ridley sea turtle during construction and operation of the Project are expected to be insignificant.
Leatherback Sea Turtle *Dermochelys coriácea*	E	NMFS FWS	NLAA NE	• The leatherback sea turtle exhibits a preference for deep, open ocean habitat outside of the reproductive period. Only one documented nest has been recorded along the Gulf Coast of Texas since the 1940's; therefore, it is highly unlikely that the species would occur within the Project Site or along the portion of the LNG carrier transit through the Brownsville Ship Channel. • Although the bow wave pushed by LNG carriers during transit is expected to push sea turtles away from the vessel, Texas LNG would provide the NMFS' Vessel Strike Avoidance Measures to LNG carrier captains and would advocate compliance with the measures identified in the document. • Texas LNG would implement its Spill Prevention and Response Plan to avoid and/or minimize impacts on sea turtles during construction and operation of the Project. • Based on the overall rarity of the leatherback sea turtle in the Action Area, combined with the implementation of the measures described above, the potential for construction and operation of the Project to impact the leatherback sea turtle is expected to be insignificant.

TABLE 5.0-1
Texas LNG Project Summary of Effect Determination

Common Name *Scientific Name*	Listing Status	Agency Jurisdiction	Determination of Effect	Rationale
Loggerhead sea turtle *Caretta caretta*	T	NMFS FWS	NLAA NE	• Loggerhead sea turtles are known to occur in waters off the Gulf Coast of Texas throughout the year. The majority of the loggerhead sea turtle nesting activity within the United States occurs in Florida, with only occasional nesting activity in Texas. Use of the Brownsville Ship Channel by loggerhead sea turtles is rare. • Potential impacts on this species from the Project and avoidance and mitigation measures are similar to those described above for green sea turtles. Therefore, impacts on the loggerhead sea turtle during construction and operation of the Project are expected to be insignificant.
	CH	NMFS	NLAM	• The vessel transit routes traverses an area designated as critical habitat for the loggerhead sea turtle within the Gulf of Mexico (Unit LOGG-S-02). *Sargassum* (floating mats of seaweed) on the surface of the water near the LNG carrier transit route would likely be pushed away by the bow wave created by the LNG vessel. However, it is possible that *Sargassum* directly in the path of an LNG carrier could be bisected during LNG carrier transit. • Impacts on designated critical habitat from the Project could occur if offshore disposal of waste (e.g., plastics). However, implementation of good housekeeping and waste management procedures that prohibit overboard solid waste disposal during transit would substantially reduce the potential for waste-related degradation of the designated critical habitat for loggerhead sea turtles. • While impacts on this critical habitat from Project-related LNG carrier transit could occur, the impacts would be temporary, limited to a very small portion of the designated critical habitat, and would not preclude the overall functions and values of the habitat.

E – Endangered
P – Proposed for listing
T – Threatened
CH - Critical habitat
NAM - No adverse modification of critical habitat
NLAA - May affect, but is not likely to adversely affect
NLAM - May affect, but is not likely to adversely modify critical habitat
NE – No effect
NLTJ – May affect, but is not likely to jeopardize

6.0 CUMULATIVE IMPACTS

In Biological Opinions (BO), the FWS is required to consider "cumulative effects," which are defined as the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in a BO (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA (FWS and NMFS, 1998).

Cumulative effects on federally listed species may occur where state, tribal, local, or private actions that are reasonably certain to occur are constructed in the Action Area and would affect federally listed species directly or indirectly through habitat alteration or loss. The Commission examined these actions within its draft EIS for the Project and the cumulative impacts discussion in the draft EIS is incorporated here by reference. These non-federal or potentially non-federal actions may include:

- oil and gas exploration and production (including non-jurisdictional natural gas gathering systems);
- FERC-jurisdictional natural gas interstate transportation projects;
- other energy projects, including power plants or electric transmission lines;
- mining operations;
- transportation or road projects; and
- commercial/residential/industrial and other development projects.

Section 4.13.1 of the draft EIS provides a listing of other projects in the geographic scope of analysis considered for cumulative impacts. The geographic scope for threatened and endangered species was generally determined to be the Hydrologic Unit Code (HUC) 12 watershed; however, due to the diversity in life history and range of threatened and endangered species potentially affected by the Texas LNG Project, cumulative impacts were independently reviewed for each species or group of species. For example, threatened or endangered bird species are more mobile with larger ranges when compared to terrestrial reptiles that may not extend beyond a relatively small area. Discussions of cumulative impacts on threatened and endangered species are grouped by taxa and are limited to only those threatened and endangered species identified in this BA as potentially affected by the Texas LNG Project. Species that are not anticipated to be present at the Project Site, or otherwise affected by the Texas LNG Project, due to a lack of suitable habitat or species range, are not discussed further with regard to cumulative impacts.

6.1 MAMMALS

6.1.1 West Indian Manatee

There are no other projects within the geographic scope for the West Indian manatee (those projects within the Brownsville Ship Channel) that are non-federal actions and considered under the ESA. Therefore, cumulative impacts on the West Indian manatee are not anticipated to occur.

6.1.2 Whales

There are no other projects within the geographic scope for the listed whales and the proposed Gulf of Mexico Bryde's whale (those projects within the Brownsville Ship Channel) that are non-federal actions and considered under the ESA. Therefore, cumulative impacts on the listed whales and the proposed Gulf of Mexico Bryde's whale are not anticipated to occur.

6.1.3 Ocelot and Jaguarundi

The geographic scope for cumulative impacts on the ocelot and jaguarundi was considered to be terrestrial projects located within the HUC 12 watershed affected by the Texas LNG Project. Projects considered for cumulative impacts on the ocelot and jaguarundi include the non-jurisdictional facilities associated with the LNG projects (i.e., Rio Grande LNG Project, Annova LNG Project and Texas LNG Project), Valley Crossing Pipeline, Kingsville to Brownsville Pipeline, San Roman Wind Farm, Cross Valley Project, six transportation projects, five Port of Brownsville Projects, SpaceX Commercial Spaceport Project, Stargate Facility, Palo Alto Battlefield Cultural Landscape Restoration, and Bahia Grande Coastal Corridor Project.

Dense thornscrub associated with the lomas on the Texas LNG Project Site provide suitable habitat for ocelot and jaguarundi, as discussed in sections 3.3.2.1 and 3.3.2.2. Further, surveys of the Project Site identified feline tracks consistent with ocelot; however, these could not be definitively identified. While suitable habitat is present on the Project Site and is within the known range of ocelots and jaguarundi, the Project Site likely serves only as stopover or temporary habitat for transient individuals rather than a breeding pair due to its size and lack of connectivity with larger more contiguous tracts, such as those present within the Laguna Atascosa NWR. Further, if an ocelot or jaguarundi is present on the site at the start of construction activities it would likely relocate to suitable adjacent habitat. Therefore, we have determined that the Texas LNG Project is not likely to adversely affect the ocelot and jaguarundi; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 7.0).

As discussed in greater detail in sections 3.3.2.1 and 3.3.2.2, the primary threat to ocelot and jaguarundi populations in the U.S. is habitat loss, degradation, and fragmentation (FWS, 2013a). The Texas LNG Project would contribute to habitat loss; however, this loss represents a small fraction of the overall available habitat present in the region. Nevertheless, due to the large home ranges of ocelots and importance of corridor habitat to connect to Mexican populations, even incremental habitat loss could be significant. Also as discussed in section 3.3.2.1, the population size in Texas and growing isolation from loss of habitat connectivity with ocelot and jaguarundi populations in Mexico are contributing to a growing threat of genetic inbreeding in the Texas ocelot and jaguarundi populations. Moreover, the construction of roads through ocelot and jaguarundi habitat has resulted in high rates of road mortality, further inhibiting population growth and connectivity with adjacent populations (FWS, 2013a). These are important factors to consider when addressing potential cumulative impacts on these species.

Not all of the projects listed above are anticipated to impact ocelot and jaguarundi habitat, such as the San Roman Wind Farm, which is located in primarily agricultural and open land, and the Port of Brownsville projects, which are located within densely developed, previously disturbed areas. In addition, several projects would result in beneficial impacts on ocelots and jaguarundis including the Bahia Grande Coastal Corridor Project, the purpose of which is to further conserve land, and the Highway 100 Wildlife Crossings, which are intended to minimize impacts from road traffic. In addition, these projects along with several of the transportation projects could result in increased road traffic and/or additional roads for transiting ocelots and jaguarundis to cross. Direct mortality as a result of construction of the projects considered in this cumulative impacts analysis for ocelots and jaguarundi are unlikely due to the ability of individuals to leave the area; however, long-term impacts resulting from habitat loss and the potential for subsequent reduced genetic diversity from inbreeding could occur.

As discussed above, the past and continued development in and around Brownsville and across the border in Mexico has decreased the available corridor habitat necessary to connect ocelot and jaguarundi populations in Mexico and the U.S. While relatively small barriers such as the Brownsville Ship Channel and SH 4 do not create a significant impediment to individual movements, ocelots and jaguarundi require contiguous dense thornscrub for cover over longer distances (TPWD 2017a; 2017b). In addition, ocelots and jaguarundis are elusive species with relatively large home ranges and low population densities that tend to avoid human development and activity (FWS, 2013a). The current remaining habitat corridor in the region to connect U.S. and Mexico populations is located adjacent to and within the proposed Texas LNG Project Site north of the Brownsville Ship Channel.

In addition, increased road traffic along SH 4 associated with the Kingsville to Brownsville Pipeline, Valley Crossing Pipeline, SpaceX Commercial Spaceport Project, and the Stargate Facility, as well as increased traffic along SH 48 associated with the Texas LNG Project, Kingsville to Brownsville Pipeline, Valley Crossing Pipeline, and the Port of Brownsville projects would result in increased potential for vehicle strikes on ocelots and jaguarundis.

As described above, there is potential for the continued reduction of suitable ocelot and jaguarundi habitat. The loss, degradation, and fragmentation of habitat have been cited by the FWS in its 2010 Recovery Plan, as the primary threat to U.S. ocelot and jaguarundi populations; however, abundant suitable habitat is available in the NWRs in the region. Further, the projects assessed for cumulative impacts on ocelots and jaguarundis would increase road traffic, particularly during periods of concurrent construction, which is the primary cause of direct mortality on U.S. ocelot and jaguarundi populations (TPWD 2017a; 2017b). Due to the past, present, and proposed future development throughout the geographic scope for assessing cumulative impacts on ocelots and jaguarundis and the available suitable habitat in nearby NWRs, we have determined that cumulative impacts on ocelots and jaguarundis would be moderate.

6.2 BIRDS

6.2.1 Northern Aplomado Falcon

The geographic scope for cumulative impacts on the northern aplomado falcon was considered to be terrestrial projects located within the HUC 12 watershed affected by the Texas LNG Project. Projects considered for cumulative impacts on the northern aplomado falcon include the Rio Grande LNG Project and associated non-jurisdictional facilities, Annova LNG Project and associated non-jurisdictional facilities, non-jurisdictional facilities associated with the Texas LNG Project, Valley Crossing Pipeline, Kingsville to Brownsville Pipeline, San Roman Wind Farm, Cross Valley Project, transportation projects, Port of Brownsville Projects, SpaceX Commercial Spaceport Project, Stargate Facility, Palo Alto Battlefield Cultural Landscape Restoration, and Bahia Grande Coastal Corridor Project.

The Texas LNG Project Site provides suitable nesting and foraging habitat for the northern aplomado falcon. As discussed in section 4.1.1.2, Texas LNG implemented design measures recommended by the FWS to avoid impacts on suitable habitat to the extent practicable. Further, surveys of the Project Site did not identify any existing nests that could be utilized by northern aplomado falcons. Texas LNG has also indicated that surveys would be conducted prior to the start of construction to ensure that no nesting birds are present. Therefore, we have determined that the Texas LNG Project is not likely to adversely affect the northern aplomado falcon; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 7.0).

For the majority of projects considered, impacts on northern aplomado falcons are not known; however, suitable habitat is also present on the Annova LNG and Rio Grande LNG sites and would likely be crossed by the linear transmission and pipeline projects in the area. The Port of Brownsville projects are primarily located in an already industrialized area that likely does not provide suitable habitat for northern aplomado falcons. Further, the San Roman Wind Farm, LNG projects, and overhead transmission line projects include elevated structures and wires that could result in bird strikes. Texas

LNG has indicated that it would minimize the likelihood of bird strikes with the communication tower through implementation of measures recommended by FWS. Texas LNG has also indicated it would light elevated structures (in accordance with Federal Aviation Administration regulations) in a manner that would cause the least impact on migratory birds (flashing lights). It is anticipated that other projects with elevated structures would implement similar measures to minimize impacts the northern aplomado. However, while these measures would minimize impacts on northern aplomado falcons, bird strikes with elevated structures could still occur. Impacts on habitat associated with the pipeline and transmission lines are anticipated to be temporary with construction areas restored following the completion of activities.

Permanent aboveground facilities such as the LNG projects would result in the removal of suitable foraging and nesting habitat for Aplomado falcons. These cumulative impacts on habitat could prevent establishment of nesting pairs and would limit available foraging habitat within the area; therefore, cumulative impacts on northern aplomado falcons are anticipated to be permanent and moderate.

6.2.2 Shorebirds

Other projects considered for cumulative impacts on threatened or endangered shorebirds (piping plover and red knot) are those that would conduct activities adjacent to the Brownsville Ship Channel. Projects considered for cumulative impacts on piping plover and red knot include the Rio Grande LNG Project, Annova LNG Project, Valley Crossing Pipeline, Kingsville to Brownsville Pipeline, waterway improvement projects, and Port of Brownsville projects.

We have determined that the Texas LNG Project is not likely to adversely affect the two federally listed shorebirds (piping plover and red knot), as discussed in sections 4.1.2 and 4.1.3; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 7.0). Suitable wintering habitat is present within the Texas LNG Project Site for both species and designated critical habitat is present within PA 5A for piping plover. Texas LNG has indicated that it would implement measures recommended by FWS to minimize potential impacts on piping plover and red knot by conducting preconstruction surveys. Further, based on consultations with FWS, PA 5A may serve as habitat for piping plover and red knot; however, PA 5A no longer contains the primary constituent elements for wintering piping plover critical habitat because the dredge material has raised the ground level and effectively cut off water flow that is required for a tidal flat.

The other industrial development projects considered, including the LNG projects and Port of Brownsville projects are anticipated to result in similar impacts on piping plover and red knot. The Texas LNG Project, other LNG projects, and some of the Port of Brownsville projects would result in the permanent conversion of the existing shoreline habitat to industrial land; however, the dredging of the Texas LNG marine berth would likely restore tidal flats north of the Texas LNG Project Site, potentially creating habitat for shorebirds (see sections 4.1.2.1). The projects considered would result in a cumulative impact on piping plover and red knot; however, there is abundant wintering habitat present throughout the southern Texas coast, including within the Laguna Atascosa NWR, Lower Rio Grande Valley NWR, and the Loma Ecological Preserve. Therefore, cumulative impacts on piping plovers and red knots are not anticipated to be significant.

6.3 SEA TURTLES

Other projects considered for cumulative impacts on sea turtles are those that would conduct activities within or otherwise affect the Brownsville Ship Channel. Projects considered for impacts on sea turtles include the Valley Crossing Pipeline, Kingsville to Brownsville Pipeline, waterway improvement projects, and the in-water activities associated with the Port of Brownsville projects.

As discussed in section 4.4.1.3, we have determined that the Texas LNG Project is not likely to adversely affect sea turtles; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 7.0). Impacts on sea turtles associated with the Texas LNG Project are most likely to occur as a result of dredging and pile driving activities, as well as increased vessel traffic during construction and operation. Texas LNG has indicated that it would implement measures designed to minimize potential impacts on sea turtles including conducting the majority of pile driving from land, prior to dredging, utilizing a cutterhead suction dredge, and providing all vessels associated with the Project guidance regarding measures to be implemented to avoid vessel strikes. Based on the implementation of these measures, we have determined that the Texas LNG Project is not likely to adversely affect sea turtles; however, due to the concurrent construction schedules and scopes of the other projects considered, cumulative impacts on sea turtles would be likely to occur.

Impacts on sea turtles resulting from the other two LNG projects considered (Rio Grande LNG and Annova LNG) would be similar to those discussed for the Texas LNG Project, as would the measures that would be implemented to minimize impacts (see our recommendation in section 7.0). While both the Valley Crossing Pipeline and the Kingsville to Brownsville Pipeline would cross the Brownsville Ship Channel, it is anticipated that these crossings would be conducted via horizontal directional drill and would not result in any direct impacts on the Brownsville Ship Channel. Therefore, these pipeline projects are not anticipated to affect sea turtles. In addition, all but one (GEOTRAC Industrial Hub) of the Port of Brownsville projects considered were all recently completed and would not overlap with construction of the Texas LNG Project. Therefore, the recently completed Port of Brownsville projects are not anticipated to contribute to cumulative impacts on sea turtles. The GEOTRAC Industrial Hub consists of multiple parcels of land identified for future industrial development, several of which are adjacent to the Brownsville Ship Channel. While development of these areas is anticipated to be ongoing as future projects arise, it is unknown whether the development of any of the parcels adjacent to the Brownsville Ship Channel would overlap with the Texas LNG Project. If development of these areas did overlap with construction of the Texas LNG Project, impacts are anticipated to be similar, potentially requiring dredging and/or shoreline stabilization, vessel traffic, and land disturbance. If constructed concurrent with the Texas LNG Project, development of other parcels along the Brownsville Ship Channel as part of the GEOTRAC Industrial Hub, could contribute to cumulative impacts on sea turtles.

Based on the BO issued for the Brazos Island Channel Improvement Project, dredging activities in the Brownsville Ship Channel utilizing hopper dredges routinely result in the direct mortality of sea turtles (COE, 2014). While the COE would implement numerous measures to reduce sea turtle mortality, such as pre-dredging trawls to safely remove sea turtles from the area, NMFS has conducted a jeopardy analysis and issued a take permit to the COE with limits on the number of sea turtles that can be taken during dredging activities. It is anticipated that the other waterway improvement projects, all of which require dredging activities, would have the potential to similarly impact sea turtles.

Publicly available information regarding the current anticipated schedules for the projects discussed above indicate that it is possible that construction activities associated with several of the waterway improvement projects and both of the other LNG projects would be concurrent with the Texas LNG Project. In general, sea turtles present in the area at the start of construction activities are anticipated to relocate to nearby suitable habitat or avoid the area. However, the concurrent construction activities within the Brownsville Ship Channel could limit the habitat available to which sea turtles could relocate. For instance, a sea turtle startled into moving from one project area may relocate to another project area, and so on until suitable habitat is found. During dredging activities in which hopper dredges are used, such as the Brazos Island Harbor Channel Improvement Project, this could cause sea turtles to move into the dredging area that might otherwise have been avoided by the turtle.

Increased disturbance and searching for available habitat could result in increased stress and energy expenditure for sea turtles in the area. Further, increases in sedimentation and turbidity as well as disturbance of benthic environments that serve as habitat for sea turtle prey species could also result in cumulative impacts on sea turtles by reducing water quality and prey availability.

Concurrent pile driving and dredging activities are anticipated to result in cumulative impacts from increased underwater noise. Due to the short impulsive nature of pile driving noises, it is very unlikely that the peak sound pressure levels from multiple pile drivers would occur at exactly the same instant, so there would be no increase in the predicted pile driving peak sound pressure levels. Rather, the number of pile driving events would increase due to the multiple active construction areas. Further, at locations midway between two active pile driving projects, the sound exposure levels would be expected to increase during simultaneous pile driving activities. The threshold distances for permanent and temporary injury for sea turtles, as outlined for the Texas LNG Project in table 4.4-2, would not be expected to increase significantly in size. However, during simultaneous pile driving at all three LNG projects, the behavioral disturbance area for sea turtles would increase. In some cases the behavioral disturbance distances for the projects would overlap and would likely encompass much of the Brownsville Ship Channel. The anticipated cumulative impacts from underwater noise impacts are further discussed in the draft EIS.

The greatest impact on sea turtles during concurrent pile driving would be limiting the available habitat for avoiding increased underwater noise levels. Sea turtles would be more likely to encounter behavioral and injury thresholds when avoiding pile driving associated with one project. For example, a sea turtle avoiding pile driving associated with the Rio Grande LNG Project could relocate near pile driving associated with the Texas LNG Project resulting in increased energy expenditure as well as increased potential for injury. Both the Annova LNG and Rio Grande LNG projects are anticipated to implement measures similar to Texas LNG, including limiting in-water pile driving to the minimum extent practicable, utilizing soft starts, utilizing mitigation measures such as bubble curtains or cushion blocks (see our recommendation in section 7.0), and consulting with NMFS regarding other measures that could be implemented.

In addition to impacts on sea turtles resulting from construction activities, increased vessel traffic associated with the LNG projects and anticipated to occur as a result of the Port of Brownsville projects could also affect sea turtles in the area. Vessel strikes are a common cause of sea turtle mortality; however, it is anticipated that most vessels would adhere to the NMFS Southeast Region's *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008). Further, the Brownsville Ship Channel is an active vessel transit route to the Port of Brownsville and receives over 1,000 ships per year (BND, 2017). Therefore, the increase in ship traffic could increase the likelihood of vessel strikes; however, this increase is not anticipated to be significant due to implementation of NMFS guidance.

Based on the size and proximity of the projects considered, as well as the overlapping construction schedules, a cumulative impact on sea turtles is anticipated to occur. All projects are subject to the requirements of the ESA and are thus required to consult with NMFS regarding potential impacts on sea turtles. Through this consultation process, the projects considered would be required to implement best management practices and/or other measures recommended by NMFS to minimize potential impacts on sea turtles. In some instances, such as the Brazos Island Harbor Channel Improvement Project, take of sea turtles may still be likely and NMFS would issue a take permit. In other cases, such as the Texas LNG Project, implementation of these measures may result in a determination that the project is not likely to adversely affect sea turtles. Individually, the projects considered are not anticipated to have significant impacts on sea turtles; however, the density and nature of activities potentially occurring within the area and at the same time would result in moderate cumulative impacts on resident sea turtles; however, these impacts are not anticipated to have population-level effects.

7.0 FERC REQUIREMENTS

We included several environmental recommendations in our draft EIS, listed below. These recommendations may be accepted or fulfilled by Texas LNG prior to certificate issuance, or alternatively required by the Commission's Order (if the Project is authorized by the Commission) and must be fulfilled prior to construction. Several of these recommendations are pertinent to avoidance, minimization, or mitigation of effects for wildlife and aquatic habitats, including those containing or potentially containing federally listed species. These recommendations include:

- **No. 15 - Prior to construction,** Texas LNG shall consult with the FWS to develop a revised Migratory Bird Plan that addresses TPWD and FWS recommendations. Texas LNG shall file with the Secretary the final Migratory Bird Plan and evidence of consultation with the FWS.

- **No. 16 - Prior to initiating pile driving activities**, Texas LNG shall perform initial test drives to measure the actual underwater noise generated during in-water pile driving. Following the completion of the initial test drives, Texas LNG shall file with the Secretary and NMFS the acoustic monitoring methods and results, including any additional mitigation measures that it will implement to reduce noise to acceptable levels. Texas LNG shall not initiate in-water pile driving for the Project until approved by the Director of OEP.

- **No. 17 - During in-water construction activities,** Texas LNG shall utilize biological monitors to ensure that federally listed or other special status species are not present within the Project area. In the event that federally listed or other special status species are observed, Texas LNG shall stop all in-water construction activities until the individual(s) leave the area on their own and Texas LNG shall notify FWS or NMFS.

- **No. 18 -** Texas LNG shall not begin construction activities <u>until</u>:

  a. the FERC staff receives comments from the FWS and the NMFS regarding the proposed action;

  b. the staff completes formal consultation with the FWS and NMFS, if required; and

  c. Texas LNG has received written notification from the Director of OEP that construction or use of mitigation may begin.

8.0 REFERENCES

Baker, A., P. Gonzalez, R.I.G. Morrison, and B.A. Harrington. 2013. Red Knot (Calidris canutus). The Birds of North America Online (A. Poole Ed.). Ithaca: Cornell Lab of Ornithology.

