Federal Energy Regulatory Commission
Office of Energy Projects
Washington, DC 20426

ANNOVA LNG BROWNSVILLE PROJECT

Final Environmental Impact Statement

Volume II - Appendices

Annova LNG Common Infrastructure, LLC
Annova LNG Brownsville A, LLC
Annova LNG Brownsville B, LLC
Annova LNG Brownsville C, LLC

Docket No. CP16-480-000
FERC\EIS: 0291F
April 2019

Cooperating Agencies:

U.S. Army Corps of Engineers

National Park Service

U.S. Environmental Protection Agency

U.S. Fish and Wildlife Service

U.S. Coast Guard

U.S. Department of Energy

U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration

National Oceanic and Atmospheric Administration - National Marine Fisheries Service

Federal Aviation Administration

APPENDIX A
DISTRIBUTION LIST FOR THE *NOTICE OF AVAILABILITY*

APPENDIX A
DISTRIBUTION LIST FOR THE *NOTICE OF AVAILABILITY*

<u>Federal Government – Elected Officials</u>

U.S. Representative Filemon Vela, TX

U.S. Senator John Cornyn, TX

U.S. Senator Ted Cruz, TX

<u>Federal Agencies</u>

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

Bureau of Ocean Energy Management, Chief, Division of Environmental Assessment Dr. Jill Lewandowski

Bureau of Oceans and International Environmental & Scientific Affairs, Foreign Affairs Officer Alexander Yuan

Bureau of US Customs and Border Protection – Gateway Bridge

Bureau of US Customs and Border Protection - Seaport

Council on Environmental Quality, Assoc. Director for NEPA Oversight, Edward Boling

Council on Environmental Quality, Deputy General Counsel Manisha Patel

Federal Energy Regulatory Commission, Office of Energy Projects, Division of Gas, Project Manager Eric Tomasi

Federal Bureau of Investigation

Housing and Urban Development, Office of Environment and Energy, Community Planner Danielle Schopp

National Center for Environmental Health, Centers for Disease Control, Director of Division of Emergency and Environmental Health Services Sharunda Buchanan

National Marine Fisheries Service, National NEPA Coordinator

National Marine Fisheries Service, Habitat Conservation Division, Heather Young

National Marine Fisheries Service, Protected Resources Division, Kelly Shotts

National Marine Fisheries Service, Southeast Region, Mike Tucker

National Oceanic and Atmospheric Administration, NEPA Policy and Compliance, Steve Kokkinakis

National Park Service, Chief, Environmental Planning and Compliance Branch, Patrick Walsh

National Park Service, Intermountain Region, Christine Whitacre

National Park Service, Palo Alto Battlefield National Historical Park, Rolando Garza

National Park Service, Palo Alto Battlefield National Historical Park, Mark Spier

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

Office of the Deputy Assistant Secretary of the Army (Installations), Liaison, DoD Siting Clearinghouse SAF/IEI

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

Office of the Deputy Under Secretary of Defense (Installations & Environment), Chief, Mission Evaluation Branch DoD Siting Clearinghouse

Office of the Assistant Secretary of the Navy, Energy, Installations, and Environment

U.S. Army Corps of Engineers, Planning and Policy Division, John Furry

U.S. Army Corps of Engineers, Galveston District, Field Office Lead, Nicholas Laskowski

U.S. Army Corps of Engineers, Policy Analysis Branch, Galveston District, Denise Sloan

U.S. Coast Guard, Rusty Wright

U.S. Coast Guard, Commandant, Deepwater Ports Standards Division, Attorney/Advisor, Curtis Borland

U.S. Coast Guard, Sector Corpus Christi, Jalyn Stineman

U.S. Coast Guard, Sector Corpus Christi, Samuel Creech

U.S. Customs & Border Protection, Dept. of Homeland Security, Branch Chief Christopher Oh

U.S. Department of Agriculture, Natural Resources Conservation Service, National Environmental Coordinator, Andree DuVarney

U.S. Department of Agriculture, FSA, Conservation and Environmental Program Division, National Environmental Compliance Manager, Nell Fuller

U.S. Department of Agriculture, Gateway Bridge

U.S. Department of Agriculture Forest Service– Ecosystem Management Coordination, Joe Carbone

U.S. Department of Defense Siting Clearinghouse

U.S. Department of Energy, Office of Environmental Management, Principal Deputy Assistant Secretary Mark Whitney

U.S. Department of Energy, Office of NEPA Policy and Compliance, Acting Director Brian Costner

U.S. Department of Energy, Director, Division of Natural Gas Regulatory Activities, John Anderson

U.S. Department of Health and Human Services, Environmental Program Manager, Edward Pfister

U.S. Department of Health and Human Services, Chief Environmental Officer, Everett Bole, CHMM

U.S. Department of Interior, Bureau of Land Management, Senior NEPA Specialist, Kerry Rogers

U.S. Department of Interior, Bureau of Land Management, FERC Contact

U.S. Department of Interior, Bureau of Indian Affairs, NEPA Coordinator, Terry L. McChlung

U.S. Department of Interior, Bureau of Indian Affairs, BJ Howerton

U.S. Department of Interior, Bureau of Safety and Environmental Enforcement, Chief, Environmental Enforcement Division, Charles Barbee

U.S. Department of Interior, Bureau of Safety and Environmental Enforcement, Chief, Environmental Compliance Division, David Fish

U.S. Department of Interior, director, Office of Environmental Policy and Compliance

U.S. Department of Justice, Environment & Natural Resources Division, NEPA Coordinator

U.S. Department of Transportation, Office of Assistant Secretary for Transportation Policy, Camille Mittelholtz

U.S. Department of Transportation, Office of Assistant Secretary for Transportation Policy, Helen Serassio

U.S. Department of Transportation, Surface Transportation Board, Victoria Ruston

U.S. Department of Transportation, PHMSA, OPS, Bryn Karaus

U.S. Department of Transportation, PHMSA, OPS, Melanie Stevens

U.S. Department of Transportation, PHMSA, OPS, Ahuva Battams

U.S. Department of Transportation, PHMSA, OPS, Kenneth Lee

U.S. Department of Transportation, PHMSA, William Schoonover

U.S. Department of Transportation, PHMSA, Alan Mayberry

U.S. Department of Transportation, PHMSA, Karen Lynch

U.S. Department of Transportation, PHMSA, Jeffrey Wiese

U.S. Department of Transportation, PHMSA, Buddy Secor, Jr, PE

U.S. Environmental Protection Agency, Director, NEPA Compliance Division, Cliff Rader

U.S. Environmental Protection Agency, Natural Gas STAR, Jerome Blackman

U.S. Environmental Protection Agency, Director, Office of Federal Activities, Susan Bromm

U.S. Environmental Protection Agency, Asst. Administrator, Office of Enforcement and Compliance Assurance, Lawrence Starfield

U.S. Environmental Protection Agency Region 6, Keith Hayden

U.S. Environmental Protection Agency Region 6, NEPA Coordinator, Michael Jansky

U.S. Environmental Protection Agency Region 6, Chief, Wetlands Section, Maria Martinez

U.S. Environmental Protection Agency Region 6, Wetlands Section, Alison Fontenot

US Fish and Wildlife Service, Laguna Atascosa National Wildlife Refuge

U.S. Fish and Wildlife Service, Texas Coastal Ecological Services Field Office, Pat Clements

U.S. Fish and Wildlife Service, Texas Coastal Ecological Services Field Office, Dawn Gardiner

U.S. Fish and Wildlife Service, Texas Coastal Ecological Services Field Office, Charles Ardizzone

U.S. Geological Survey, Chief, Environmental Mgt. Branch, Esther Eng

U.S. Immigration and Naturalization Service, Gateway Bridge

U.S. Marshals

U.S. Senate, Energy and Natural Resources Committee, Chairman Lisa Murkowski

Texas Agencies and Elected Officials

Governor of Texas Gregory Abbott

Lt. Governor of Texas Dan Patrick

State Representative Eddie Lucio, III

Public Utility Commission of Texas, Commissioner Kenneth Anderson

Public Utility Commission of Texas, Executive Director Brian Lloyd

Public Utility Commission of Texas, Commissioner Brandy Marquez

Public Utility Commission of Texas, Chair Donna Nelson

Railroad Commission of Texas, Chair, Christi Craddick

Railroad Commission of Texas, David Porter

Railroad Commission of Texas, Ryan Sitton

Railroad Commission of Texas, Leslie Savage

Texas Commission on Environmental Quality, Commissioner Toby Baker

Texas Commission on Environmental Quality, Commissioner Zak Covar

Texas Commission on Environmental Quality, Executive Director Richard Hyde

Texas Commission on Environmental Quality, CAPM, NEPA Coordinator Elizabeth McKeefer

Texas Commission on Environmental Quality, Chair Bryan Shaw

Texas Commission on Environmental Quality, NSR Air Permits Section, Kate Stinchcomb

Texas Department of Public Safety, Tony Pena, Jr.

Texas Department of Transportation, Pharr District Office, Homer Brazan, Jr

Texas General Land Office, Land Commissioner George Bush

Texas Historical Commission, Mark Wolfe

Texas Parks and Wildlife Department, Rebecca Hensley

Texas Parks and Wildlife Department, Julie Wicker

Local Governments and Elected Officials

Brownsville Navigation District, Chair Ralph Cowen

Brownsville Navigation District, Vice Chair Carlos Masso

Brownsville Navigation District, Commissioner & Secretary John Reed

Brownsville Navigation District, Commissioner Sergio Tito-Lopez

Brownsville Navigation District, Commissioner John Wood

Brownsville Navigation District/Port of Brownsville, Deputy Port Director, Donna Eymard

Cameron County Commissioners Court, Judge Carlos Cascos

City of Brownsville, Mayor Tony Martinez

City of Brownsville, Commissioner At-Large A Estela Chavez

City of Brownsville, Commissioner At-Large B Rose Gowen

City of Brownsville, Commissioner, District 1, Ricardo Longoria, Jr.

City of Brownsville, Commissioner District 2, Jessica Tetreau-Kalifa

City of Brownsville, Commissioner District 3, Deborah Portillo

City of Brownsville, Commissioner District 4, John Villarreal

City of Laguna Vista, Mayor Susie Houston

City of Port Isabel, Jared Hockema

City of Port Isabel, Mayor Joe Vega

City of South Padre Island, Mayor Barry Patel

County Administrator, Pete Sepulveda, Jr.

County Commissioner Precinct 1, Sofia Benavides

County Commissioner Precinct 2, Alex Dominquez

County Commissioner Precinct 3, David Garza

County Commissioner Precinct 4, Dan Sanchez

Port of Brownsville, CEO & Director Eduardo Campirano

Port of Brownsville, Director of Engineering Services, Ariel Chavez

Port of Brownsville, Harbormaster, Michael Davis

Port of Brownsville, Director of Administrative Services, Deborah Duke

Port of Brownsville, Director of Finance, Stephen Fitzgibbons

Port of Brownsville, Chief of Police and Security, Carlos Garcia

Port of Brownsville, Director of Maintenance, Joe Garza

Port of Brownsville, Commissioner, Sergio Lopez

Port of Brownsville, Human Resources Manager, Jaime Martinez

Port of Brownsville, Administrative Assistant to Port Director/CEO, Margie Recio

Port of Brownsville, Director of Cargo Services, Tony Rodriguez

Port of Brownsville, Director of Industrial Development, Beatrice Rosenbaum

Port of Brownsville Public Scale, Inc.

Libraries

Brownsville Public Library

Laguna Vista Public Library

Port Isabel Public Library

Media

Port Isabel-South Padre Press

The Brownsville Herald

Native Americans

Alabama-Coushatta Tribe of Texas, THPO, Bryant Celestine

Carrizo/Comecrudo Nation of Texas, Juan Mancia

Comanche Nation of Oklahoma, THPO, Jim Arterberry

Lipan Apachae Tribe of Texas, Chairman, Bernard Barcena, Jr.

Tonkawa Tribe of Oklahoma, President, Donald Patterson

Intervenors

The Friends of Laguna Atascosa National Wildlife Refuge

Ricardo Salinas

David Thurston

Mary Voltz

Affected Landowners on or Adjacent to Proposed Facilities and Routes

Brownsville Navigation District / Port of Brownsville

U.S. Fish and Wildlife Service

Other Interested Parties

Abbott, Marilyn

Abedor, Betty

ABF Freight Systems Inc.

Adam, Lisa

Adler, June

Adrian, Jan

Adrianita, Inc, Mauricio Chavez

Agapie, Helen

Aguilar Brothers, Inc, Josue Aguilar

Aguilar, Virginia

Alamo, Carmen

Alamo, Carmen

Albrecht, Jeff

Alejos, Marisol

Alexander, Kathleen

Allen, Linda

Allen, Loretta

Allen, Susan

Almaguer, Ernesto

Alonzo, Lisa

Alpert, Emily

Altmeyer, David

Altum, Angelika

Alvarado, Arantza

Alvarado, Deborah

Alvarado, Veronica

Alvarez, Andy

Alvarez, Antonio

Alvarez, Carmen

Alvarez, Maria

American Commercial Lines

American Divers

American Diving

American River Transportation Company

Anastasoff, Beverly

Anders, Helen

Anderson, Dianah

Anderson, Dianah

Anderson, Leah

Anderson, Marty

Anderson, Patrick

Andrews, Justin

Andrus, Lisa

ANGA, Frank Macchiarola

Angelo Inter-Logistics

Anthony, Gail

Anthony, Gail

Aquirre, Belen

Ardington, Amy

Arellano, Daisy

Arevalo, Raul

Argo ES&H Services, LLC, Barry Chambers

Arredondo, Elma

Arredondo, Santiago

Arroyos, Glory

Ashberry, William

Ashley, June

Atkinson, Barbara

Auto Lineas, Sigifredo Garcia Palacios

Avalos, Josie
Avey, Carolyn
Avila, Jane
Ayala, Gisela
Ayodele, Oluwadare Michael
Babberney, Cameron
Babberney, Cameron
Backues, Anna
Bacon, Kim
Bagley, Susan
Bailey, Linda
Bailey, Sharon
Baker, B
Baker, B
Baldovinos, Alicia
Bales, Brenna
Ball, Stewart
Ballenso, Josh
Balog, Vera
Balogh, William
Baltrusch, Libby
Baltrusch, Libby
Balzrette, Erin
Banda, Terry
Banks, Ann
Barajas, Brooke
Bard, Greg
Barker, Wendy
Barker-Stanton, Charlotte
Barnes, John
Barr, Tim
Barr, Tim
Barron, Jack
Basham, Lonnah
Bass, Judi
Bates, Riannan
Bates, Stephen
Batton, Karal
Batton, Karal
Baughman, Kay
Bautista, Justin
Bax, Alise
Bay Bridge Texas, Shailesh Vyas
Bay, Alexis
Bayne, Dalmara
Bayside Marine, Inc, Ruben Fuentes
Bea, Linda
Bea, Linda
Beane, Debbie
Beay, William
Bechill, Debbie
Bedoli Group, Inc (All Star Metals), Nikhil Shah
Bee, Bea
Bee, Bea
Beemer, Sandra
Belisle, Mavis
Bell, David
Bell, Spencer
Benavidez, Alma Linda
Bendle, Shannon
Benedict, Catherine
Bennett, Jack
Bennett, Patricia
Benning, James
Benno, Georgine
Berg, Bill
Berger, Linda
Bergner, Christy
Bernache, Marie
Bernal, Adrion
Berry, Elizabeth
Berry, Ken
Berzon, Patricia
Best, Bill
Bethke, Linda
Betzmane, Lupita
Beverly, Robert
Bhandari, Ranjana
Bhandari, Ranjana
Bhatt, Ashvin
Biehl & Company, Mark Clive
Bieri, Sandra
Bigley, Kim
Bigwood, David

Bills, Robert
Bilokur-Tobias, Rebecca
Bilokur-Tobias, Rebecca M
Birdwell, Walter
Bishop Merrill, Dr Sarah
Bissett, Berenice & David
Bittle, Juanita
Biven, Donna
Black Dragon Pirate Ship & Thriller High Speed Boat
Black, Kimberly
Blackburn, Diane
Blackshear, Sherry
Blackwell, John
Blais, Darren
Blake, Frank
Blandford, Mark
Blanford, Julie
Blevins, Terri
Bliss, Cecelia
Blixt, Sally
Blount, James
Blount, Mary & Sammy
Bob's Bay Fishing
Bode's Bay Fishing
Bogorad, Geoff & Rossane
Boling, Blake
Bollinger, Jacqueline
Bond, Katherine
Bondy, Mamie
Bonilla-Leach, Yvette
Bonilla-Leach, Yvette
Bonner, Tracey
Boon, Royce
Boone, David
Boswell, Brian
Botts, Leslie
Boward, Karen
Bowden, Rose
Bowen, Paul
Bowling, Beth
Bowling, Deanna
Box, Ken
Bradford, Debra
Bramblett, Sharon
Branch, Keri
Brattin, Eric
Braun, Cecil
Braune, Linda
Bravo Motor Carriers, Luis Garza, Jr
Braxton, Angelika
Bray, Brent
Bray, Brent
Brazeau, Theodore
Breakfield, Sandra
Breaux, Misty
Brennecke, Don
Bresnehan, Rhonda
Brezall, Jennifer
Brian, James
Briggs Equipment Rental, Elizabeth Cantu
Brittain, Cindy
Brooks, Karl
Brooks, Patricia
Brooks, Pippa
Brophy, Tracy
Brown, Brandye
Brown, Kristen
Brown, Monika
Brown, Tracy
Browning, John
Browning, Rette
Brownsvile South Padre Island Board of Realtors, Larry Jokl
Brownsville Chamber of Commerce, Humphrey Thomas, Chair
Brownsville Gulfside Warehouse, Lee Ostos
Brownsville Historical Association
Brownsville Mooring, Rick Gomez
Brumby, Val
Brunson, Robert
Bryte, Klementyna
Buinger, Mary
Bulla, Dale
Burford, Marth

Burgoon, Larry
Burke, Stephen
Burkett, Winifred
Burks, Phyllis
Burnell Marine & Supply, Inc, Charles Burnell
Burnett, Billy
Burnett, Buena
Burns, Bill
Burns, Kathryn
Burns, Kathryn
Burson, Sandra
Burt, Susan
Burzinski, Cindy
Bush, Julie
Bustillos, Raul
Butterfield, Colleen
Butts, Jill
Byrd, Calvin
Byrd, Sandra
Byrne, Elaine
Byrne, Sean
C&J Logistical Services, Crispin Flores
C, Adam
Caceres, Herbert
Cadwalader, Wickersham & Taft LLC, Brett & Mark Snyder, Counsel to Annova LNG
Cain, Linda
Caldwell, Richard
Callahan, Jayne
Cameron County Historical Commission
Cameron, Jean
Campbell, David
Campbell, David
Campbell, JA
Canal Barge Company Inc
Canales, Susan
Canas, Nydia DL & Carlos
Cannata Nowell, Anita
Cannata Nowell, Anita
Cantrell, Lyndsay
Cantu, Elizabeth
Cantu, Pedro
Cantu, Roel
Captain Memo Corp, Manuel Fayett
Cardona, Sue & Gilbert
Cardoza, Blanca
Carey, Madalynn
Carnesi, Cody
Carpenter, John
Carpenter, Laurie
Carpenter, Robert
Carr, Karen
Carr, Michael
Carrion, Roxanne
Carrizo/Comecrudo Nation of Texas, Juan Mancias
Carter, Maria
Carter, S
Carter, S
Carver, Bob
Castaneda, Karen
Castellanos Corp, Marcos Hernandez
Castiglia, Denise
Castillo, Jesus
Castillo, Juan
Castillo, Sandra
Castro, Erica
Caton, Annie
Cavazos, Deborah
Cavazos, Flora
Cavazos, Vanessa
Ceballos, Samantha
Cedillo, Bernice
Celtic Marine Corporation
Cervantes, Marisol
Cervenka, Martha
Cervone, Katherine
Ceverra, Victoria
Chaffins, Sheila
Chamberlain, Clinton
Chamberlain, Jane
Chapa, Jose
Chavarria, Sr, Gus
Chavez, Geneva
Chavez, Gerardo

Chavez, J Franco
Chavez, Jr, Amado
Choi, Debbie
Christian, Linda
Ciarocco, Joan
Cimino, Maryrose
CITGO Petroleum Corporation, Charles Milstead
Clanton, LeAnne
Clark, John
Clark, Sherri
Clark, Stephen
Clayton, Alexander
Clayton, Tom
Cleland-Sipfle, Kate
Clements, Bonnie
Clements, Bonnie
Cloyd, Stephen
Cochran, Christina
Codina, Dr Edward
Coen, Leona
Cohen, Elaine
Coldwell, Sherilyn
Cole, Donna
Cole, Elena
Cole, Elena
Coleman, Diane
Collins, Kristi
Collins, Sarah
Comacho, Tomas & Petra
Commander, Lower Rio Grande Valley Sail and Power Squadron and Lower Laguna Madre Foundation, CG Rakestraw
Converse, Camille
Co-Op Marine Railways, LLC, Raul Garcia
Cooper, Gary
Copen, Terry
Cordova, Sergio
Cordova, Sergio
Coronado, Alejandro
Cortez Castro, Diana
Costales, Ann
Cottenoir, Denise
Cottle, Lawrence
Couch, Georgia
Courim, Stephen
Courtney, Carole
Courtney, Carole
Covington, Jace
Cowen, Karen
Cox, Jeralynn
Cox, Nonya
Cozad, Bren
Cozart, Erin
Crabtree, Corliss
Crabtree, Corliss
Craddock, Kathryn
Craig, Elizabeth
Craig, Mark
Cramer, Pat
Crandall, AnaLisa
Crane, Stuart
Crane, Stuart
Crosby, Debbie
Cross, Dave & Rita
Crunk, Jeff
Crutcher, Cindy
Cummings, Alyssa
Cunningham, Ian
Cunningham, Sarah
Cupit, Willy
Curren, Leslie
Curry, Marcia
Curtis, Connie
Curtis, Cynthia
Cushnie, Deborah
CVC Construction, Inc dba Welding Works International, Alfredo De la Fuente
Dabrowski, Alfred
Dahle, Kay
Dalmolin, Brigitte
Dalton, Carolyn
Daly, Chrissy
Dampeer, Karen
Dana, Sherry