Brownsville Navigation District. 2017. Comprehensive Annual Financial Report 2016. http://www.portofbrownsville.com/wp-content/uploads/2017/01/BND-CAFR-2016.pdf. Accessed July 2017.

Burger, J., S. A. Carlucci, C. W. Jeitner, and L. Niles. 2007. Habitat Choice, Disturbance, and Management of Foraging Shorebirds and Gulls at a Migratory Stopover. Journal of Coastal Research 23:1159–1166.

Burger, J. 1991. Foraging Behavior and the Effect of Human Disturbance on the Piping Plover (Charadrius melodus). Journal of Coastal Research 7:39-52.

Campbell, L. 2003. Endangered and Threatened Animals of Texas, Their Life History and Management. Texas Parks and Wildlife Department, Wildlife Division. Austin, Texas. Revised and Approved by the U.S. Fish and Wildlife Service. Available online at https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_0013.pdf. Accessed January 2016.

Carvajal S., A. Caso., R. Flores, and M. Grigione. 2004. Presencia del jaguarundi (Herpailurusyaguarondi) en el Parque Nacional Cumbres de Monterrey, Nuevo León, México. VI Congreso Nacional de Áreas naturales Protegidas. Dr. Eduardo Aguirre Pequeño, Monterrey, Nuevo Leon.

de Oliveira, T. 1998. Leopardus wiedii. Mammalian Species, 579: 1-6.

Deutsch, C.J., C. Self-Sullican, and A. Mignucci-Giannoni. 2008. *Trichechus manatus*. The IUCN Red List of Threatened Species 2008: e.T22103A9356917. Available online at http://www.iucnredlist.org/details/22103/0. Accessed December 2015.

eBird. 2018. Species Maps. Available online at https://ebird.org/map/. Accessed July 2018.

Elliott-Smith, E., S.M. Haig, and B.M. Powers. 2009. Data from the 2006 International Piping Plover Census: U.S. Geological Survey Data Series 426.

Fischer, C. and M. Tewes. 1996. Spatial Patterns and Habitat Use by Free-ranging Cats near International Bridges in Texas. Prepared by Caesar Kleberg Wildlife Research Institute for the Texas Parks and Wildlife Department. Texas A&M University-Kingsville, Kingsville, Texas. Available online at https://tpwd.texas.gov/business/grants/wildlife/section_6/projects/mammals/e1_j55_final_report.pdf. Accessed January 2016.

Fuller, D.A., A.M. Tappan, and M.C. Hester. 1987. Sea Turtles in Louisiana's Coastal Waters. Prepared for Coastal Fisheries Institute and Louisiana Sea Grant College Program, Louisiana State University. August 1987. Available online at http://www.seagrantfish.lsu.edu/pdfs/seaturtles.pdf. Accessed April 2015.

Gerstein, E.R. 2002. Manatees, Bioacoustics, and Boats. American Scientist 90:154-163.

Griffith, G.E., S.A. Bryce, J.M. Omernik, and A.C. Rogers. 2007. Ecoregions of Texas. Prepared for the Texas Commission on Environmental Quality. Report No. AS-199 (12/07). http://ecologicalregions.info/data/tx/TXeco_Jan08_v8_Cmprsd.pdf. Accessed May 2018.

Goss-Custard, J.D., P. Triplet, F. Sueur, and A.D. Wes. 2006. Critical Thresholds of Disturbance by People and Raptors in Foraging Wading Birds. Biological Conservation. 127: 88–97.

Haines, A.M., M.E. Tewes, and L.L. Laack. 2005. Survival and Sources of Mortality in Ocelots. Journal of Wildlife Management, volume 69, 255-263.

Handley, L., D. Altsman, and R. DeMay, eds. 2007. Seagrass Status and Trends in the Northern Gulf of Maexico: 1940-2002: U.S. Geological Survey Scientific Investigations Report 2006-5287 and U.S. Environmental Protection Agency 855-R-04-003. https://pubs.usgs.gov/sir/2006/5287/pdf/CoverandContents.pdf. Accessed May 2018.

Haig, S.M., C.L. Ferland, F.J. Cuthbert, J. Dingledine, J.P. Goossen, A. Hecht, and N. McPhillips. 2005. A Complete Species Census and Evidence for Regional Declines in Piping Plovers. Journal of Wildlife Management 69(1):160-173.

Haines, A.M., M.E. Tewes, and L.L. Laack. 2005. Survival and Sources of Mortality in Ocelots. Journal of Wildlife Management, volume 69, 255-263.

Hodne, G. 2015. Texas Pelagics. Available online at http://texaspelagics.com/marine-mammals-2/spwha-dist/. Accessed November 2015.

Jefferson, T.A., M.A. Webber, and R.L. Pitman. 2008. Marine Mammals of the World. Academic Press, London.

Keddy-Hector, D.P. 2000. Aplomado Falcon (*Falco femoralis*). In A. Poole and F. Gill (eds.). The Birds of North America no. 549. The Birds of North America, Inc., Philadelphia Pennsylvania.

Laack, L. 1991. Ecology of the Ocelot (Felis pardalis) in South Texas. M.S. Thesis, Texas A&M University, Kingsville, Texas.

Moein, S.E., J.A. Musick, J.A. Keinath, D.E. Barnard, M.L. Lenhardt, and R. George. 1995. Evaluation of seismic sources for repelling sea turtles from hopper dredges, pp 90-93. In: L.Z. Hales (ed.), Sea Turtle Research Program: Summary Report. Technical Report CERC-95.

NBC5-KXAS. 2012. Rare Manatee Spotted Near Corpus Christi. Available online at: https://www.nbcdfw.com/news/local/Rare-Manatee-Spotted-Near-Corpus-Christi-170693306.html. Accessed August 2018.

National Marine Fisheries Service. 2005. Letter from to R. Crabtree (Regional Administrator) to B. Gen. Walsh (U.S. Army Corps of Engineers, South Atlantic Division). Letter dated June 24, 2005.

National Oceanic and Atmospheric Administration. 2013. Booklet Chart Southern Part of Laguna Madre. NOAA Chart 11301. National Oceanic and Atmospheric Administration, National Ocean Service, Office of Coastal Survey. Available online at http://www.charts.noaa.gov/BookletChart/11301_BookletChart.pdf. Accessed January 2016.

National Oceanic and Atmospheric Administration. 2009. Amendment 1 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan: Essential Fish Habitat. NOAA National Marie Fisheries Service, Highly Migratory Species Management Division, Office of Sustainable Fisheries, Silver Spring, MD. Available online at: http://www.fisheries.noaa.gov/sfa/hms/documents/fmp/am1/feis/feis_amendment_total.pdf Accessed June 2015.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2018a. Sperm Whale (*Physeter macrocephalus).* https://www.fisheries.noaa.gov/species/sperm-whale#overview. Accessed June 2018.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2018b. Fin Whale (*Balaenoptera physalus)* https://www.fisheries.noaa.gov/species/fin-whale. Accessed June 2018.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2018c. Gulf of Mexico Bryde's Whale *Balaenoptera edeni (GoM subspecies).* https://www.fisheries.noaa.gov/species/gulf-mexico-brydes-whale. Accessed August 2018.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2016. Status Review of Bryde's Whales (*Balaenoptera edeni)* in the Gulf of Mexico Under the Endangered Species Act. http://sero.nmfs.noaa.gov/protected_resources/brydes_whale/documents/bryde_s_whale_status_review__final.pdf. Accessed August 2018.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2016. Greater Atlantic Region Fisheries Office Acoustics Tool: Analyzing the effects of pile-driving on ESA-listed species in the Greater Atlantic Region (version November 7, 2016). Available online at: https://www.greateratlantic.fisheries.noaa.gov/protected/section7/guidance/consultation/index.html. Accessed June 2018.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2015a. Marine Mammal Stock Assessment Reports by Species/Stock – Sperm Whale, Northern Gulf of Mexico. https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock. Accessed June 2018.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2014. Hawksbill Turtle (Eretmochelys imbricata). Available online at http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.html. Accessed April 2016.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2011. Final Recovery Plan for the Sei Whale. Available online at: https://www.fisheries.noaa.gov/resource/document/final-recovery-plan-sei-whale-balaenoptera-borealis. Accessed June 2018.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2010a. Recovery Plan for the Sperm Whale (*Physeter microcephalus*). National Marine Fisheries Service, Silver Spring, Maryland. Available online at https://www.fisheries.noaa.gov/resource/document/recovery-plan-sperm-whale-physeter-macrocephalus. Accessed June 2018.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2010b. Final Recovery Plan for the Fin Whale (*Balaenoptera physalus)* Office of Protected Resources – NMFS, NOAA. https://www.fisheries.noaa.gov/resource/document/final-recovery-plan-fin-whale-balaenoptera-physalus. Accessed June 2018.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2008. Vessel Strike Avoidance Measures and Reporting for Mariners. National Marine Fisheries Service, Southeast Regional Office, St. Petersburg Florida. Revised February 2008. Available online at http://sero.nmfs.noaa.gov/protected_resources/section_7/guidance_docs/documents/copy_of_vessel_strike_avoidance_february_2008.pdf. Accessed January 2016.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 1998. Recovery Plan for the Blue Whale (*Balaenoptera musculus*). Prepared by Reeves R.R., P.J. Clapham, R.L. Brownell, Jr., and G.K. Silber for the National Marine Fisheries Service, Silver Spring, MD. 42 pp.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2015. Kemp's Ridley 5-Year Review. Available online at http://www.nmfs.noaa.gov/pr/listing/final_july_2015_kemp_s_5_year_review.pdf. Accessed October 2015.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2013a. Hawksbill Sea Turtle (*Eretmochelys imbricate*) 5-year Review: Summary and Evaluation. National Marine Fisheries Service Office of Protected Resources, Silver Spring, Maryland and U.S. Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Services Office, Jacksonville, Florida. http://www.nmfs.noaa.gov/pr/pdfs/species/hawksbillseaturtle2013_5yearreview.pdf. Accessed December 2015.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2013b. Leatherback Sea Turtle (Dermochelys coriacea), 5-year Review: Summary and Evaluation. National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland and U.S. Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Services Office, Jacksonville, Florida. Available online at http://www.nmfs.noaa.gov/pr/listing/5yearreview_leatherbackturtle.pdf. Accessed December 2015.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (Caretta caretta), Second Revision. Available online at http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_loggerhead_atlantic.pdf. Accessed December 2015.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1993. Recovery Plan for Hawksbill Turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico. National Marine Fisheries Service, St. Petersburg, Florida. Available online at: http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_hawksbill_atlantic.pdf. Accessed July 2017.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1992. Recovery Plan for Leatherback Turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico. National Marine Fisheries Service, Washington, DC. Available online at http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_leatherback_atlantic.pdf. Accessed December 2015.

National Park Service. 2015. Sea Turtle Nesting Season 2014. http://www.nps.gov/pais/learn/nature/nesting2014.htm. Accessed April 2015.

National Park Service. 2013. Sea Turtle Nesting Season. South Padre Island National Seashore. Available online at http://www.nps.gov/pais/learn/nature/2015-nestingseason.htm. Accessed November 2015

Natural Resources Conservation Service. 2017. Web Soil Survey. http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm. Accessed May 2018

Navarro-Lopez, D. 1985. Status and Distribution of the Ocelot (Felis pardalis) in South Texas. M.S. Thesis, Texas A&M University, Kingsville, Texas.

Nowak, R. 1999. Felis yagouaroundi. In: Walker's Mammals of the World, Vol. 1, 6th Edition. Baltimore and London: The John Hopkins University Press.

Orr, T., S. Herz, and D. Oakley. 2013. Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, Virginia. Available online at http://www.data.boem.gov/PI/PDFImages/ESPIS/5/5298.pdf. Accessed April 2014.

Renaud, M.L., J.A. Carpenter, S.A. Manzella, and J.A. Williams. 1992. Telemetric Tracking of Green Sea Turtles (Chelonia mydas) in Relation to Dredged Channels at South Padre Island, Texas July through September 1992. Available online at http://www.seaturtle.org/PDF/RenaudML_1992_NMFSSEFSCTechReport.pdf. Accessed January 2016.

Ronconi, R.A., K.A. Allard, and P.D. Taylor. 2015. Bird Interactions with Offshore Oil and Gas Platforms: Review of impacts and monitoring techniques. Journal of Environmental Management, 147, 34-45.

Russell, R.W. 2005. Interactions Between Migrating Birds and offshore oil and gas platforms in the northern Gulf of Mexico: Final Report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009.

Schmidly, D. J., Bradley, R. D. 2016. The Mammals of Texas, Seventh Edition, p. 387. Accessed online: https://books.google.com/books?id=OdsDDQAAQBAJ&pg=PA387&lpg=PA387&dq=sei+whale+the+mammals+of+texas&source=bl&ots=G9UAErvn0O&sig=CtsVPgu4Fk7a2nIYOd09X63QLNg&hl=en&sa=X&ved=2ahUKEwiwgZnGy-rcAhXp7YMKHSITCjIQ6AEwDHoECAQQAQ#v=onepage&q=sei%20whale%20the%20mammals%20of%20texas&f=false. Accessed June 2018.

Smit,C.J. and G.J.M. Visser. 1993. Effects of Disturbance on Shorebirds: a summary of existing knowledge from the Dutch Wadden Sea and Delta area. Wader Study Group Bulletin 68: 6-19
Tewes, M.E. 1986. Ecological and Behavioral Correlations of Ocelot Spatial Patterns. Ph.D. Dissertation, University of Idaho, Moscow, Idaho.

Texas Parks and Wildlife Department. 2018. Texas Ecoregions. https://tpwd.texas.gov/education/hunter-education/online-course/wildlife-conservation/texas-ecoregions. Accessed May 2018.

Texas Parks and Wildlife Department. 2017a. Ocelot. https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_0013_ocelot.pdf. Accessed July 2017.

Texas Parks and Wildlife Department. 2017b. Jaguarundi. https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_0013_jaguarundi.pdf. Accessed July 2017.

Texas Parks and Wildlife Department. 2017c. TPWD Seagrass Viewer. http://tpwd.maps.arcgis.com/apps/webappviewer/index.html?id=af7ff35381144b97b38fe553f2e7b562. Accessed July 2017.

Texas Parks and Wildlife Department. 2016. Species Fact Sheet: Northern Aplomado Falcon. http://tpwd.texas.gov/huntwild/wild/species/aplomfal/. Accessed November 2016.

Texas Parks and Wildlife Department. 2015a. Species Fact Sheet: Kemp's Ridley Sea Turtle. Available online at http://tpwd.texas.gov/huntwild/wild/species/ridley. Accessed November 2015.

Texas Parks and Wildlife Department. 2015b. Species Fact Sheet: Leatherback Sea Turtle. https://tpwd.texas.gov/huntwild/wild/species/lethback/. Accessed November 2015.

Texas Parks and Wildlife Department. 2015c. Species Fact Sheet: Loggerhead Sea Turtle. https://tpwd.texas.gov/huntwild/wild/species/logghead/. Accessed November 2015.

Texas Parks and Wildlife Department. 2015d. Species Fact Sheet: Loggerhead Sea Turtle. https://tpwd.texas.gov/huntwild/wild/species/logghead/. Accessed November 2015.

Texas Parks and Wildlife Department. 2013. Ecological Mapping Systems of Texas: GIS data by Ecoregion: West Gulf Coastal Plain. Updated February 2013. Available online at https://tpwd.texas.gov/education/hunter-education/online-course/wildlifeconservation/texas-ecoregions. Accessed December 2015.

Texas Parks and Wildlife Department. 2010. https://www.cerc.usgs.gov/morap/Assets/UploadedFiles/Projects/Texas_Ecological_Systems_Classification/Phase_3_Interpretive_Booklet.pdf. Accessed May 2018.

Texas State Historical Association. 2018. Online history of Brownsville. https://tshaonline.org/handbook/online/articles/hdb04. Accessed June 2018.

The Mammals of Texas – Online Edition. 2018. Fin Whale. http://www.nsrl.ttu.edu/tmot1/balaphys.htm. Accessed June 2018.

U.S. Army Corps of Engineers. 2014. Brazos Island Harbor, Texas Channel Improvement Project. Final Integrated Feasibility Report-Environmental Assessment. http://www.swg.usace.army.mil/Portals/26/docs/BIH/Feasibility.pdf. Accessed June 2018.

U.S. Army Corps of Engineers. 2013. Brazos Island Harbor, Texas channel Improvement Project. Draft Integrated Feasibility Report-Environmental Assessment. http://www.swg.usace.army.mil/Portals/26/docs/Cheryl%20Jaynes/2-BIH%20DIFR-EA%202013.pdf. Accessed February 2017.

U.S. Energy Information Administration. 2014. Annual Energy Outlook 2014. Report No. DOE/EIA-0383ER(2014). https://www.eia.gov/outlooks/aeo/pdf/0383(2014).pdf. Accessed May 2018.

U.S. Environmental Protection Agency. 2013. Natural Gas, Clean Energy. Issued September 25, 2013.

U.S. Fish and Wildlife Service. 2018a. Species Profile for the Northern Aplomado Falcon (Falco femoralis septentionalis). https://ecos.fws.gov/ecp0/profile/speciesProfile.action?spcode=B06V#rangeInfo. Accessed May 2018.

U.S. Fish and Wildlife Service. 2018b. Species Profile for the Hawksbill sea turtle (Eretmochelys imbricata). https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=C00E. Accessed May 2018.

U.S. Fish and Wildlife Service. 2016a. Information, Planning and Conservation System. http://ecos.fws.gov/ipac/. Accessed January 2016.

U.S. Fish and Wildlife Service. 2015a. Creating a Wildlife Corridor. https://www.fws.gov/refuge/Lower_Rio_Grande_Valley/resource_management/wildlife_corridor.html. Accessed May 2018.

U.S. Fish and Wildlife Service. 2015b. Personal communication, Texas LNG Site Visit with FWS, NPS, TPWD, FERC, and Natural Resources Group, LLC. Brownsville, Texas. September 16, 2015.

U.S. Fish and Wildlife Service. 2015c. Biological Opinion, Consultation No. 02ETCC00-2015-F-0022. Available online at: https://www.fws.gov/southwest/es/Documents/R2ES/BO_TxDOT_SH100_CameronCnty_2015.pdf. Accessed July 2017.

U.S. Fish and Wildlife Service. 2015d. Green Turtle Factsheet. Available online at http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/PDF/Green-Sea-Turtle.pdf. Accessed October 2015.

U.S. Fish and Wildlife Service. 2015e. Kemp's Ridley Sea Turtle Factsheet. Available online athttp://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/kemps-ridley-seaturlte.htm. Accessed October 2015.

U.S. Fish and Wildlife Service. 2015f. Lower Rio Grande Valley National Wildlife Refuge. Available online at: https://www.fws.gov/refuge/Lower_Rio_Grande_Valley/. Accessed July 2017.

U.S. Fish and Wildlife Service. 2014a. Northern Aplomado Falcon (Falco femoralis septentionalis) 5-year Review: Summary and Evaluation. U .S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, Albuquerque, New Mexico. https://ecos.fws.gov/docs/five_year_review/doc4436.pdf. Accessed May 2018.

U.S. Fish and Wildlife Service. 2014b. Draft Recovery Plan for the Tamaulipan Kidneypetal (*Texas Ayenia*).

http://www.fws.gov/southwest/es/Documents/R2ES/TexasAyenia_DraftRecoveryPlan_Final_June2014.pdf. Accessed December 2015.

U.S. Fish and Wildlife Service. 2013a. Gulf Coast Jaguarundi Recover Plan. First Revision. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, New Mexico. December 2013. http://www.fws.gov/southwest/es/Documents/R2ES/GulfCoastJaguarundi_FinalRecoveryPlan_Dec2013.pdf. Accessed January 2015.

U.S. Fish and Wildlife Service. 2013b. The South Texas Refuge Complex. U.S. Fish and Wildlife Service Wildlife Refuges, Southwest Region. Available online at: http://www.fws.gov/southwest/refuges/texas/strc/. Accessed April 2015.

U.S. Fish and Wildlife Service. 2012a. Comprehensive Conservation Strategy for the Piping Plover (Charadrius melodus) in its Coastal Migration and Wintering Range in the Continental United States. Available online at http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjljumNmsjJAhVSq4MKHb1WAUAQFggcMAA&url=http%3A%2F%2Fwww.fws.gov%2Fmidwest%2Fendangered%2Fpipingplover%2Fpdf%2FCCSpiplNoApp2012.pdf&usg=AFQjCNHqGup62hkrQYsipBd4afwyvkj4Mw&sig2=Qqvh72oId-UVmVGvcSb9Tg&bvm=bv.108538919,d.amc.Accessed December 2015.

U.S. Fish and Wildlife Service. 2012b. Whooping Crane (*Grus americana*), 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Aransas National Wildlife Refuge, Austwell, Texas and Corpus Christi Ecological Service Field Office, Texas. Available online at: https://ecos.fws.gov/docs/five_year_review/doc3977.pdf. Accessed July 2018.

U.S. Fish and Wildlife Service. 2011a. Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition to List the Red Knot Subspecies Calidris canutus roselaari as Endangered. Available online at http://www.fws.gov/alaska/fisheries/fieldoffice/fairbanks/pdf/red_knot_90%20Day.pdf. Accessed December 2015.

U.S. Fish and Wildlife Service. 2010a. Draft Ocelot (*Leopardus pardalis*) Recovery Plan, First Revision. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, New Mexico. https://www.fws.gov/southwest/es/Documents/R2ES/Draft_Ocelot_Recovery_Plan-First_Revision.pdf. Accessed December 2015.

U.S. Fish and Wildlife Service. 2010b. South Texas Ambrosia 5-year Review: Summary and Evaluation. FWS, Corpus Christi Ecological Services Field Office, Corpus Christi, Texas. https://ecos.fws.gov/docs/five_year_review/doc3601.pdf. Accessed February 2017.

U.S. Fish and Wildlife Service. 2009. Piping Plover (*Charadrius melodus*), 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Northeast Region, Hadley, Massachusetts and Midwest Region's East Lansing Field Office, Michigan. http://www.fws.gov/northeast/endangered/PDF/Piping_Plover_five_year_review_and_summary.pdf. Accessed December 2015.

U.S. Fish and Wildlife Service. 2007. Northern Aplomado Falcon (Falco femoralis septentrionalis). https://www.fws.gov/endangered/esa-library/pdf/aplomado_falcon_fact_sheet.pdf. Accessed May 2018.

U.S. Fish and Wildlife Service. 2006. International Recovery Plan, Whooping Crane (*Grus americana*), Third Revision. Available online at: https://ecos.fws.gov/docs/recovery_plan/070604_v4.pdf. Accessed July 2018.

U.S. Fish and Wildlife Service. 2001a. Endangered and Threatened Wildlife and Plants; Final Determinations of Critical Habitat for Wintering Piping Plovers; Final Rule. Available online at https://www.federalregister.gov/articles/2001/07/10/01-16905/endangered-and-threatened-wildlife-and-plants-final-determination-of-critical-habitat-for-wintering. Accessed December 2015.

U.S. Fish and Wildlife Service. 2001b. Florida Manatee Recovery Plan. Third Revision. U.S. Fish and Wildlife Service, Southeast Region, Atlanta, Georgia. Available online at http://www.fws.gov/northflorida/Manatee/Recovery%20Plan/2001_FWS_Florida_Manatee_Recovery_Plan.pdf. Accessed December 2015.

U.S. Fish and Wildlife Service. 1990. Aplomado Falcon Recovery Plan. U.S. Fish and Wildlife Service. Albuquerque, New Mexico. 56pp.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook, Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act. March 1998, Final. https://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf. Accessed May 2018.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1991. Recovery Plan for U.S. Population of Atlantic Green Turtles (Chelonia mydas). U.S. Fish and Wildlife Service, Southeast Region, Atlanta, Georgia and National Marine Fisheries Service, Washington, DC. Available online at http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_green_atlantic.pdf. Accessed December 2015.