Daniel B Hastings, Inc, Matthew Leyendecker
Daniels, Michael
Danna, David
Danny B Fishing Charters
Darr-Hall, Jamie
Dartez, Carroll
Dassing, Dwayne
Daves, Tom
Davidson, Dr David
Davidson, Kathryn
Davidson, Steve
Davila, Alfred
Davis, Danny
Davis, Michael
Davis, Shonna
Davis, Vicki
Davison, Pamela
Day, Joanne
Day, Linda
De Anda, Norma
De Angelis, Christine
de Jesus Mirquez, Diana & Maria
de la Pena, David
De La Rosa, Edlyn
De Lara, Celia
Dee, Wendy
Deep Six Diving
Deep South-Tex Terminal, LP, Fred Figueroa
Defenders of Wildlife, Jason Rylander, Senior Attorney
DeGroff, Dorinda
DeHaas, Lorraine
Del Campo, Francisco
Delaney, Janet
DeLavan, Mary Jo
DeLay, James
Delgado, Santos
Delossantos, Nicholas
DeMello, Cecelia
Demobio, Angely
Demoss, Aine
Densing, Lindsey
Denson, Tommie
Deslaurier, Toni
Devine, Jeanne
Deykes, Lowell
DeZelle, Jessica
Diaz, Fernandio
Dick, Marion
Dietz, Jennielee
Dietz, Leada
Dix Agency Brownsville, LP, Robert Ostos
Dix Shipping Company, Lee Ostos
Dixon, Amy
Dixon, Joyce
Dlc, Jill
Dobbs, Michael
DoD Siting Clearinghouse, Steve Sample
Dodaro, Raymond
Dodds, Kathrin
Doggett Heavy Machinery Service, Greta Daniels
Dolphin Docks
Don Nico Trawlers, Inc, Hilario Ordonez Pimienta
Dougherty, Janet
Drake, Monica
Draper, Mallory
Dredgeservice, LLC, Charlie Ange
Drescher, Sandra
Druke, Carmen
Dubois, Merir
Dubrick, Michael
Ducks Unlimited, William Hunter Schnabl
Duda, Tim
Duesterhoeft, Diane
Duesterhoeft, Diane
Duke, Deborah
Duker, Yvonne
Dunbar Hernandez, Cecilia
Duncan, Don
Duncan, Sylvia
Durrance, Joseph
Duval, Beth
Dwarka, Sandy
Dwarka, Sandy

E, Cheryl
Easterling, Anne
Eckert, Barbara
Eckes, Alexandrea
Edelman, Patti
Edelstein-Best, Julie
Effinger, Joaquin
Ehemann, Barbara
EIIxondo, Ignacio
Ekstrom, Nicole
Elder, Kenneth
Elkins, Helen
Emerson, Judith
Emshoff, Arthur
England, Ctney
English, Danie
Epstein, Kelly
Ersson, Melanie Ann
Escamille, JA
ESCO Marine Inc, Richard Jaross
Escobedo, Rubie
Eskew, Candyce
Esmaili, Abde
Espinoza, Margarita
Ethridge, Cole
Euler, Keith
Eustis, Scott
Eustis, Scott
Evans, Pamella
Evitt, Kinney
Exelon Business Services Company, LLC, Susan B Bergles, Assistant General Counsel
Faidley, Richard
Faile, Kay
Farenkopf, Nathan
Farr, Kathy
Farrokhi, Farideh
Faulkner, Anita
Favela, Jennifer
Fel Glo, Inc, Felipe Mendez
Fellows, Arthur
Ferchaud, Rick
Ferguson, Robert & Frieda
Ferguson, Tyler
Fisher, Lisa
Fite, Donald
Fitzpatrick, Dr Paul
Fivklkng, Sarsh
Fleeman, Paul
Fleming, Charis
Flesner, JoAnn
Fletcher, Barbara
Flores, Blanca & Jesus
Flores, Marilyn
Flores, RosaLinda
Flosi, Dr Alicen
Fly, Carol
Fonseca, Dr Vincent
Forbes, William
Foreign Trade Zone #62, Tony Rodriguez
Foreign Trade Zone Board
Foreman, Charles
Fossom, Karen
Foster, D
Foster, Halima
Foster, Kay
Foster, Lucy
Foster, Marguerite
Foster, Will
Fouche, Jan
Fovar, Marie
Fowler, Idell
Fowler, Rick
Frank, Sharon
Franklin, Mary
Frarnk, Lesta
Frazier, Lynda
Freeman, M
Freer, Judith
Frick, Patricia
Friedman, Diane
Friends of the Wildlife Corridor, Richard Ramke
Frost Bank, Patti Ayala
Fry, Kim

Fry, Pearl
Fuller, Aaron
Fullerton, Nancy
Fuqua, Chad
Fusinato, Robert
Fusinato, Robert
G&O Shrimp Co, Inc, Gerald Pockrus
G, Jacque
G., Jacque
Gallaway, Ann
Galvan, Viola
Gamez, Angie
Gamez, Laura
Ganger, Patricia
Garcia, A Hector
Garcia, Alex
Garcia, Ariana
Garcia, Belen
Garcia, Carlos
Garcia, Carlos
Garcia, Hector
Garcia, Juan Carlos
Garcia, Oscar
Garcia, Patrick
Garcia, Patty
Garcia, Raul dba Garcia Bookeeping, Raul Garcia
Garcia, Shirley
Garcia, Yuri
Garcia, Zeilha
Gard, Paul
Gardner, Robert
Garrett, Cecilia
Garrett, Sandra
Garrett, Yolanda
Garza, Cathy
Garza, Cathy
Garza, Cynthia
Garza, Denise
Garza, Maria
Garza, Silvia
Garza, Stefany
Garza, Tina
Garza-Birdwell, Yolanda
Gauna, Matt
Gauna, Matt
Geery, Susan
General Steamship Corporation, Ltd, Thomas Miller
Gianakos, Mary
Gibson, Jody
Gibson, Melanie
Gijsbers van Wijk, Helena
Gillespie, Sharon
Gillham, Patsy
Gilliand, Jeannine
Gimblet, JR
Givens, Vera
Gladys Porter Zoo, Dr Patrick Burchfield
Glenberg, Laurel
GloriaJr, Jesus
Gluntz, Carol
Goette, Edna
Goetz, Shane
Goff, Gayle
Gomez, Belda
Gomez, Benjamin
Gomez, Cynthia
Gomez, Jr, Albert
Gonzales, Patricia
Gonzales, Toni
Gonzalez Garcia, Thania
Gonzalez Trawlers, Inc, Jorge Gonzalez, Jr
Gonzalez, Christina
Gonzalez, Elke
Gonzalez, Eva
Gonzalez, Jaime
Gonzalez, Jaul
Gonzalez, Jazmin
Gonzalez, Mary
Gonzalez, Mary
Gonzalez, Nohemi
Gonzalez, Nohemi
Gonzalez, Rebecca
Gonzalez, Ronando
Goodman, Mark

Goodman, Mark
Goodwin, Jodi
Goodykoontz, Deborah
Gordon, Rick
Goss, Patsy
Gossett, Glenn
Graham, Jim
Graul, Kara
Green, Darcy
Green, Earl
Greene, Susan
Gregory, Zulma
Griffin, Terence
Griffith, Gloria
Griffith, Virginia
Grimaldo, Mary
Groshardt, Joanne
Gross, Emily
Guajardo, Caroline
Guajardo, Hector
Guaraldi, Thomas
Guerra, Lydia
Guffey, Carol
Guh, H
Guitron, Luis
Gulf Facilities, Ken & Nico Schaefer
Gulf Stream Marine, Mark Hoskins
Gunnerson, Denny
Gutierrez, Maximillian
H Sáenz, Jr Inc, Beto Saenz
Haber, Arnold
Hadovsky, Linda
Hagaman, Celeste
Hahn, Todd
Hailey, Keith
Hall, Donna
Hall, Phyllis
Hallen, Vikki
Hamilton, Joyce
Hamilton, Joyce
Hancock, Tommy
Hands, Frank
Hanley, Katherine
Hanratty, Linda
Hansen, Dr Yvonne
Hansen, Edd, Yvonne
Happytide Charters
Hardin, Andrew
Hargrave, Charles
Haro, Osbert
Harp, Edith
Harrington, Rita
Harris, Rhonda
Harris, Shirlene
Harris, Shirlene
Harrison, Karon
Harrison, Michael
Harrison, Wayne
Hartford, Jeffrey
Hartwell, Edward
Hawke, Kimberly
Hawks, E Diana
Head, Jonathan
Head, Jonathan
Heare, Lorna
Heath, William
Heggen, Sandra
Heifner, Mary
Heig, Lauren & Greg
Heino, Ruth
Held, Herbert
Helton, Jeff
Henderson, Marian
Hendricks, Diane
Hendrix, Laura
Hendrix, Sunshyne
Hennen, Michael
Henning, Marcus
Herbert, Jacqueline
Hermann, Marianne
Hernandez, Brenda
Hernandez, Cynthia
Hernandez, Denise
Hernandez, Emily

Hernandez, Jesus
Hernandez, Leticia
Hernandez-Barron, Brenda
Herrera, Jennifer
Herrera, Yesenia
Herrington, Paula
Herting, Joshua
Herzing, Suzanne
Hewes, William
Hibbitts, Edna
Hickey, James
Hights, Sharyn
Hill, Jim
Hill, Toni
Hilliard, Kenneth
Hime, Vickie
Hindley, Bradford
Hinojosa, Maria Antonia
Hlad, Greg
Hockaday, Mabel
Hoenes, Bill
Hoggatt, Denice
Hogle, Harriett
Hohl, Sharon
Holcomb, James
Holder, Matthew
Holguin, George
Holguin, Mary
Holler, Stephen
Holleschau, Karen
Holleschau, Karen & Leigh
Hollman, Mary & Larry
Holtz, Steve
Holtzman, Larry & Susan
Homer, Michael
Honel, Michael
Hood, Dell
Hood, Gayle
Hook, Misty
Hopkins, Davi
Horton, Kevin
Houlik-Ritchey, Emily
Houlik-Ritchey, Emily
Houston, Tamara
Howell, Laurie
Hradsky, Susan
Hradsky, Susan
Hughes, Ginger
Hughes, Ken
Hughes, Lisa
Hughes, Teran
Hutchings, Lee
Ibarra, Griselda & Saul
Ibert, Denne
Inglis, Adrienne
Ingraham, E
Ingraham, E
Ingram Barge Line
Inman, Robert
Inspectorate
International Income Tax Service, LLC, Elmer Shull
International Shipbreaking, Ltd, Robert Berry
Inter-Transfer,-TRIMAC INC
Ireland, Ellen
Iron Mike Marine, Inc, Randy Chambers
Irvine, Charles
Island Outfitters
ISS Marine Services, Inc dba Inchcape Shipping Services, Glenn Foster
Jacquemotte, Diane
Jacques, Sally
Jakubik, Paul
James, Deborah
James, Deborah
James, Suzanne
James, Suzanne
Janavaris, Jimmy
Janick, Lori
Janis, Bertha
Jaramillo, Jose Raul & Johanna
Jatinen, Jane
Jaudzemis, Kathleen
Jaudzemis, Kathleen
Jeffery, Katheryn

Jenkins, Janell
Jenney, Lida
Jevric, Virginia
Jimenez, Citlally
Jimenez, Michelle
Jimenez, Odilia
Johnson, Bernie
Johnson, Joanne
Johnson, Kenneth
Johnson, Lilli
Johnson, Matthew
Johnson, Patrice
Johnson, Preciosa
Johnson, Shane
Johnson, Shannon
Johnson, Sheilla
Johnson, Vivian
Johnston, Elise
Jolly, Karen
Jolly, Karen
Jones, Anne
Jones, Cecil
Jones, Julie
Jones, Linda
Jones, Mitzi
Jones, Nancy
Jones, Patricia
Jones, Patricia
Jones, Patricia
Jonick Lopez International Transport & Warehouse, Sergio Lopez
Jordan, Mel
Jordan, Perry & Michael
Jorgensen, Julia
Jozwiak, Mary
Juan's Electric, Juan Delgadillo
Judd, Susanne
Junkin, Douglas
Justice, Bruce
Kane, Jay
Kantola, Barbara
Kantola, Barbara
Kasper, Tanya
Kasper, Tanya
Katzen, Ellen
Kaufman, Stephanie
Kaushik, Nagender
Kavanagh, Dr Kate
Kavanaugh, Michael
Kay, Cheryl
Kelcher, Patricia
Keller, Dr John
Kern, Edward
Kerstetter-Kennedy, Tina
Kessler, Marjorie
King, Christen
King, Judy
Kirby Inland Corp
Kirkpatrick, Gabriel
Klein, James
Kline, Kristen
Knight, Mavis
Knox, Richard
Kobler, Linda
Kohn, Ethan
Kolenovsky, Jay
Konicek, Linda
Korab, Lela
Koreski, Patti
Kotch, Brant
Kresha, Matthew
Kring, Juli
Krog, Karen
Krone, Robert
Kruse, Teresa
Kuretza, Monica
Kvapil, Samara
L, Martha
Lagrone, Amy
Laguna Sailing Charters
Lamberty, Jean
Lamons, Kristina
Lancaster, Stephen
Landfield, Kathleen

Landfield, Kathleen
Landro, Inc dba S T Marine, Leonel Alejandro
Landry, Don
Lane, Pat
Lane, Sandra
Lane, Veva
Lane, Veva
Lang, Jeffry
Langford, Jeanette
Langley, Wayne
Langston, John
Lankton, Jackie
Lansdale, Joe & Karen
Lansdale, Karen
Lara, Bethany
Lara, H Javier
Lara, Stephanie
Lardy, Cheryl
Lareau, Patricia
Larsen, Ken
Latigo, Lauren
Lauritsen, Nancy
Law, Susan
Lawrence, Claire
Lawrence, Claire
Lawrence, Georgia
Lawrence, Jaen
Lawrence, Katherine
Lawrence, Preston
Lazell, Dr. James
Lazell, James
Leach, Stephen
Leal, Alma
Leal, Fidencio
Leal-McBride, Odilia
Leatherman Van Praag, Jane
Leaverton, David
Lee, Bill
Lee, Dr Tom
Leerssen, Taryn
Lees, Jackie
Leggon, Janette
Lehr, Karen
Leidner, Tammie
Leidner, Tammie
Lema, Roxann
Lemon, Kerry
Lents, Carla
Lewis, Alexander
Lewis, Beth & James
Lewis, Remmic
Lewis, Trey
Lewis, Weldon
Lewis, Weldon
Libby, Aida
Lienhard, Pamela
Lienhard, Pamela
Liles, Benjamin
Limberg, Kim
Limberg, Kim
Lin, Dr Judy
Lin, Stella
Linda Lou Boat Corporation, Jack Waller
Lindley, Kenton
Lindqvist, Dr Annika
Lindsey, Anne
Lininger, Steve
Linwood Trawlers, Inc c/o Raul Garcia, Dolby Linwood
Lionetti, Marc
Lira, Kelsey
Liu, Sue
Livingston, Catherine
Llanes, Daniel
Llatona, Kay
Lloyd, Jeanne
Lobdill, Jerry
Lock, Dat
Locke, Stephen
Loe, Lee
Loera Customs Brokerage, Minerva Loera
Logan, T
Logan, T.
Lohse, Hunter

Lone Star Chapter Sierra Club, Reggie James, Interim Chapter Director
Lone Star Charters
Long Island Village Board of Directors, Ed McBride
Long, Cheri
Long, Kay
Longoria, B Celeste
Looney Kochie, Lois
Lopez, Alicia
Lopez, Elizabeth
Lopez, Gilberto
Lopez, Gilberto
Lopez, Lourdes
Lopez, Marco
Lopez, Randy
Lopez, Stephanie
Lorenz, Marilyn & Chuck
Lothe, Richard & Dorothy
Loveless, Philip
Lovett, Susan
Lowe, James
Lower Rio Grand Group Sierra Club, Jim Chapman
Lucas, Sherry
Lucio, Jr, Eddie
Lucio, Richard
Lucko-Powell, Lisa
Ludwig, Jack
Luke, Tawnya
Luna, Epuardi
Luna, Monica Lee
Lupori, Stacy
M&M Mooring Services, Mark Clive
M, J
M/V Challenge 42, Inc, Raul Cervantes
Macfarlane, Jane
Macias, Michael
MacKinnon, Bonnie Lynn
Maddem, Richard
Madden, Jensie
Madole, Richard
Madrigal, Julie
Maguire, Cynthia
Maher, Javad
Mahoney, Ruth Ann
Mahoney, Ruth Ann
Mains, Robin
Mane, Cathy
Mannchen, Brandt
Mannchen, Brandt
Maquilogistics, Carlos Ruiz
Marcum, Gina
Marcum, Gina
Mares, Alfred
Margos, Carol
Marhoun, Donna
Maria Elena, Inc, Seth Sanders
Marine & Industrial Safety, Yolanda Linarte
Marine Metal, Omar Perez
Marine Railway, Inc, Greg Londrie
Marine Refrigeration Co, Andrew Jurek
Marine Salvage & Services, Inc, Billy Kenon
Marolt, Carla
Marone, Susan
Mars, Elaine
Marshall, Rebecca
Martec Leasing LLC, Ania Mierzejewska
Martin Gas Marine
Martin, Barbara
Martin, Gregory
Martin, Patricia
Martin, Sonia
Martines, Elora
Martinez Tijerina, Kathryn
Martinez, Adriana
Martinez, Hector
Martinez, Janie
Martinez, Lourdes
Martinez, Martha
Martinez, Rosario
Maschal, Tim
Mason, Caitlin
Mason, Susan
Massa, Ayn
Matcek, Vicki

Matejek, Ann
Mathes, Ann
Matheson, Neill
Mathis, Jesse
Matlock, Benjamin
Matlock, Benjamin
Matlock, Teresa
Matteson, James
Matusoff, Cathy
Maua, Marisela
Maverick Terminals Brownsville, LLC, Canevari Castan
May, Michele
Maycotte, Ernesto
Mayfield, Joan
Mayfield, Maureen
Mayo, Judy
Mays, Frieda
Mcbrayer, Kay
McBrayer, Kay
McBride, Debbie
McBride, Ed
McCall, Kaye
McCollam, Clare
McCormick, Jana
McCradic, Anthony
McDonald, Mary
McDonald, Mary
McDowell, Clionton
McElroy, Jim
McEnany, Judy
McEwen, Bruce
McFall, Cynthia
McGaffey, Barbara
McGowen, Mary
McIntosh, Malva
McIntyre, Kellen
McKee, George
McKee, Jim
McKinney, William
McLean, Janyce
McLish, Rachel
McMahan, Lindsey
McMahon, Marci
McManis, Katrin
McManus, Clyde
McMillan, Joy
McMurtrey, Michael
McNeese, Amanda
McQueen, Jim
McRaynolds, Cindy
McReynolds, Allen
McVean, Nancy
Mead, Barbara
Medrano, Dalila & Ana
Meeks, Dana
Mehis, Jim
Meinerding, Doris
Mejia, Felipe
Mendez, Jennifer
Mendieta, Vince
Mendoza, Alma
Mercedes City Commission, Howard Wade
Merrill, Rebecca
Merrill, Trish
Merz, Evelyn
Merzbacher, Mary
Meyer, La Vina Jo
Meyers, Mickey
Meyerson, Jeff
Meza, Alex
Meza, Miguel
Michuda, Bianca
Michuda, Bianca
Mick, Robert
Milam, Tim
Milazzo, Julia
Miles, Toni
Millard, Ann
Miller, Jesse
Miller, John
Miller, Keena
Miller, Pamela
Miller, Rebecca

Millsap, Lisa
Milo, James
Miloy, Tyler
Mireles, Danielle
Misak, Kevin
Miss Anid, Inc, Manuel Sanchez
Mitchell, Connie
Mitchell, Crystal
Mock, T Randall
Moga, Hugo
Monahan, Michael
Monita, Inc c/o Garcia Bookkeeping, Benjamin Lopez
Monroe, Kim
Montag, Alexander
Montag, Alexander
Montalvo, Cecilia
Montapert, Anthony
Montgomery, Dot
Montgomery, Michael & Linda
Moore Diesel Service, Wenn Moore
Moore, Ellen
Moore, Geroge
Moore, Jr, Joseph
Moore, Linda
Moore, Linda
Moore, Norma
Moore, Pauline
Mora, Thomas
Mora, Val
Mora, Val
Morales, Armando
Morales, Dulce
Morales, Joel
Moravek, Martha & Joe
Morgan, Claudia
Morgan, Matt
Morgenstern, Bill
Morlock, Juan
Morris, Joyce
Moses, Sylvette
Mosher, Haraold
Mouledous, Laurey
Mueller, Ken
Mullens, Troy
Mullican, Mack
Munez, Amanda
Munroe, Laura
Murphy, Michael
Murua, Aimee
Muscara, Joe
Muse, Dyan
Museum of South Texas History
Musgrove, Keith
Musgrove, Keith and Tracy
Myers, Dixie
Myers, Donald
N, Carter
N, M
Nash, Carol
National Seafoods, Inc, William Kenon
Nazor, Craig
Nazor, Craig
Neinast, Thomas
Newfeld, David
Newfield, Myra
Newman, Dr Janet
Newman, Kathy
Nichols, Carol
Nichols, Douglas
Nickerson, Judith
Nicks, Carol
Nicol, Deborah
Nicol, Eliya Zay
Nicol, Scott
Nieland, Tom
Nitishin, Lawrence
Nolan, Sylvia
Norberto Perez, CPA, PC, Norberto Perez
Norrell, Marie
Norrell, Marie
Northrop, Emily
Norton, Karen
Norton, Karen
Noy, Nick