U.S. Geological Survey. 2013. USGS Targets Tiny Stowaways in Ships' Ballast Water. Available online at http://www2.usgs.gov/blogs/features/usgs_top_story/usgs-targetstiny-stowaways-in-ships-ballast-water/. Accessed March 2016.

Zonick, C. and M. Ryan. 1995. Ecology and Conservation of Piping Plovers Wintering along the Texas Gulf Coast. A final report to the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service. Located at: Texas Parks and Wildlife Department, Galveston, Texas.

APPENDIX E

STATE-LISTED SPECIES

APPENDIX E State-listed Species Potentially Present within the Project Area [a]			
Common Name ***Scientific Name***	**State Status**	**Habitat Assessment**	**Potentially Occurring Within Project Site**
Birds			
American peregrine falcon *Falco peregrinus anatum*	Endangered	Migrants can be throughout the state occupying a variety of habitat including coastal habitats. Resident species of the Trans-Pecos region within open habitats, near water.	Suitable habitat present[b]
Peregrine falcon *Falco peregrinus*	Endangered	Two subspecies of peregrine falcon migrate within Texas (the artic peregrine falcon, found in the western part of the state and the American peregrine falcon, found along the Texas coast). Due to the similarity in appearance, they are generally referenced on the species level. Habitat requirements are the same as that discussed for the American peregrine falcon.	Suitable habitat present[b]
Cactus ferruginous pygmy-owl *Glaucidium brasilianum cactorum*	Threatened	Nests in cavities, primarily in saguaro cacti, but they will also utilize tree cavities. Historically occurred in southern Texas, but U.S. distribution is now limited to two counties within Arizona.	No suitable habitat present
Common black hawk *Buteogallus anthracinus*	Threatened	Habitat includes cottonwood-lined rivers and streams, and willow tree groves on the floodplain of the lower Rio Grande River.	No suitable habitat present
Eskimo curlew *Numenius borealis*	Endangered	Historically occurred in South Texas during migration utilizing interior and coastal prairies.	Suitable habitat present[c]
Gray hawk *Asturina nitida*	Threatened	Wooded stream areas are preferred habitat, but can inhabit scrub areas, forest edges, and open clearings. Breeding habitat includes tall trees near streams, prefers cottonwoods with adjacent areas of mesquite.	No suitable habitat present
Interior least tern *Sterna antillarum athalassos*	Endangered	Breeds along inland river systems in Texas. Nesting habitat consists of bare or sparsely vegetated sand, shell, and gravel beaches, sandbars, islands, and salt flats along rivers and reservoirs.	No suitable habitat present
Northern beardless-tryannulet *Camptostoma imberbe*	Threatened	Habitat within southern Texas includes woodlands adjacent to streams. Prefers mesquite, hackberry, ebony, and huisache woodlands.	No suitable habitat present
Reddish egret *Egretta rufescens*	Threatened	Occurs in protected coastal habitats such as tidal flats and salt marshes associated with bay and estuary systems.	Suitable habitat present[b]
Rose-throated becard *Pachyramphus aglaiae*	Threatened	Occurs throughout the year in native woodlands near the Rio Grande River. Prefers wooded canyons, river groves, and sycamores.	No suitable habitat present

APPENDIX E **State-listed Species Potentially Present within the Project Area** [a]			
Sooty tern *Sterna fuscata*	Threatened	Generally stays out at sea and avoids areas near mainland coasts and shallow waters. Nests on open, sparsely vegetated beaches of small islands.	No suitable habitat present
Texas botteri's sparrow *Aimophila botterii texana*	Threatened	Occurs in grasslands and short-grass prairies with scattered shrubs.	No suitable habitat present
Tropical parula *Parula pitiayumi*	Threatened	Breeds in southern Texas, where suitable nesting habitat consists of groves of live oaks and mesquites with Spanish moss.	No suitable habitat present
White-faced ibis *Plegadis chihi*	Threatened	Habitat includes freshwater wetlands, irrigated fields, flooded pastures, and agricultural fields. Occasionally forages in salt water marsh. Breeds in colonies within dense marsh or low trees above water.	Suitable habitat present
White-tailed hawk *Buteo albicaudatus*	Threatened	Habitats include coastal prairie and dry grasslands with scattered shrubs or low trees of hackberry, mesquite, and oak.	Suitable habitat present[b]
Wood stork *Mycteria Americana*	Threatened	Forages mostly in freshwater, including flooded agricultural fields, shallow marshes, and ponds. Nesting habitat mainly includes cypress swamps.	No suitable habitat present
Zone-tailed hawk *Buteo albonotatus*	Threatened	Inhabits deciduous or pine-oak woodlands near rivers or streams, wooded canyons.	No suitable habitat present
Mammals			
Coues' rice rat *Oryzomys couesi*	Threatened	Occurs within the lower Rio Grande Valley mostly in cattail-bulrush marshes and aquatic grassy areas near oxbow lakes. Builds nests in small trees and cattails near or above water.	No suitable habitat present
Jaguar *Panthera onca*	Endangered	Habitat includes dense chaparral. Believed to be extirpated within Texas.	No suitable habitat present
Southern yellow bat *Lasiurus ega*	Threatened	Occurs within natural groves of palm trees along the Rio Grande River, but will also utilize ornamental palms. Roosts primarily beneath hanging fronds of palm trees.	No suitable habitat present
White-nosed coati *Nasua narica*	Threatened	Inhabits woodlands and canyons in southern Texas. Forages on the ground and in trees.	No suitable habitat present
Reptiles			
Black-striped snake *Coniophanes imperialis*	Threatened	Occurs in southern Texas and prefers sandy soil areas with piles of rotting cacti.	Suitable habitat present

APPENDIX E State-listed Species Potentially Present within the Project Area [a]			
Northern cat-eyed snake *Leptodeira septentrionalis*	Threatened	Occurs within thornscrub and subtropical habitat.	Suitable habitat present
Speckled racer *Drymobius margaritiferusi*	Threatened	Occurs within dense thickets or palm groves with vegetative litter, generally found near water.	No suitable habitat present
Texas horned lizard *Phrynosoma cornutum*	Threatened	Found in arid and semiarid open habitats with sparse vegetative cover, generally found within areas with loose sand or loamy soils.	Suitable habitat present[b]
Texas indigo snake *Drymarchon melanurus erebennus*	Threatened	Inhabits dense riparian corridors within thornbush-chaparral woodlands of south Texas.	Suitable habitat present[b]
Texas scarlet snake *Cemophora coccinea lineri*	Threatened	Habitat includes mixed hardwood scrub within sandy soils.	No suitable habitat present
Texas tortoise *Gopherus berlandieri*	Threatened	Inhabits scrub and brush areas with sandy well-draining soils.	Suitable habitat present[b]
Amphibians			
Black-spotted newt *Notophthalmus meridionalis*	Threatened	Prefers shallow, warm water with vegetative cover, such as roadside ditches and ponds.	Suitable habitat present
Mexican treefrog *Smilisca baundinii*	Threatened	Occurs in sub-humid regions near streams and resacas.	No suitable habitat present
Sheep frog *Hypopachus variolosus*	Threatened	Occurs within moist sites in arid areas, such as grassland and savanna, including animal burrows and under vegetative litter.	Suitable habitat present
South Texas siren (large form) *Siren sp. 1*	Threatened	Inhabits wet or occasionally wet areas, such as ditches, canals, arroyos, canals, ditches, and shallow depressions.	Suitable habitat present
White-lipped frog *Leptodactylus fragilis*	Threatened	Occurs within a wide variety of moist habitats habitat such as cultivated fields, roadside ditches and low grasslands.	Suitable habitat present
Mollusks			
False spike mussel *Quadrula mitchelli*	Threatened	Found in medium to large rivers with substrates varying from mud to mixtures of sand, gravel and cobble. May have once occurred in the Rio Grande basin, but may be extirpated from Texas.	No suitable habitat present
Mexican fawnsfoot mussel *Truncilla cognata*	Threatened	Found in the Rio Grande basin, habitat is likely sand or gravel bottom within flowing rivers and streams.	No suitable habitat present

APPENDIX E **State-listed Species Potentially Present within the Project Area [a]**			
Salina mucket *Potamilus metnecktayi*	Threatened	Inhabits fast moving streams within the Rio Grande basin, found submerged along the river bank in soft sediments, such as clay and silt.	No suitable habitat present
Texas hornshell *Popenaias popeii*	Threatened	Found within the Rio Grande basin in areas where sediment collects in crevices, along river banks, and at the base of boulders.	No suitable habitat present
Fish			
Mexican goby *Ctenogobius claytonii*	Threatened	Habitat includes fresh and brackish coastal streams, and rivers.	No suitable habitat present
Opossum pipefish *Microphis brachyurus*	Threatened	Spawns in freshwater or low salinity estuaries. Although they may occur within Rio Grande estuary, permanent populations are limited to tropical and subtropical areas.	No suitable habitat present
Rio Grande silvery minnow *Hybognathus amarus*	Endangered	Believed to be extirpated. Historically within the Rio Grande River system within backwater areas of medium to large streams.	No suitable habitat present
River goby *Awaous banana*	Threatened	Found within brackish coastal, clear waters with slow current, sandy bottoms and no vegetation.	No suitable habitat present
Smalltooth sawfish *Pristis pectinata*	Endangered	Habitat includes estuaries with muddy or sand bottoms.	No suitable habitat present
Plants			
Star cactus *Astropphytum asterias*	Endangered	Found in sparsely vegetated openings between thickets within mesquite grasslands or shrublands. Habitat includes gravelly clays or loams over the Catahoula and Frio formations.	Project is located outside this species' current range.

[a] State listed species that are also federally listed are identified and discussed in section 4.7 and are not included herein.
[b] Species observed within the Project site during biological field surveys.
[c] Species is thought to be extirpated from the United States.

References:

Audubon Society. 2016. Guide to North American Birds. Available online at http://www.audubon.org/bird-guide. Accessed May 2017.

Cornell Lab of Ornithology. 2017. All About Birds. Available online at https://www.allaboutbirds.org/. Accessed May 2017.

Froese, R. and D. Pauly. Editors. 2017. FishBase. Available online at www.fishbase.org. Accessed May 2017.

Texas A&M Agrilife Extension. 2017. The Texas Breeding Bird Atlas. Peregrine Falcon (*Falco Peregrinus*). Available online at http://txtbba.tamu.edu/species-accounts/peregrine-falcon/. Accessed May 2017.

Texas Parks and Wildlife Department. 1994. The Mammals of Texas. Available online at http://www.nsrl.ttu.edu/tmot1/Default.htm. Accessed May 2017.

Texas Parks and Wildlife. 2003. Endangered and Threatened Animals of Texas- Their Life History and Management. Available online at https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_0013.pdf. Accessed May 2017.

Texas Parks and Wildlife Department. 2017a. Rare, Threatened, and Endangered Species of Texas by County. Annotated County Lists of Rare Species. Cameron County. Available online at http://tpwd.texas.gov/gis/rtest/. Accessed May 2016.

Texas Parks and Wildlife Department. 2017b. American Peregrine Falcon (*Falco peregrinus anatum*). Available online at http://tpwd.texas.gov/huntwild/wild/species/amperegrine/. Accessed May 2017.

Texas Parks and Wildlife Department. 2017c. Eskimo Curlew (*Numenius borealis*). Available online at http://tpwd.texas.gov/huntwild/wild/species/eskcurl/. Accessed May 2017.

Texas Parks and Wildlife Department. 2018. Interior Least Tern (*Sterna antillarum athalassos*). Available online at: https://tpwd.texas.gov/huntwild/wild/species/leasttern/. Accessed July 2018.

U.S. Fish and Wildlife Service. 2006. Threatened and Endangered Species. Eskimo Curlew (*Numenius borealis*). Available online at https://www.fws.gov/alaska/fisheries/endangered/pdf/consultation_guide/62_ESCU_Factsheet.pdf. Accessed July 2017.

U.S. Fish and Wildlife Service. 2008. Arizona Ecological Services- Documents by Species. Cactus Ferruginous Pygmy Owl. Availble online at https://www.fws.gov/southwest/es/arizona/Documents/Redbook/Cactus%20Ferruginous%20Pygmy%20owl.pdf. Accessed May 2017.

APPENDIX F

CUMULATIVE AIR CALCULATIONS

CUMULATIVE AIR QUALITY IMPACTS DURING LNG TERMINAL OPERATIONS

Introduction

Many of the public scoping comments issued for the Texas LNG Project express concern over cumulative air quality impacts from emissions of the three LNG terminals – Texas LNG, Rio Grande LNG, and Annova LNG – proposed to be located on the Brownsville Ship Channel. Therefore, we conducted a cumulative impact analysis to quantify the impacts of simultaneous operation of all three planned terminals. As discussed in section 4.11.1 of the EIS, a full NAAQS analysis (including existing and permitted emissions sources) is required in the TCEQ air permitting process for Texas LNG's air quality permit for 1-hour and annual NO_2 for the LNG Terminal. However, the full NAAQS Analysis prepared for the TCEQ is not required to include the mobile sources (e.g., LNG tankers and support vessels), or stationary sources from other projects that are planned, but have not yet been permitted. Therefore, we conducted a cumulative impact assessment to estimate the criteria pollutant concentrations during concurrent operation of the three proposed Brownsville area LNG terminals, including marine vessel emissions. Our assessment includes all criteria pollutants and averaging periods for which dispersion modeling was conducted. The methods, results, and conclusions are summarized below.

Methodology

The predicted ambient air quality impacts from the operation of the Texas LNG, Rio Grande LNG, and Annova LNG terminals were used assess the potential cumulative impacts during concurrent operation of all three facilities. The cumulative impacts were compiled for five criteria pollutants (NO_2, CO, $PM_{2.5}$, PM_{10}, and SO_2) and their associated averaging periods (e.g., 1-hour, 8-hour, 24-hour, and annual) for comparison to the primary NAAQS.

Each applicant provided air dispersion modeling results for operation of their project at full buildout. The emissions from operation of the projects included both the stationary emission sources at the LNG terminal and the mobile marine sources (e.g., LNG tankers and support vessels) within the moored safety zone. The modeling results for the Rio Grande LNG Terminal also include Rio Bravo Pipeline's proposed Compressor Station 3, located within the Rio Grande LNG Terminal site.

Impacts from each of the three projects were predicted using the same standardized receptor grid, so that the predicted impacts could be compiled at the same spatial locations. The standardized receptor grid included 30,000 receptors laid out in three nested receptor grids: 10,000 fine receptors with 150-meter spacing; 10,000 medium receptors with 450-meter spacing; and 10,000 coarse receptors with 1,000-meter spacing. This nested grid provided increased receptor density or coverage in the vicinity of the three projects, where higher impacts are predicted. Table F.1-1 includes the detailed parameters used to develop the nested receptor grid for this cumulative impact analysis.

TABLE F.1-1 Receptor Grid Coordinates					
Description	Southwest Corner		Spacing (m)	Grid Extent (km)	Grid Matrix Configuration
	UTM Easting (m)	UTM Northing (m)			
Grid Centerpoint	677718.13	2879943.75	N/A	N/A	100 x 100 (10,000)
Fine Receptors	670218.13	2872443.75	150	15 x 15	100 x 100 (10,000)
Medium Receptors	655218.13	2857443.75	450	45 x 45	100 x 100 (10,000)
Coarse Receptors	627718.13	2829943.75	1,000	100 x 100	100 x 100 (10,000)

The modeling was conducted using the parameters established for each applicant's air quality impacts analysis; therefore, some of the model assumptions differ between the analyses. Specific examples of variation described below include the meteorological data inputs and concentration ranks used to quantify model outputs. The detailed modeling methodologies for each project are available on the FERC docket for each project.[1]

Representative hourly meteorological data are used in dispersion modeling to establish the atmospheric conditions near a pollutant source, and allow the model to predict the dispersion of pollutants based on site-specific conditions. The Annova and Texas LNG assessments are based on a 1-year meteorological dataset, while the Rio Grande LNG used a 5-year meteorological dataset.

In addition, as depicted in table F.1-2, in some cases, the applicants used concentration ranks that differ from TCEQ modeling guidance.[2] Concentration ranks are statistically-determined, and higher concentration ranks are more conservative. For example, TCEQ recommends that, when using a 1-year meteorological dataset, the maximum high, first high (H1H) value should be reported for 1-hour NO_2; however, Texas LNG provided the maximum high, eighth high (H8H) value, which is lower and therefore less conservative than TCEQ's recommendation.

Pollutant concentrations for given averaging periods for each of the three projects were combined with a background concentration to develop the cumulative impacts for each pollutant. The results of the cumulative assessment are provided in the following section.

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[1] The air dispersion model protocols are available on FERC's eLibrary website, located at http://www.ferc.gov/docs-filing/elibrary.asp, by searching Docket Number CP16-454 or CP16-455 and accession number 20170224-5143 for the Rio Grande LNG Project; Docket Number CP16-116 and accession numbers 20170928-5165 and 20171212-5161 for the Texas LNG Project, and Docket Number CP16-480 and accession number 20160713-4004 for the Annova LNG Project.

[2] Texas Commission on Environmental Quality. 2015. Air Quality Modeling Guidelines, APDG 6232. Online at: https://www.tceq.texas.gov/assets/public/permitting/air/Modeling/guidance/airquality-mod-guidelines6232.pdf.

Table F.1-2
Concentration Ranks for Each Criteria Pollutant at Each Averaging Period in Air Dispersion Modeling

Pollutant	Averaging Period	Concentration Rank			TCEQ Guidance
		Annova LNG	Rio Grande LNG	Texas LNG	
CO	1-hour	H2H	H2H	H2H	For full NAAQS Analysis, when using one year of meteorological data, report the maximum H1H. When using five years of meteorological data, report the maximum H2H.
	8-hour	H2H	H2H	H2H	
NO_2	1-hour	H1H	8th Highest Max Daily 1-hour values averaged over 5 years	8th Highest Maximum Daily 1-hour values averaged over 1 year	For full NAAQS Analysis, when using one year of meteorological data, report the maximum H1H. When using five years of meteorological data, report the maximum H8H.
	Annual	Annual values averaged across 1 year	Annual values averaged across 1 year	Annual values averaged across 1 year	
SO_2	1-hour	H1H	H4H	4th Highest Maximum Daily 1-hour values averaged over 1 year	For full NAAQS Analysis, when using one year of meteorological data, report the maximum H1H. When using five years of meteorological data, report the maximum H4H.
PM_{10}	24-hour	H1H	H6H (did not use concatenated meteorological data)	H6H	For full NAAQS Analysis, when using one year of meteorological data, report the maximum H1H. When using five years of meteorological data, report the maximum H6H for the concatenated 5-year period.
$PM_{2.5}$	24-hour	H1H	H8H	8th Highest Maximum Daily 1-hour values averaged over 1 year	For full NAAQS Analysis, when using one year of meteorological data, report the maximum H1H. When using five years of meteorological data, report the maximum 5-year average of H8H for each receptor.
	Annual	Annual values averaged across 1 year	Annual values averaged across 1 year	Annual values averaged across 1 year	Annual values averaged across 1 year

Results and Conclusions

Figures F-1 through F-8 depict the cumulative impact assessment based on the air pollutant dispersion model output provided for the Texas LNG, Rio Grande LNG, and Annova LNG terminals. The estimated cumulative peak concentration for each pollutant and associated averaging period is based on combining the predicted concentration from each project at each receptor location regardless of the time when each concentration occurs. Since the timing and location of the maximum predicted impacts from each terminal would differ, the method used to develop the peak cumulative concentrations is conservative. The cumulative peak concentrations were compared to the NAAQS. While this cumulative analysis does not follow the EPA-prescribed methodology for a full impacts analysis that would be conducted as a part of the Federal PSD permitting process to assess stationary source project impacts relative to the NAAQS, the primary NAAQS represent standardized air quality criteria and were therefore used as a benchmark for comparison against modeling results. Table F.1-3 summarizes the peak concentrations estimated for concurrent operation of the three projects.

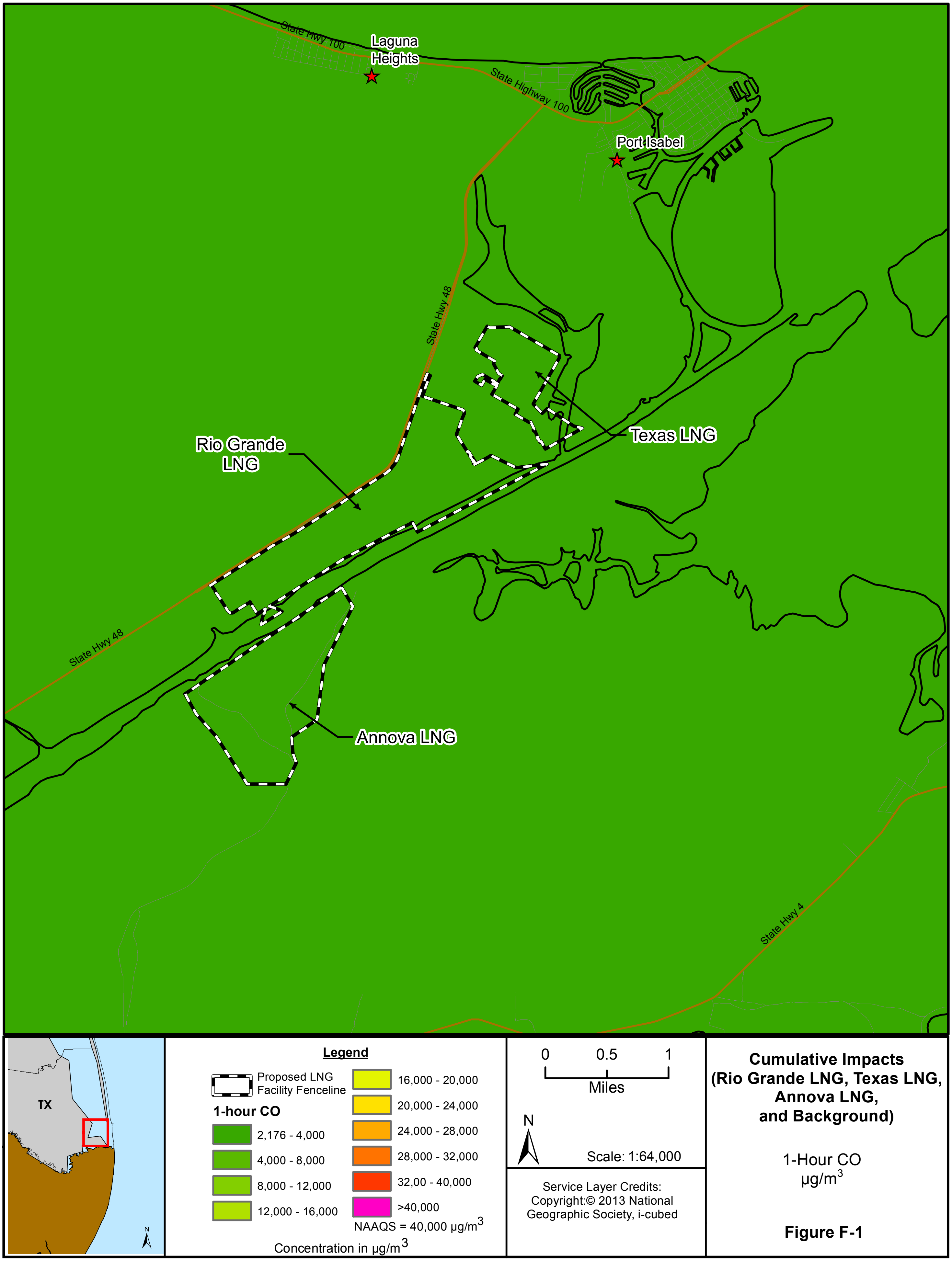
Table F.1-3
Peak Concentrations Estimated in Cumulative Air Dispersion Modeling for Stationary Source and Marine Vessels for the Brownsville Area LNG Projects