Obek, Anna
Obrien, Gina
Ocean Port Maintenance, Inc, Jorge Gonzalez, Jr
Oceanus Intl, Thomas Hayden
Ochoa, Marcelino, Marcelino Ochoa
Ockerman, Leslie
O'Connor, Angelita
Odear, Elizabeth
Oil Patch Fuel & Supply, Inc, Carl Gayman
Okulewicz, Kathy
Okwumabua, Verena
Okwumabua, Verena
Olguin, Martin
Olguin, Martin
Olivarez, Cristela
Olivarez, Gilbert
Oliveira, Rene
Olschesky, Karyn
Olson, Charles
O'Malley, Lorelei
One Cypress Terminals, Inc, Mike McCann
O'Neal, Nancy
O'Neil, Carol
O'Neill, Catherine
Oppenheim, Jenniferr
O'Quinn, Blake
Orloff, Michael
Orr, Carla
Ortega, Nora
Ortega, Vanessa
Osborne, Suzanne
Osprey Cruises
Otken, Marilyn
Owen, Daina
Owen, Robert
Pace, Edgar & Cinda
Pacheco, Leonor
Packard, Karen
Padgett, Robyn
Padier, James
Pagan, Leslie
Palder, Evelyn
Pallana, Ranjana
Palmer, Saralie
Pantel, Jesus
Paquette, Cynthia
Paragraphs On Padre Blvd, J Montover
Paredes, Myra
Paredes, Myra
Parker & Company, Abel Medina
Parker & Company, David Dubois
Parker & Company, Steve Muschenheim
Parker, Delores
Parker, Jr, Frank
Parker, Marilyn
Parrot Eyes Fishing Charters
Parsons, James
Pasztor, Patricia
Patch, Frances
Patrick, Duane
Patteson, Patricia
Patton, Audrey
Paukman, Joseph
Paul, Jeff
Pauler, Donna
Pauwels, Anita
Peace, Annalisa
Peace, Tom
Pearson, Rick
Peck, Terry
Pena, Deanna
Peniche, Lori
Penmar Systems, Inc, Kay Krapf
Pennington, Carol
Perez, Betty
Perez, Caryn
Perkins, Joel
Perkins, Mitzi
Perkins, Mitzi
Perry, Ed
Perry, Joy
Perry, Kathleen
Perry, Robert
Pesaresi, Martin

Pesaresi, Martin
Peters, Lisa
Petrarca, John
Pettit, Jean & Douglas
Petty, Christine
Petty, Jospeh
Pfeiffer, Karen
Pfost, Tom
Philip T Cowen
Phillips, Pamela
Pierce, Kristen
Piersol, Laurel
Piper, Laurie
Pittman, Casey
Pizana, Jr, Jesse
Plitt Leasing Co, Ltd, Walter Plitt
Pollo's Diesel/Mota's Refrigeration, Ramon Ortega
Ponce, Daniel
Ponder, Dr Fred
Ponder, Misty
Port Isabel Chamber of Commercee, Chair
Port Isabel Historical Museum
Port Restaurant, Luis Ricardo Cortinas
Porter, Emory
Power, Laurel
Poynter, Mark
Poythress, Marianne
Prado, Issac
Pratt, Byron
Preservation Texas
Pressgrove, Cheryl
Prevost, Jennifer
Prevott, Ray
Pride, Mark
Purata Trawlers, Inc, Pedro Purata
Purdy, Patrick
Putman, Holly
Putnam, Gary
Quality Weighing Services
Quenan, Joan
Quezada, Francisco
Quigley, Erin
Rabb, Sharon
Race, Margery
Rahbar, Asad
Ramirez, David
Ramos, Andres
Ramos, Jannette
Ramos, Richard
Ramsey, Liz
Randall, Victoria
Raul Garcia Bookkeeping, Jorge Gonzalez
Rausch, Carol
Rausch, Carol
Rausch, Carol
Ray Wolf Commercial Diving Incorporated
Ray, Yvonne
Raymond, Norma
Reardon, Julie
Recio, Marsie
Reece, Ray
Reed, Dawn
Reed, Jane
Reedy, Boyd
Reeves, Angie
Regnier, Sharynn
Reichel, Rhonda
Reid, Nelda
Reinhardt, Jason
Reising, Brian
Rental World, Robert Suarez
Reves, Mickey
Revord, Michael
Reyes Marine Industries, Inc, Carlton Reyes
Reyes, James
Reyes, Lonnie
Reyes, Samantha
Reynolds, Kaileen
Reynolds, Kenneth & Sharon
Reynolds, Linda
Reynolds, Tabitha
RGV Hispanic Chamber of Commerce, Cynthia Sakulenzki
Rhein, Herman

Rice, Wanda
Rich, Donna
Richard, Karen
Richards, Gary
Richert, Barbara
Richey, Robert
Richter, Dwight
Richter, Richard
Riddle, Rick
Riebeling, Andrea
Riker, Holly
Riley, Dr Steven
Rivas, Bianca
RM Walsdorf, Inc, RM Walsdorf
Roark, Dan
Roberts, Lyn
Roberts, Lyn
Roberts, Mark
Roberts, Peggy
Robertson, Kathleen
Robinson, Dennis
Robinson, Donald
Robinson, Staci
Roca Construction Co, Ricardo Roca, Sr
Roche, Jose
Rodco Marine Supply, Inc, Juan Rodriguez
Rodriguez, Bonnie & Ernie
Rodriguez, Cesar
Rodriguez, Daniel
Rodriguez, Priscilla
Rogers, Dirk
Rogers, Joe
Rogers, Judith
Rogers, Robert
Rohrbach, Terry
Rohwedder, Caroline
Romano, Denise
Romo, Jacqueline
Rooney, John
Rosas, Jorge
Rose, Mary Sue
Roser & Cowen Logistical Service, Danny Lopez
Roser & Cowen Logistical Service, Neto Roser
Roser Customs Service, Inc, Rico Roser
Rosevelt, Ken & Linda
Ross, Bruce
Ross, Nancy
Roy, Randy
RSC Equipment Rental, Chris Lowery
RTW Properties, LP, Bill Mallory
Ruffin, Claire
Ruiz, Chris
Ruiz, Severo
Runnells, Kathryn
Russell, Catherine
Russo, Melissa
Rust, Tom
Rutherford, Cyndi
S, Maria
Sabin, Sandra
Sada, Holly
Saenz, Jamaila
Saenz, Jesse
Saenz, Norma
Salamon, Mark
Salas, Alexa
Saldivar, Teresa
Salinas, Jason
Salinas, Kenneth
Sanchez, Carroll
Sanchez, Elaine
Sanchez, III, Andres
Sanchez, Manuel
Sanchez, Saul
Sanchez, Seraluna
Sanchez, Seraluna
Sandall, Karen
Sandefar, Madeleine
Sandel, Morris
Sanders George, Kim
Sands Cleary, Susan
Sardina, Evelyn
Sardina, Evelyn
Sargeant, Sandra

Sariol, Teresa
Saucedo, Jess
Savage, Lois
Saxon, Rich
Sayles, Katherine
Schaefer Stevedoring, Ken Schaefer
Schafer, Sharon
Schatz, Monica
Schill, Brian
Schleicher, Dorothy
Schlie, Darilynn
Schmidt, Charles
Schmidt, Mary
Schmidt, Melinda
Schmoker, Henry
Schniederjan, Patricia
Schoech, Dr D
Schroeder, Black
Schroeder, Briana
Schroeder, Kristen
Schultz, Mary
Schwarz, Carol
Sciarrillo, Loisann
Scott, Bennie
Scott, Dorinda
Scott, K
Scott, Leticia
Scott, Millard
Sea Breeze Marine, Inc c/o Raul Garcia, Juan Gaona
Sea Kirk, Inc d/b/a La Manana, Fred Feurtado
Sea Ranch Marina
Sea Turtle, Inc, Shane Wilson
Sears, Brenda
Sebesta, Emilie
Seff, Joshua
Seibert, Roxanne
Seifert, James
Seifert, Mike
Sells, Greg
Serna, Arnoldo
Serna, Joyce
Shade, Grover
Shaffer, Tria
Shannon, Brooke
Sheats, Ned
Shelburne, GB
Shelton, Johnna
Shenberger, Ronald
Shephard, Phil
Sheppard, Andy
Shippee, Bob
Shivers, Shelly
Shrier, Donald
Shuff, Janet
Shuff, Janet
Shumate, Gayle
Shurgot, Joseph
Sieve, Elizabeth
Signet Maritime Corporation, Ida Treviño
Sikes, Eddie
Silguero, Lisa
Silva, Irma
Simmer, Doug
Simmer, Doug
Simpson, Jacquelynn
Simpson, Sally
Sivley, Steve
Skillman, Gloria
Skillman, Gloria
Smith, David
Smith, E Neil
Smith, Horace
Smith, Jeannie
Smith, Kate
Smith, LA
Smith, Lawrence
Smith, Leslie
Smith, Shirley
Smith, Thomas & Lisa
Snell, Jade
Snodgrass, Inc, Sam Snodgrass
Snook, Helen
Snook, Helen
Snyder, Gary

Soles, Thad
Solis, Mare
Sollis, Al
South Padre Island Chamber of Commerce, Roxanne Guenzel
South Padre Island Watersports
Southern Wave
Southwell, Dolly
Southwestern Motor Transport, Inc
Sparks, Mary
Speers, Susan
Spencer, David
Spencer, Larry
SPI Fish Killer Tours
Spoon, Cindy
Spottswood, Dana
Spradlin, Michael
Sprecher, Donyce
Springfield, Juanita
Squires, Emma
St Clair, Laura
St Louis, Al
Stahl, Dennis
Stclair, Laura
Stedman, Dr Deborah
Steele, Art
Stein, Terry
Stephens, Gary
Stewart, Donna
Stewart, Sharron
Stierlen, Lorelei
Stippec, Rudy & Barbara
Stippec, Rudy and Barbara
StLouis, Al
Stoddart, Jacque & John
Stofan, Sandra
Stoker, Stephen
Stolt Transportation Services
Stone, Lisa
Stoughton, Romlee
Streb, Sandra
Strong, William
Stuart, Peter
Suarez, Mariu
Suarez, Pat
Subsea 7, Stuart Redpath
Suissa, David
Sularz, Michael
Sullivan, Karen
Summers, Daniel
Summers, Susan
Sunbelt Transport, Inc
Surfrider Foundation South Texas Chapter, Rob Nixon
Sustaita, Matthew
Swarts, Hilary
Swiatkowski, Ray
Swolinski, Susan
T Parker Host Gulf, Inc, Randy Tate
Tamez, Emilio
Taque, Heather
Tashnick, Walter
Tatum, Margaret
Tave, Jeff
Taylor, K
Teague, Susan & John
Teeter, Keith
Tejas Equipment Rental, Esteban Lozano
Telfair, II, Ray
Tellez, Michelle
Templet, Mel
Terrier Transportation, Mary Rivera
Tetra Tech, John Crookston, Deputy Project Manager
Tetra Tech, John Scott, Project Manager
Texas Gold Shrimp Tour
Texas Guld Trawling
Texas Shrimp Association, Andrea Hance
Texas Southmost College, Lily Tercero, PhD, President
Texas Sportfish
Texas State Technical College, Stella Garcia, Interim President
Tharp, Brett
Thaxter, John
The Los Fresnos Area Chamber of Commerce, Val Champion, Executive Director

The Original Dolphin Watch
Theroux, Maureen
Thomas, Gary
Thomas, Heather Joy
Thomas, Randy
Thompson, Dean
Tillman, Henry
Tischer, Jennifer
Tobias, Carol & Frank
Tobin, Ralph
Todd, David
Tomlinson, Barbara
Tomlinson, Barbara
Torres, Elias
Torres, John-Michael
Torres, Lore Maris
Torres, Mafalda
Torres, Maria
Torres, Yolanda
Torrey, Julie
Towns, Anna
Trahn, Margaret
Trammell, Rebecca
TRANSMONTAIGNE Operating Co, Kevin Garcia
Travis, Donna Mae
Triggs, Mark
Triplett-Wilkerson, Michelle
Troxell, Shawn
Troxell, Shawn
Truesdell, Carolyn
Tuch,
Tupper, Mary
Turner, Jessica
Tute, Gary
Two Fishing Friends, Inc, Emigdio Cruz
Tyma, Ellen
Underwood, Ralph
Unruh, Dawn
US Offshore, Inc, Robert Berry
Usrey, Tara
V, Ernesto
Valdez, Denise
Valdez, Lellani & Felix
Valdez, Nadia
Valerio, Avely
Valero Brownsville Terminal, LLC, James Stegall
Valle Hernandez, Jose Antonio
Valle, Beymalda
Vallejo, Juliet & Sandra
Valley Lubricants, Inc, David Eymard
Valley Trucking Company
Vallie, Margaret
van Dalert, Marinda
Van Dellen, Adrian
van Dijik, Marie
Van Haaften, Rene
Van Leekwijck, Natalie
Vandel, Diana
Vanderslice, Tiffany
vanWert, Jane
Vanya, Rene
Vanya, Rene
Varljen, Anne
Vassilakidis, Pat
Vazquez, Jessika
Veit, Barbara
Vela, Erica
Vela, Fabian
Vela, Luanne
Velez, Jill
Veltman, Beverly
Venmar Shrimp, Inc, Jose Manuel Aponte
Vera, Irma
Verbeke, Betty
Verein, Vejeya
Villarreal, Christina
Villarreal, Eloisa
Vincentnathan, Lynn
Vise, Pamela
Volkerts, James
Volunteer Barge & Transport, Inc
Volz, Mary
Vulcan Construction Materials, LP, David Farrar
W, Alex

Waggoner, Hope
Wagner, Hunter
Wagner, Kimberly
Wagner, Kimberly
Wagner, Ruth
Wagner, Stephanie
Waits, Mark
Waldorf, Kimberly & Robert
Walker, Lynda
Walker, Tatjana
Wallace, Cathy
Wallace, Leigh Ann
Wallace, Mollie
Walton, JD
Ward, Dr Ralph
Ward, Harrison
Ward, Whitney
Warfield, Benjamin
Watenpool, Chris
Watt, Michael
Way, Susie
Wayte, Marilyn
Weathers, Theresa
Weathers, Theresa
Weathersbee, Jim
Weaver, Cheyenne
Weaver, Mary
Webb, Shirley
Weber, Regina
Weber, Regina
Webster, Dr Michael
Weedman, Shawn
Wehberg, Shelley
Weiss, Ronnie
Welch, Mary
Welch, Shane
Wells, Charlotte
Wengler, Doris
Werchan, Meranne
Westermann, William
Wetmore, Larry
Wetmore, Larry
Wharton, Becky
Wharton, Becky
Whistler, Marley
Whitaker, Penny
White, Sue
White, Susan
Whitener, Barbara
Whitten, Darice
Whitwell, Giselle
Whitwell, Giselle
Wierenga, Lucinda
Wierenga, Lucinda
Wiggins, James
Wigle, Jean
Wilcox, Mary
Wildfong, William
Wilkinson, Quinta
Wilkinson, Quinta
Willbourn, Summer
Williams, Charlene
Williams, James
Williams, Maria
Williams, Norman
Williams, Sabine
Williams, Susan
Williams, Terrie
Williams, Tracy
Williams, Troy
Williamson, Cynthia
Williamson, Mary
Willing, Rick
Willis, John
Willis, Kimberly
Willmann, M'Liss
Willoby, Randolph
Wills, Deb
Wilson, Grant
Wilson, John
Wilson, Judith
Wilson, Nancy
Wimberly, Siena
Wimmer, Martin

Windham, Dallas
Windsor, Lucinda
Wing, Byron
Winnette, Laurie
Winsett, Bettie
Winstead, Annie
Wisdom, Ami
Witte, Mark
Wolfe Sandbalsting & Industrial Painting, Don Wolfe
Wong, Victor
Wood, Shelva
Woodall, Sandra
Woolverton, David
Wordlaw, Christine
Worthington, Geoge
Wren, Rebecca
Wyche, Paula
Wyrick, Brenda
Yado, Sissi
Yancey, Donald
Yarber, John
You, Sam
Youker, Katy
Youker, Rob
Young, John
Young, Ron
Youngblood, Taylor
Younger, Patricia
Yu, Christian
Zaloski, Shari
Zamarripa, Mary Jane
Zamarron, Michelle
Zambie, David
Zamora, Bertha
Zamora, Cecilia
Zamora, Rita
Zappone, MaryJo
Zarrinnam, Shirin
Zavala, Alfonso
Zavala, Rafael
Zeigler, John
Zetley, Herb
Zwarun, Andrew
Zwarun, Andrew

APPENDIX B
ANNOVA'S PLAN AND PROCEDURES

Upland Erosion Control, Revegetation, and Maintenance Plan

Client: Annova LNG, LLC.

Project: Annova LNG Brownsville

Location: Brownsville, Texas

Document Number: 183169-REFF-0036

Black & Veatch Project Number: 183169

Annova Project Number: 0001

File No. 30.0000

Rev	Revision Description	DATE	BY	CHK'D	APP'D
A	Issued for Initial Review (DRAFT)	8/03/2015	MMS	PWS	DMW
B	Revised for Final RR1	4/22/2016	MMS		DMW
C	Revised to incorporate the FERC 10/20/2016 Comments	10/31/2016	MMS		DMW

1.0 APPLICABILITY

A. This Plan identifies baseline mitigation measures for minimizing erosion and enhancing revegetation. Annova LNG, LLC (Annova LNG), the Project sponsor, have made this plan project-specific as part of the Brownsville Project (Project) Federal Energy Regulatory Commission (FERC) Natural Gas Act (NGA) Section 3 certification process. This Plan applies to the Project site and temporary work space areas as approved by the FERC.

The Project is a mid-scale liquefied natural gas (LNG) export terminal located on the southern bank of Brownsville Ship Channel, approximately 8.2 miles upstream from the channel mouth at Brazos Santiago Pass. Annova LNG will have long-term use of approximately 731 acres to construct and operate the 6.0 million metric tons per annum (mtpa) LNG facility. The natural gas delivered to the site via the feed gas pipeline will be treated, liquefied, and stored on site in two single-containment LNG storage tanks, each with a net capacity of approximately 42.3 million gallons (160,000 cubic meters [m^3]). The LNG will be loaded onto LNG carriers for export.

The coordinates of the site center are:
26° 00’ 20.09” N/longitude -97° 16’ 02.70” W.

Non-jurisdictional facilities that may be constructed and operated by third parties (i.e., gas and water pipelines; electric and telecommunication lines) are not addressed in this Plan.

If the Project is authorized, variances to the measures in this Plan will be submitted to the Director of the Office of Energy Projects (Director). The Director will consider approval of the variances if the Director agrees that a ~~varianceOnce variances to the measures in this Plan will be submitted to the Director of the Office of Energy Projects (Director). Approval by the Director is expected, assuming the Director agrees the variance~~:

1. provides equal or better environmental protection;

2. is necessary because a portion of this Plan is infeasible or unworkable based on project-specific conditions; or

3. is specifically required in writing by another federal, state, or Native American land management agency for the portion of the project on its land or under its jurisdiction.

Project-related impacts on wetland and waterbody systems are addressed in the Project Wetland and Waterbody Construction and Mitigation Procedures (Procedures).

2.0 SUPERVISION AND INSPECTION

2.1. ENVIRONMENTAL INSPECTION

1. The number and experience of Environmental Inspectors and monitors assigned to the construction site will be appropriate for the number/significance of resources affected.

2. Environmental Inspectors will have peer status with all other activity inspectors.

3. Environmental Inspectors will have the authority to stop activities that violate the environmental conditions of the FERC's Orders, stipulations of other environmental permits or approvals, or landowner easement agreements; and to order appropriate corrective action.

2.2. RESPONSIBILITIES OF ENVIRONMENTAL INSPECTORS

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

1. Inspecting construction activities for compliance with the requirements of this Plan, the Procedures, the environmental conditions of the FERC's Orders, the mitigation measures proposed by Annova LNG (as approved and/or modified by the Order), other environmental permits and approvals, and environmental requirements in landowner lease/easement agreements.