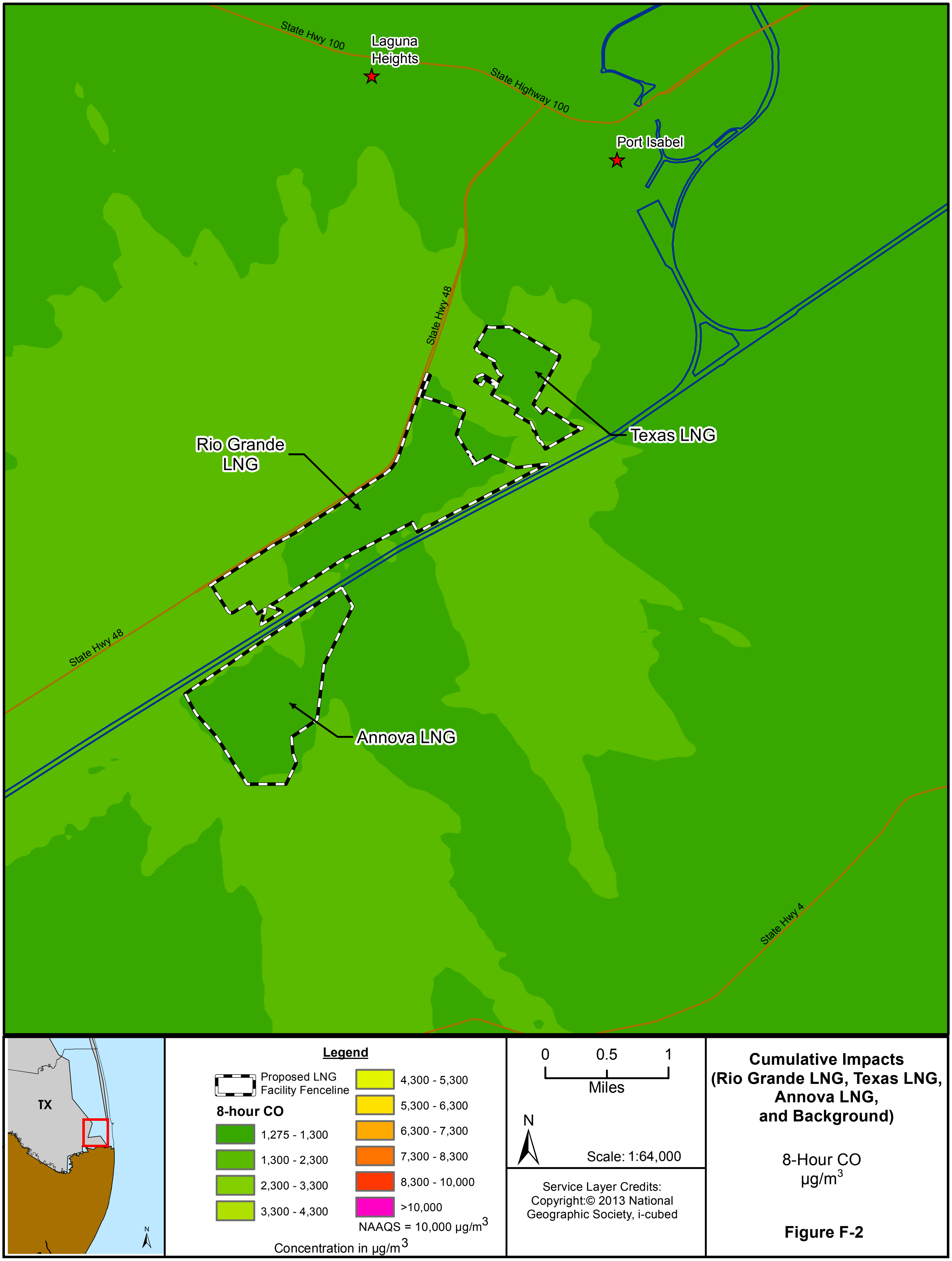
Criteria Air Pollutant	Averaging Period	Background Concentration[a] ($\mu g/m^3$)	Peak Concentration based on Modeled Results ($\mu g/m^3$)[b]			NAAQS ($\mu g/m^3$)
			Peak Concentration[c]	Laguna Heights	Port Isabel	
CO	1-hour	2,175.5	2,746	2,337	2,324	40,000
	8-hour	1,259.5	1,453	1,294	1,290	10,000
NO_2	1-hour	49.9	196	73	72	188
	Annual	6.1	9	6	6	100
SO_2	1-hour	10.6	23	14	14	196
PM_{10}	24-hour	62.0	64	62	62	150
$PM_{2.5}$	24-hour	22.9	25	23	23	35
	Annual	9.1	9	9	9	12

[a] Background concentrations retrieved from Tables 4-1 and 4-2 of dispersion modeling report provided for the Texas LNG project (available on FERC's eLibrary website, located at http://www.ferc.gov/docs-filing/elibrary.asp, by searching Docket Number CP16-116 and accession numbers 20170928-5165).
[b] Modeled impacts include stationary sources and marine vessels (e.g., LNG carriers) at the LNG terminal sites.
[c] Peak concentrations predicted for each of the three projects for each receptor location were conservatively combined without regard to time of occurrence.

As shown above, predicted peak cumulative pollutant concentrations for the three projects were below the NAAQS, with the exception of the 1-hr NO_2 NAAQS. The predicted maximum cumulative impact of NO_2 for the 1-hour averaging period is estimated to be greater than the 1-hr NO_2 NAAQS of 188 $\mu g/m^3$. The predicted peak cumulative impact is geographically located between the fence lines of the Rio Grande LNG and Texas LNG terminals as depicted in figure F-3. Because it is unlikely that all three terminals would be loading LNG vessels simultaneously, the peak concentrations presented in table F.1-3 are a conservative representation of combined impacts. As depicted in figure F-3 and table F.1-3, 1-hr NO_2 concentrations in residential areas in Port Isabel and Laguna Heights are estimated to be below 75 $\mu g/m^3$, which is well below the NAAQS.

As depicted in figures F-1 through F-8, cumulative impacts are expected to disperse for all pollutants before reaching population centers in Port Isabel and Laguna Heights and would be below the NAAQS. Therefore, while concurrent operations of the LNG terminals would result in increased concentrations of air pollutants in the immediate vicinity of the terminals, the projects' emissions are not expected to result in a significant impact on regional air quality.

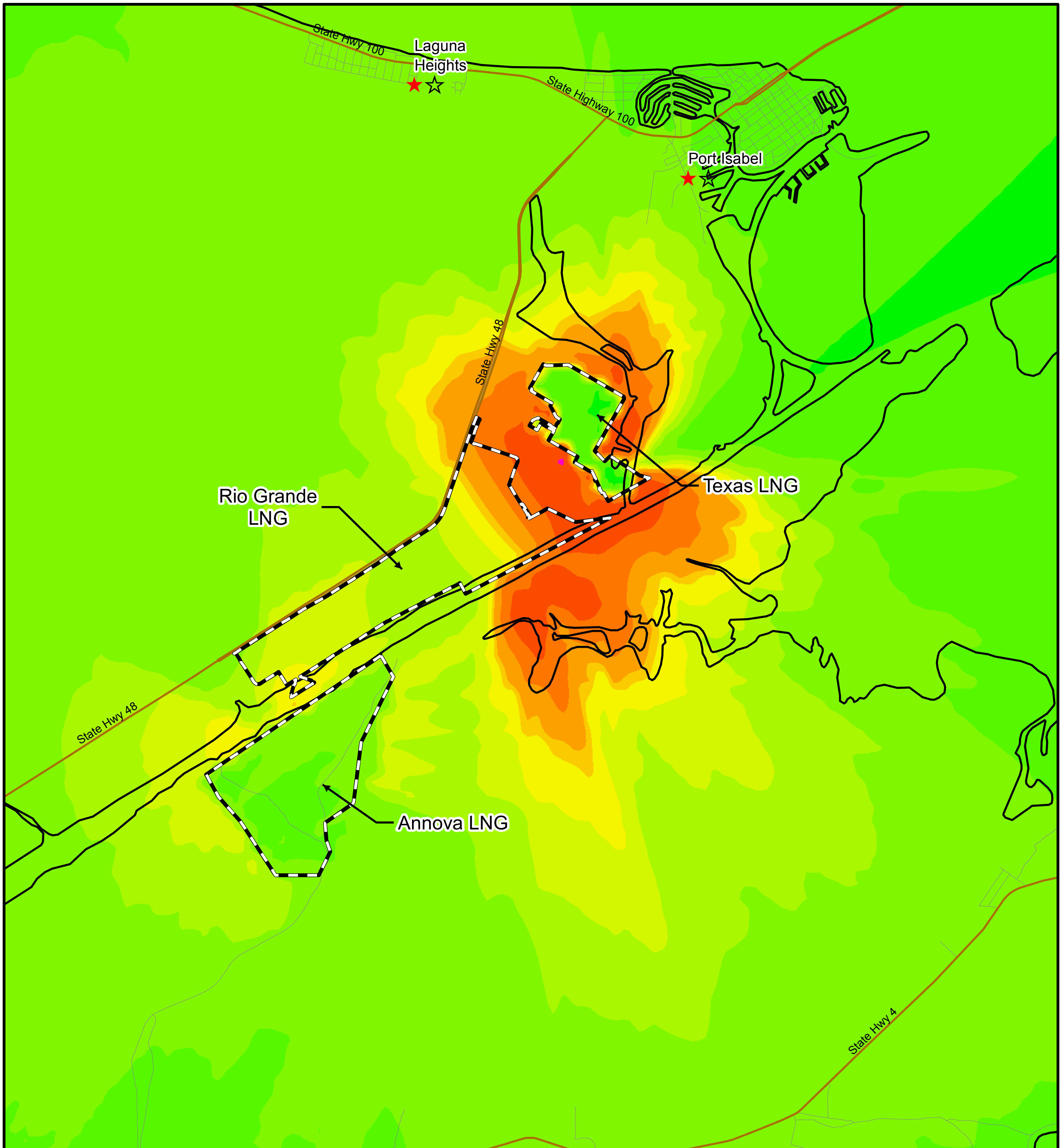

State Hwy 100
Laguna Heights
State Highway 100
Port Isabel
State Hwy 48
Texas LNG
Rio Grande LNG
State Hwy 48
Annova LNG
State Hwy 4
TX
Legend
Proposed LNG Facility Fenceline
1-hour CO
2,176 - 4,000
4,000 - 8,000
8,000 - 12,000
12,000 - 16,000
16,000 - 20,000
20,000 - 24,000
24,000 - 28,000
28,000 - 32,000
32,00 - 40,000
>40,000
NAAQS = 40,000 μg/m3
Concentration in μg/m3
0 0.5 1
Miles
N
Scale: 1:64,000
Service Layer Credits: Copyright:© 2013 National Geographic Society, i-cubed
Cumulative Impacts (Rio Grande LNG, Texas LNG, Annova LNG, and Background)
1-Hour CO
μg/m3
Figure F-1

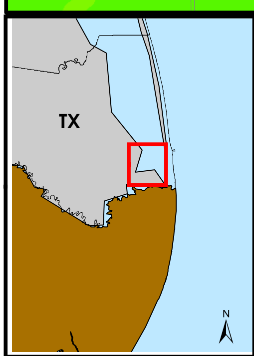


Cumulative Impacts (Rio Grande LNG, Texas LNG, Annova LNG, and Background)

8-Hour CO
μg/m³

Figure F-2





Legend

Proposed LNG Facility Fenceline

1-hour NO_2

56.6 - 60	100 - 110
60 - 70	110 - 115
70 - 80	115 - 130
80 - 90	130 - 150
90 - 100	150 - 188
	>188

NAAQS = 188 μg/m^3

Concentration in μg/m^3

0 0.5 1

Miles

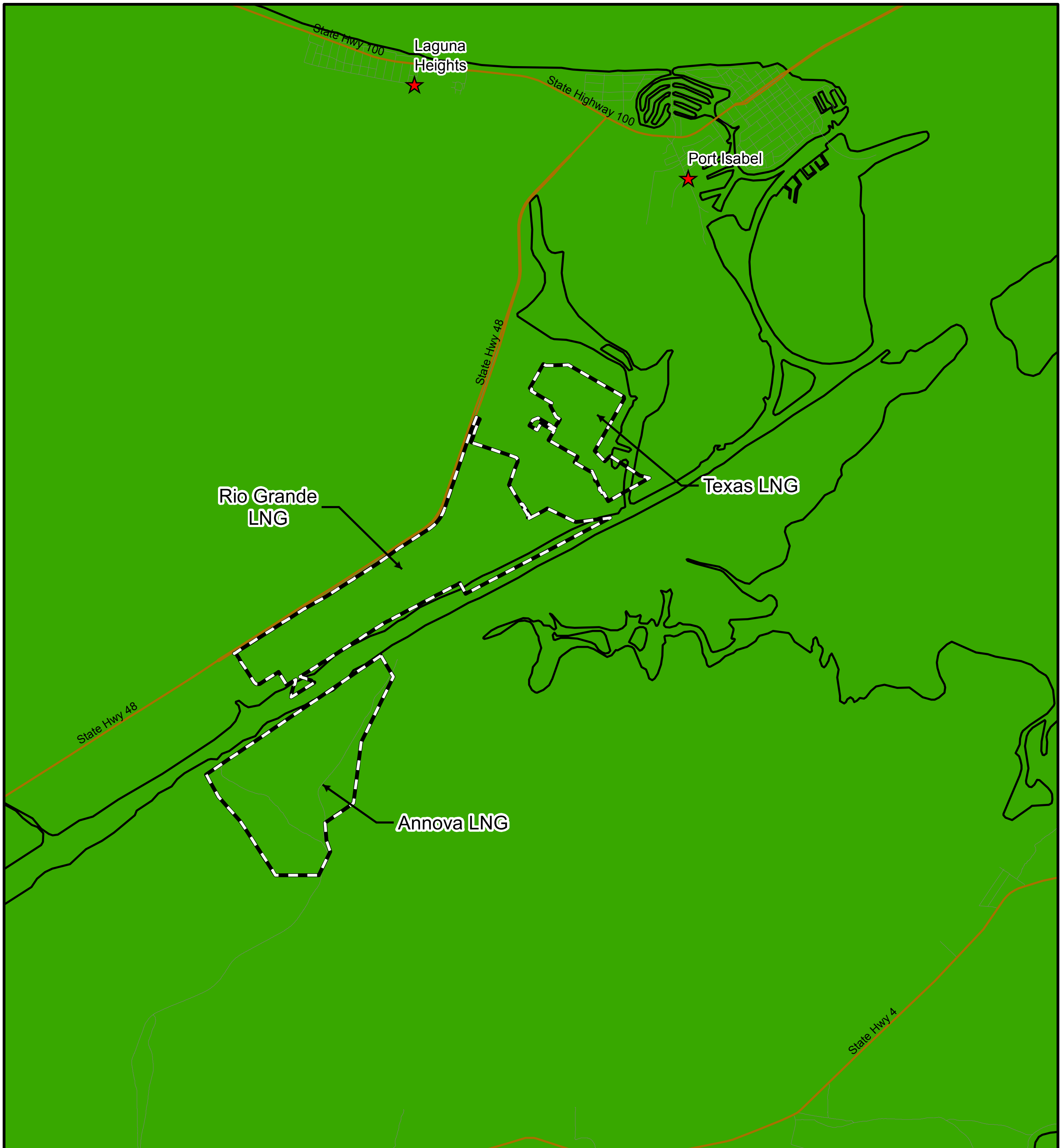
N

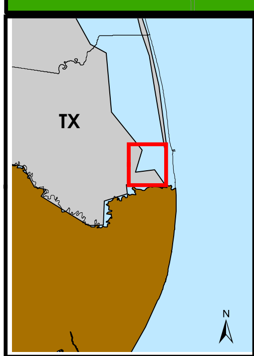
Scale: 1:64,000

Cumulative Impacts (Rio Grande LNG, Texas LNG, Annova LNG, and Background)

1-Hour NO_2
μg/m^3

Figure F-3





Legend

Proposed LNG Facility Fenceline

Annual NO2

- 6.1 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 100
- >100

NAAQS = 100 µg/m^3

Concentration in µg/m^3

0 0.5 1

Miles

N

Scale: 1:64,000

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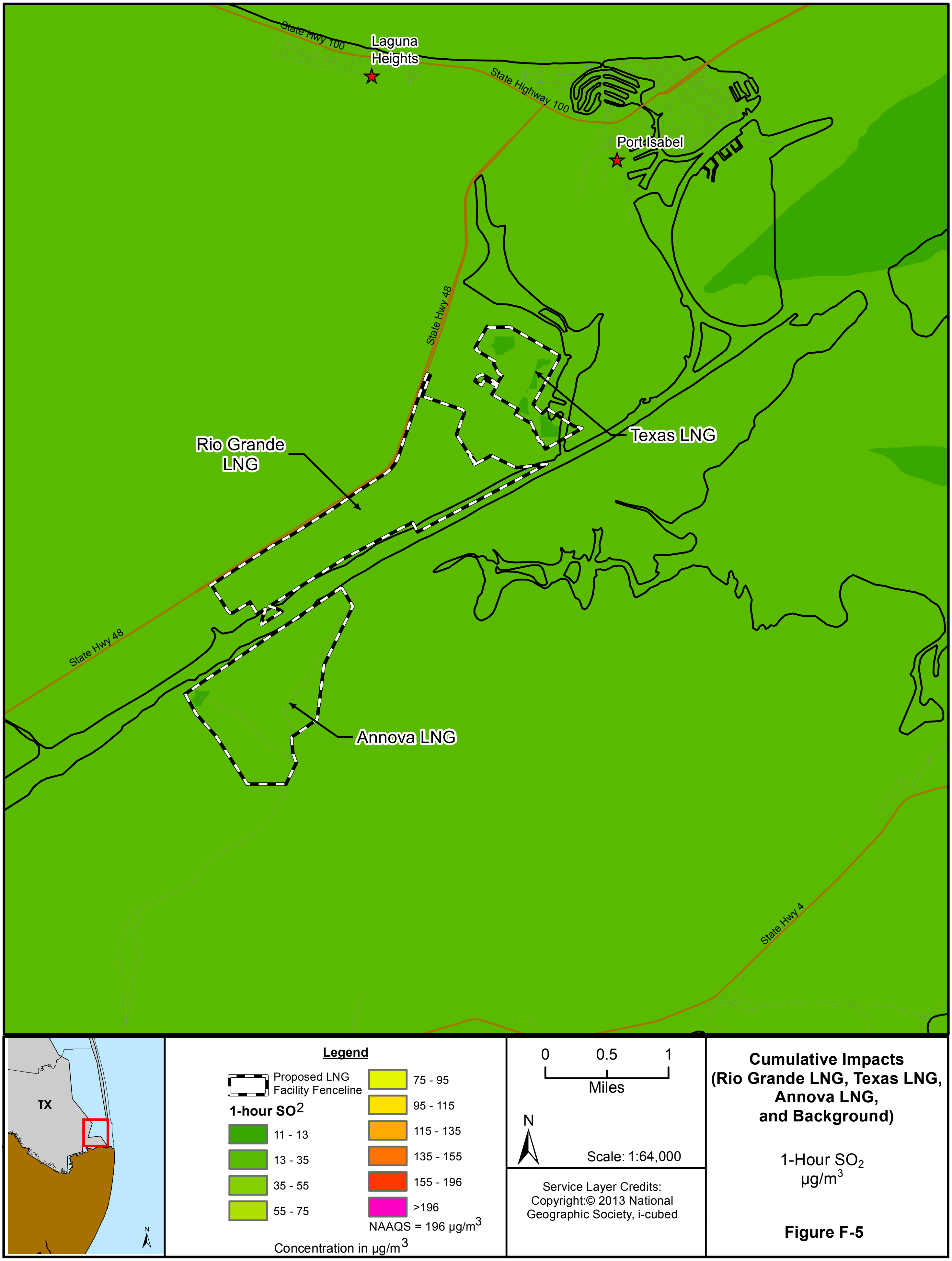
Cumulative Impacts (Rio Grande LNG, Texas LNG, Annova LNG, and Background)

Annual NO_2
µg/m^3

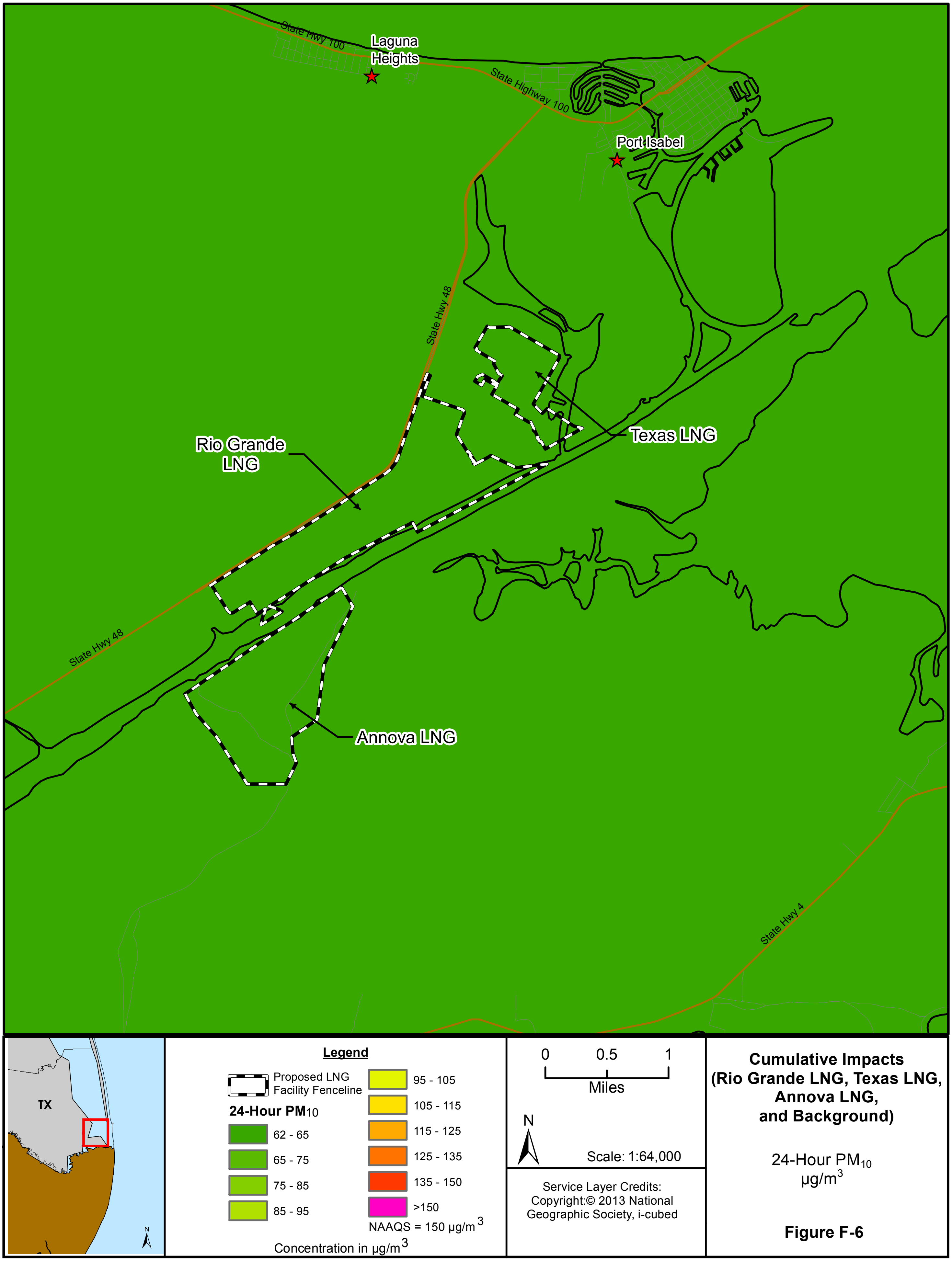
Figure F-4



Cumulative Impacts (Rio Grande LNG, Texas LNG, Annova LNG, and Background)