2. Identifying, documenting, and overseeing corrective actions, as necessary to bring an activity back into compliance;

3. Verifying that the limits of authorized construction work areas and locations of access roads associated with the Project are visibly marked before clearing, and maintained throughout construction;

4. Verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements in the construction work area;

5. Identifying erosion/sediment control and soil stabilization needs in all areas;

6. Ensuring that the installation of slope breakers will not cause erosion or direct water into sensitive environmental resource areas, including cultural resource sites, wetlands, waterbodies, and sensitive species habitats;

7. 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, cultural resource sites, 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;

8. Test subsoil and topsoil as appropriate to measure compaction, and determine the need for corrective action prior to seeding:

9. Advising the Construction Manager when environmental conditions (such as wet weather or frozen soils) make it advisable to restrict or delay construction activities to avoid topsoil mixing or excessive compaction;

10. Ensuring the final contours are in accordance with final project grading plans;

11. Verifying that imported soil used for revegetation, of which none is anticipated, has been certified as free of noxious weeds and soil pests;

12. 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;

13. Inspecting and ensuring the maintenance of temporary erosion control measures at least:

    a. on a daily basis in areas of active construction or equipment operation;

    b. on a weekly basis in areas with no construction or equipment operation; and

    c. within 24 hours of each 0.5 inch of rainfall;

14. 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;

15. Keeping records of compliance with the environmental conditions of the FERC's Orders, and the mitigation measures proposed by Annova LNG in the application submitted to the FERC, and other federal or state environmental permits during active construction and stabilization activities;

16. Identifying areas that should be given special attention to ensure stabilization after the construction phase; and

17. Verifying that locations for disposal of excess construction materials for beneficial reuse comply with Section 3.5.

3.0 PRECONSTRUCTION PLANNING

Annova LNG or their designated project representative will perform the following before construction:

3.1. CONSTRUCTION WORK AREAS

1. Identify all construction work areas (e.g., construction temporary facilities, extra work space areas, material storage and contractor yards, borrow and disposal areas, access roads) required for safe construction. Annova LNG will ensure that appropriate cultural resources and biological surveys have been conducted, as determined necessary by the appropriate federal and state agencies.

2. Annova LNG will consider expanding any required cultural resources and endangered species surveys in anticipation of the need for activities outside of authorized work areas.

3. Plan construction sequencing to limit the amount and duration of land disturbance, as necessary, to prevent excessive erosion or sediment flow into sensitive environmental resource areas.

3.2. DRAIN TILE AND IRRIGATION SYSTEMS

No existing drain tiles and irrigation systems are within Project site boundaries.

3.3. GRAZING DEFERMENT

No grazing lands are within Project site boundaries.

3.4. ROAD CROSSINGS AND ACCESS POINTS

Plan for safe and accessible conditions at facility access points and related roadway crossings during construction.

3.5. DISPOSAL PLANNING

Determine methods and locations for the regular collection, containment, and disposal of excess construction materials and debris (e.g., timber, slash, mats, garbage, drill cuttings and fluids, excess rock) throughout the construction process. 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.

3.6. AGENCY COORDINATION

Annova LNG will coordinate with the appropriate local, state, and federal agencies as outlined in this Plan and/or required by the FERC's Orders.

1. Obtain written recommendations from the local soil conservation authorities or land management agencies regarding permanent erosion control and revegetation specifications.

2. Develop specific procedures in coordination with the appropriate agencies to prevent the introduction or spread of invasive species, noxious weeds, and soil pests resulting from construction activities.

3. Develop specific procedures in coordination with the appropriate agencies and landowners, as necessary, to allow wildlife movement and protection during construction.

3.7. SPILL PREVENTION AND RESPONSE PROCEDURES

Annova LNG or designee will develop project-specific Spill Prevention and Response Procedures, as specified in the Procedures. A copy will be filed with the Secretary of the FERC (Secretary) prior to construction and made available in the field during construction.

3.8. RESIDENTIAL CONSTRUCTION

No properties with residences are located within 50 feet of construction work areas.

3.9. WINTER CONSTRUCTION PLANS

No winter construction is anticipated due to the humid subtropical climate of Brownsville. If weather conditions change such winter construction becomes necessary, Annova LNG will develop and file a project-specific winter construction plan with the FERC in accordance with the FERC *Upland Erosion Control, Revegetation and Maintance Plan.*

4.0 INSTALLATION

4.1. APPROVED AREAS OF DISTURBANCE

1. Project-related ground disturbance will be limited to the construction site, temporary work space areas, material storage yards, borrow and disposal areas, access roads, and other areas approved in the FERC's Orders. Any project-related ground disturbing activities outside these areas will require prior Director approval. This requirement does not apply to activities needed to comply with the Plan and Procedures (i.e., slope breakers, energy-dissipating devices, dewatering structures) or minor field realignments and workspace shifts per landowner needs and requirements that do not affect other landowners or sensitive environmental resource areas. Construction activities outside of authorized areas are subject to applicable survey and permit requirements, and landowner easement agreements.

2. The construction site and affected areas for a project is not to extend beyond that described in the FERC application unless otherwise modified by a FERC Order.

   Project use of additional limited areas is subject to landowner or land management agency approval and compliance with all applicable survey and permit requirements. When additional areas are used, each one will be identified and the need explained in the biweekly construction reports to the FERC, if required. The following material will be included in the reports:

   a. the location of each additional area referenced to previously filed project plans showing the additional areas;

   b. identification of the filing at FERC containing evidence that the additional areas were previously surveyed; and

   c. a statement that landowner approval has been obtained and is available in project files.

   Prior written approval of the Director is required when the authorized construction work areas would be expanded by more than 25 feet.

4.2. TOPSOIL SEGREGATION

1. Unless the landowner or land management agency specifically approves otherwise, topsoil will not be mixed with subsoil. Topsoil will be fully stripped from work areas specified by the landowner or land managing agency.

2. Where topsoil segregation is required, Annova LNG will:

   a. segregate at least 12 inches of topsoil in deep soils (more than 12 inches of topsoil); and

   b. make every effort to segregate the entire topsoil layer in soils with less than 12 inches of topsoil.

3. Maintain separation of salvaged topsoil and subsoil throughout all construction activities.

4. Segregated topsoil may not be used for constructing temporary slope breakers, improving or maintaining roads, or as a fill material, without prior approval.

5. 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.

4.3. DRAIN TILES – NOT APPLICABLE

4.4. IRRIGATION – NOT APPLICABLE

4.5. ROAD CROSSINGS AND ACCESS POINTS

1. Maintain safe and accessible conditions at facility access points and related road crossings and access points during construction.

2. Minimize the use of tracked equipment on public roadways. Remove any soil or gravel spilled or tracked onto hardtop (asphaltic or concrete) roadways daily or more frequent as necessary to maintain safe road conditions. Repair damages to hardtop roadway surfaces, shoulders, and bar ditches, as identified in consult with local authorities.

4.6. TEMPORARY EROSION CONTROL

Install temporary erosion controls immediately after initial disturbance of the soil. Temporary erosion controls must be properly maintained throughout construction (on a daily basis) and reinstalled as necessary until replaced by permanent erosion controls.

1. Temporary Slope Breakers

   a. Temporary slope breakers are intended to reduce runoff velocity and divert water off construction work areas. Temporary slope breakers may be constructed of materials such as soil, silt fence, staked hay or straw bales, or sand bags.

   b. Install temporary slope breakers on all disturbed areas, as necessary to avoid excessive erosion. Temporary slope breakers must be installed on slopes greater than 5 percent where the base of the slope is less than 50 feet from waterbodies and wetlands at the following spacing (closer spacing will be used if necessary):

Slope (%)	Spacing (feet)
5 - 15	300
>15 - 30	200
>30	100

   c. Direct the outfall of each temporary slope breaker to a stable, well vegetated area or construct an energy-dissipating device at the end of the slope breaker and off the construction work areas.

   d. Position the outfall of each temporary slope breaker to prevent sediment discharge into wetlands, waterbodies, or other sensitive environmental resource areas.

2. Sediment Barriers

Sediment barriers are intended to stop the flow of sediments and to prevent the deposition of sediments beyond approved workspaces or into sensitive resources.

a. Sediment barriers may be constructed of materials such as silt fence, staked hay or straw bales, compacted earth (e.g., driveable berms across travelways), sand bags, or other appropriate materials.

b. At a minimum, install and maintain temporary sediment barriers in construction work areas 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 crossing until revegetation is successful as defined in this Plan. Leave adequate room between the base of the slope and the sediment barrier to accommodate ponding of water and sediment deposition.

c. Where wetlands or waterbodies are adjacent to and downslope of construction work areas, install sediment barriers along the edge of these areas, as necessary to prevent sediment flow into the wetland or waterbody.

3. Mulch

a. Apply mulch on 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.

b. Mulch can consist of weed-free straw or hay, wood fiber hydromulch, erosion control fabric, or some functional equivalent.

c. Mulch disturbed upland areas if:

(1) erosion and sedimentation is not controlled with installation of erosion control measures; or

(2) construction activity is interrupted for a period of 14 days or more, such that soil stabilization becomes necessary.

d. 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.

e. If wood chips are used as mulch, do not use more than 1 ton/acre and add the equivalent of 11 lbs/acre available nitrogen (at least 50 percent of which is slow release).

f. Ensure that mulch is adequately anchored to minimize loss due to wind and water.

g. 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.

h. Do not use synthetic monofilament mesh/netted erosion control materials 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.

5.0 STABILIZATION AND CLEANUP

5.1. CLEANUP

Final facility clean-up will be conducted under the direction of Annova LNG in consideration of long-term operation of the facility.

1. Commence cleanup operations following final grading, topsoil replacement, and installation of permanent erosion control structures.
2. Grade the disturbed areas to direct storm water flows in accordance with stormwater management plans and leave the soil in the proper condition for planting.
3. Remove construction debris from all construction work areas unless the landowner or land managing agency approves leaving materials onsite for beneficial reuse, stabilization, or habitat restoration.
4. Remove temporary sediment barriers when replaced by permanent erosion control measures or when revegetation is successful.

5.2. PERMANENT EROSION CONTROL DEVICES

1. Trench Breakers – Not Applicable

2. Permanent Slope Breakers

   a. Permanent slope breakers are intended to reduce runoff velocity, divert water off construction work areas, and prevent sediment deposition into sensitive resources. Permanent slope breakers may be constructed of materials such as soil, stone, or some functional equivalent.

   b. Construct and maintain permanent slope breakers in appropriate areas.

   In the absence of written recommendations, use the following spacing unless closer spacing is necessary to avoid excessive erosion on construction work areas:

Slope (%)	Spacing (feet)
5 - 15	300
>15 - 30	200
>30	100

   c. Construct slope breakers to divert surface flow to a stable area without causing water to pool or erode behind the breaker. In the absence of a stable area, construct appropriate energy-dissipating devices at the end of the breaker.

   d. Slope breakers may extend slightly (about 4 feet) beyond the edge of the construction work area to effectively drain water off the disturbed area. Where slope breakers extend beyond the edge of construction work areas, they are subject to compliance with all applicable survey requirements.

5.3. SOIL COMPACTION MITIGATION

Test topsoil for compaction in areas disturbed by construction activities, as needed. Use penetrometers or other appropriate devices to conduct tests.

5.4. REVEGETATION

1. General

   a. Annova LNG is responsible for ensuring successful revegetation of soils disturbed by project-related activities in accordance with final project plans, except as noted in Section 5.4.1.b.

   b. Restore all turf, ornamental shrubs, and specialized landscaping in accordance with the landowner's request, or compensate the landowner. Restoration work must be performed by personnel familiar with local horticultural and turf establishment practices.

2. Soil Additives

   Fertilize and add soil pH modifiers in accordance with recommendations from the local soil conservation authority.

3. Seeding Requirements

   a. Prepare a seedbed in disturbed areas to a depth of 3 to 4 inches using appropriate equipment to provide a firm seedbed. When hydroseeding, scarify the seedbed to facilitate lodging and germination of seed.

   b. Seed disturbed areas in accordance with recommendations for seed mixes, rates, and dates obtained from the local soil conservation authority.

   c. Perform seeding of permanent vegetation within the recommended seeding dates. If seeding cannot be done within those dates, use appropriate temporary erosion control measures discussed in section IV.F and perform seeding of permanent vegetation at the beginning of the next recommended seeding season. Dormant seeding or temporary seeding of annual species may also be used, if necessary, to establish cover, as approved by the Environmental Inspector.

   d. In the absence of written recommendations from the local soil conservation authorities, seed all disturbed soils within 6 working days of completion of final grading, weather and soil conditions permitting, subject to the specifications in Section 5.4.a through c.

   e. Base seeding rates on Pure Live Seed. Use seed within 12 months of seed testing.

f. Treat legume seed with an inoculant specific to the species using the manufacturer's recommended rate of inoculant appropriate for the seeding method (broadcast, drill, or hydro).

g. In the absence of written recommendations from the local soil conservation authorities, a seed drill equipped with a cultipacker is preferred for seed application.

Broadcast or hydroseeding can be used in lieu of drilling at double the recommended seeding rates. Where seed is broadcast, firm the seedbed with a cultipacker or roller after seeding. In rocky soils or where site conditions may limit the effectiveness of this equipment, other alternatives may be appropriate (e.g., use of a chain drag) to lightly cover seed after application, as approved by the Environmental Inspector.

6.0 6.0 OFF-ROAD VEHICLE CONTROL

To each owner or manager of restricted lands, offer to install and maintain measures to control unauthorized vehicle access to the right-of-way. These measures may include:

A. signs;

B. fences with locking gates;

C. slash and timber barriers, pipe barriers, or a line of boulders across the right-of-way; and

D. rootballs or other appropriate trees or shrubs across the right-of-way.

7.0 POST-CONSTRUCTION ACTIVITIES AND REPORTING

Post-construction activities will be conducted under the direction of Annova LNG in consideration of long-term operation of the facility.

7.1. MONITORING AND MAINTENANCE ~~– NOT APPLICABLE~~

1. Conduct follow-up inspections of all disturbed areas, as necessary, to determine the success of revegetation and address erosion concerns. At a minimum, conduct inspections after the first and second growing seasons.

2. Revegetation will 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.

Continue revegetation efforts in areas formerly disturbed by construction until ground cover provides similar pre-construction stabilization.

3. Efforts to control unauthorized off-road vehicle use, in cooperation with the landowner, will continue throughout the life of the project. Maintain signs, gates, and permanent access roads as necessary.

7.2. REPORTING

1. Annova LNG will maintain records that identify by construction area:

   a. method of application, application rate, and type of fertilizer, pH modifying agent, seed, and mulch used;

   b. acreage treated;

   c. dates of backfilling and seeding;

   d. names of landowners requesting special seeding treatment and a description of the follow-up actions; and f. any problem areas and how they were addressed.

2. Annova LNG will file with the Secretary quarterly activity reports documenting the results of follow-up inspections required by Section 7.1.1; any problem areas, and corrective actions taken for at least 2 years following construction.

Wetland and Waterbody Construction and Mitigation Procedures

Client: Annova LNG, LLC.

Project: Annova LNG Brownsville

Location: Brownsville, Texas

Document Number: 183169-REFF-00XX

Black & Veatch Project Number: 183169

Annova Project Number: 0001

File No. 30.0000

Rev	Revision Description	DATE	BY	CHK'D	APP'D
A	Issued for initial review (DRAFT)	8/03/2015	MMS	PWS	DMW
B	Revised for Final RR1	4/22/2016	MMS		DMW
C	Revised to incorporate the FERC 10/20/2016 Comments	10/31/2016	MMS		DMW

1.0 APPLICABILITY

A. This Procedure identifies baseline mitigation measures for minimizing the extent and duration of project-related disturbance on wetlands and waterbodies. Annova LNG, LLC (Annova LNG), the Project sponsor, have made this plan project-specific as part of the Brownsville Project (Project) Federal Energy Regulatory Commission (FERC) Natural Gas Act (NGA) Section 3 certification process. This Procedure applies to the Project site and temporary work space areas as approved by the FERC.

The Project is a mid-scale liquefied natural gas (LNG) export terminal located on the southern bank of Brownsville Ship Channel, approximately 8.2 miles upstream from the channel mouth at Brazos Santiago Pass. Annova LNG will have long-term use of approximately 731 acres to construct and operate the 6.0 million metric tons per annum (mmtpa) LNG facility. The natural gas delivered to the site via the feed gas pipeline will be treated, liquefied, and stored on site in two single-containment LNG storage tanks, each with a net capacity of approximately 42.3 million gallons (160,000 cubic meters [m^3]). The LNG will be loaded onto LNG carriers for export.

The coordinates of the site center are:
26° 00’ 20.09” N/longitude -97° 16’ 02.70” W.

Non-jurisdictional facilities that may be constructed and operated by third parties (i.e., gas and water pipelines; electric and telecommunication lines) are not addressed in this Procedure.

If the Project is authorized, variances to the measures in this Plan will be submitted to the Director of the Office of Energy Projects (Director). The Director will consider approval of the variances if the Director agrees that a varianceOnce the Project is certificated, changes from the variances to the measures in these Procedures to the Director of the Office of Energy Projects (Director). Approval by the Director is expected, assuming the Director agrees the variance:

1. provides equal or better environmental protection;

2. is necessary because a portion of these Procedures is infeasible or unworkable based on project-specific conditions; or

3. is specifically required in writing by another federal, state, or Native American land management agency for the portion of the project on its land or under its jurisdiction.

Project-related impacts on non-wetland areas are addressed in the Project Upland Erosion Control, Revegetation, and Maintenance Plan (Plan).

B. DEFINITIONS

1. "Waterbody" includes any natural or artificial stream, river, or drainage with perceptible flow at the time of crossing, and other permanent waterbodies such as ponds and lakes:

   a. "minor waterbody" includes all waterbodies less than or equal to 10 feet wide at the water's edge at the time of crossing;

   b. "intermediate waterbody" includes all waterbodies greater than 10 feet wide but less than or equal to 100 feet wide at the water's edge at the time of crossing; and

   c. "major waterbody" includes all waterbodies greater than 100 feet wide at the water's edge at the time of crossing.

2. "Wetland" includes any area that is not in actively cultivated or rotated cropland and that satisfies the requirements of the current federal methodology for identifying and delineating wetlands.

2.0 PRECONSTRUCTION FILING

A. Annova LNG or its designee will file with the Secretary of the FERC (Secretary) prior to the beginning of construction, for the review and written approval:

1. site-specific justifications for extra work areas that would be closer than 50 feet from a waterbody or wetland; and

2. site-specific justifications for construction greater than 75-feet-wide in wetlands.

B. Annova LNG or its designee will file with the Secretary prior to the beginning of construction the following information:

1. Spill Prevention and Response Procedures specified in Section 4.A;

2. a schedule identifying when dredging will occur within the Brownsville Ship Channel. Annova LNG will revise the schedule as necessary to provide FERC staff at least 14 days advance notice of beginning dredging operations.

3. a wetland delineation report as described in Section 6.A.1, if applicable; and

4. the hydrostatic testing information specified in Section 7.B.3.

3.0 ENVIRONMENTAL INSPECTORS

A. At least one Environmental Inspector having knowledge of the wetland and waterbody conditions in the project area is required. The number and experience of Environmental Inspectors assigned to each construction spread will be appropriate for the duration of the construction and the number/significance of resources affected.

B. The Environmental Inspector's responsibilities are outlined in the Project's Plan.

4.0 PRECONSTRUCTION PLANNING

A. Annova LNG will develop and implement project-specific Spill Prevention and Response Procedures for construction in accordance with applicable federal and state requirements. A copy of the Spill Prevention and Response Procedures will be filed with the Secretary prior to construction and made available in the field .

1. Annova LNG and its contractors will structure construction operations in a manner that reduces the risk of spills or the accidental exposure of fuels or hazardous materials to waterbodies or wetlands. Annova LNG and its contractors will, at a minimum, ensure that:

a. employees handling fuels and other hazardous materials are properly trained;

b. equipment is in good operating order and inspected on a regular basis;

c. fuel trucks transporting fuel to on-site equipment travel only on approved access roads upon entering the Project site;

d. equipment is parked overnight and/or fueled at least 100 feet from a waterbody or in an upland area at least 100 feet from a wetland boundary. These activities can occur closer only if the Environmental Inspector determines that there is no reasonable alternative, and Annova LNG and its contractors have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill;

e. hazardous materials, including chemicals, fuels, and lubricating oils, are not stored within 100 feet of a wetland or waterbody unless the

Environmental Inspector determines that there is no reasonable alternative, and Annova LNG and its contractors have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill. This applies to storage of these materials and does not apply to normal operation or use of equipment in these areas;

f. concrete coating activities are not performed within 100 feet of a wetland or waterbody boundary, unless the Environmental Inspector determines that there is no reasonable alternative, and the project sponsor and its contractors have taken appropriate steps (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill;

g. portable diesel engine driven pumps operating within 100 feet of a waterbody or wetland boundary utilize appropriate secondary containment systems to prevent spills; and

h. bulk storage (equal to or greater than 55 gallons) of hazardous materials, including chemicals, fuels, and lubricating oils have appropriate secondary containment systems to prevent spills.

2. Annova LNG and its contractors will structure construction operations in a manner that provides for the prompt and effective cleanup of spills of fuel and other hazardous materials. At a minimum, Annova LNG and its contractors will:

a. provide a sufficient number of spill kits and supplies of absorbent and barrier materials to allow the rapid containment and recovery of spilled materials. Regular on-site construction personnel will be trained on the procedure for reporting spills and unanticipated discoveries of contamination;

b. provide tools and material sufficient to stop leaks;

c. have available the reporting protocol that includes the contact names and telephone numbers for - local, state, and federal agencies (including, if necessary, the U. S. Coast Guard (USCG) and the National Response Center) and Annova LNG personnel that must be notified of a spill; and

d. follow the procedures outlined in the Project's Spill Prevention, Control, and Countermeasure (SPCC) Plan in cleaning up the spill, in excavating and disposing of soils or other materials contaminated by a spill, and in collecting and disposing of waste generated during spill cleanup. The SPCC Plan applies to the Project construction and does not apply to facility operation.