1-Hour SO_2
μg/m^3

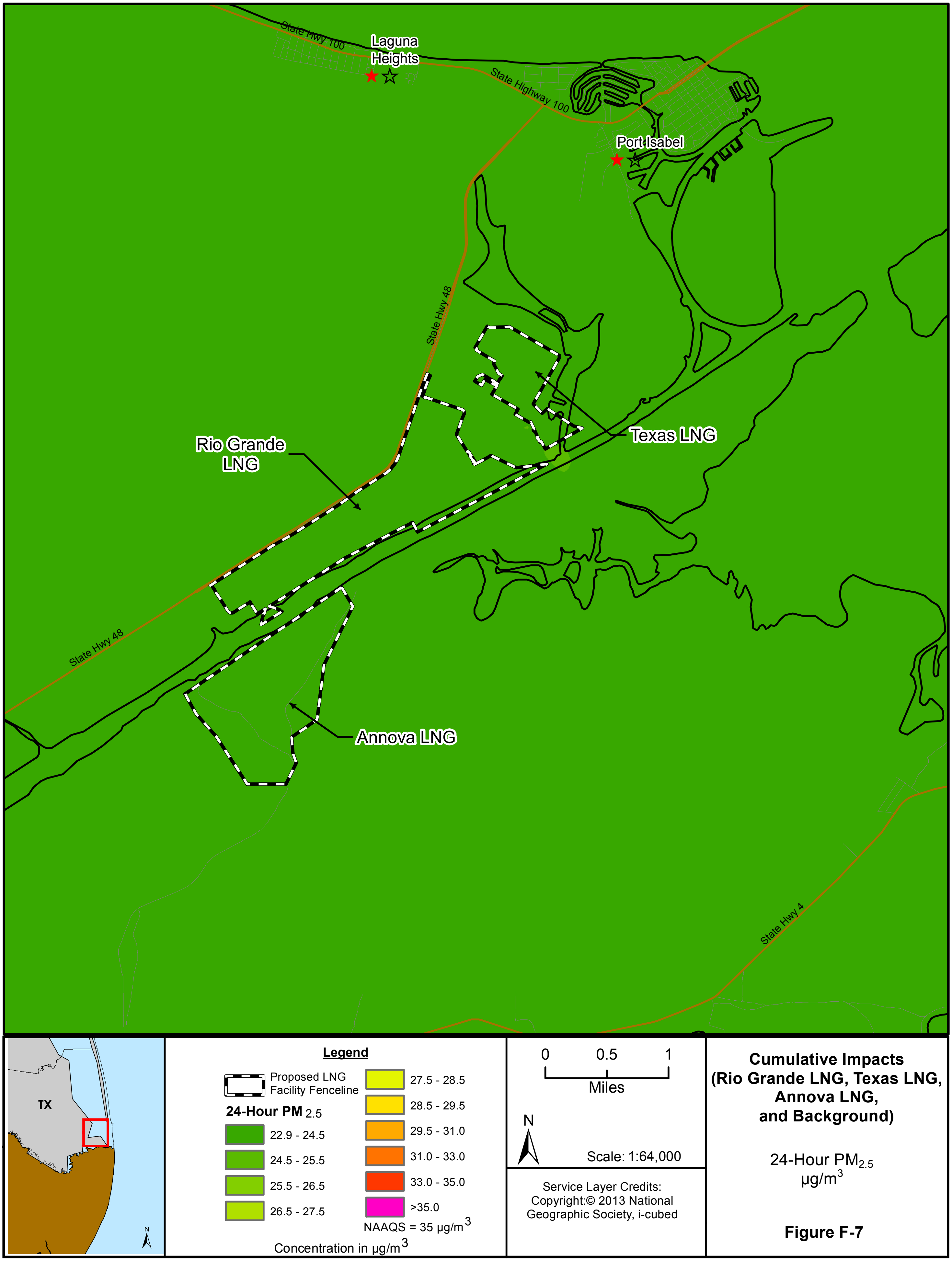
Figure F-5



Cumulative Impacts (Rio Grande LNG, Texas LNG, Annova LNG, and Background)

24-Hour PM_{10} $\mu g/m^3$

Figure F-6



Legend

Proposed LNG Facility Fenceline

24-Hour PM $_{2.5}$

22.9 - 24.5	27.5 - 28.5
24.5 - 25.5	28.5 - 29.5
25.5 - 26.5	29.5 - 31.0
26.5 - 27.5	31.0 - 33.0
	33.0 - 35.0
	>35.0

NAAQS = 35 μg/m^3

Concentration in μg/m^3

0 0.5 1

Miles

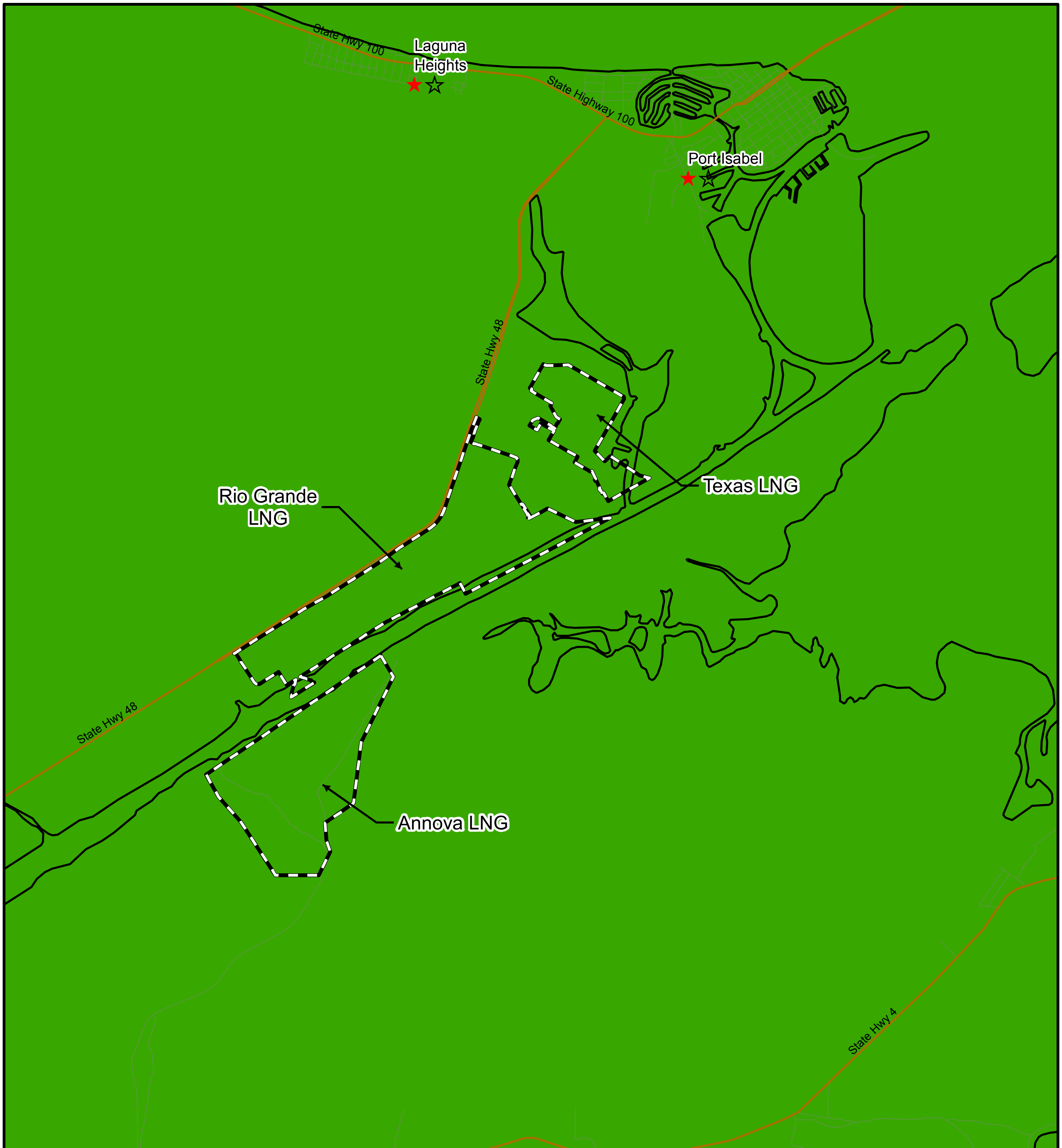
N

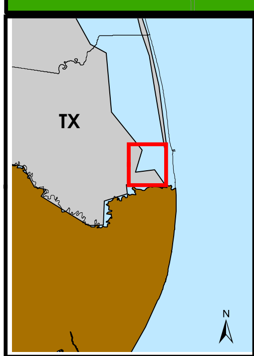
Scale: 1:64,000

Cumulative Impacts (Rio Grande LNG, Texas LNG, Annova LNG, and Background)

24-Hour $PM_{2.5}$
μg/m^3

Figure F-7





Legend

Proposed LNG Facility Fenceline

Annual $PM_{2.5}$

- 9.1 - 9.5
- 9.5 - 9.8
- 9.8 - 10.0
- 10.0 - 10.2
- 10.2 - 10.4
- 10.4 - 10.6
- 10.6 - 10.8
- 10.8 - 11
- 11.0 - 12
- >12

NAAQS = 12 $\mu g/m^3$

Concentration in $\mu g/m^3$

0 0.5 1

Miles

N

Scale: 1:64,000

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Cumulative Impacts (Rio Grande LNG, Texas LNG, Annova LNG, and Background)

Annual $PM_{2.5}$
$\mu g/m^3$

Figure F-8

APPENDIX G

DETAILED CUMULATIVE NOISE CALCULATIONS

SLR

Technical Memorandum

To: Eric Tomasi
Environmental Engineer
Federal Energy Regulatory Commission

From: David M. Jones, P.E, INCE Bd. Cert.
Principal Acoustical Engineer
SLR International Corporation
6001 Savoy Drive, Suite 215
Houston, Texas 77036
dmjones@slrconsulting.com

Date: May 30, 2018

Subject: Texas LNG Construction Noise Normalization for Cumulative Noise Impact Assessment

1. INTRODUCTION

At the request of Perennial Environmental, SLR International Corporation (SLR) has been acting as the Federal Energy Regulatory Commission (FERC) third-party reviewer for noise components of the Texas LNG Project. As part of this review, SLR has been compiling the cumulative noise impact section of the Draft Environmental Impact Statement (DEIS) for the Project. The cumulative impact section assesses the potential cumulative effects from all reasonably foreseeable future actions in the geographic scope of the Texas LNG project. There are two other LNG projects proposed for the geographic area of the Texas LNG project: the Annova LNG and the Rio Grande LNG projects.

2. CONSTRUCTION NOISE PREDICTIONS

Each of the three LNG projects calculated the construction sound level contributions at a set of project-specific noise sensitive areas (project NSAs) using slightly different sound level metrics. As part of the cumulative assessment, SLR has developed a set of cumulative NSAs and calculation points (CPs). There were two CPs representing locations at which noise impacts might be of concern but which were not NSAs: the observation platform for the Palmito Ranch Battlefield National Historic Landmark and a location in the Laguna Atascosa National Wildlife Refuge (LANWR). The cumulative NSAs were generated from the combination of the three sets of project NSAs by combining NSAs in close proximity and removing duplicated NSA locations. **Table 1**, below, summarizes the NSAs and metrics used for each project.

Table 1: Summary of NSAs and Sound Level Metrics

Project	Number of NSAs	Number of NSAs that Correspond with Cumulative NSAs	Construction Evaluation Metric	Comment
Annova LNG	4	4	24-hour L_{dn}	24-hour Construction
Rio Grande LNG	4	4	L_{max} / L_{eq}	Daytime only construction
Texas LNG	3	2	24-hour L_{dn}	Construction includes 24-hours per day dredging, 10-hours per day other construction - Concurrent with 24-hour operations of Phase 1 equipment

The project NSAs did not necessarily coincide with the full set of cumulative NSAs. As such, it was necessary to predict the sound levels at those cumulative NSAs for which there is not corresponding project NSA. In order to sum the sound level contributions of the three different projects, the sound levels were predicted for the cumulative set of NSAs and CPs and the metrics for the different projects had to be standardized so that they could be compared.

2.1. Propagation Calculations

Each project predicted construction sound levels at a specific set of project NSAs closest to that project. Using a standard hemispherical spreading formula, SLR used these predicted sound levels, along with the distances from the acoustic center of each project to the project NSAs and standardized cumulative NSAs or CPs, to predict the sound levels at the standardized cumulative NSAs or CPs.

The hemispherical spreading formula is: $L_{p2} = L_{p1} + 20 \times \log_{10}(\text{Distance1} / \text{Distance2})$

Where L_{p1} is the sound pressure level at Distance1 and L_{p2} is the sound pressure level at Distance2. Distances must be in the same units.

This is a conservative calculation methodology as it does not account for additional propagation losses due to atmospheric absorption, ground effect, foliage, or terrain effects. It will thus tend to overestimate the potential construction sound levels.

Table 2 shows a summary of the sound levels as predicted by each project at the project-specific NSAs, the distance from the NSAs to the project acoustic center, and the distance from the acoustic center to the cumulative NSA points. For those cumulative NSAs or CPs at which there is no corresponding project NSA, the sound levels have been calculated by using the predicted levels at the project NSA in parenthesis and propagating them to the cumulative NSA distance. Sound levels that have been calculated in this manner are shown as shaded and italicized values.

Table 2: Summary of LNG Project Construction Sound Levels at the Cumulative NSAs / CPs

Cumulative NSA / CP	Project-Specific NSA Designation	Distance from NSA / CP to Project	Existing Sound Level	Predicted Construction Sound Level Contribution	Predicted Construction Sound Level Contribution
		miles	(L_{dn} dBA)	(L_{eq} dBA)	(L_{dn} dBA)
ANNOVA LNG					
NSA C1	NSA 1	4.2	56.0	N/A	49.0
NSA C2	[a] (NSA 2)	5.2	50.2		*47.1*
NSA C3	[a] (NSA 2)	5.4	50.2		*46.8*
NSA C4	NSA 2	4.6	46.0		48.0
NSA C5	NSA 3	2.3	46.0		54.0
NSA C6	[a] (NSA 2)	3.9	46.0		*49.8*
CP 1	NSA 4	3.3	43.0		52.0
CP 2	[a] (NSA 2)	1.7	59.0		*56.9*
RIO GRANDE LNG					
NSA C1	NSA 2	3.7	56.0	52.2	49.2
NSA C2	NSA 3	3.7	50.2	46.1	43.1
NSA C3	NSA 4	3.9	50.2	45.7	42.7
NSA C4	[a] (NSA 2)	4.9	46.0	49.7	*46.7*
NSA C5	NSA 1	5.5	46.0	50.9	*47.9*
NSA C6	[a] (NSA 2)	5.4	46.0	49.0	*46.0*
CP 1	Palmito Ranch BF	5.4	43.0	42.9	*39.9*
CP 2	LANWR	0.8	59.0	51.7	*48.7*
TEXAS LNG					
NSA C1	[a] (NSA 2)	2.7	56.0	N/A	*50.3*
NSA C2	NSA 2	1.6	50.2		54.9
NSA C3	NSA 3	1.7	50.2		54.6
NSA C4	[a] (NSA 2)	4.4	46.0		*45.9*
NSA C5	[a] (NSA 2)	5.5	46.0		*44.1*
NSA C6	[a] (NSA 2)	7.3	46.0		*41.6*
CP 1	[a] (NSA 2)	6.8	43.0		*42.2*
CP 2	[a] (NSA 2)	1.7	59.0		*54.3*

[a] Sound levels at this cumulative NSA were not calculated by the project for construction noise. Sound levels at the project NSA in parenthesis were propagated to the cumulative NSA or CP distance as described in this memo.

2.2. Sound Level Metric Normalization

The three different LNG projects include varying degrees of detail about the construction noise calculations and schedules. Rio Grande LNG included only daytime sound levels (as L_{eq} values) for construction, as those activities would only occur during the day. Annova LNG and Texas LNG included 24-hour L_{dn} values for construction based on daytime and nighttime activities. For

Annova LNG, all construction activities are assumed for 24-hours per day. For Texas LNG, general site preparation construction is included for 10 daytime hours per day, but dredging and the Phase 1 operational noise sources are based on 24 hours per day.

In order to combine the sound levels from the three different projects, the sound level metrics had to be standardized. The 24-hour L_{dn} was chosen as the standardized metric because it is the standard FERC and EPA sound level metric, and it was used by two of the projects.

The equivalent sound level (L_{eq}) is the sound level that has the same (equivalent) sound energy as all of the sounds measured during a given period. If a noise source generates a sound level of 50 dBA over a one-hour period, it would produce a one-hour L_{eq} of 50 dBA. If the noise source generated a sound level of 50 dBA for half of the hour, but generated no noise during the other half of the hour, the one-hour L_{eq} would drop by three decibels, to 47 dBA, as a three decibel decrease indicates a halving of the sound energy.

The Rio Grande LNG construction activities will take place for 12-hours a day, from 7:00 am until 7:00 pm during daylight hours only. As the Rio Grande LNG construction will take place during the daytime for 12 hours (or half of the total hours in a day), the 24-hour L_{dn} will be three decibels lower than the predicted sound level L_{eq} during the 12-hour construction shift. The Rio Grande LNG construction sound level contributions have been calculated by subtracting three decibels from the given L_{eq}.

3. CUMULATIVE ASSESSMENT

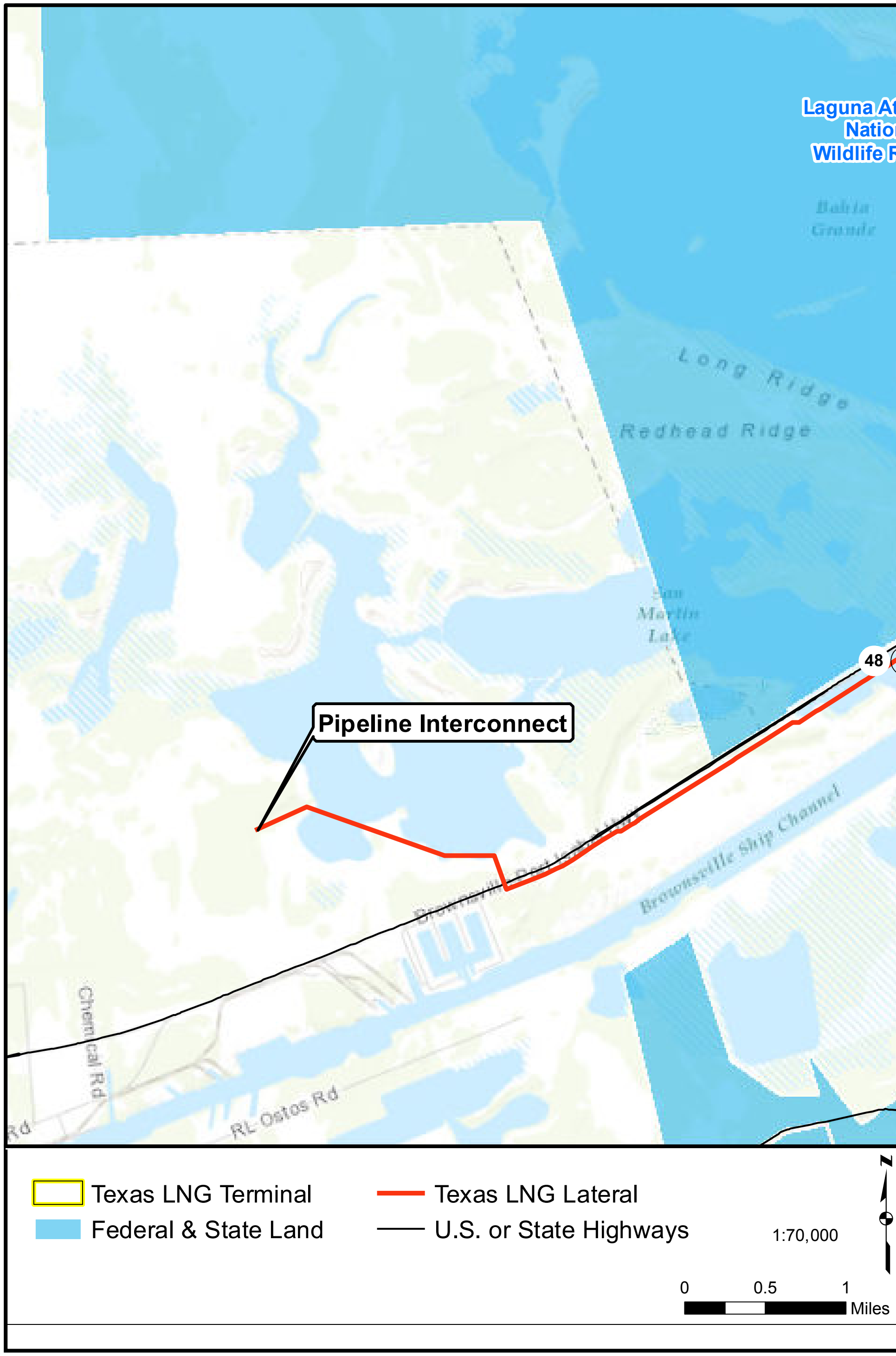
In order to predict the potential cumulative impact of construction noise from all three of the projects during simultaneous construction activities, the predicted sound levels, as L_{dn} values, can be logarithmically combined at each of the standardized cumulative assessment NSAs or CPs. This prediction would be a worst-case construction noise assessment, as it would combine the maximum construction noise contributions from all three LNG projects.

4. CONCLUSION

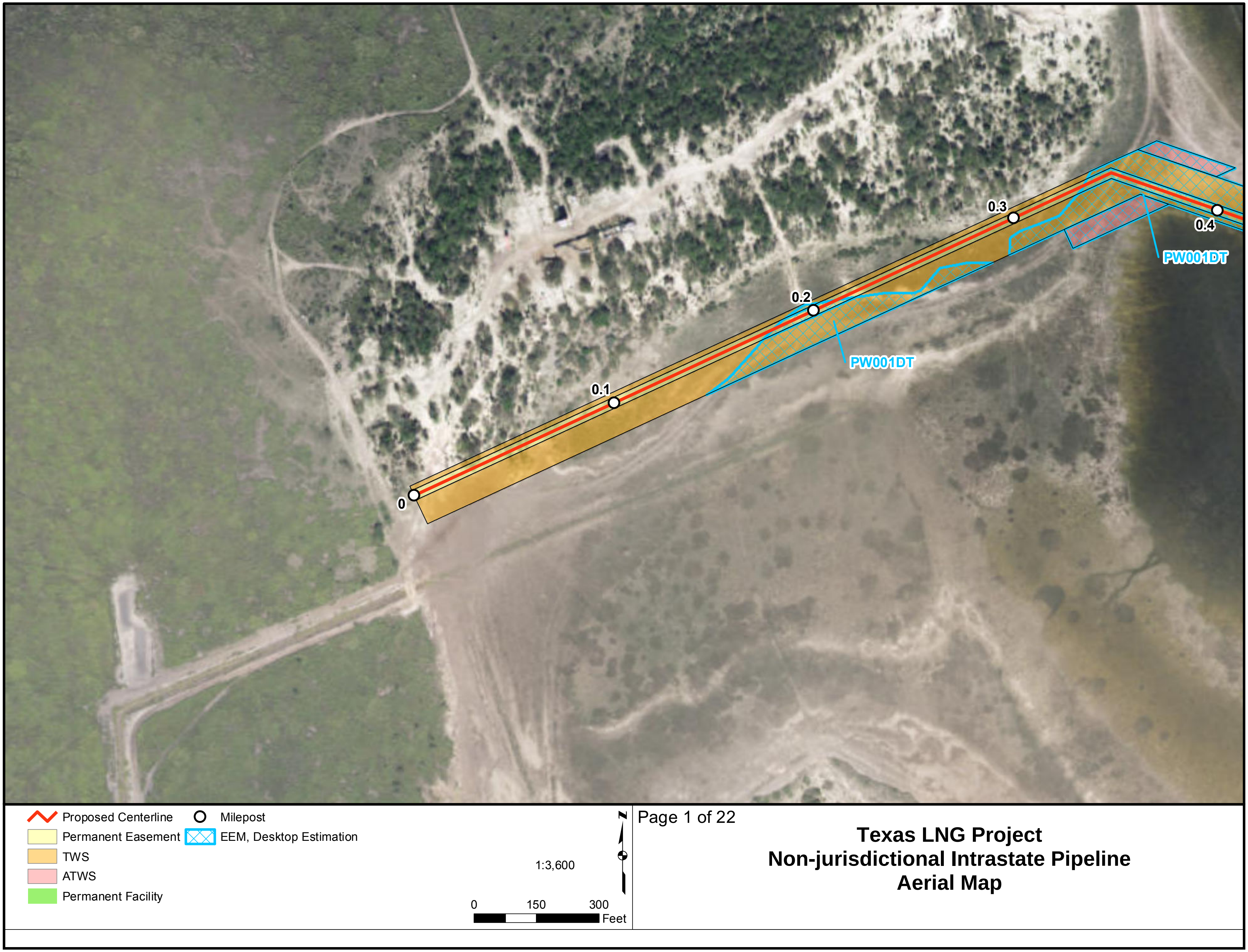
To allow comparison and cumulative assessment for the predicted construction sound levels from the three LNG projects, the sound levels had to be assessed in terms of a common set of NSAs and Calculation Points. In addition, the metric used to present the sound levels had to be normalized. The sound levels from each project have been predicted at a set of standardized cumulative NSAs and CPs from the provided project construction noise levels using a standard hemispherical spreading formula. The sound level metrics have been normalized to use the FERC standard 24-hour L_{dn} for all construction noise. The results of the standardization and normalization are shown in **Table 2**.