B. AGENCY COORDINATION

Annova LNG will coordinate with the appropriate local, state, and federal agencies as outlined in these Procedures and in the FERC's Orders.

5.0 WATERWAY/WATERBODY CONSTRUCTION

A. NOTIFICATION PROCEDURES AND PERMITS

1. Apply to the U.S. Army Corps of Engineers (COE), or its delegated agency, for the appropriate wetland and waterbody permits.

2. Since no potable surface water supply intakes are located within 3 miles downstream of the Project, written notification to authorities responsible for public water supply or industries withdrawing water from the Brownsville Ship Channel for potable use is not necessary.

3. Apply for state-issued waterbody crossing permits and obtain individual or generic section 401 water quality certification or waiver.

4. Notify appropriate federal and state authorities before beginning dredging operations as specified in applicable permits.

B. INSTALLATION

1. Time Window for Construction

Dredging operations and installation of pilings within the Brownsville Ship Channel will occur during the timeframe outlined in the permit issued by the appropriate federal or state agency.

2. Extra Work Areas

a. Locate extra work areas (such as staging areas and additional spoil storage areas) not associated with construction of the marine berth at least 50 feet away from the Brownsville Ship Channel shoreline, except where the adjacent upland consists of disturbed land.

b. Annova LNG will file with the Secretary for review and written approval by the Director, site-specific justification for each extra work area with a less than 50-foot setback from the Brownsville Ship Channel shoreline, except where the adjacent upland consists of disturbed land or marine berth construction. The justification shall specify the conditions that will not permit a 50-foot setback and measures to ensure the waterway or waterbody are adequately protected.

c. Limit the size of extra work areas to the minimum needed to construct the marine berth.

3. General Construction Procedures

a. Comply with the COE, USCG, EPA, Texas Railroad Commission, Texas Commission on Environmental Quality, and other regulatory agencies, as applicable, permit terms and conditions.

b. Waterbody buffers (e.g., extra work area setbacks, refueling restrictions) must be clearly marked in the field with signs and/or highly visible flagging until construction-related ground disturbing activities are complete.

4. Spoil Pile Placement and Control

a. Excavated upland spoil material will be temporarily stored within the Project site boundaries in construction spoil stockpiles at least 10 feet from the water's edge or in additional extra work areas as described in Section 5.B.2.

b. Use sediment and turbidity barriers to prevent the flow of spoil or silt-laden storm water into the channel.

c. Dredged spoil material will be placed on-site and into Port of Brownsville (Port) placement areas, as authorized by applicable regulatory agencies and the Port.

5. Equipment Bridges

a. Construct and maintain equipment bridges to allow unrestricted flow and to prevent soil from entering the waterbody, as applicable. Examples of such bridges include:

(1) equipment pads and culvert(s);
(2) equipment pads or railroad car bridges without culverts;
(3) clean rock fill and culvert(s); and
(4) flexi-float or portable bridges.

Additional options for equipment bridges may be utilized that achieve the performance objectives noted above. Do not use soil to construct or stabilize equipment bridges.

b. Design and maintain each equipment bridge to withstand and pass the highest flow expected to occur while the bridge is in place. Align culverts to prevent bank erosion or streambed scour. If necessary, install energy dissipating devices downstream of the culverts.

c. Design and maintain equipment bridges to prevent soil from entering the waterbody.

d. Remove temporary equipment bridges as soon as practicable following completion of final grading and site stabilization.

e. Obtain any necessary approval from the COE, or the appropriate state agency for permanent bridges.

6. Dry-Ditch Crossing Methods – Not Applicable

7. Crossings of Minor Waterbodies – Not Applicable

8. Crossings of Intermediate Waterbodies – Not Applicable

9. Construction in Major Waterways/Waterbodies

Before construction, Annova LNG will file with the Secretary for the review and written approval by the Director a detailed, site-specific construction plan and scaled drawings identifying areas to be disturbed by construction for the LNG terminal, marine berth, and LNG carrier turning basin. The plan will include extra work areas, spoil storage areas, sediment control structures, etc., as well as mitigation for navigational issues.

The Environmental Inspector may adjust the final placement of the erosion and sediment control structures in the field to maximize effectiveness.

10. Temporary Erosion and Sediment Control

Install sediment barriers (as defined in Section 4.F.3.a of the Plan) immediately after initial disturbance of the waterway or waterbody or adjacent upland. Sediment barriers must be properly maintained throughout construction and reinstalled as necessary (such as during excavation and initial grading) until replaced by permanent erosion controls or stabilization of disturbed upland areas is complete. Temporary erosion and sediment control measures are addressed in more detail in the Plan; however, the following specific measures are to be implemented:

a. install sediment barriers, where necessary to prevent the flow of sediments into the waterway or waterbody. Removable sediment barriers (or driveable berms) shall be installed across access roads, where applicable. These removable sediment barriers can be removed during the construction day, but must be re-installed after construction has stopped for the day and/or when heavy precipitation is imminent;

b. where waterways or waterbodies are adjacent to the construction and the site slopes toward the waterbody, install sediment barriers along the edge of the construction work areas as necessary to contain spoil within the construction right-of-way and prevent sediment flow into the waterbody; and

c. use silt/turbidity curtains, as necessary, to minimize transport of displaced silt, sediment or solids while construction activities are occurring in or directly adjacent to a waterway or waterbody.

11. Construction Dewatering

Dewater the excavation or trench in a manner that does not cause erosion and does not result in silt-laden water flowing into any waterbody. Remove the dewatering structures as soon as practicable after the completion of dewatering activities.

C. REVEGETATION and STABLIZATION

1. Install erosion control blankets or a functional equivalent on waterway or waterbody banks at the time of final bank recontouring. Do not use synthetic monofilament mesh/netted erosion control materials in areas designated as sensitive wildlife habitat unless the product is specifically designed to minimize harm to wildlife. Anchor erosion control blankets or matting with staples or other appropriate devices.

2. Application of riprap for bank stabilization must comply with COE, or its delegated agency, permit terms and conditions.

3. Unless otherwise specified by state permit, limit the use of riprap to areas where flow conditions preclude effective vegetative stabilization techniques such as seeding and erosion control fabric.

4. Revegetate disturbed riparian areas with native species of conservation grasses, legumes, and woody species, similar in density to adjacent undisturbed lands, as applicable.

5. Install permanent slope breakers, as needed, across the base of slopes greater than 5 percent that are less than 50 feet from the waterway or waterbody to prevent sediment transport. In addition, install sediment barriers and silt/turbidity curtains as outlined in Section 5.B.10.

   In some areas, with the approval of the Environmental Inspector, an earthen berm may be suitable as a sediment barrier adjacent to the waterway or waterbody.

D. POST-CONSTRUCTION MAINTENANCE

1. Do not use herbicides or pesticides in or within 100 feet of a waterway or waterbody except as allowed by the appropriate land management or state agency.

6.0 WETLAND CROSSINGS

A. GENERAL

1. Annova LNG will conduct a wetland delineation using the current federal methodology and file a wetland delineation report with the Secretary before construction.

   This report will identify:

   a. by Project area all wetlands that would be affected;

   b. the National Wetlands Inventory (NWI) classification for each wetland;

   c. the crossing length of each wetland in feet; and

   d. the area of permanent and temporary disturbance that would occur in each wetland by NWI classification type.

2. Design the facility to avoid wetland areas to the maximum extent possible. If a wetland cannot be avoided the facility will be designed in a manner that minimizes disturbance to wetlands.

3. Limit disturbance to wetland areas in accordance with COE permits and approved drawings. Early in the planning process Annova LNG will identify site-specific areas where spoil piles could be difficult to maintain because existing soils lack adequate unconfined compressive strength.

4. Wetland boundaries and buffers must be clearly marked in the field with signs and/or highly visible flagging until construction-related ground disturbing activities are complete.

5. Implement the measures of Sections 5.0 and 6.0 for construction within or adjacent to a waterway or wetland. If all measures of Sections 5.0 and 6.0 cannot be met, Annova LNG will file with the Secretary a site-specific construction plan for review and written approval by the Director before construction. This crossing plan will address at a minimum:

   a. spoil control;

   b. restoration of waterway or waterbody banks and wetland hydrology;

   c. timing of the waterway or waterbody construction;

   d. method of construction; and

   e. size and location of all extra work areas.

6. Do not locate aboveground facilities in any wetland, except where the location of such facilities has been approved by the appropriate regulatory agencies.

B. INSTALLATION

1. Extra Work Areas and Access Roads

   a. Locate all extra work areas (such as staging areas and additional spoil storage areas) at least 50 feet away from wetland boundaries, except where the adjacent upland consists of disturbed land.

   b. Annova LNG will file with the Secretary for review and written approval by the Director, site-specific justification for each extra work area with a less than 50-foot setback from wetland boundaries, except where adjacent upland consists of disturbed land. The justification must specify the site-specific conditions that will not permit a 50-foot setback and measures to ensure the wetland is adequately protected.

   c. Construction access across a wetland area is permitted when the wetland soil is firm enough to avoid rutting or has been appropriately stabilized to avoid rutting (e.g., with timber riprap, prefabricated equipment mats, or terra mats).

In wetlands that cannot be appropriately stabilized, construction equipment other than that needed to install the wetland crossing will use access roads located in upland areas. Where access roads in upland areas do not provide reasonable access, limit all other construction equipment to one pass through the wetland.

d. The only access roads, other than the construction travel paths within the Project site boundaries, that can be used in wetlands are those existing roads that can be used with no modifications or improvements, other than routine repair, and no impact on the wetland.

2. Construction Procedures

a. Comply with COE, or its delegated agency, permit terms and conditions.

b. Assemble the facility components an upland area unless the wetland is dry enough to adequately support the construction activity.

c. Limit construction equipment operating in wetland areas to that needed to perform the construction activity.

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

Annova LNG may burn woody debris in wetlands, if approved by the COE and in accordance with state and local regulations, ensuring that all remaining woody debris is removed for disposal.

e. Segregate the top 1 foot of topsoil, as appropriate, from the area disturbed.

f. Do not use rock, soil imported from outside the wetland, tree stumps, or brush riprap to support equipment in a wetland area.

g. 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.

h. Remove project-related material used to support equipment, as appropriate, upon completion of construction.

3. Temporary Sediment Control

Install sediment barriers (as defined in Section 4.F.3.a of the Plan) immediately after initial disturbance of the wetland or adjacent upland. Sediment barriers must be properly maintained throughout construction and reinstalled as necessary (such as after backfilling temporary storm water diversion ditches). Except as noted below in Section 6.B.3.c, maintain sediment barriers until replaced by permanent erosion controls or restoration of adjacent upland areas is complete. Temporary erosion and sediment control measures are addressed in more detail in the Plan.

a. Install sediment barriers across the entire construction right-of-way immediately upslope of the wetland boundary at all wetland crossings where necessary to prevent sediment flow into the wetland.

b. Where wetlands are adjacent to the construction area, and the grade slopes toward the wetland, install sediment barriers along the edge of the construction right-of-way as necessary to contain spoil within the construction area and prevent sediment flow into the wetland.

c. Install sediment barriers along the edge of construction areas as necessary to contain spoil and sediment within the construction workspace. Remove these sediment barriers during site cleanup following completion of final grading.

4. Construction Dewatering

Dewater the excavation or trench in a manner that does not cause erosion and does not result in silt-laden water flowing into any wetland. Remove the dewatering structures as soon as practicable after the completion of dewatering activities.

C. STABILIZATION AND CLEAN UP

1. Restore pre-construction wetland contours to maintain the original wetland hydrology, where applicable.

2. For each wetland within or adjacent to the construction limits of disturbance, and where the grade slopes toward the wetland, install permanent slope breakers across the construction area at the base of slopes greater than 5

percent where the base of the slope is less than 50 feet from the wetland, or as needed to prevent sediment transport into the wetland. In addition, install sediment barriers as outlined in the Plan. In some areas, with the approval of the Environmental Inspector, an earthen berm may be suitable as a sediment barrier adjacent to the wetland.

3. Do not use fertilizer, lime, or mulch in a wetland area unless required in writing by the appropriate federal or state agency.

4. Consult with the appropriate federal or state agencies to develop a project-specific wetland restoration plan, as applicable. The revegetation and stabilization plan will include measures for re-establishing herbaceous and/or woody species, controlling the invasion and spread of invasive species and noxious weeds (e.g., purple loosestrife and phragmites), and monitoring the success of the revegetation and weed control efforts. The revegetation and stabilization plan will be made available to the FERC staff upon request.

5. Until a project-specific wetland restoration plan is developed and/or implemented, temporarily revegetate affected wetlands with annual ryegrass at a rate of 40 pounds/acre (unless standing water is present).

6. Ensure that ~~disturbed~~ wetland areas temporarily disturbed by construction~~, and remain as wetlands following construction~~ are stabilized and successfully revegetated with wetland herbaceous and/or woody plant species in accordance with COE authorizations, and as recommended by the appropriate regulatory agency or local soil conservation authority, where applicable, to prevent conversion of wetlands to uplands.

7. Remove temporary sediment barriers located at the boundary between wetland and adjacent upland areas after stabilization (and revegetation where applicable) of adjacent upland areas are judged to be successful as specified in Section 7.A.4 of the Plan.

D. POST-CONSTRUCTION MAINTENANCE AND REPORTING

1. Do not conduct routine vegetation mowing or clearing over wetlands outside the LNG plant primary security boundary/fence line. However, to facilitate perimeter patrols and security observations, a corridor external and adjacent to the primary security fence line up to 20 feet wide may be cleared at a frequency necessary to maintain the 20-foot corridor in an herbaceous state. In addition, broadleaf trees within 15 feet of the corridor that could compromise the facility security may be selectively trimmed or cut and removed.

2. Do not use herbicides or pesticides in or within 100 feet of a wetland, except as allowed by the appropriate federal or state agency.

3. Monitor and record the success of wetland revegetation annually until wetland revegetation is successful, where applicable.

4. Wetland revegetation will be considered successful if all of the following criteria are satisfied:

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

    b. 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;

    c. 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

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

5. Within 3 years after construction, Annova LNG will file a report with the Secretary identifying the status of the wetland revegetation efforts and documenting success as defined in Section 7.D.5, above.

   For wetland areas where revegetation has been implemented, and is not successful at the end of 3 years after construction, develop and implement (in consultation with a professional wetland ecologist) a remedial revegetation plan to actively revegetate wetlands. Continue revegetation efforts and file a report annually documenting progress in these wetlands until wetland revegetation is considered successful by a professional wetland ecologist.

7.0 HYDROSTATIC TESTING

A. NOTIFICATION PROCEDURES AND PERMITS

1. Apply for state-issued water withdrawal permits, as required.

2. Apply for National Pollutant Discharge Elimination System (NPDES) or

state-issued discharge permits, as required.

3. Notify appropriate state agencies of intent to use specific sources at least 48 hours before testing activities unless they waive this requirement in writing.

B. GENERAL

1. Perform testing and inspections of welded and non-welded pipeline systems in accordance with appropriate engineering codes and standards, before installation under waterbodies or wetlands.

2. If diesel engine driven pumps used for hydrostatic testing are within 100 feet of a waterway, waterbody or wetland, address secondary containment and refueling of these pumps in the project's Spill Prevention and Response Procedures.

3. Annova LNG will file with the Secretary before construction a list identifying the location of waterways or waterbodies proposed for use as a hydrostatic test water source or discharge location.

C. INTAKE SOURCE AND RATE

1. Screen the intake hose to minimize the potential for entrainment of fish.

2. Do not use state-designated exceptional value waters, waterbodies which provide habitat for federally listed threatened or endangered species, or waterbodies designated as public water supplies, unless appropriate federal, state, and/or local permitting agencies grant written permission.

3. Maintain adequate flow rates to protect aquatic life, provide for all waterbody uses, and provide for downstream withdrawals of water by existing users.

4. Locate hydrostatic test manifolds outside wetlands and riparian areas to the maximum extent practicable.

D. DISCHARGE LOCATION, METHOD, AND RATE

1. 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.

2. Do not discharge into state-designated exceptional value waters, waterbodies which provide habitat for federally listed threatened or endangered species, or

waterbodies designated as public water supplies, unless appropriate federal, state, and local permitting agencies grant written permission.

APPENDIX C
DREDGED MATERIAL TRANSPORT PLAN

Annova LNG
Brownsville Project

Dredged Material Transport Plan

July 2016

Submitted by:

4 Houston Center
1221 Lamar Street, Suite 750
Houston, TX 77010

TABLE OF CONTENTS

Section Page

Tables ii
Figures iii
Acronyms and Abbreviations v

1 INTRODUCTION 1-1
1.1 Applicable Regulations and Requirements 1-1
1.2 Plan Implementation Responsibility 1-1

2 PROJECT DESCRIPTION 2-1
2.1 Marine Transfer Facilities 2-1
2.2 Excavation and Dredging 2-1
2.3 Existing Conditions 2-7
2.4 Beneficial Use Options 2-7
2.5 Dredged Material Placement Areas 2-8
2.5.1 DMPA 4A 2-8
2.5.2 DMPA 4B 2-9
2.5.3 DMPA 5A 2-9
2.5.4 DMPA 5B 2-9
2.5.5 Proposed Placement Area 2-9

3 DREDGED MATERIAL TRANSPORT 3-1

4 MAINTENANCE DREDGING 4-1
4.1 Maintenance Dredging Volumes 4-1
4.2 Maintenance Dredging Placement 4-1

5 REFERENCES 5-1

TABLES

Table Page

Table 1 Estimates of Excavated and Dredged Material 2-6

Table 2 Types and Examples of Beneficial Use Options 2-8

Table 3 Dredged Material Placement Area Characteristics 2-11

FIGURES

Figure Page

1 Project Location and Vicinity (Aerial) ... 2-2
2 Dredging Footprint Plan View ... 2-3
3 Dredging Area Cross-Section ... 2-4
4 Brownsville Navigation District Dredged Material Placement Areas ... 2-10
5 Proposed DMPA-5A Dike Cross-Section, Typical ... 2-13
6 Hydraulic Dredge Pipeline Route ... 3-2
7 Typical Floating Dredge Pipe Section ... 3-3

APPENDICES

Appendix Page

Appendix A Beneficial Use Concepts for Dredged Material A-1

ACRONYMS AND ABBREVIATIONS

Annova	Annova LNG Common Infrastructure, LLC, Annova LNG Brownsville A, LLC, Annova LNG Brownsville B, LLC, and Annova LNG Brownsville C, LLC
BIH	Brazos Island Harbor
BND	Brownsville Navigation District
BSC	Brownsville Ship Channel
CWA	Clean Water Act
DMPA	dredged material placement area
DMTP	Dredged Material Transport Plan
LNG	liquefied natural gas
m^3	cubic meters
MLLW	mean lower low water (0 MLLW = +0.85 NAVD88)
MOF	material off-loading facility
mtpa	million tonnes per annum
NAVD88	North American Vertical Datum of 1988 (0 NAVD88 = -0.85 MLLW)
Project	Annova LNG Brownsville Project
USACE	United States Army Corps of Engineers
yd^3	cubic yards

1 INTRODUCTION

Annova LNG Common Infrastructure, LLC; Annova LNG Brownsville A, LLC; Annova LNG Brownsville B, LLC; and Annova LNG Brownsville C, LLC (collectively, "Annova") is proposing to construct, own, and operate the Annova LNG Brownsville Project (Project) in Cameron County, Texas. The purpose of the Project is to operate a mid-scale natural gas liquefaction facility along the South Texas Gulf Coast for exporting natural gas to international markets. The mid-scale size of the facility meets the requirements of multiple foreign purchasers whose annual demand is best met with increments of 1 million tonnes per annum (mtpa). The Project will include six liquefaction trains, each with a nameplate capacity of 1.0 mtpa, for an aggregate nameplate capacity of 6 mtpa and a maximum output at optimal operating conditions of 6.95 mtpa.

This Dredged Material Transport Plan (DMTP) describes the methods developed to transport and place excavated and dredged material resulting from construction and operation of the Project in accordance with applicable federal and state regulations.

1.1 APPLICABLE REGULATIONS AND REQUIREMENTS

A Section 10/Section 404 permit from the U.S. Army Corps of Engineers (USACE) is required to conduct dredge/fill activities within "waters of the United States." Several conditions must be addressed as part of the USACE Section 10/404 permit compliance process. The permit offers blanket coverage for the requirements of Section 10 of the Rivers and Harbors Act; Section 404 of the Clean Water Act (CWA); and Section 103 of the Marine Protection, Research, and Sanctuaries Act. The permit also requires adherence to the Texas Coastal Zone Management Act and Section 401 of the CWA. A Coastal Zone Management Act consistency determination and Section 401 Water Quality Certification review will be conducted by the Railroad Commission of Texas as part of the Section 10/404 permit review process.

1.2 PLAN IMPLEMENTATION RESPONSIBILITY

Annova is the operator/owner for this Project and has overall responsibility for implementing this plan through the engineering, procurement, and construction implementation through various contracts/subcontracts, subject to the USACE permit requirements and Federal Energy Regulatory Commission and USACE acceptance.

As of the date of this Plan, not all contractors/subcontractors have been identified; however, when contractors/subcontractors are selected, training sessions for construction personnel will be held before and during all construction activities. While this training will focus on DMTP implementation, it will also include instructions on the implementation of other construction mitigation measures, as appropriate.

2 PROJECT DESCRIPTION

Annova will construct the Project on approximately 731 acres of land on the south bank of the Brownsville Ship Channel (BSC) at approximately mile marker 8.2 (Figure 1). The Project site is available to Annova through a real estate lease option agreement with the Brownsville Navigation District (BND).

The Project includes two principal parts: the liquefied natural gas (LNG) facilities and the associated marine transfer facilities. The LNG facilities will be designed to receive 0.9 billion cubic feet per day of third-party feed gas via pipeline. The natural gas delivered to the site via the feed gas pipeline will be treated to remove constituents that would freeze during the liquefaction or affect the liquefaction process, primarily hydrocarbons other than methane, carbon dioxide, and water. Annova will liquefy the treated natural gas using the Black & Veatch Poly Refrigerant Integrated Cycle Operation (PRICO®) technology. The LNG will be stored in two single-containment LNG storage tanks, each designed to store approximately 160,000 cubic meters (m^3) to match the capacity of typical LNG carriers. The LNG will be pumped from the storage tanks to the marine transfer facilities. The marine transfer facilities will load LNG carriers at the berth using cryogenic piping and associated equipment for mooring the carrier. The Project includes the following major components: gas pretreatment facilities; liquefaction facilities; LNG storage tanks; a boil-off gas handling system; a flare system; marine transfer facilities; control, administration, and support buildings; access roads; and utilities (power, water, and communication.).

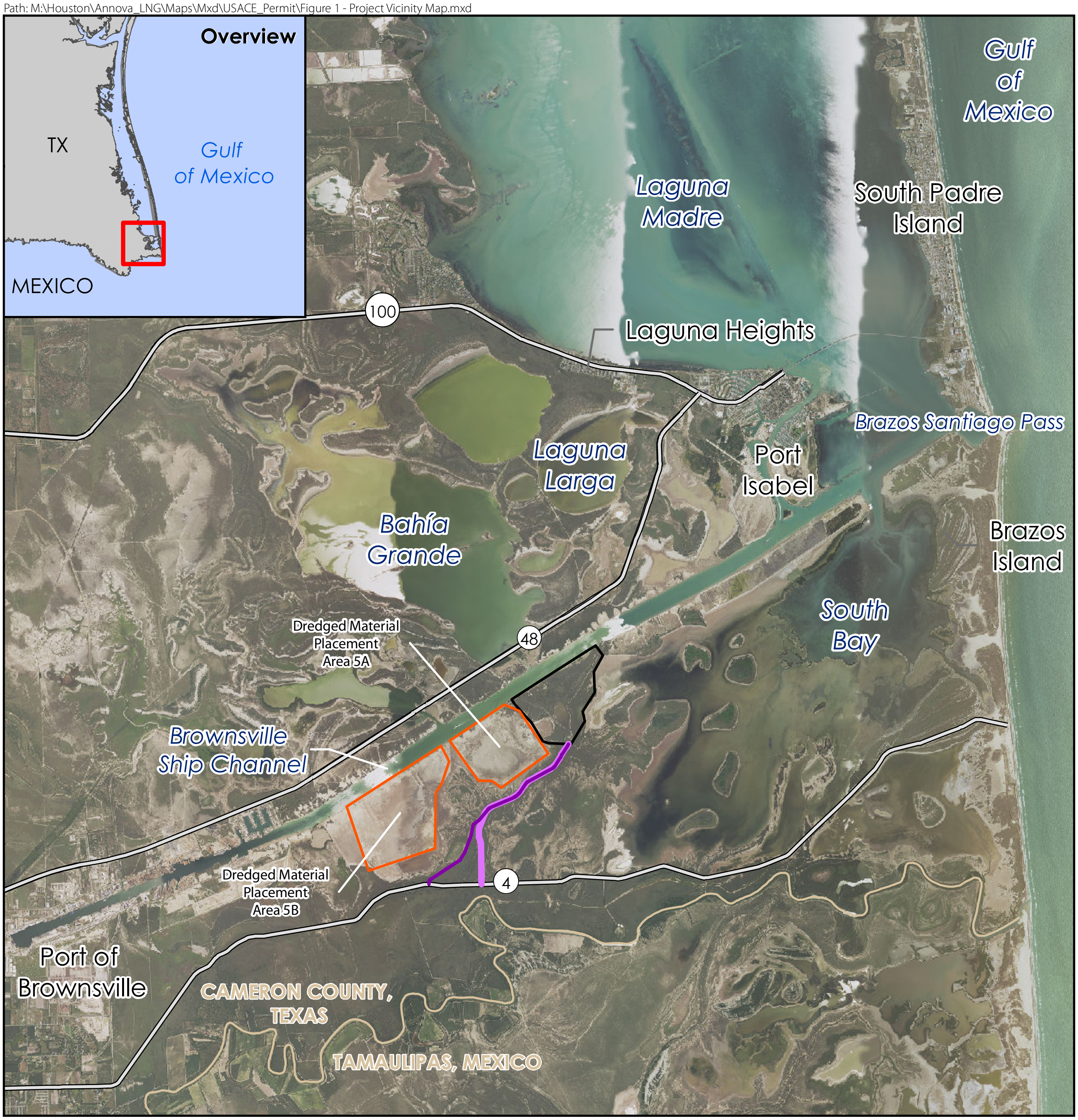
2.1 MARINE TRANSFER FACILITIES

The marine transfer facilities were designed to accommodate 138,000-m^3 to 177,000-m^3 LNG carriers. The berth will include a 1,500-foot-diameter turning basin, with adjacent approach area to accommodate passage between the channel and turning basin. The LNG carriers will dock at the LNG loading berth on the south side of the marine berth, and the material off-loading facility (MOF) will be located on the west side of the basin. The MOF will accommodate the delivery by barge of major equipment and modular plant components during construction. The MOF will be maintained for use during the operational life of the facility as needed.

2.2 EXCAVATION AND DREDGING

The excavation and dredging area for the marine berth and turning basin on the north and south sides of the BSC are shown on Figure 2, and cross-section profiles are shown on Figure 3. The south marine berth and turning basin will be created through a combination of mechanical dredging/excavation and hydraulic cutter suction dredge, and the north turning basin will be created by hydraulic cutter suction dredge. The BSC has an authorized depth of -42 feet mean lower low water (MLLW). The basins will be dredged to -45 feet MLLW and will have a 3:1

Path: M:\Houston\Annova_LNG\Maps\Mxd\USACE_Permit\Figure 1 - Project Vicinity Map.mxd



Legend

SCALE

0 1 2 3 Miles

- Access Road Alternative 1
- Access Road Alternative 2 (Preferred Option)
- Project Site
- Dredged Material Placement Area
- State Highway

SOURCE: Annova LNG 2015; ESRI 2015; TX DOT 2014; NAIP 2014

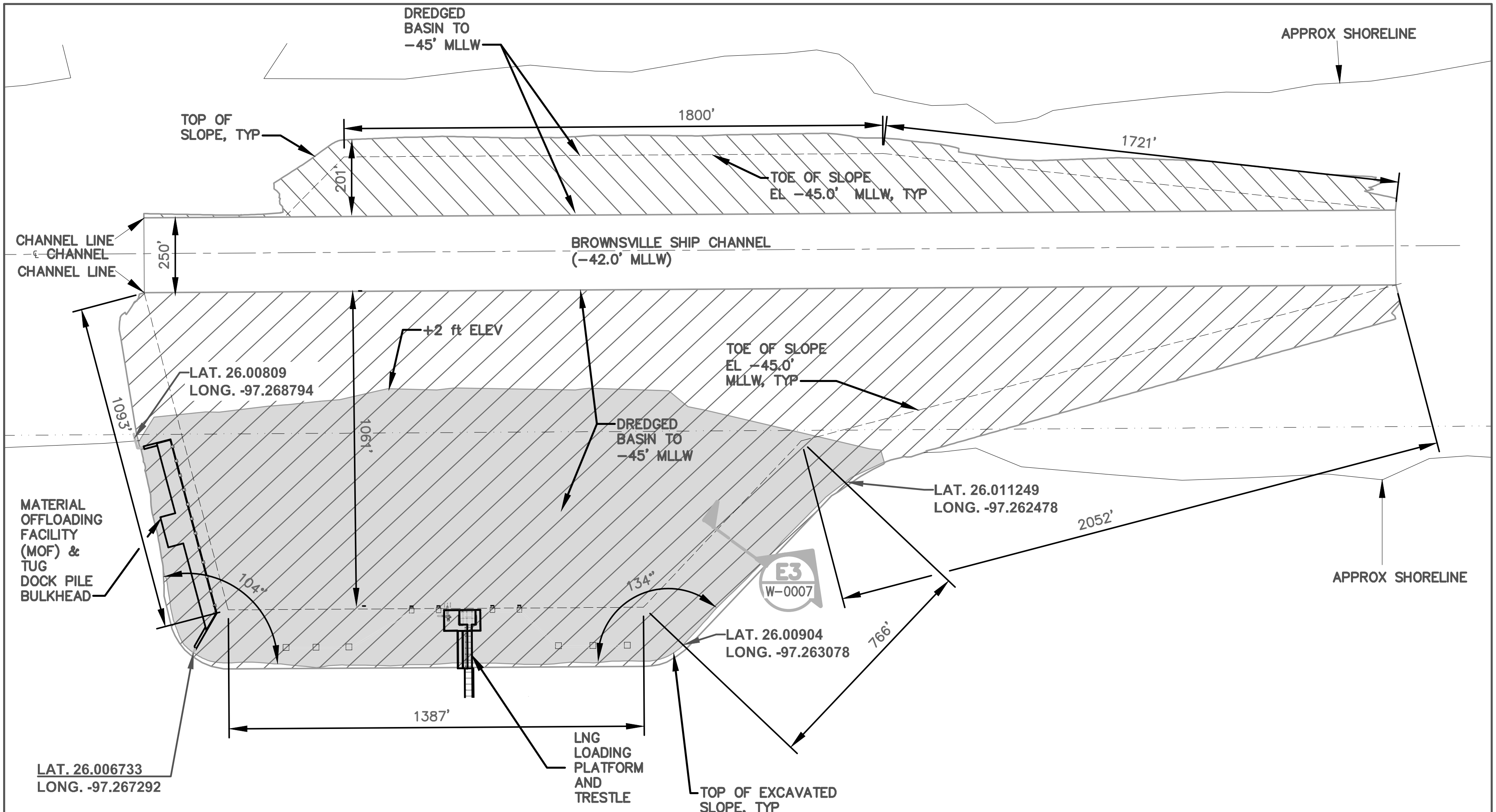
Figure 1

Project Location and Vicinity (Aerial)

Annova LNG Brownsville Project

Cameron County, Texas

USACE Application # SWG-2015-00110



250' 0' 250' 500'

SCALE

PLANT NORTH | TRUE NORTH

SOURCE: B&V DRAWING # 183169-00G0-W-0006 RevB

LEGEND

- ABOVE ELEV −20.0' MLLW
- BASIN SOUTH SIDE OF CHANNEL
- BASIN NORTH SIDE OF CHANNEL
- BROWNSVILLE SHIP CHANNEL CENTERLINE
- MOORING DOLPLHIN
- BREASTING DOLPHIN
- D1 W−0007 CROSS SECTION CALL OUT

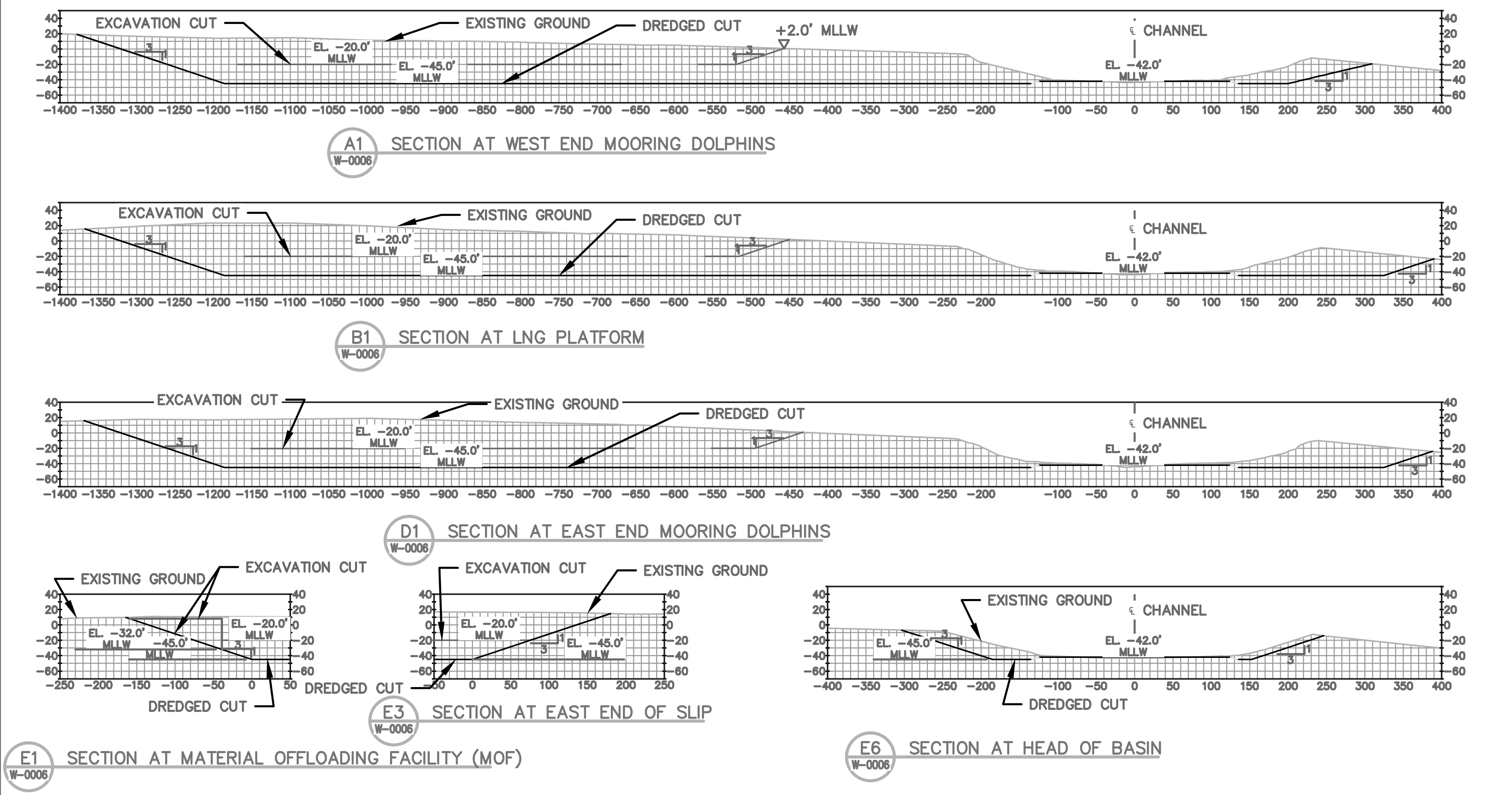
FIGURE 2 REV 1
DREDGING FOOTPRINT, PLAN VIEW

ANNOVA LNG BROWNSVILLE PROJECT

CAMERON COUNTY, TEXAS

annova LNG

SWG 2015-00110



SOURCE: B&V DRAWING # 183169-00G0-W-0007 RevB

NOTES:

1. DIMENSIONS SHOWN IN FEET.
2. VERTICAL DATUM BASED ON MEAN LOWER LOW WATER (MLLW).
3. BATHYMETRY DATA REFERENCED FROM USACE CHANNEL SURVEY, DECEMBER 10, 2014.
4. TOPOGRAPHIC DATA REFERENCED FROM ANNOVA LNG SURVEY MARCH 24, 2015 BY FRONTIER SURVEYING COMPANY.
5. CROSS-SECTION LOCATIONS ARE PRESENTED ON B&V DRAWING # 183169-00G0-W-0006 RevB.
6. VERTICAL DATUM BASED ON MEAN LOWER LOW WATER (MLLW).

FIGURE 3
DREDGING AREA, CROSS-SECTION
ANNOVA LNG BROWNSVILLE PROJECT
CAMERON COUNTY, TEXAS

SWG 2015-00110

slope from the top to the toe of each basin, including along the MOF in locations where sheet piling is not used. The -45 feet MLLW includes the additional 3 feet for advance maintenance and over-depth volumes. No dredging will occur within the BSC navigation channel.

The marine berth and turning basin encompass 76 acres at the top of slope at approximately 0 feet MLLW. The south basin toe of the slope is 4,133 feet along the BSC; 1,093 along the MOF; 1,387 feet along the LNG loading berth; 766 feet along the east basin side; and 2,052 feet along the east approach. The distance from the edge of the BSC to the LNG berth is approximately 1,050 feet. Of the 76 acres of the south basin at 0 feet MLLW, approximately 39 acres currently are land and 37 acres currently are submerged.

The north turning basin is located directly opposite on the far side of the BSC to allow adequate LNG carrier maneuvering and turning space. The north basin toe is a four-sided convex polygon that extends approximately 200 feet from the BSC along the northern toe of slope. The north basin encompasses 20 acres at the top of slope at approximately 0 feet MLLW. The north basin toe of the slope is 3,600 feet along the BSC; 278 feet along the west side; 1,800 feet along the north side; and 1,721 feet along the east approach.

- Excavation and dredging quantities were computed using the site plan shown on Figure 2 and topographic data provided by Black & Veatch. Hydrographic data collected in March 2015 from the latest USACE channel survey project were used for the underwater portion of the Project. Civil3D software was used to create the surfaces needed to calculate the dredging volumes. Land-based material above water down to elevation +2 feet North American Vertical Datum 88 (NAVD88), or +2.85 feet MLLW, as compared with tidal datum 8779770 for Port Isabel, Texas, will be excavated using conventional earth-moving equipment. The excavated material will be used as on-site fill.

- Mechanical dredging/excavation (in former land area) to -20.85 feet NAVD88 (or -20 feet MLLW) will use conventional earth-moving equipment and dewatering will use local sumps and pumping. Material will be placed on the Project site.

- Hydraulic dredging below -20 feet MLLW (in former land area) and hydraulic dredging of the remaining area currently under water to -45.85 feet NAVD88 (or -45 feet MLLW) will use hydraulic cutter suction dredge equipment and will place the dredged material in BND-owned Dredged Material Placement Areas (DMPAs). DPMA 5A located west of the Project site is the preferred area.

Figure 3 shows a cross-section through the marine basin from the south at the LNG facility and to the north across the shipping channel. The highest elevation on land is +24 feet NAVD88, situated in the middle of the southern edge of the basin. At the marine slip, the elevation at the top of the slope at the LNG trestle will be +20 feet NAVD88; however, the western and eastern faces of the slip will be variable because of the existing terrain elevation.

Table 1 provides areas and computed quantities for the marine basin above elevation +2 feet NAVD88 and to -45 feet MLLW. The quantities noted are the volume of topsoil and the volume of material from the land area for the marine berth and turning basin.

The areas shown in Figure 2 will be mechanically dredged from an elevation of +2 feet NAVD88 down to -20 feet MLLW. Table 1 provides areas and computed quantities for the mechanical dredging/excavation with dewatering. The remaining area currently under water from -20 feet MLLW to the design depth of -45 feet MLLW will be dredged using hydraulic cutter suction dredge equipment. Dredged material will be placed into a BND-owned DMPA (described in Section 3 below). Table 1 provides areas and computed quantities for the hydraulic dredging and includes 3 feet of allowable over-depth dredging.

Table 1
Estimates of Excavated and Dredged Material

Project Facility	Excavation/Dredging Method	Approximate Area (acres)	Duration (days)	Estimated Volume (cubic yards)	Estimated Volume by Soil Texture[a] (cubic yards)	Proposed Placement Location
Marine Berth and Turning Basin (South)	Excavation of Topsoil	39	39	60,000	Clay – 60,000	Project site
	Excavation to +2 feet NAVD88	39		530,000	Clay – 530,000	
	Excavation from +2 feet NAVD88 to -20.85 NAVD88	76	113	1,125,000	Clay – 1,125,000	
	Dredging to -45 feet MLLW[b]	76	88	3,520,000	Sand – 3,520,000	Dredged Material Placement Area 5A
Turning Basin (North)	Dredging to -45 feet MLLW[b]	20	19	726,000	Clay – 573,080 Sand – 153,920	Dredged Material Placement Area 5A
Total excavation for placement on the Project site				1,715,000	Clay – 1,715,000	
Total material for Dredged Material Placement Area 5A				4,246,000	Clay – 573,000 Sand – 3,673,000	
Total material excavated and dredged				5,961,000	Clay – 2,288,000 Sand – 3,673,000	

Notes:
(a) Volume includes advance maintenance and over-depth volumes.
(b) Based on soil borings conducted at the Project site that show clay layers to -35 feet NAVD88 and sand from -35 to -65 feet NAVD88.

Key:
MLLW = mean lower low water

2.3 EXISTING CONDITIONS

The USACE conducted sediment sampling for contaminants as part of the Brazos Island Harbor (BIH), Texas, Channel Improvement Project. Analytical results for those samples indicated there are no chemical or physical concerns regarding placement of BSC sediments in upland placement areas (USACE 2014). Nevertheless, although the data indicate there are no contaminants of concern in the BSC, soil, sediment, and water samples will be collected within the dredging footprint for analysis of the composition and chemistry of the bottom and sub-bottom of the dredge area before the Project is constructed. Samples will be collected and analyzed for chemical constituents as described in Annova's Dredge Area Sampling and Analysis Plan (Attachment D of this Permit Application) in order to characterize the dredged material that is proposed for placement in a BND-owned DMPA. See Annova's Dredged Area Sampling and Analysis Plan for a detailed description of the field sampling methods, analytical program, and quality control procedures that will be implemented for characterizing the material to be dredged.