APPENDIX H

INTRASTATE NON-JURISDICTIONAL NATURAL GAS PIPELINE DRAWINGS



Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Overview Map


0
0.1
0.2
0.3
0.4
PW001DT
PW001DT
Proposed Centerline
Milepost
Permanent Easement
EEM, Desktop Estimation
TWS
ATWS
Permanent Facility
1:3,600
0 150 300
Feet
N
Page 1 of 22
Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

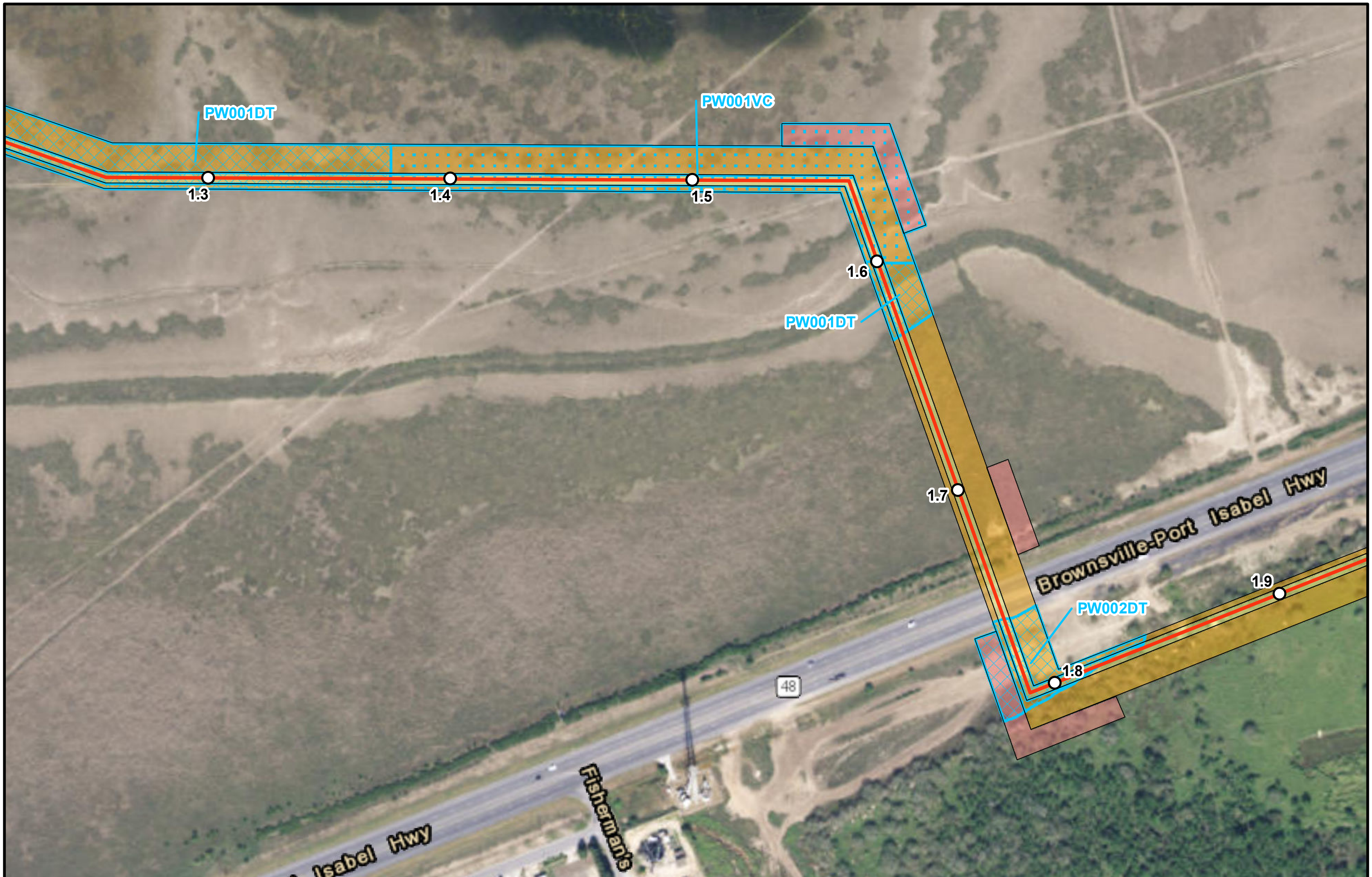
Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Milepost
Permanent Easement
EEM, Desktop Estimation
TWS
Permanent Facility

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map



Proposed Centerline
Permanent Easement
TWS
ATWS
Permanent Facility
Milepost
EEM, Desktop Estimation
EEM, Digitized Delineation

1:3,600

0 150 300 Feet

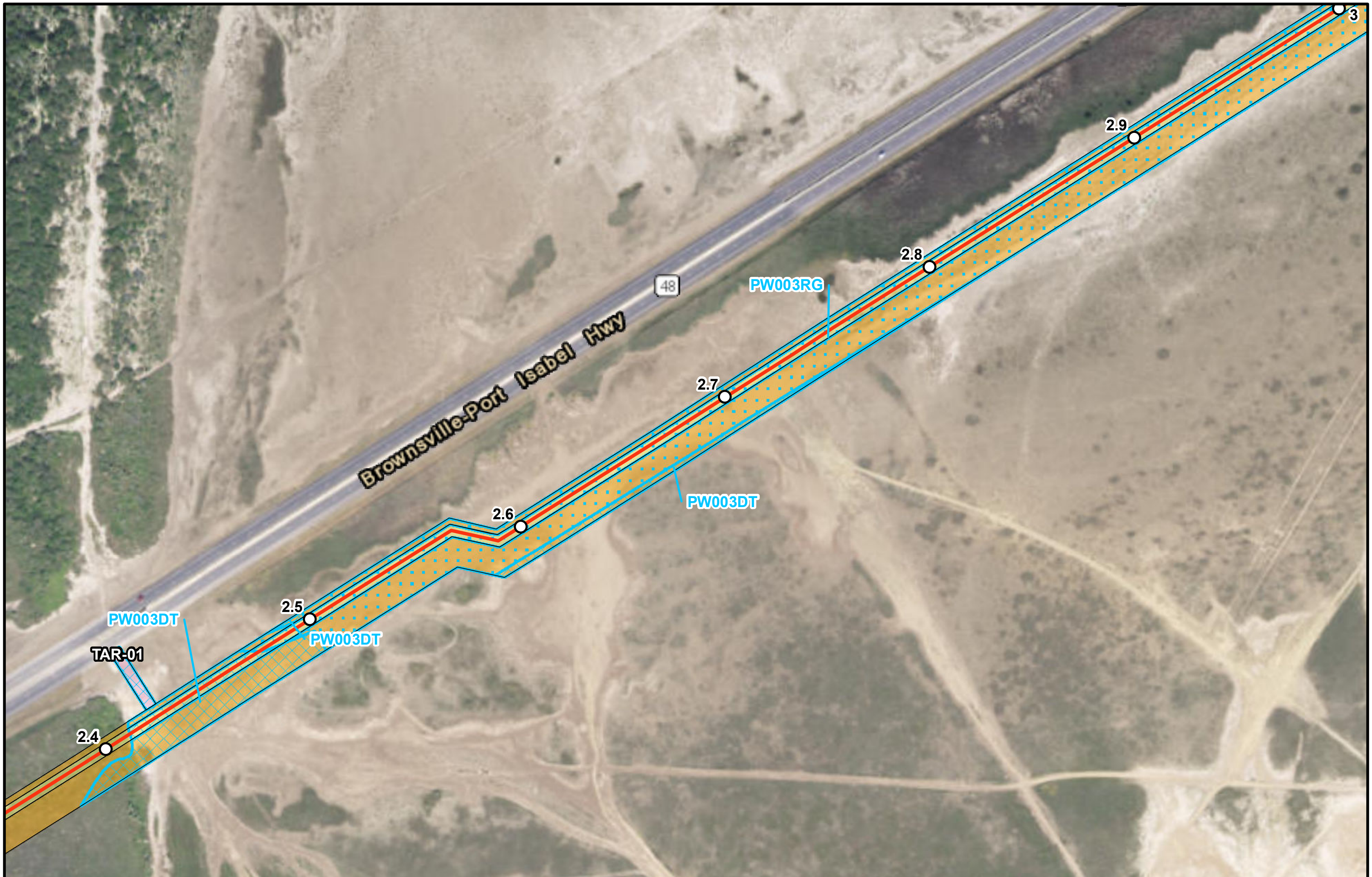
Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Permanent Easement
TWS
Temporary Access Road
Permanent Facility
Milepost
EEM, Desktop Estimation

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map



Proposed Centerline
Permanent Easement
TWS
Temporary Access Road
Permanent Facility
Milepost
EEM, Desktop Estimation
EEM, Digitized Delineation

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Permanent Easement
TWS
Temporary Access Road
Permanent Facility
Milepost
EEM, Digitized Delineation

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Permanent Easement
Permanent Easement (HDD)
TWS
ATWS
Temporary Access Road
Permanent Facility
Milepost
EEM, Desktop Estimation
EEM, Digitized Delineation
HDD Entry/Exit

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Permanent Easement
Permanent Easement (HDD)
TWS
ATWS
Permanent Facility
Milepost
EEM, Desktop Estimation
EEM, Digitized Delineation
EEM/EUS, Digitized Delineation
Waterbody, Desktop Estimation
Waterbody, Digitized Delineation
HDD Entry/Exit

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

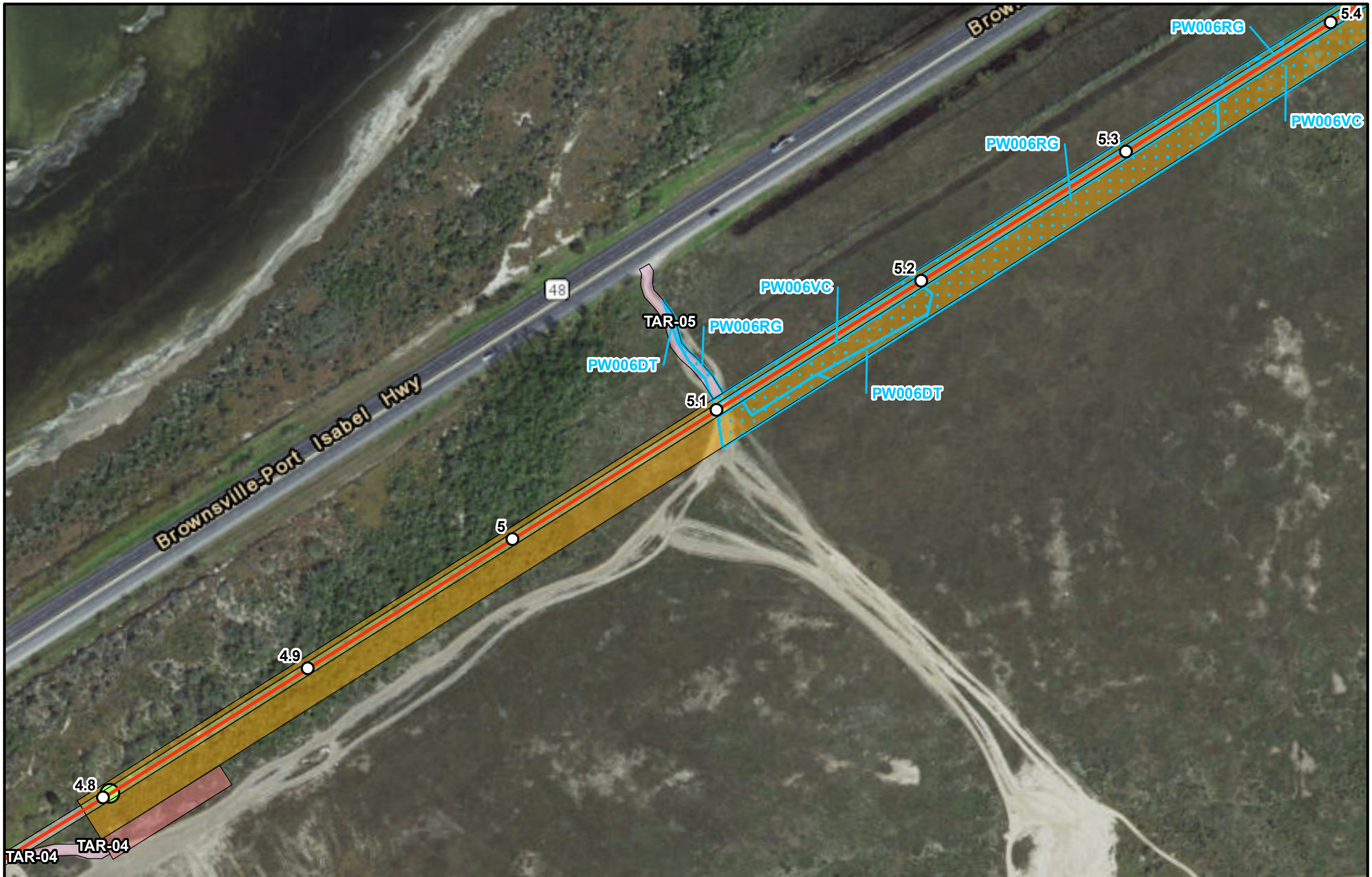
Proposed Centerline
Permanent Easement
Permanent Easement (HDD)
TWS
ATWS
Temporary Access Road
Permanent Facility
Milepost
EEM, Digitized Delineation
EEM/EUS, Desktop Estimation
EEM/EUS, Digitized Delineation
Waterbody, Desktop Estimation
Waterbody, Digitized Delineation
HDD Entry/Exit

N

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map



Proposed Centerline
Milepost
HDD Entry/Exit
Permanent Easement
EEM, Desktop Estimation
Permanent Easement (HDD)
EEM, Digitized Delineation
TWS
ATWS
Temporary Access Road
Permanent Facility

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Milepost
HDD Entry/Exit
Permanent Easement
EEM, Desktop Estimation
Permanent Easement (HDD)
EEM, Digitized Delineation
TWS
ATWS
Permanent Facility

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Permanent Easement (HDD)
Permanent Facility
Milepost
EEM, Digitized Delineation
ESS, Digitized Delineation
Waterbody, Digitized Delineation

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Milepost
HDD Entry/Exit
Permanent Easement
ESS, Digitized Delineation
Permanent Easement (HDD)
TWS
ATWS
Permanent Facility

N

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Permanent Easement
Permanent Easement (HDD)
TWS
ATWS
Permanent Facility
Milepost
ESS, Digitized Delineation
HDD Entry/Exit

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Milepost
Permanent Easement
EEM, Digitized Delineation
TWS
Permanent Facility

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Milepost
Permanent Easement
EEM, Digitized Delineation
TWS
Permanent Facility

1:3,600

0 150 300 Feet

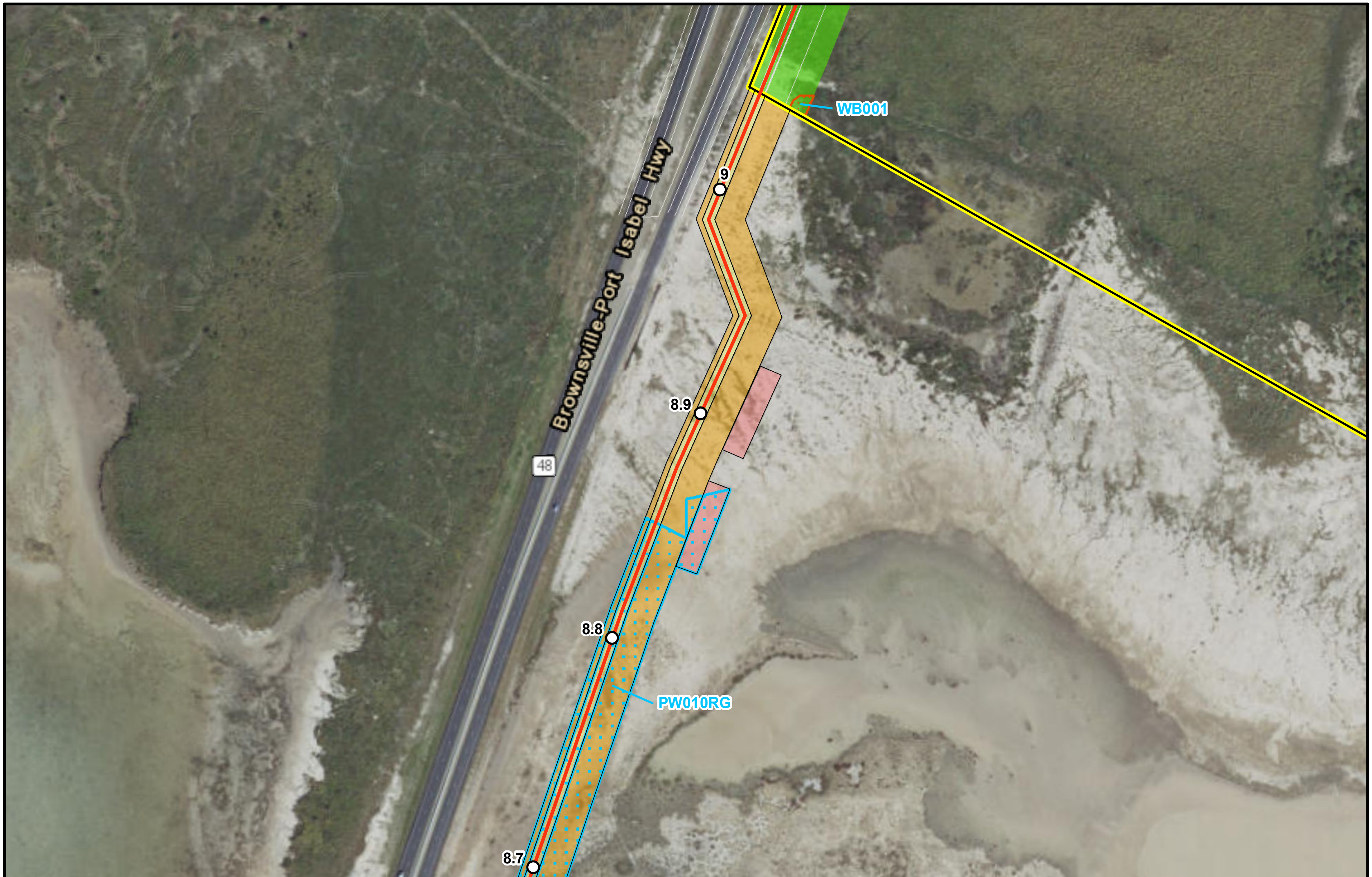
Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Milepost
Permanent Easement
EEM, Digitized Delineation
TWS
Temporary Access Road
Permanent Facility

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map



Proposed Centerline
Milepost
Proposed Project Site
Permanent Easement
EEM, Digitized Delineation
Project Facilities
TWS
PEM, Delineation
ATWS
Permanent Facility

1:3,600

0 150 300 Feet

Page 19 of 22

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Milepost
Proposed Project Site
Permanent Facility
PEM, Delineation
Project Facilities

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Milepost
Proposed Project Site
Permanent Facility
Project Facilities

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

Proposed Centerline
Milepost
Proposed Project Site
Permanent Facility
Mudflat, Delineation
Project Facilities
PEM, Delineation

1:3,600

0 150 300 Feet

Texas LNG Project
Non-jurisdictional Intrastate Pipeline
Aerial Map

APPENDIX I

REFERENCES

REFERENCES

Abbott, R., and E. Bing-Sawyer, 2002. Assessment of Pile-Driving Impacts on the Sacramento Blackfish (Othodon microlepidotus). Draft report prepared for the California Department of Transportation, District 4.

Aaron Economic Consulting, LLC. 2014. Comprehensive Resort Market Analysis. South Padre Island, Texas. Available online at: http://southpadreislandedc.com/sites/default/files/files/Resources%20%26%20Studies/Updating_Tourism_and_Visitations_Data_report_2014_V_111514.pdf. Accessed February 2017.

Aldana Engineering & Traffic Design. 2015. Texas LNG Project Traffic Study. April 2015.

Apex Clean Energy, 2017. Apex Clean Energy. Available online at: https://www.apexcleanenergy.com/projects/. Accessed October 2018.

Arkive.org. 2018. Berlandier's tortoise. Available online at: https://www.arkive.org/berlandiers-tortoise/gopherus-berlandieri/. Accessed October 2018.

Audubon Society. 2016. Guide to North American Birds. Available online at http://www.audubon.org/bird-guide. Accessed November 2016.

Baker (Jr.), E.T. 1979. Report 236: Stratigraphic and Hydrologic Framework of Part of the Coastal Plains of Texas, Texas Department of Water Resources, Austin, Texas. Available online at https://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R236/R236.pdf. Accessed September 2016.

Baker, R.C. and O.C. Dale. 1961. Ground-Water Resources of the Lower Rio Grande Valley Area, Texas. Bulletin 6014, Volume 1. Available online at http://www.twdb.texas.gov/publications/reports/bulletins/doc/b6014v1/b6014vi.pdf. Accessed September 2016.

Barnes et al. 1977. Power Plant Construction Noise Guide. Bolt, Beranek and Newman, Incorporated.

Barnes, Virgil E. 1992. Geological Atlas of Texas, Southeast Quadrant Sheet. Available online at: http://pubs.usgs.gov/ds/2005/170/downloads/pdf/. Accessed April 2015.

Baskin, Jon A. 2009. The Pleistocene Fauna of South Texas. Texas A&M University – Kingsville. Available online at: http://users.tamuk.edu/kfjab02/SOTXFAUN.htm. Accessed September 2016.

Becker, Alistair and Whitfield, A.K. and Cowley, P.D. and Jarnegren, Johanna, and Naesje, T.F. 2013. Potential effects of artificial light associated with anthropogenic infrastructure on the abundance and foraging behavior of estuary-associated fishes. Journal of Applied Ecology 50(1): 43−50. Available online at: http://onlinelibrary.wiley.com/doi/10.1111/1365-2664.12024/full. Accessed April 2017.

Benfield, M.C. and Minello, T.J.. 1996. Relative effects of turbidity and light intensity on reactive distance and feeding of an estuarine fish. Environmental Biology of Fishes.

Volume 46, Issue 2. Available online at: https://link.springer.com/article/10.1007/BF00005223. Accessed April 2017.

BBP and Associates, LLC. 2010. Visitor's and Event Center and Hotel Feasibility Study. Port Isabel, Texas. Available online at: http://portisabel-texas.com/cityhall/wp-content/uploads/2010/10/BBPHotel-EventVisitorCenterFeasibilityStudy-_Port-Isabel-TX.pdf. Accessed February 2017.

Black and Veatch. 2017. Preliminary Sedimentation Cumulative Effects Study. Memorandum to Annova Brownsville LNG. FERC Docket No. CP16-480-000, Accession No. 20170731-5180.