2.4 BENEFICIAL USE OPTIONS

Annova is coordinating with the USACE, the U.S. Environmental Protection Agency, and state and local entities to evaluate the potential for beneficial use of dredged material. Annova will be generating dredged and excavated material from two sources over the life of the Project. The initial development of the turning basin and marine berth (i.e., new work) will generate approximately 5,961,000 cubic yards (yd^3) of excavated and dredged material, with approximately 1,715,000 yd^3 of excavated material to be placed on the site, as shown in Table 1. Maintenance dredging will be required every other year for an estimated 30 years, generating approximately 200,000 yd^3 per event. New work material composition is expected to be largely clay with sand layers, while the maintenance material is expected to contain a higher percentage of sand.

Annova will conduct additional characterization of the dredged material and consult with regulatory agencies to define the potential for beneficial use of the dredged material. Ongoing Project design and development and additional geotechnical investigations and testing will allow refinement of existing proposed beneficial use options (on-site fill, marsh restoration, shoreline stabilization, and habitat restoration and creation) and, potentially, other uses to be identified for subsequent implementation.

Beneficial use of dredged material includes placing or using dredged sediments as resource material in productive ways that provide environmental, economic, or social benefits, according to the USACE (USACE 2015). Appendix A provides a summary of beneficial use concepts for dredged material under consideration. Table 2 lists common types and examples of dredged material uses. Examples of beneficial uses of dredged material include habitat development (e.g., wetland enhancement, restoration or creation, fishery enhancement); development of parks and recreational facilities (e.g., walking and bicycle trails, wildlife viewing areas); agricultural, forestry, and horticultural uses; strip-mine reclamation/solid waste management (e.g., fill for strip mines, landfill capping); shoreline construction (e.g., levee and dike construction); construction/industrial development (e.g., bank stabilization, site filling and leveling, brownfields reclamation); and beach nourishment (e.g., restoration of eroding beaches).

Table 2
Types and Examples of Beneficial Use Options

Engineered Uses	Agricultural and Product	Environmental Enhancement
• Berm Creation • Shore Protection • Capping Landfills and Industrial Sites • Replacement fill • Beach Nourishment • Land Creation • Land Improvement	• Aquaculture • Construction Materials • Decorative Landscaping Products • Topsoil	• Agriculture, Forestry, Horticulture, and Aquaculture • Fish & Wildlife Habitats • Fisheries Improvement • Wetland Restoration • Habitat development

Annova plans to use on-site placement of mechanically excavated material as fill for the Project as the preferred beneficial use option, excluding topsoil. Approximately one-fourth of the material removed to develop the marine facilities is proposed to be used on-site, based on current engineering information. The mechanically excavated material consists primarily of clay and is intended to be used for general site landscaping and grading. Assuming moderate compaction of the mechanically excavated material, approximately 1.3 million cubic yards of fill will be used to raise the elevation in these receiving areas up to +8 feet NAVD88.

2.5 DREDGED MATERIAL PLACEMENT AREAS

Due to the relatively small areas available within the Project site and the area required for dredge slurry dewatering, on-site placement of hydraulically dredged material would not be practicable. Therefore, Annova proposes to place these materials into BND-owned DMPAs or use them for off-site beneficial uses if feasible and practicable alternatives can be identified. There are a number of DMPAs adjacent to the BSC that have been evaluated as potential placement areas. The BND-owned placement areas are identified on Figure 4. Based on their proximity to the Project area, DMPAs 4A, 4B, 5A, and 5B were evaluated.

2.5.1 DMPA 4A

DMPA 4A is approximately 469 acres in size and is located east of the Project site and south of the Port Isabel Channel. DMPA 4A was last used for dredged material placement in 2009. The drop-outlet structure is currently known to be silted and in need of refurbishment. DMPA 4A is located in piping plover critical habitat unit TX-01, which places significant restrictions on the use of this DPMA and increased liability associated with degradation of the habitat.

2.5.2 DMPA 4B

DMPA 4B is approximately 243 acres in size and is located directly east of the Project site. The site is surrounded by a containment dike with an average height of 7 feet above the existing grade and a length of about 16,340 linear feet. The site has not been used for maintenance dredging for several years and the drop-outlet structure is currently not functioning. DMPA 4A is located in piping plover critical habitat unit TX-01, which places significant restrictions on the use of this DPMA and an increased liability associated with degradation of the habitat.

2.5.3 DMPA 5A

DMPA 5A is approximately 704 acres in size and is located directly west of the Project site. DMPA 5A is surrounded by a containment dike with an average height of 6 feet above the existing grade and a length of about 21,690 linear feet. The site is used for placement of maintenance dredged material from the adjacent section of the BSC navigation channel. The drop-outlet structure was recently refurbished and is functioning well.

2.5.4 DMPA 5B

DMPA 5B is approximately 1,020 acres in size and is located west of DMPA 5A. The site is surrounded by a containment dike with an average height of 12 feet above the existing grade and a length of about 29,343 linear feet (based upon post-construction surveys provided by the BND). The site is used for placement of maintenance dredged material from the adjacent section of the BSC navigation channel. The drop-outlet structure was recently refurbished and is functioning well.

2.5.5 PROPOSED PLACEMENT AREA

Potential placement areas were evaluated based on three criteria: distance from the Project site, available capacity, environmental considerations, and efficiency of placing the material. A dike with a smaller length to area ratio provides a more efficient site than a site with a longer length to area ratio. Sites are generally compartmentalized with internal dike “training structures” to increase the flow path from the pipeline discharge point to the outfall structure. This provides greater capacity for fine material to settle out of the discharge slurry before it is released back into the BSC. Large, square-shaped areas also provide more opportunity to work the material with dozers soon after placement without adversely affecting the settling process. Table 3 describes the respective characteristics of each DMPA.

NOTES:

1. LINE DRAWING REPRESENTS APPROXIMATE BOUNDARY OF DREDGED MATERIAL PLACEMENT AREA /SURFACE WATER.

LEGEND

BROWNSVILLE SURFACE WATER

DREDGED MATERIAL PLACEMENT AREA

SOURCE: B&V DRAWING # 183169.44.0160-Rev. C
NAIP 2014

FIGURE 4
BROWNSVILLE NAVIGATION DISTRICT DREDGED MATERIAL PLACEMENT AREAS
ANNOVA LNG BROWNSVILLE PROJECT
CAMERON COUNTY, TEXAS

annova LNG

SWG 2015-00110

Table 3
Dredged Material Placement Area Characteristics

DMPA	Distance to the Site (miles)	Dike Length (feet)	DMPA Area (acres)	Length:Area Ratio	USACE Dike Crest Requirements	Levee Raising Requirement[1]
4A	3 – 4	33,910	469	72.3	+35 feet NAVD88	17 feet
4B	Adjacent	16,338	243	67.2	+24 feet NAVD88	28 feet
5A	Adjacent	21,628	704	30.7	+17 feet NAVD88	12.5 feet
5B	3	29,343	1020	28.8	+19 feet NAVD88	8.5 feet

Source: B&V File 183169-REFF-0027

[1] The levee-raising requirements reflect the Project only and do not include capacity for material from the BIH Channel Improvement Project.

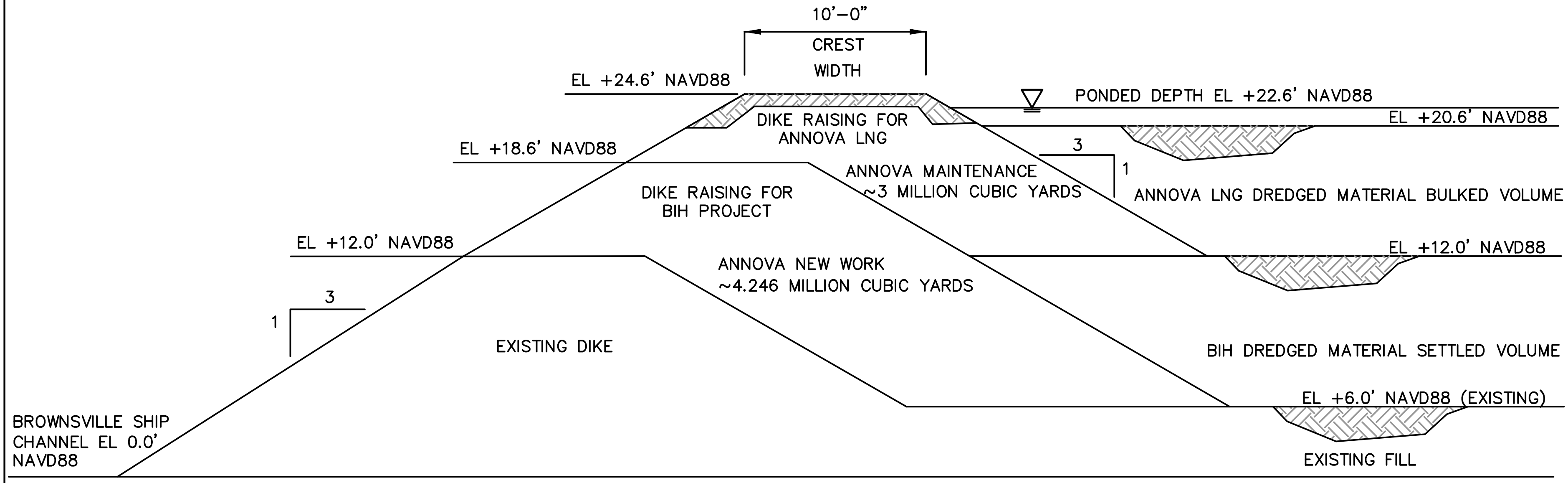
Based on the assumption that material excavated to +2 feet MLLW will be kept at the Project site, a total of 4,246,000 yd^3 of dredged material will require off-site placement. Typical capacity requirements for hydraulic dredging are 2.5 times the volume of dredged clay material and 1.3 times the volume for a dredged slurry consisting primarily of sandy material. Assuming a bulking factor of 1.9 to account for cohesive material, a volume of 10,200,000 yd^3 is needed within the placement areas.

Based on the dike length to area ratio of 30.7 for DMPA 5A, the dike will need to be raised 12.6 feet above the existing height to provide the capacity needed for the dredged material from the for Annova Project and BIH Channel Improvement Project, including freeboard for the decant slurry. Existing levee crest elevations range from +12 to +14 feet NAVD88 at DMPA 5A, which will result in an overall elevation of +23 to +25 feet NAVD88 for placement of Annova new work material and material from the BIH Channel Improvement Project (see Figure 5). The USACE's Engineering Appendix for the BIH Channel Improvement Project (2014) indicates that the subgrade at DMPA 5A can sustainably accommodate a total levee crest elevation of +42 feet NAVD88.

DMPA 5A is closer to the Project site than DMPA 5B, which is 3 miles away. Therefore, Annova identified DMPA 5A as the preferred placement area for dredged material from the Project site, with DMPA 5B serving as a suitable alternative.

Annova is consulting with the BND and the USACE regarding the use of DMPA 5A. The BND owns and is responsible for maintenance of the DMPAs, while the USACE has an easement for the total containment capacity. Based on consultations with the BND and the USACE, maintenance obligations for the DMPAs will pass from the BND to the USACE following the BIH Channel Improvement Project. Therefore, Annova is consulting with the USACE Operations and Real Estate Divisions regarding the availability and use of DMPA 5A.

The BIH Channel Improvement Project may use DMPA 5A for dredged material from maintenance dredging. Annova evaluated levee height for the cumulative use of DMPA 5A for the BIH project, proposed LNG facilities on the BSC, and the Annova Project. Appendix 1H of Resource Report 1 provides the cumulative analysis of dredged material placement.



NOTES:

1. ALL VALUES ARE APPROXIMATE.
2. TOP OF DIKE ELEVATION – FEET ABOVE EXISTING GRADE (NAVD88).
3. BRAZOS ISLAND HARBOR (BIH).

LEGEND

FILL MATERIAL

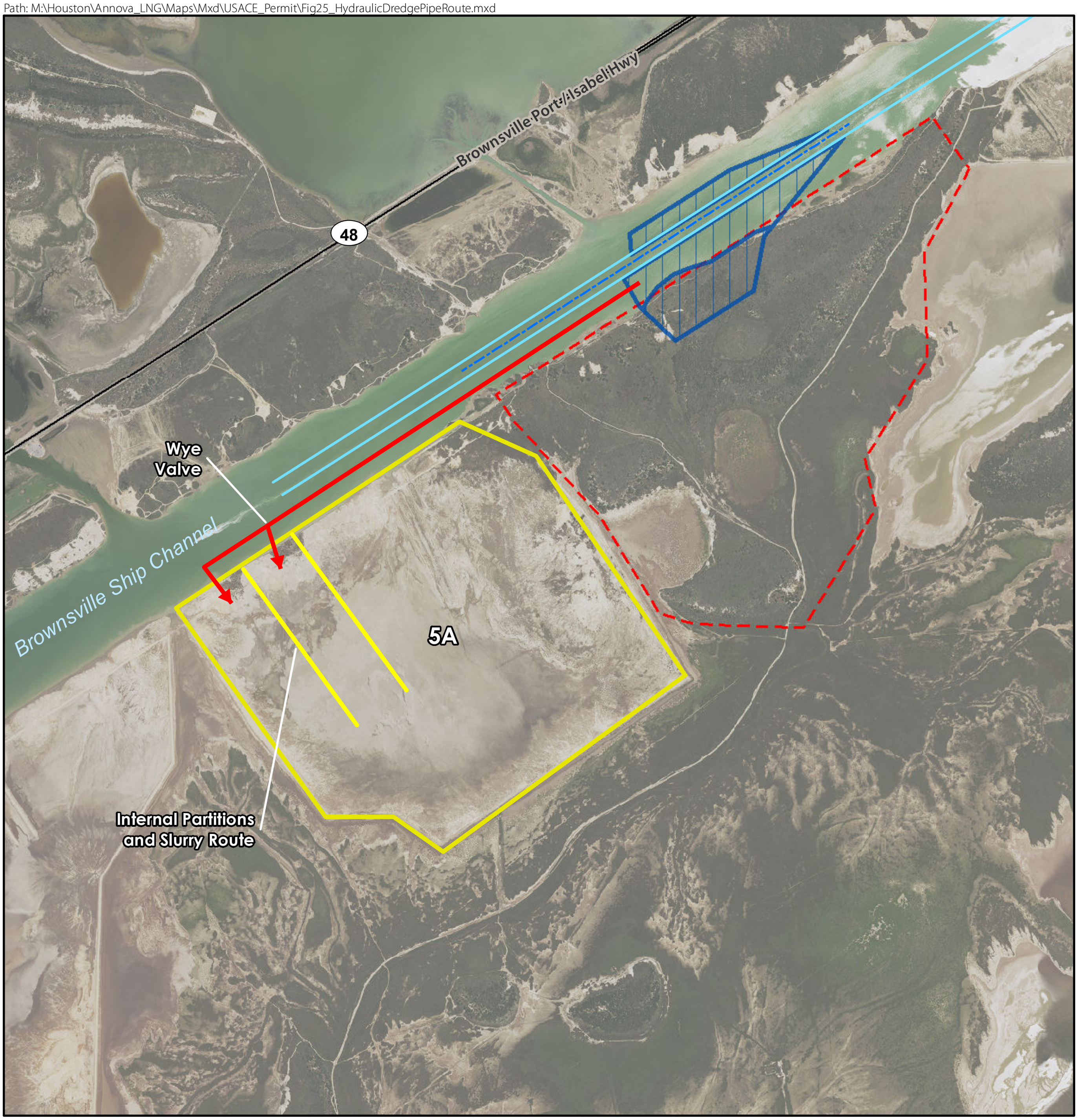
FIGURE 5
PROPOSED DMPA-5A DIKE, CROSS-SECTION, TYPICAL
ANNOVA LNG BROWNSVILLE PROJECT
CAMERON COUNTY, TEXAS

SOURCE: B&V DRAWING # 183169-00G0-FIG-06

3 DREDGED MATERIAL TRANSPORT

Upon mobilization of the dredge barge, a floating dredged material pipeline (27 inches in diameter, depending on the barge) will be installed and anchored along the south shore of the BSC such that no alteration to tidal flow will occur. The approximately 8,350-foot-long section of pipeline will be floated, marked with navigation lights and reflective signs, and monitored to ensure the safety of area traffic. The pipe will be flushed prior to opening to minimize turbidity released from the dredge pipe and visually monitored for leaks during operation. Figure 6 shows the proposed placement of the floating dredged material pipeline at DMPA 5A, and Figure 7 shows a floating dredged material pipe typical cross section. The dredge pipe will include a wye valve, which will evenly distribute the dredged material into two internal partitions within DMPA 5A. This distribution of the material will ensure that particle settling upon discharge from the pipe will be able to keep pace with the production rate of the dredge. The effluent outfall at the drop-outlet structure will be monitored for turbidity and erosion issues. Turbidity at the outfall will be limited to 280 nephelometric turbidity units, per 40 Code of Federal Regulations § 450.22. The BSC is not impaired for turbidity and no total maximum daily loads other than for bacteria have been established for this waterbody. It is anticipated that the floating dredged material pipeline will be installed no more than one month prior to the start of dredging activities and will be removed within one month following the completion of dredging activities.

Path: M:\Houston\Annova_LNG\Maps\Mxd\USACE_Permit\Fig25_HydraulicDredgePipeRoute.mxd



N

SCALE

0 1,000 2,000 Feet

SOURCE: Annova LNG 2015; ESRI 2014

Legend

- Internal Partitions and Slurry Route
- Hydraulic Dredge Pipeline Route
- Channel Centerline
- Channel Limit
- Dredging Footprint
- Project Site
- Dredged Material Placement Areas

Figure 6

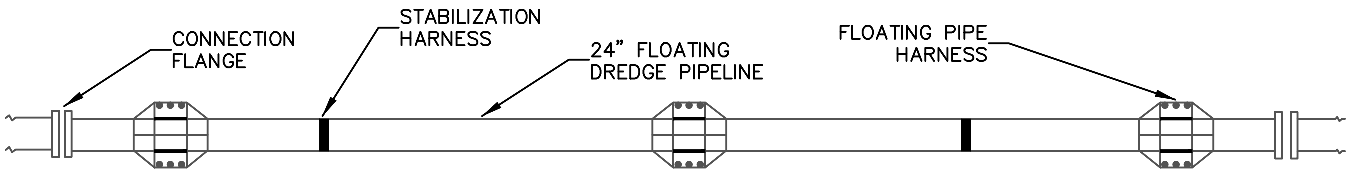
Hydraulic Dredge Pipeline Route

Annova LNG Brownsville Project

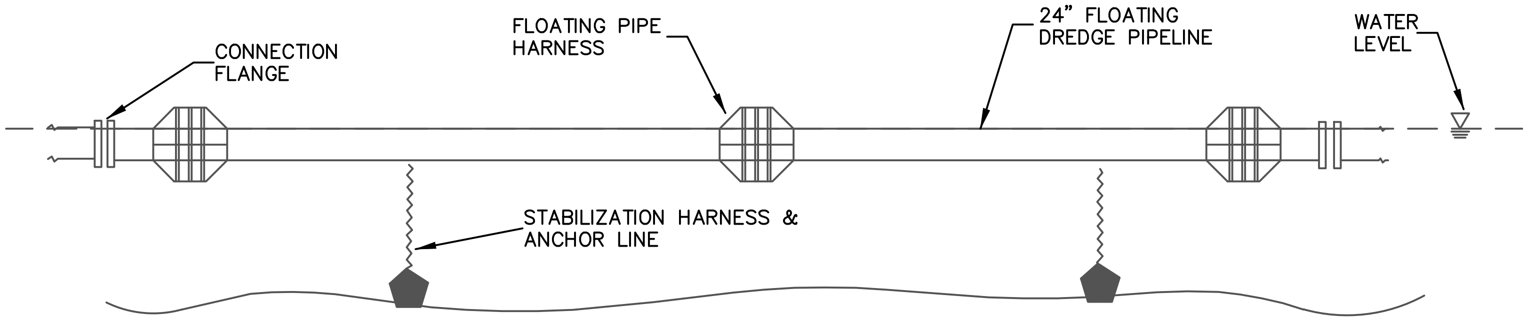
Cameron County, Texas

annova LNG

SWG 2015-00110



PLAN VIEW
NOT TO SCALE



PROFILE VIEW
NOT TO SCALE

NOTES:

1. SLACK IN STABILIZING ANCHORS WILL BE KEPT TO A MINIMUM TO PREVENT DRIFT.
2. DREDGE PIPE WILL BE FLUSHED PRIOR TO OPENING TO MINIMIZE TURBIDITY RELEASED FROM PIPE.

FIGURE 7
TYPICAL FLOATING DREDGE PIPE SECTION
ANNOVA LNG BROWNSVILLE PROJECT
CAMERON COUNTY, TEXAS

annova LNG

SWG 2015-00110

3-4

This page intentionally left blank.

4 MAINTENANCE DREDGING

4.1 MAINTENANCE DREDGING VOLUMES

With relatively low currents and few tributaries driving outflow or sediment recharge, shoaling in the BSC is relatively low and localized. Consultation with the BND suggests that there are several areas in the BSC where shoaling is observed. One such area is the "pilot channel" outfall from the Bahia Grande wetland area, which outfalls directly across the channel from the marine berth. Consultation with the Brazos Santiago Pilot's Association; however, suggests that the shoaling rates in this area have been decreasing over time. The pilot channel is the subject of a proposed widening project, which would further reduce sedimentation.