Bolt, Beranek, and Newman. 1973. Fundamentals of Abatement and Highway Traffic Noise. Report No. PB-222-703, Federal Highway Administration.

Breuer, Joe. 1972. Ecological Survey of the Brownsville Ship Channel – 1971-1972. Available online at: https://journals.tdl.org/txcfpr/index.php/txcfpr/article/viewFile/33/30. Accessed February 2017.

The Brownsville Herald. 2014. Liquid storage project adds much needed capacity to port. Available online at: http://www.brownsvilleherald.com/news/business/article_00ee412e-7f29-11e3-86c8-0019bb30f31a.html. Accessed July 2017.

Brownsville Navigation District. 2017. Comprehensive Annual Financial Report 2016. Available online at: http://www.portofbrownsville.com/wp-content/uploads/2017/01/BND-CAFR-2016.pdf. Accessed July 2017.

Brownsville Navigation District. 1983. Lease between Brownsville Navigation District and U.S. Fish and Wildlife Service describing La Loma Ecological Preserve.

Bureau of Economic Geology. 1996. Physiographic Map of Texas. University of Texas at Austin. Available online at: http://www.beg.utexas.edu/UTopia/images/pagesizemaps/physiography.pdf. Accessed January 2015.

Bureau of Economic Geology. 1976. Brownsville-McAllen Sheet. Available online at: https://ngmdb.usgs.gov/Prodesc/proddesc_16427.htm. Accessed February 2017.

Cameron County, 2015a. Jaime J. Zapata Memorial Boat Ramp and Kayak Launch Area. Available online at: http://www.cameroncountyparks.com/jaime-zapata-hwy-48. Accessed July 2017.

Cameron County, 2015b. Isla Blanca Park. Available online at: http://www.cameroncountyparks.com/IslaBlancaPark. Accessed July 2017.

Cameron County Regional Mobility Authority. 2017. 2016 Project Status Report. Available online at: https://ccrma.org/wp-content/uploads/2018/08/CCRMA-Project-Status-Report-2017_Final.pdf. Accessed July 2017.

Campbell, L. 2003. Endangered and Threatened Animals of Texas, Their Life History and Management. Texas Parks and Wildlife Department, Wildlife Division. Austin, Texas. Revised and Approved by the U.S. Fish and Wildlife Service. Available online at: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_0013.pdf. Accessed January 2016.

Central Dredging Association. 2011. Underwater sound in relation to dredging. Central Dredging Association Position Paper, Prepared by the CEDA Working Group on Underwater Sound under the remit of CEDA Environmental Commission. Available online at: https://dredging.org/media/ceda/org/documents/resources/cedaonline/2011-11_ceda_positionpaper_underwatersound_v2.pdf. Accessed August 2018.

Central Flyway Council. 2018. Migratory Bird Management. Available online at: https://centralflyway.org/. Accessed August 2018.

Chowdhury, Ali H. and Robert E. Mace. 2007. Groundwater Resource Evaluation and Availability Model of the Gulf Coast Aquifer in the Lower Rio Grande Valley of Texas. Texas Water Development Board Report 368. Available online at: https://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R368/R368_GulfCoastGAM.pdf. Accessed September 2016.

City of Port Isabel. 2010. Future Land Use Map. Available online at: http://www.portisabel-texas.com/cityhall/wp-content/uploads/2010/pages/190.pdf. Accessed February 2017.

Comisión Federal de Electricidad. 2017. Sur de Texas – Tuxpan (Mexico) Gas Pipeline). Available online at: http://www.cfe.gob.mx/Licitaciones/Licitaciones/Documents/SurdeTexasTuxpanMarinoing.pdf. Accessed July 2017.

Commission for Environmental Cooperation. 2011. Aquatic Invasive Species in the Rio Bravo/Laguna Madre Ecological Region. Background Paper 2011-02. Montreal, Canada. Available online at: http://www3.cec.org/islandora/en/item/10259-aquatic-invasive-species-in-rio-bravolaguna-madre-ecological-region-en.pdf. Accessed April 2015.

Cornell Lab of Ornithology. 2015. All About Birds. Available online at: https://www.allaboutbirds.org/. Accessed June 2018.

Council on Environmental Quality. 2005. Guidance on the Consideration of Past Actions in Cumulative Effects Analysis. Available online at: https://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-PastActsCumulEffects.pdf. Accessed February 2017.

Council on Environmental Quality. 1997. Environmental Justice, Guidance under the National Environmental Policy Act. Executive Office of the President, Washington, D.C.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. Prepared for the U.S. Fish and Wildlife Service. FWS/OBS-79/31. December 1979.

Davies, T.W., M. Coleman, K.M. Griffith, and S.R. Jenkins. 2015. Night-time lighting alters the composition of marine epifaunal communities. Biology Letters 11:20150080. Available online at: http://rsbl.royalsocietypublishing.org/content/roybiolett/11/4/20150080.full.pdf. Accessed July 2017.

Dean Runyan Associates. 2015. The Economic Impact of Travel on Texas 1990-2014p. June 2015. for Texas Tourism Office of the Governor Texas Economic Development &

Tourism. Dean Runyan Associates Portland, Oregon. Available online at: http://www.deanrunyan.com/doc_library/TXImp.pdf. Accessed September 2016.

Department of Homeland Security. 2017. Homeland Infrastructure, Foundation-Level data (HIFLD), Natural Hazards. Available online at: hifld-geoplatform.opendata.arcgis.com. Accessed August 2018

D.K. Shifflet & Associates, Ltd. 2015. 2014 Texas Tourism Region and MSA Visitor Profile: Gulf Coast Region. Available online at: http://travel.texas.gov/tti/media/PDFs/2014-Gulf-Coast-Region.pdf. Accessed September 2016.

Enbridge. 2017. Valley Crossing Pipeline. Available online at: http://www.enbridge.com/projects-and-infrastructure/projects/valley-crossing-pipeline. Accessed July 2017.

Environmental Laboratory. 1987. U.S. Army Corps of Engineers Wetland Delineation Manual. Technical Report Y-87-1. U.S. Army Engineer Waterways Experiment Station. Vicksburg, Mississippi.

Evans Ogden, L.J. 1996. Collision Course: The Hazards of Lighted Structures and Windows to Migratory Birds, Special Report Published by WWF Canada and the Fatal Light Awareness Program, 46 pages.

Evans, W.R. and K.V. Rosenberg. 1999. Acoustic Monitoring of Night-Migrating Birds: a Progress Report. In: R.E Bonney. Jr., D.N. Pashley and R. Cooper (eds.), Strategies for Bird Conservation: the Partners in Flight Planning Process. Cornell Lab of Ornithology, Ithaca, NY.

Federal Aviation Administration. 2014. Final Environmental Impact Statement SpaceX Launch Site. Available online at: https://www.faa.gov/about/office_org/headquarters_offices/ast/environmental/nepa_docs/review/launch/spacex_texas_launch_site_environmental_impact_statement/. Accessed June 2017.

Federal Highway Administration. 2006. Highway Construction Noise Handbook. Available online at: https://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/. Accessed October 2018.

Federal Emergency Management Agency. 2018. Cameron County FIRM/FEMA Map. FEMA, 2014. Available online at: www.co.cameron.tx.us/dot/docs/Cameron_County_Flood_Map.pdf.

Federal Energy Regulatory Commission. 2005. Final Environmental Impact Statement for Vista del Sol LNG Terminal, LP and Vista del Sol Pipeline, LP's Vista del Sol LNG Terminal Project. FERC Docket No. CP04-395-000 et al. Accession No. 20050419-0034.

Fire Department.net. 2016. Cameron County, TX Fire Departments. Available online at: http://www.firedepartment.net/directory/texas/cameron-county. Accessed February 2017.

Gagliano, S.M. 1999. Faulting, Subsidence and Land Loss in Coastal Louisiana. Prepared by Coastal Environments, Inc. and Lee Wilson & Associates for U.S. Environmental Protection Agency, Region 6. Contract No. 68-06-0067. Available online at: http://www.coastalenv.com/Final_FAULTING__SUBSIDENCE_AND_LAND_LOSS.pdf. Accessed June 2016.

GEOTRAC Industrial Hub. 2015. Overview. Available online at: http://geotracindustrialhub.com/. Accessed July 2017.

GovTribe. 2018. Gulf Intracoastal Waterway (GIWW), Texas, Corpus Christi to Port Isabel and the Channel to Harlingen in Nueces, Kleberg, Kenedy, Willacy and Cameron Counties, Texas, Pipeline Dredging. Available online at: https://govtribe.com/project/gulf-intracoastal-waterway-giww-texas-corpus-christi-to-port-isabel-and-the-channel-to-harlingen-in-nueces-kleberg- kenedy-willacy-and-cameron-counties-texas-pipeline-dredging. Accessed May 2018.

Gulf Coast Ecosystem Restoration Council. 2017. Laguna Madre Watershed – Bahia Grande Coastal Corridor (TX_RESTORE_001_000_Cat 1). Available online at: https://restorethegulf.gov/sites/default/files/Bahia%20Grande%20Coastal%20Corridor_0.pdf. Accessed July 2017.

Gulf Coast Ecosystem Restoration Council. 2014. RESTORE Act Bucket 2 Round 1 November 2014. Council Member Proposal – State of Texas. The Bahia Grande Coastal Corridor Project. Available online at: https://www.restorethegulf.gov/sites/default/files/Bahia%20Grande%20Coastal%20Corridor.pdf. Accessed July 2017.

Gulf of Mexico Fishery Management Council. 2010. Fishery Management Plans and Amendments. Available online at: http://www.gulfcouncil.org/fishery_management_plans/index.php. Accessed February 2017.

Gulf of Mexico Fishery Management Council. 2005. Generic Amendment Number 3 for Addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and Adverse Effects of Fishing in the Following Fishery Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, United States Water, Red Drum Fishery of the Gulf of Mexico; Reef Fish Fishery of the Gulf of Mexico; Coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico and South Atlantic; Coral and Coral Reefs of the Gulf of Mexico. Available online at: http://sero.nmfs.noaa.gov/habitat_conservation/efh/guidance_docs/final3_efh_amendment.pdf. Accessed December 2016.

Gulf of Mexico Fishery Management Council. 2004. Final Environmental Impact Statement for the Generic Amendment to the following fishery management plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, Red Drum Fishery of the Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, Stone Crab Fishery of the Gulf of Mexico, Coral and Coral Reef Fishery of the Gulf of Mexico, Spiny Lobster Fishery of the Gulf of Mexico and South Atlantic; Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic. Available online at: http://gulfcouncil.org/Beta/GMFMCWeb/downloads/Final%20EFH%20EIS.pdf. Accessed February 2017.

Handley, L., Altsman, D., and DeMay, R., eds. 2007. Seagrass Status and Trends in the Northern Gulf of Mexico: 1940-2002: U.S. Geological Survey Scientific Investigations Report 2006-5287 and U.S. Environmental Protection Agency 855-R-04-003, 267 p.

Herps of Texas. 2017. Herps of Texas. Available online at: http://www.herpsoftexas.org/. Accessed July 2017.

Hosman, R.L. 1996. Regional Stratigraphy and Subsurface Geology of Cenozoic Deposits, Gulf Coastal Plain, South-Central United States. U.S. Geological Survey Professional Paper 1416-G.

Howard Energy Partners. 2017. Bulk Liquid Storage – Brownsville Liquids Terminal – Two. Available online at: http://www.howardenergypartners.com/capabilities-operations/bulk-liquid-storage. Accessed July 2017.

ICF Jones and Stokes. 2012. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Updated October 2012. Available online at: http://www.dot.ca.gov/hq/env/bio/files/Guidance_Manual_2_09.pdf. Accessed March 2015.

Idriss, I.M. and Boulanger, R.W. 2010. SPT-based liquefactoin triggering procedures, UC Davis Center for Geotechnical Modeling, Report No. UCD/CGM-10/02, December.

Instituto Nacional de Estadistica y Geographia. 2010. México en Cifras: Información Nacional, Por Entidad Federativa Y Municipos. Available online at: http://www.inegi.org.mx/. Accessed September 2016.

Kline, Richard J. and Lucia B. Carreon. 2013. Population genetics of the threatened South Texas Siren (large form SP1). Available online at: https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/grants-research/media/2013-siren.pdf. Accessed July 2017.

Knezovich, J.P. 1994. Chemical and Biological Factors Affecting Bioavailability of Contaminants in Seawater. In J.L. Hamelink, P.F. Landrum, H.L. Bergman, and W.H. Benson (eds). Bioavailability: Physical, Chemical, and Biological Interactions. Lewis Publishers, Boca Raton, Florida.

Lee, J., Calderón Mandujano, R., Lopez-Luna, M.A., Vasquez Díaz, J. & Quintero Díaz, G.E. 2007. Drymarchon melanurus. The IUCN Red List of Threatened Species 2007. Available online at: http://www.iucnredlist.org/details/63774/0. Accessed July 2017.

Longcore, T., and C. Rich. 2004. Ecological Light Pollution. Frontiers in Ecology and the Environment 2(4): 191-198.

Lyndon B. Johnson School of Public Affairs. 1978. Preserving Texas' Natural Heritage, Policy Research Project Report, Number 31. The University of Texas at Austin.

Maekawa, Z and Lord, P. 1994. Environmental and Architectural Acoustics. Suffolk, Great Britain: St. Edmundsbury Press.

McKenna, K.K. P.G. 2014. Texas Coastwide Erosion Response Plan. Texas General Land office. Available online at: http://www.glo.texas.gov/coast/coastal-management/forms/files/coastwide-erosion-response-plan.pdf

McLellan, T.N., R.N. Havis, D.F. Hayes, and G.L. Raymond. 1989. Field studies of Sediment Resuspension Characteristic of Selected Dredges. TR-HL-89-9, COE Waterways Experiment Station, Vicksburg, MS. Available online at: http://acwc.sdp.sirsi.net/client/search/asset/1003509. Accessed February 2017.

Moffatt and Nichol. 2017. Texas LNG Brownsville, Texas Dredging Plume Propagation.

National Oceanic Atmospheric Administration. 2018 Historical Hurricane Tracker. Available online at: https://coast.noaa.gov/hurricanes/. Accessed August 2018.

National Oceanic and Atmospheric Administration. 2017a. Water Temperature Table of All Coastal Regions. Available online at: https://www.nodc.noaa.gov/dsdt/cwtg/all_meanT.html. Accessed July 2017.

National Oceanic and Atmospheric Administration. 2017b. Global And Regional Sea Level Rise Scenarios for the United States. U.S. Department Of Commerce, National Ocean and Atmospheric Administration, National Ocean Service Center for Operational Oceanographic Products and Services, January 2017.

National Oceanic and Atmospheric Administration, National Weather Service Forecast Office. 2016a. NOWData - NOAA Online Weather Data. Available online at: http://www.nws.noaa.gov/climate/xmacis.php?wfo=bro. Accessed September 9, 2016.

National Oceanic and Atmospheric Administration. 2016b. 2015 Local Climatological Data, Annual Summary with Comparative Data, Brownsville, Texas.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2018. Pile Driving Calculations. Available online at: http://www.dot.ca.gov/hq/env/bio/files/NMFS%20Pile%20Driving%20Calculations.xls. Accessed June 2018.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2016a. GIS Data for Gulf of Mexico EFH and HAPC. Available online at: http://sero.nmfs.noaa.gov/maps_gis_data/habitat_conservation/efh_gom/index.html. Accessed December 2016.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2016b. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing. Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. NOAA Technical Memorandum NMFS-OPR-55. Available online at: http://www.nmfs.noaa.gov/pr/acoustics/Acoustic%20Guidance%20Files/opr-55_acoustic_guidance_tech_memo.pdf. Accessed February 2017.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2016c. Greater Atlantic Region Fisheries Office Acoustics Tool: Analyzing the effects of pile-driving on ESA-listed species in the Greater Atlantic Region (version November 7, 2016). Available online at: https://www.greateratlantic.fisheries.noaa.gov/protected/section7/guidance/consultation/index.html. Accessed June 2018.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2012. An Overview of Protected Species in the Gulf of Mexico. Available online at:

http://sero.nmfs.noaa.gov/protected_resources/outreach_and_education/documents/protected_species_gom.pdf. Accessed July 2017.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2009. Amendment 1 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan: Essential Fish Habitat. Available online at: http://www.nmfs.noaa.gov/sfa/hms/documents/fmp/am1/feis/feis_amendment_total.pdf. Accessed December 2016.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2008. Vessel Strike Avoidance Measures and Reporting for Mariners. National Marine Fisheries Service, Southeast Regional Office, St. Petersburg Florida. Revised February 2008. Available online at: http://sero.nmfs.noaa.gov/protected_resources/section_7/guidance_docs/documents/copy_of_vessel_strike_avoidance_february_2008.pdf. Accessed January 2016.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2006. Final Consolidated Atlantic Highly Migratory Species Fishery Management Plan. Available online at: http://www.nmfs.noaa.gov/sfa/hms/documents/fmp/consolidated/total.pdf. Accessed

National Park Service. 2017. State of the Park Report for Palo Alto Battlefield National Historical Park. Available online at: https://www.nps.gov/stateoftheparks/paal/naturalresources/vegetation.cfm. Accessed May 2018.

National Wild and Scenic Rivers System. 2017. Explore Designated Rivers. Available online at: https://www.rivers.gov/map.php. Accessed July 2017.

Natural Resources Conservation Service. 2016. Official Soil Series Descriptions. Available online at: https://soilseries.sc.egov.usda.gov/osdname.aspx. Accessed September 2016.

Natural Resources Conservation Service. 2013. Web Soil Survey. Available online at: http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm. Accessed September 2016.

Natural Resources Conservation Service. 1993. Soil Survey Manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. Washington, DC.

The Nature Conservancy. 2018. Reconnecting the Bahia Grande. Available online at: https://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/texas/bahia-grande.xml. Accessed May 2018.

NatureServe. 2016. NatureServe Explorer. Available online at: http://explorer.natureserve.org/. Accessed November 2016.

Nexstar Broadcasting, Inc. 2015. Centurion Terminals Breaks Ground on Processing and Storage Facility at Port of Brownsville. Available online at: http://www.rgvproud.com/news/local-news/centurion-terminals-breaks-ground-on-processing-and-storage-facility-at-port-of-brownsville/232513205. Accessed July 2017.

Oil and Gas Journal. 2017. U.S. Gulf Coast Crude Terminals Expanding to Meet Permian Growth. Available online at: http://www.ogj.com/articles/print/volume-115/issue-

3/transportation/us-gulf-coast-crude-terminals-expanding-to-meet-permian-growth.html. Accessed July 2017.

Owen, Donald E. 2008. Geology of the Chenier Plain of Cameron Parish, southwestern Louisiana. The Geological Society of America, Filed Guide 14. Available online at: http://fieldguides.gsapubs.org/content/14/27.full.pdf+html.

Padre Elite Team Blog. 2016. City of SPI 2016 Beach Re-nourishment Project. Available online at: https://padreeliteteam.wordpress.com/2016/12/05/city-of-spi-2016-beach-renourishment-project/. Accessed July 2017.

Page, William R., D. Paco VanSistine, and Kenzie J. Turner. 2005. Preliminary geologic map of southernmost Texas, United States, and parts of Tamaulipas and Nuevo Leon, Mexico: U.S. Geological Survey Open-File Report 2005-1409, Denver, Colorado. Available online at: http://pubs.usgs.gov/of/2005/1409/pdf/OFR1409Map.pdf. Accessed February 2017.

Patterson, J.W. 2012. Evaluation of New Obstruction Lighting Techniques to Reduce Avian Fatalities Technical Note: DOT/GAA/TC-TN12/9.

Peters, Gary. 2015. Into the light: How marine life is affected by artificial light in harbours. Available online at: https://www.ship-technology.com/features/featureinto-the-light-marine-life-affected-by-artificial-light-in-harbours-4615259/. Accessed July 2018.

Pollinator Health Task Force. 2015. National Strategy to Promote the Health of Honey Bees and Other Pollinators. Available online at: https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/Pollinator%20Health%20Strategy%202015.pdf. Accessed July 2018.

Poole, Jackie M., Jason R. Singhurst, and William R. Carr. 2010. A List of Rare Plants of Texas. December 2010 Edition. Available online at: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_rp_w7000_1142.pdf. Accessed July 2017.

Popper, A.N., M.C. Hastings. 2009. The Effects of Anthropogenic Sources of Sound on Fishes. Journal of Fish Biology 75:455-489. Available online at: http://www.wsdot.wa.gov/NR/rdonlyres/ 0B027B4A-F9FF-4C88-8DE0-39B165E4CD94/61427/BA_AnthroSoundonFish.pdf. Accessed February 2017.

Port of Brownsville. 2013. Port of Brownsville Presentation for the South Texas Manufacturers Association. August 2013. Available online at: http://www.stma-tx.org/meetings/20130827/STMA-Presentation-Port-of-Brownsville.pdf. Accessed June 2015.

Port of Brownsville. 2017a. Gulf Shrimp Season Under Way. Available online at: http://www.portofbrownsville.com/gulf-shrimp-season-under-way/. Accessed July 2018.

Port of Brownsville. 2017b. 2017 Directory. Available online at: http://www.portofbrownsville.com/wp-content/uploads/2017/06/POB_2017DIRECTORY_web.pdf. Accessed April 2018.

Port of Brownsville. 2015. End of Year Cargo Statistics Reports 2014. Provided by Deborah Duke, Director of Administrative Services, Port of Brownsville, to K. Welder. June 18, 2015.

Prewitt, E. R. 1974. Preliminary Archeological Investigations in the Rio Grande Delta of Texas. Bulletin of the Texas Archeological Society 45:55-65.

Professional Service Industries, Inc. 2015. Geotechnical Investigation Report: Texas LNG FEED Project. PSI Project No. 01286-1252.

Railroad Commission of Texas. 2016. Public GIS Viewer. http://wwwgisp.rrc.texas.gov/GISViewer2/. Accessed September 2016.

Railway Age. 2015. First U.S. – Mexico rail bridge in more than a century is now operational. http://www.railwayage.com/index.php/trade-shows/first-us-mexico-rail-bridge-in-more-than-a-century-now-operational.html. Accessed July 2017.

RPS Austin. 2017 Sampling and Analysis Report Pre-dredge Environmental Testing Conducted during 1Q 2017. REIN-16-0006.

Ruple, D.L. 1993. Shoreline Erosion Losses. Proceedings of the 59th Meeting of the Coastal Engineering research Board, 16-18 November 1993 Point Clear, Alabama. Available online at: http://bigfoot.wes.army.mil/5914.html

Stadlar, J.H. and D.P. Woodbury. 2009. Assessing the Effects to Fishes from Pile Driving: Application of new hydroacoustic criteria. Inter-noise 2009. August 23-26, 2009, Ottawa, Canada.

Stevenson, D.A., and R. P. McCulloh. 2001. Earthquakes in Louisiana. Louisiana Geological Survey - Public Information Series No. 7.

Source and Strategies Inc. 2015. Office of the Governor. Economic Development and Tourism. Texas Hotel Performance Report: Second Quarter 2015. Available online at: http://www.sourcestrategies.org/texas/reports/TXDT0215.pdf. Accessed February 2017.

Spaceflight Insider. 2016. Work on SpaceX's Boca Chica Launch Site Continues. Available online at: http://www.spaceflightinsider.com/organizations/space-exploration-technologies/work-spacexs-boca-chica-launch-site-continues/. Accessed July 2017.

Stanyard, William F., Larissa A. Thomas, and Larry McKee. 2016. Cultural Resources Revised Report: Phase I Survey and Supplemental Investigations at 41CF8.

Tehler, Anders. 2011. Roccella, the Sonoran species reviewed. Stockholm, Sweden.

Tenaska, Inc. 2018. Tenaska Brownsville Generating Station. Available online at: http://www.tenaskabrownsville.com/qa/. Accessed April 2018.

Texas A&M Agrilife Extension. 2017a. The Breeding Bird Atlas, Peregrine Falcon. Available online at: https://txtbba.tamu.edu/species-accounts/peregrine-falcon/. Accessed July 2017.

Texas A&M Agrilife Extension. 2017b. The Breeding Bird Atlas, White-faced Ibis. Available online at: https://txtbba.tamu.edu/species-accounts/white-faced-ibis/. Accessed July 2017.

Texas A&M Agrilife Extension. 2017c. The Breeding Bird Atlas, White-tailed Hawk. Available online at: https://txtbba.tamu.edu/species-accounts/white-tailed-hawk/. Accessed July 2017.

Texas Almanac. 2015. Nonpetroleum Minerals. Available online at: http://texasalmanac.com/topics/business/nonpetroleum-minerals. Accessed April 2015.

Texas Coastal Management Program. 2014. Texas Coastal Management Program – Biennial Report 2013-2014. Available online at: http://www.glo.texas.gov/coast/coastal-management/forms/files/CMP-Biennial-Report-2014.pdf. Accessed November 2016.

Texas Commission on Environmental Quality. 2014. 2014 Texas Integrated Report. Available online at: https://www.tceq.texas.gov/waterquality/assessment/14twqi/14txir. Accessed September 2016.

Texas Commission on Environmental Quality (TCEQ). 2010. Chapter 307, Texas Surface Water Quality Standards. §307.1 – 307.10. Available online at: https://www.tceq.texas.gov/assets/public/waterquality/standards/TSWQS2010/TSWQS2010_rule.pdf. Accessed September 2016

Texas Department of State Health Services. 2014. Texas Hospital List, 2013. Available online at: http://dshs.state.tx.us/chs/hosp/hosp2.aspx. Accessed March 2015.

Texas Department of Transportation. 2018. Project Tracker. Available online at: https://www.txdot.gov/inside-txdot/projects/project-tracker.html. Accessed September 25, 2018.

Texas Department of Transportation. 2016. State Highway 32 East TIGER Discretionary Grant Application. Available online at: http://ftp.dot.state.tx.us/pub/txdot-info/fed/tiger/2016/sh32/ea.pdf. Accessed May 2018.

Texas Department of Transportation. 2015. District Traffic Maps – 2012. Available online at: http://www/txdot.gov/inside-txdot/division/transportation-planning/maps/district-2012.html. Accessed March 2015.

Texas Department of Transportation. 2011. Access Management Manual. Available online at: http://onlinemanuals.txdot.gov/txdotmanuals/acm/acm.pdf. Accessed July 2017.

Texas Department of Transportation. 2009. Draft Environmental Assessment Re-Evaluation – FM 511 from US 77/US83 to SH48 and the Port of Brownsville. Available online at: https://drive.google.com/file/d/0B1RnqRLFkRdVOXp1WnF0VFRuVVk/view. Accessed July 2017.

Texas Department of Water Resources. 1983. Laguna Madre Estuary: A Study of the Influence of Freshwater Inflows LP-182. Available online at: http://www.twdb.texas.gov/publications/reports/limited_printing/doc/LP182.pdf. Accessed February 2017.

Texas Education Agency. 2017. General Information. Available online at: http://tea.texas.gov/Texas_Schools/General_Information/. Accessed February 2017.

Texas General Land Office. 2015. Texas Coastal Sediments Geodatabase. Available online at: http://gisweb.glo.texas.gov/txsed/index.html. Accessed September 2016.

Texas Historical Commission. 2017. Palmito Ranch Battlefield National Historic Landmark. Available online at: http://www.thc.texas.gov/preserve/projects-and-programs/military-sites/palmito-ranch-battlefield-national-historic-landmark. Accessed July 2017.

Texas Invasive Plant and Pest Council. 2011. Invasive Database. *Pterois volitans*. Lionfish, Red Lionfish. Available online at: http://www.texasinvasives.org/animal_database/detail.php?symbol=14. Accessed February 2017.

Texas Natural Diversity Database. 2015. Wildlife Diversity Program of Texas Parks and Wildlife Department. Austin, Texas. Accessed January 2015.

Texas Parks and Wildlife Department. 2018. Texas Natural Regions. Available online at: https://tpwd.texas.gov/education/resources/texas-junior-naturalists/regions. Accessed October 2018.

Texas Parks and Wildlife Department. 2017a. TPWD Seagrass Viewer. Available online at: http://tpwd.maps.arcgis.com/apps/webappviewer/index.html?id=af7ff35381144b97b38fe553f2e7b562. Accessed July 2017.

Texas Parks and Wildlife Department. 2017b. Shrimp Regulations and Restrictions. Available online at: http://tpwd.texas.gov/regulations/outdoor-annual/fishing/shellfish-regulations/shrimp-regulations. Accessed July 2017.

Texas Parks and Wildlife Department. 2017c. Reddish Egret. Available online at: https://tpwd.texas.gov/huntwild/wild/species/reddishegret/. Accessed July 2017.

Texas Parks and Wildlife Department. 2017d. Texas Horned Lizard. Available online at: https://tpwd.texas.gov/huntwild/wild/species/thlizard/. Accessed July 2017.

Texas Parks and Wildlife Department. 2017e. Texas Tortoise. Available online at: https://tpwd.texas.gov/huntwild/wild/species/txtort/. Accessed July 2017.

Texas Parks and Wildlife Department. 2017f. South Bay Paddling Trail. Available online at: http://tpwd.texas.gov/fishboat/boat/paddlingtrails/coastal/south_bay/. Accessed July 2017.

Texas Parks and Wildlife Department. 2017g. Port Isabel Lighthouse State Historic Site. Available online at: http://tpwd.texas.gov/state-parks/port-isabel-lighthouse. Accessed July 2017.

Texas Parks and Wildlife Department. 2017h. Ocelot. Available online at: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_0013_ocelot.pdf. Accessed July 2017.

Texas Parks and Wildlife Department. 2017i. Jaguarundi. Available online at: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_0013_jaguarundi.pdf. Accessed July 2017.

Texas Parks and Wildlife Department. 2016a. Texas Monarch and Native Pollinator Conservation Plan. Available online at: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_rp_w7000_2070.pdf. Accessed July 2018.

Texas Parks and Wildlife Department. 2016b. Management Recommendations for Native Insect Pollinators in Texas. Available online at: http://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_1813.pdf. Accessed July 2017.

Texas Parks and Wildlife Department. 2015a. Texas GEMS – South Bay Coastal Preserve. Available online at: http://tpwd.texas.gov/landwater/water/conservation/txgems/southbay/index.phtml. Accessed February 2017.

Texas Parks and Wildlife Department. 2015b. Rare, Threatened and Endangered Species of Texas by County. Available online at: http://tpwd.texas.gov/gis/rtest/. Accessed November 2015.

Texas Parks and Wildlife Department. 2015c. Letter dated May 5 from R. Hooten (Habitat Assessment Biologist, Texas Parks and Wildlife Department) to D. Glessner (Permitting General Manager, Texas LNG).

Texas Parks and Wildlife Department. 2014. 2014-2015 Texas Commercial Fishing Guide. Available online at: http://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_v3400_0074.pdf. Accessed April 2015.

Texas Parks and Wildlife Department. 2013. Ecological Mapping Systems of Texas: GIS data by Ecoregion: West Gulf Coastal Plain. Updated February 2013. Available online at: https://tpwd.texas.gov/education/hunter-education/online-course/wildlife-conservation/texas-ecoregions. Accessed February 2018.

Texas Parks and Wildlife Department. 2012. Texas Tortoise Best Management Practices. Available online at: https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/habitat_assessment/media/texas_tortoise_bmps.pdf. Accessed July 2017.

Texas Parks and Wildlife Department. 2010. Texas Vegetation Classification Project: Interpretive Booklet of Phase 3. Available online at: http://www.cerc.usgs.gov/morap/Assets/UploadedFiles/Projects/Texas_Ecological_Systems_Classification/PHase_3_Interpretive_Booklet.pdf. Accessed February 2018.

Texas Parks and Wildlife Department. 2002. Executive Summary. The Texas Shrimp Fishery. A report to the Governor and the 77th Legislature of Texas. Available online at: http://tpwd.texas.gov/publications/pwdpubs/media/pwd_rp_v3400_857.pdf. Accessed February 2017.

Texas State Historical Association. 2017. Bahia Grande. Available online at: https://tshaonline.org/handbook/online/articles/rrb01. Accessed July 2017.

Texas State Historical Association. 2010. Handbook of Texas Online. Brazos Island State Scenic Park. Available online at: https://tshaonline.org/handbook/online/articles/gkb10. Accessed November 2016.

Texas Water Development Board. 2016a. Historical Water Use Estimates. Available online at: http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp. Accessed November 2016.

Texas Water Development Board. 2016b. Water Data Interactive. Available online at: http://www2.twdb.texas.gov/apps/waterdatainteractive/groundwaterdataviewer. Accessed September 2016.

Texas Water Development Board. 2016c. 2017 State Water Plan. Available online at: http://www.twdb.texas.gov/waterplanning/swp/2017/index.asp. Accessed November 2016.

Texas Water Development Board. 1990. Evaluation of Ground-water Resources in the Lower Rio Grande Valley, Texas. Available online at: https://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R316/R316.pdf. Accessed February 2017.

Tunnel, K.W., and Judd, F.W. 2002, The Laguna Madre of Texas and Tamaulipas: Corpus-Christi, Texas, Texas A&M University Press, 372 p.

URS. 2016. Seismic and Tsunami Hazard Evaluations for the Texas LNG FEED Project in Brownsville, Texas.

USA Cops. 2016. Cameron County. Available online at: http://www.usacops.com/tx/cameron.html. Accessed January 2016.

U.S. Army Corps of Engineers. 2015a. Department of the Army Regional and Programmatic General Permit. Permit No. SWG 2002-02904. Available online at: http://www.swg.usace.army.mil/Portals/26/docs/regulatory/GPs/2015%20Pier%20GP.pdf . Accessed November 2016.

U.S. Army Corps of Engineers. 2015b. USACE Galveston District awards $6.9 million contract to dredge Brownsville Ship Channel, Port Isabel Channel. Available online at: http://www.swg.usace.army.mil/Media/News-Releases/Article/606508/usace-galveston-district-awards-69-million-contract-to-dredge-brownsville-ship/. Accessed May 2015.

United States Army Corps of Engineers. 2015c. USACE Galveston District to Begin Beach Re-nourishment Project at South Padre Island. Available online at: http://www.swg.usace.army.mil/Media/News-Releases/Article/622215/usace-galveston-district-to-begin-beach-renourishment-project-at-south-padre-is/. Accessed July 2017.

U.S. Army Corps of Engineers. 2014. Brazos Island Harbor, Texas Channel Improvement Project. Final Integrated Feasibility Report-Environmental Assessment. Available online at: http://www.swg.usace.army.mil/Portals/26/docs/BIH/Feasibility.pdf. Accessed September 2016.

U.S. Army Corps of Engineers. 2010. Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Atlantic and Gulf Coastal Plain Region. Version 2.0. U.S. Army Engineers Research and Development Center, Vicksburg, MS.

U.S. Census Bureau. 2016. American Fact Finder. Available online at: https://factfinder.census.gov/faces/nav/jsf/pages/download_center.xhtml. Accessed February, 2017.

U.S. Census Bureau. 2015a. QuickFacts. Available online at: http://www.census.gov/quickfacts/table/PST045215/00. Accessed September 2016.

U.S. Census Bureau. 2015b. 2010-2014 American Community Survey 5-Year Estimates. http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml. Accessed September 2016.

U.S. Census Bureau. 2010. Labor Force Statistics. Available online at: http://www.census.gov/people/laborforce/about/acs_employ.html. Accessed September 2016.

U.S. Department of Agriculture. 2017. Noxious Weeds State. Available online at: https://plants.usda.gov/java/AdvancedSearchServlet?statefips=US48&fed_nox_status_ind=with&dsp_statefips=on&dsp_fed_nox_status_ind=on&Synonyms=all&viewby=sciname. Accessed February 2017.

U.S. Department of Energy. 2018. Long Term Applications Received by DOE/FE to Export Domestically Produced LNG from the Lower-48 States (as of September 20, 2018). Available online at: https://www.energy.gov/sites/prod/files/2018/09/f56/Summary%20of%20LNG%20Export%20Applications.pdf. Accessed October 2018.

U.S. Department of the Interior. 2015. Consultation No. 02ETCC00-2015-F-002 with Texas Department of Transportation – Environmental Affairs Division. Available online at: https://www.fws.gov/southwest/es/Documents/R2ES/BO_TxDOT_SH100_CameronCnty_2015.pdf. Accessed July 2017.

U.S. Department of Transportation. 2017. America's Byways. Available online at: https://www.fhwa.dot.gov/byways/byways. Accessed July 2017.

U.S. Environmental Protection Agency and U.S. Army Corps of Engineers. 2017. Brazos Island Harbor, Texas Maintenance and New Work Ocean Dredged Material Disposal Sites Site Management Plan. Available online at: https://www.epa.gov/sites/production/files/2017-06/documents/2017_brazos_island_harbor_odmds_smmp_maintenance_and_new_work.pdf. Accessed October 2018.

U.S. Environmental Protection Agency. 2016a. NEPAssist. Available online at: https://www.epa.gov/nepa/nepassist. Accessed September 2016.

U.S. Environmental Protection Agency. 2016b. Sole Source Aquifers. Available online at: https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=9ebb047ba3ec41ada1877155fe31356b. Accessed September 2016.

U.S. Environmental Protection Agency. 2015. Overview of the Drinking Water Sole Source Aquifer Program. Available online at: https://www.epa.gov/dwssa/overview-drinking-water-sole-source-aquifer-program#What_Is_SSA. Accessed September 2016.

U.S. Environmental Protection Agency. 2013. Cultural Resources Assessment (CRA) – Tenaska Brownsville Generating Station – Transmission Interconnect Line. Tenaska Brownsville Partners, LLC. Cameron County, Texas. https://archive.epa.gov/region6/6pd/air/pd-r/ghg/web/pdf/tenaska-brownsville-cultural-121913-part3.pdf. Accessed February 2017.

U.S. Environmental Protection Agency. 2011. Environmental Justice Frequently Asked Questions. Available online at: https://compliancegov.zendesk.com/hc/enus/sections/202370188. Accessed September 2018.

U.S. Environmental Protection Agency. 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. Office of Noise Abatement and Control. March 1974.

U.S. Environmental Protection Agency. 1971. Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances. Office of Noise Abatement and Control. December 1971.

U.S. Fish and Wildlife Service. 2018a. Flyways. Available online at: https://www.fws.gov/birds/management/flyways.php. Accessed August 2018.

U.S. Fish and Wildlife Service. 2018b. Information for Planning and Consultation. Available online at: https://ecos.fws.gov/ipac/. Accessed August 2018.

U.S. Fish and Wildlife Service. 2016. Communication Tower Siting, Construction, Operation, and Decommissioning Recommendations. Available online at: https://www.fws.gov/midwest/endangered/section7/telecomguidance.html. Accessed July 2017.

U.S. Fish and Wildlife Service. 2015a. Laguna Atascosa National Wildlife Refuge: Bahia Grande Unit. Available online at: https://www.fws.gov/refuge/laguna/about/bahia_grande_unit.html. Accessed November 2016.

U.S. Fish and Wildlife Service. 2015b. Lower Rio Grande Valley National Wildlife Refuge. Available online at: https://www.fws.gov/refuge/Lower_Rio_Grande_Valley/. Accessed July 2017.

U.S. Fish and Wildlife Service. 2015c. Personal communication, Texas LNG Site Visit with FWS, NPS, TPWD, FERC, and Natural Resources Group, LLC. Brownsville, Texas. September 16, 2015.

U.S Fish and Wildlife Service. 2010a. Laguna Atascosa National Wildlife Refuge Comprehensive Conservation Plan 2010. Available online at: https://catalog.data.gov/dataset/laguna-atascosa-national-wildlife-refuge-comprehensive-conservation-plan. Accessed July 2017.

U.S. Fish and Wildlife Service. 2010b. Draft Ocelot (*Leopardus pardalis*) Recovery Plan, First Revision. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, New Mexico. Available online at: https://www.fws.gov/southwest/es/Documents/R2ES/Draft_Ocelot_Recovery_Plan-First_Revision.pdf. Accessed December 2015.

U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern. Available online at: https://www.fws.gov/migratorybirds/pdf/grants/BirdsofConservationConcern2008.pdf. Accessed February 2017.

U.S. Fish and Wildlife Service. 2002. Colonial-Nesting Waterbirds. A Glorious and Gregarious Group. Available online at: https://www.fws.gov/uploadedFiles/waterbird-fact-sheet.pdf. Accessed February 2017.

U.S. Fish and Wildlife Service. 1997. Final Lower Rio Grande Valley and Santa Ana National Wildlife Refuges – Comprehensive Conservation Plan.

U.S. Geologic Survey. 2018a. Earthquake Hazards Program, Quaternary Fault and Fold Database of the United States. Available online at: https://earthquake.usgs.gov/hazards/qfaults/. Accessed August 2018.

U.S. Geological Survey. 2018b. Magnetic Anomaly Maps and Data for North America. Available online at: https://mrdata.usgs.gov/magnetic/map-us.html#home. Accessed August 2018.

U.S. Geological Survey. 2017. U.S. Volcanoes and Current Activity Alerts. Available online at: https://volcanoes.usgs.gov/index.html. Accessed Aug 2018.

U.S. Geological Survey. 2015. 2010-2011 Minerals Yearbook: Texas (Advance Release). Available online at: http://minerals.usgs.gov/minerals/pubs/state/2010_11/myb2-2010_11-tx.pdf. Accessed September 2016.

U.S. Geological Survey. 2014a. Active Mines and Mineral Plants in the US. Available online at: http://mrdata.usgs.gov/mineplant/. Accessed September 2016.

U.S. Geological Survey. 2009. Regional Assessment of Tsunami Potential in the Gulf of Mexico. Available online at: http://nws.weather.gov/nthmp/documents/GoM-Final01regionalAssessment.pdf. Accessed June 2016.

U.S. Geological Survey. 2000. A Tapestry of Time and Terrain - Pamphlet to accompany Geologic Investigations Series I–2720. Available online at: https://pubs.usgs.gov/imap/i2720/.

U.S. Geological Survey. 1996. Groundwater Atlas of the United States: Oklahoma and Texas. Hydrologic Investigations Atlas 730-E. Paul D. Ryder. Reston, Virginia.

U.S. Geological Survey. 1993. Quaternary Geologic Map of Monterrey 4 Degrees x 6 Degrees Quadrangle, United States: IMAP 1420 (NG-14). Available online at: http://pubs.er.usgs.gov/publication/i1420(NG14). Accessed February 2017.

U.S. Geological Survey. 2017. Texas Geologic Map data. Available online at: http://mrdata.usgs.gov/geology/state/state.php?state=TX. Accessed October 2017.

The University of Texas Rio Grande Valley. 2018. Boca Chica Beach: STARGATE Technology Center. Available online at: http://www.utrgv.edu/umc/news/building-our-future/stargate/index.htm. Accessed May 2018.

The University of Texas Rio Grande Valley. 2017. STARGATE – Who We Are Now. Available online at: http://www.utrgv.edu/stargate/. Accessed July 2017.

Whale and Dolphin Conservation Society. 2004. Oceans of Noise 2004 – A WDCS Science Report.

Wind Power Engineering and Development. 2016. ACCONIA's San Roman Wind Farm begins commercial operation in South Texas. Available online at: https://www.windpowerengineering.com/business-news-projects/accionas-san-roman-wind-farm-begins-commercial-operation-south-texas/. Accessed February 2018.

World Maritime News. 2015. Port of Brownsville Opens New Marine Cargo Dock. Available online at: http://worldmaritimenews.com/archives/168714/port-of-brownsville-opens-new-marine-cargo-dock/. Accessed July 2017.

World Meteorological Organization. 2010. Guidelines for Converting between Various Wind Averaging Periods in Tropical Cyclone Conditions. Available online at: https://www.wmo.int/pages/prog/www/tcp/documents/WMO_TD_1555_en.pdf. Accessed August 2018.

APPENDIX J

LIST OF PREPARERS

FEDERAL ENERGY REGULATORY COMMISSION

Monib, Kareem – Project Manager, Project Description, Alternatives, Land Use, Socioeconomics, Cumulative Impacts

M.S., Chemical Engineering, 2000, Pennsylvania State University

B.S., Chemical Engineering, 1998, University of Delaware

Allen, Christine – Resource Specialist, Water Resources, Wetlands, Fisheries, Vegetation, Wildlife, Special Status Species

B.S., Marine Biology, 2005, University of North Carolina, Wilmington

Dague, Brady, PE – Reliability and Safety

BS, Civil Engineering, 2010, University of Maryland

Friedman, Paul – Resource Specialist, Cultural Resources

M.A., History, 1980, University of California at Santa Barbara

B.A., Anthropology and History, 1976, University of California at Santa Barbara

Glaze, James – Resource Specialist, Geology

B.S., Geology, 1975, California Lutheran University

Kusy, Steven – Liquefied Natural Gas (LNG) Reliability and Safety

B.E., Stevens Institute of Technology, 2009, Hoboken, NJ

Peng, Andrew – Reliability and Safety

B.C.E., Civil Engineering, 2014, University of Delaware

Tomasi, Eric – Cumulative Air Quality and Noise

B.S., Aerospace Engineering, 1994, Boston University

Warn, Kenneth – Resource Specialist, Air Quality and Noise

M.P.P., Environmental Policy, 2005, George Washington University

M.S., Chemical Engineering, 1995, Lehigh University

B.S., Chemical Engineering, 1992, Colorado School of Mines

U.S. DEPARTMENT OF ENERGY / OFFICE OF FOSSIL ENERGY

Moorman, Kyle

U.S. ARMY CORPS OF ENGINEERS

Sloan, Denise L.

U.S. COAST GUARD

U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 6

Fontenot, Allison

U.S. FISH AND WILDLIFE SERVICE

Clements, Pat

Perez, Christopher

NATIONAL PARK SERVICE

Garza, Rolando

Meyer, Mark

Spier, Mark

Stanley, Randy

U.S. DEPARTMENT OF TRANSPORTATION, PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION

Battams, Ahuva

White, Sentho

U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION

<u>NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION – NATIONAL MARINE FISHERIES SERVICE</u>

<u>PERENNIAL ENVIRONMENTAL SERVICES, LLC</u>

Butler, Amy – Project Manager, Project Description, Water Resources, Wetlands, Fisheries, Vegetation, Wildlife, and Cumulative

M.S., Natural Resource Sciences, 2011, University of Nebraska – Lincoln

B.S., Natural Resource Sciences, 2008, Washington State University

Yoo, Leslie – Deputy Project Manager, Threatened and Endangered Species, Alternatives, Land Use, Recreation, and Visual Resources

M.S., Zoology, 2001, Oklahoma State University

B.A., Biology, 1995, Randolph-Macon Woman's College

Cochran, Megan – Resource Specialist, Geology, Soils, and Socioeconomics

B.S., Environmental Studies, 2013, Texas A&M University

Peyton, Abigail – Resource Specialist, Cultural Resources

M.A., Archaeology, 2005, Texas State University

B.A., Anthropology, 2001, Baylor University

<u>POWER ENGINEERS, INC.</u>

Corio, Louis A. – Resource Specialist, Air Quality

M.S., Meteorology, 1983, Rutgers University – Cook College

B.S., Meteorology, 1980, University of Maryland

Guerrero, Priscilla A. – Resource Specialist, Air Quality

Ph.D., Civil and Environmental Engineering, 2013, University of Texas

M.S., Environmental and Water Resources Engineering, 2009, University of Texas

B.S. Metallurgical and Materials Engineering, 2007, University of Texas

SLR INTERNATIONAL CORPORATION

Morrill, Laurie – Resource Specialist, Noise

M.S., Environmental Studies, 2011, University of Melbourne

B.A., Physics, 2001, Reed College

Jones, David M. – Resource Specialist, Noise

B.S., Mechanical Engineering, 1996, Rice University

Ronald R. Spillman, P.E.

B.A., Biology, 1977, University of Texas

B.S., Engineering Science, 1979, University of Texas