The BSC's current annual sedimentation rate is approximately 10 yd^3 per linear foot (USACE 2014). However, because of the configuration of the marine slip, it will be subject to shoaling rates in excess of that observed in the main channel. It is likely that the highest sedimentation rates will be in the areas at the mouth of the slip, near the edge of the cut, and around the marine berth. It is estimated that a total annual volume of 50,000 yd^3 to 100,000 yd^3 of maintenance dredging will be required. As such, Annova is proposing a continual dredging operation to remove up to 200,000 yd^3 every other year. Over the Project's design life of 30 years, this will generate a total volume of up to 3 million yd^3 of material requiring disposal.

4.2 MAINTENANCE DREDGING PLACEMENT

Placement of 3 million yd^3 of material in DMPA 5A over the lifespan of the Project will require an additional levee increase in elevation of 2.6 feet (see Figure 5). As the annual maintenance volume is approximately 100,000 yd^3, no freeboard allowance has been included in this capacity requirement. The frequency of dredging will be either on a one-year or two-year cycle, depending on actual accumulation rate.

5 REFERENCES

Black and Veatch. Dredged Material Management Plan for LNG Basin, Rev. C (183169-REFF-0027).

U.S. Army Corps of Engineers (USACE). 2014. *Brazos Island Harbor, Texas, Channel Improvement Project. Final Integrated Feasibility Report–Environmental Assessment*. U.S. Army Corps of Engineers, Galveston District. July 2014.

_________. 2015. Engineering Research and Development Center (ERDC) Beneficial Uses of Dredged Material. Available on line at http://el.erdc.usace.army.mil/dots/budm/budm.cfm

Appendix A

Beneficial Use Concepts for Dredged Material

This page intentionally left blank.

Annova LNG
Brownsville Project

Beneficial Use Concepts for Dredged Material

Prepared by:

BLACK & VEATCH
Building a world of difference.

TABLE OF CONTENTS

Section Page

1.0 INTRODUCTION 1
2.0 LOCAL AND PROJECT SITE GEOLOGY 1
3.0 BENEFICIAL USES OF DREDGED MATERIAL....................................2
3.1 On-Site Fill....................................3
3.2 Bird Islands 3
3.3 Marsh Restoration, Beach Nourishment, and Shoreline Stabilzation..........4
3.4 Upland Habitat Creation 4
4.0 SUMMARY....................................5
5.0 REFERENCES 5

TABLES

Table Page

2-1 Types and Examples of Beneficial Use Options.. 3

3-1 Summary of Beneficial Use Options 5

ACRONYMS AND ABBREVIATIONS

BSC	Brownsville Ship Channel
Project	Annova LNG Brownsville Project
NDT	National Dredging Team
USACE	U.S. Army Corps of Engineers
EPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

Annova is coordinating with the U.S. Army Corps of Engineers (USACE), the U.S. Environmental Protection Agency (USEPA) and state and local entities to evaluate the potential for beneficial use of dredged material. The USACE is responsible for maintaining the navigable waterways in the U.S. traditionally and leads the development of beneficial use of dredged material projects. The USACE, along with the USEPA and other federal and state resource agencies focus on beneficial uses of dredged material because of recognized environmental benefits and the increasing lack of disposal capacity in traditional disposal sites. The National Dredging Team (NDT) recognizes dredged material as a valuable resource that can be used in environmentally beneficial ways. The NDT's national guidance document, which explains the role of the Federal Standard in implementing beneficial uses of dredged material from the USACE's new and maintenance navigation projects, describes a number of recommended uses of dredged material for various productive purposes. Examples of beneficial uses of dredged material include habitat development (e.g., wetland restoration or creation, rookery islands, fishery enhancement); development of parks and recreational facilities (e.g., walking and bicycle trails, wildlife viewing areas); agricultural, forestry, and horticultural uses; sanitary landfill cover/capping; shoreline construction (e.g., levee and dike construction); construction/industrial development (e.g., bank stabilization, brownfields reclamation); and beach nourishment (e.g., restoration of eroding beaches).

Annova will be generating dredged and excavated material from two sources over the life of the Project. The initial development of the turning basin and marine berth, i.e., " new work," will generate approximately 5,371,000 cubic yards. Maintenance dredging will be required every other year for an estimated 30 years, generating approximately 200,000 cubic yards per event. New work material composition is expected to be largely clay with sand, while the maintenance material is expected to contain a higher percentage of sand.

Annova will conduct additional characterization of the dredged material combined with discussions with land owners needing fill material and consultation with regulatory agencies to define the potential for beneficial use of the dredged material. This summary represents beneficial use options based on current field investigations and test information. Ongoing Project design and development and additional geotechnical investigations and testing will allow refinement of existing proposed beneficial use options (on-site fill, marsh restoration, shoreline stabilization, and habitat restoration and creation) and, potentially, other uses to be identified for subsequent implementation.

2.0 LOCAL AND PROJECT SITE GEOLOGY

The surficial geologic units surrounding the Project include Quaternary alluvium, tidal flat deposits, muddy floodplain, clay dunes, and recent dredge spoils. Silty and sandy floodplain alluvium is composed of mostly silt and sand. Tidal flat deposits consist of varying amounts of sand, silt, clay (mud) and shells. Muddy floodplain alluvium is composed of mostly clay and silt (mud) deposits. Clay dune deposits are composed of eolian (wind-deposited) calcareous clay and silt deposited in lomas or low hills. These clay dunes form surrounding tidal flats and shallow basins in areas with pronounced wet and dry seasons during the year (Bowler 1973).

The geotechnical investigation report indicates that the Project site subsurface stratigraphy consists of four distinct layers (Black & Veatch 2016). The data show that Layer 1 consists of clay material that extends from the existing ground surface to between elevations -20 to -50 feet NAVD88. Layer 2 consists of sand material, ranging from 10 to 40 feet thick. The bottom elevation ranges from -40 to -60 feet NAVD88, with the bottom of the stratum shallower on the west side of the site. Layer 3 consists of a clay material with a depth up to 90 feet. This stratum appears interlayered with sand layers, especially on the northern portion of the site. Layer 4 consists of a sand material below elevation -150 feet NAVD88 to a maximum investigated depth of -200 feet NAVD88 (primarily identified based on the relatively high standard penetration tests N60-values).

Outlined below are options considered for beneficial use of dredged material based on existing knowledge of local and on-site geologic conditions and the proximity of Port Isabel, South Padre Island, national wildlife refuges, and Bahia Grande to the Project site.

3.0 BENEFICIAL USES OF DREDGED MATERIAL

Beneficial use of dredged material includes using dredged sediments as resource material in productive ways, which provide environmental, economic, or social benefit, according to the USACE (USACE 2015). Dredged material can be used beneficially for engineered and agricultural products and environmental enhancement purposes, as described on the beneficial uses website (*http://el.erdc.usace.army.mil/dots/budm/budm.cfm*) and in the seven categories described below (USACE 2006):

1. ***Habitat Restoration and Development:*** using dredged material to build and restore wildlife habitat, especially wetlands or other water-based habitat (e.g., nesting islands and offshore reefs).
2. ***Beach Nourishment:*** using dredged material (primarily sandy material) to restore beaches subject to erosion.
3. ***Parks and Recreation:*** using dredged material as the foundation for parks and recreational facilities (e.g., waterside parks) providing such amenities as swimming, picnicking, camping, or boating.
4. ***Agriculture, Forestry, Horticulture, and Aquaculture:*** using dredged material to replace eroded topsoil, elevate the soil surface, or improve the physical and chemical characteristics of soils.
5. ***Strip-Mine Reclamation and Solid Waste Management:*** using dredged material to reclaim strip mines, to cap solid waste landfills, or to protect landfills.
6. ***Construction/Industrial Development:*** using dredged material to support commercial or industrial activities (including brownfields redevelopment), primarily near waterways (e.g., expanding or raising the height of the land base, providing bank stabilization). In addition, dredged material may be used in construction material.
7. ***Multiple-Purpose Activities:*** using dredged material to meet a series of needs simultaneously, such as habitat development, recreation, and beach nourishment, which might all be supported with a single beneficial use project.

Table 2-1 lists common types and examples of dredged material use categorized by purpose: engineered, agricultural and product, and environmental enhancement.

Table 2-1
Types and Examples of Beneficial Use Options

Engineered Uses	Agricultural and Product	Environmental Enhancement
• Berm Creation • Shore Protection • Capping Landfills and Industrial Sites • Replacement fill • Beach Nourishment • Land Creation • Land Improvement	• Aquaculture • Construction Materials • Decorative Landscaping Products • Topsoil	• Agriculture, Forestry, Horticulture, and Aquaculture • Fish & Wildlife Habitats • Fisheries Improvement • Wetland Restoration • Habitat development

Considerations for the selection of beneficial uses include the availability of the site, dredged material physical and chemical compatibility, potential environmental impact, and practicability (cost, technology, and logistics). Given that the dredged material is originating from a marine rather than freshwater environment, certain options were eliminated from further analysis, including aquaculture/agriculture/forestry/horticulture, decorative landscaping products, topsoil, freshwater fisheries improvement, and solid waste management. Based on initial geotechnical investigation data and publically available information associated with previous Brazos Island Harbor dredging projects, the following beneficial use options were preliminarily identified for further consideration: (1) on-site fill; (2) bird island building; (3) coastal marsh and tidal wetland restoration, beach nourishment, and shoreline protection; and (4) upland habitat enhancement and creation.

3.1 ON-SITE FILL

Annova plans to use on-site placement of mechanically excavated material as fill for the Project as the preferred beneficial use option, excluding topsoil. Approximately one-fourth of the material removed to develop the marine facilities is proposed to be used on-site, based on current engineering information. The mechanically excavated material consists primarily of clay and is intended to be used for general site landscaping and grading. Assuming moderate compaction of the mechanically excavated material, approximately 1.3 million cubic yards of fill will be used to raise the elevation in these receiving areas up to +8 feet NAVD88.

3.2 BIRD ISLANDS

Bird nesting islands have been successfully constructed using dredged material. In the late 1980s, a coalition of eight governmental agencies identified environmentally and economically responsible ways to utilize new work and maintenance materials dredged from an expansion of the Houston Galveston ship channel in Galveston Bay. With over 4,000 acres of marsh creation, the agencies identified bird island construction as an appropriate beneficial use of new work dredged material. Although restoring or creating bird nesting islands offers an opportunity for beneficial use along the Gulf Intracoastal Waterway or in and near Bahia Grande, this option requires further analysis of the physical and chemical characteristics of the sediments to be dredged. In addition to suitability review, other areas to be evaluated include potential impacts on road and marine traffic for transport of dredged material by truck and barge, respectively; and schedule and cost.

3.3 MARSH RESTORATION, BEACH NOURISHMENT, AND SHORELINE STABILZATION

Aerial imagery, studies of shoreline change, and local coastal erosion control plans indicate eroded shorelines in the region that could benefit from placement of dredged material. Intense hurricanes can cause significant damage to the shoreline and to constructed jetties. The sand in the new work material from the Project may be suitable for both marsh restoration and beach nourishment, subject to further characterization. Also, dredged material selectively placed, shaped, and vegetated could restore eroded shorelines and provide an increased level of storm surge reduction. Maintenance material was used in the Aransas National Wildlife Refuge to restore marsh (ERDC 2015). There may be options to restore marsh and stabilize shoreline at either Laguna Atascosa or Lower Rio Grande National Wildlife Refuges, along Laguna Madre shoreline or Brownsville Ship Channel (BSC) shoreline, respectively.

The South Padre Island, ranked as one of the top beaches in the U.S., is used during the spring (March-May), summer (June-August), and fall (September-November) for public access and recreation as well as commercial fishing activities; therefore, the practicability and safety of transporting and handling large volumes of material (particularly on the changing beach surface in the tidal environment) while maintaining access for the public will require coordination with local government and business entities. Other principle areas to be evaluated include suitability of dredged material, viability of material transport through pipelines and pumps, and potential impacts on road and marine traffic for possible transport of dredged material by truck or barge, respectively.

3.4 UPLAND HABITAT CREATION

Using excavated clay material and harvesting native vegetation from the Project site to build lomas is a beneficial use option requiring further evaluation. Lomas are brush-covered clay dunes situated within tidal and wind-tidal flats. Lomas with dense brush cover in the proximity of the Project area have been known to facilitate the travel of endangered cats from Mexico to protected habitat in the Laguna Atascosa National Wildlife Refuge north of the BSC (USACE 2013). The U.S. Fish and Wildlife Service (USFWS) recovery strategy involves the restoration/creation of habitat like that provided by these lomas (USFWS 2010 and 2012).

Important considerations for this option include the total volume of material needed, the potential need to store or stage material and native plants until it is required for use at the designated areas, and the practicability of supplying large volumes of water to sufficiently increase the survivability of transplanted native species. Additionally, upland habitat creation placement options would increase the potential environmental impacts such as vehicle and fugitive dust emissions. Finally, this option would have potential significant Project cost implications associated with the re-handling of the dredged material and the transport and placement of material at the end location.

4.0 SUMMARY

The beneficial use options discussed above reflect preliminary information on the sediment characteristics for the Project and the specific landscape that may benefit from use of dredged material. Specific beneficial use options will be evaluated based on costs and consideration of environmental and social benefits. The evaluation will consider the volume of material used in each option, transport distances and methods, land acquisition requirements, and coordination with stakeholders. The potential beneficial use options for the Project and the associated logistics are summarized in Table 3-1. In each case, the engineering, economic, regulatory, and environmental feasibility will determine the viability of the preferred concepts presented herein.

Table 3-1
Summary of Beneficial Use Options

Beneficial Use Option	Material Required	Federal / Non-Federal Partners
On-site Placement	Clay	None Necessary
Levee Raising	Clay	U.S. Army Corps of Engineers / Brownsville Navigation District
Beach Nourishment	Sand	Texas General Land Office / City of South Padre Island
Lomas Creation	Clay	U.S. Fish and Wildlife Service
Marsh Restoration	Sand	U.S. Army Corps of Engineers / Galveston Navigation District

5.0 REFERENCES

Black & Veatch. 2016. *Geotechnical Investigation Report, Annova LNG Brownsville Project*. Document Number 183169-STDY-0006. March 21, 2016.

U.S. Army Corps of Engineers (USACE). 2013. Brazos Island Harbor, Texas Channel Improvement Project, Appendix I, Endangered Species Act – Draft Biological Assessment Cameron County, Texas. June 2013

______2015. Dredging and Dredged Material Management. Engineer Manual 1110-2-5025. U.S. Army Corps of Engineers, Washington, DC.

______2015. Engineer Research and Development Center (ERDC). Beneficial Uses of Dredged Material available online at: http://el.erdc.usace.army.mil/dots/budm/budm.cfm

U.S. Environmental Protection Agency (EPA). https://www.epa.gov/sites/production/files/2015-08/documents/role_of_the_federal_standard_in_the_beneficial_use_of_dredged_material.pdf

EPA and USACE. Identifying, Planning, and Financing Beneficial Use Projects Using Dredged Material. October 2007

U.S. Fish and Wildlife Service (USFWS). 2010. Draft Ocelot (*Leopardus pardalis*) Recovery Plan –First Revision. Southwest Region, Albuquerque.

_____. 2012. Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions, Notice of Review, 77 FR 69994 (November 12, 2012).

APPENDIX D
MIGRATORY BIRDS OF CAMERON COUNTY

TABLE D-1

Migratory Birds in Cameron County a/

Species	Potential Occurrence in the Project Area	Nesting Season in the Project Area	Description of Nesting Habitat	Potential Nesting Habitat at the Project Site?
Altamira oriole *(Icterus gularis)*	Year-round	N/A	Found on branch tips of trees emergent from canopy, dead branches of live or dead trees, sometimes on guy wires of power poles, often on branches growing out over water, bare ground, or low vegetation.	No
American oystercatcher *(Haematopus palliatus)*	Year-round	N/A	Nests are shallow depressions scraped into higher parts of sandy or rocky beaches above the high tide line.	No
Audubon's oriole *(Icterus graduacauda)*	Year-round	N/A	Commonly found in mesquite trees or bushes in thickets and open woods, often 6 to 16 feet off the ground.	No
Bald eagle *(Haliaeetus leucocephalus)*	Wintering	N/A	Generally nest on large trees with accessible limbs capable of holding nests.	No
Bell's vireo *(Vireo bellii)*	Breeding	April-July	Suspended from small, lateral or terminal forks of low, pendant branches in dense shrubs, small trees, and sometimes herbaceous vegetation. Typically found near the periphery of substrate plants and in association with small canopied openings in vegetation.	Yes
Black skimmer *(Rynchops niger)*	Year-round	N/A	Simple nests consisting of shallow scrapes in the sand.	No
Botteri's sparrow *(Peucaea botterii)*	Breeding	July-September	Typically found hidden in dense grass clumps on the ground on mostly flat terrain; found at the base of tufts or under projecting overhangs.	Yes
Buff-bellied hummingbird *(Amazilia yucatanensis)*	Year-round	N/A	Found in small trees or shrubs in horizontal branches typically 3 to 10 feet high.	No
Burrowing owl *(Athene cunicularia)*	Wintering	N/A	Nests in vacated prairie dog burrows where they may live in colonies.	No
Cassin's sparrow *(Aimophila cassinii)*	Year-round	N/A	Primarily found in short-grass prairies with scattered shrubby mesquite, cacti, yucca or oak.	No
Chestnut-collared longspur *(Calcarius ornatus)*	Wintering	N/A	Typically nests on the ground in excavated depressions, either exposed or under clumps of grass.	No
Curve-billed thrasher *(Toxostoma curvirostre)*	Year-round	N/A	Nests are generally a deep cup but may be flat with only a slight depression for the eggs. The outer layer often consists of thorny twigs, whereas the inner layers are of smooth sticks, roots, and coarse grasses. Fine grasses, rootlets, or hair may be used to line the cup.	No
Dickcissel *(Spiza americana)*	Breeding	May-August	Located in dense vegetation in grasses, forbs, or low woody plants, with nearly complete overhead cover. Nests are located in low vegetation but not directly on the ground.	Yes
Elf owl *(Micrathene whitneyi)*	Breeding	May-July	Uses available holes in saguaro cacti and sometimes in trees in forests and woodlands along drainages and lower slopes of canyons.	No

TABLE D-1 (continued)

Migratory Birds in Cameron County

Species	**Potential Occurrence in the Project Area**	**Nesting Season in the Project Area**	**Description of Nesting Habitat**	**Potential Nesting Habitat at the Project Site**
Green parakeet *(Psittacara holochlorus)*	Year-round	N/A	Prefer nesting in cavities in dead Canary Island palms.	No
Gull-billed tern *(Gelochelidon nilotica)*	Year-round	N/A	Typically nest in small to medium-sized coastal colonies, potentially in marshes and barrier beaches. Nest sites tend to be more elevated than surrounding terrain or sites of other associated tern species; typically found in barren sand or shell landscape.	No
Harris's hawk *(Parabuteo unicinctus)*	Year-round	N/A	Nests found in tall, sturdy structures; sometimes found in saguaro cacti.	No
Hooded oriole *(Icterus cucullatus)*	Breeding	April-August	Typically suspended from leaves of trees in residential areas, riparian canyons, parks and botanical gardens, or desert oases.	Yes
Hudsonian godwit *(Limosa haemastica)*	Migrating	N/A	Nests in areas of mixed forest and wetland, particularly sedge meadows and boggy muskeg surrounded by coniferous forest.	No
Lark bunting *(Calamospiza melanocorys)*	Wintering	N/A	Dry short-grass prairies.	No
Le Conte's sparrow *(Ammodramus leconteii)*	Wintering	N/A	Open habitat, such as marshy meadows, hayfields, open grassy fields, sedge fields, rice stubble, and prairie.	No
Least bittern *(Ixobrychus exilis)*	Breeding	May-August	Nests among dense, tall stands of emergent or woody vegetation, typically above or near open water.	Yes
Least tern *(Sterna antillarum)*	Breeding	April-September	Nests typically found close to nests of other species. Generally found in open areas mostly free of vegetation, above high water levels; sandy areas with sparse vegetation, mudflats, and graveled rooftops.	Yes
Lesser yellowlegs *(Tringa flavipes)*	Wintering	N/A	Breeds in open boreal forest with scattered shallow wetlands. Nests in depression in ground or moss, lined with dry grass, decayed leaves, spruce needles or other debris, placed on dry, mossy ridges or hummocks, next to fallen branches and logs, and underneath low shrubs.	No
Loggerhead shrike *(Lanius ludovicianus)*	Wintering	N/A	Typically found in trees with thorns, sometimes found in brush piles, tumbleweeds, or hardwood debris.	No
Long-billed curlew *(Numenius americanus)*	Wintering	N/A	Short-grass to mid-grass prairies on the High Plains to moist meadow-lands and mowed areas.	No
Magnificent frigatebird *(Fregata magnificens)*	Wintering	N/A	Lives on ocean coasts and islands. In breeding season it lives on mangrove islands.	No
Marbled godwit *(Limosa fedoa)*	Wintering	N/A	Salt marsh vegetation edges.	No
Mountain plover *(Charadrius montanus)*	Wintering	N/A	Short-grass prairie to cropland or barren ground.	No

TABLE D-1 (continued)

Migratory Birds in Cameron County

Species	Potential Occurrence in the Project Area	Nesting Season in the Project Area	Description of Nesting Habitat	Potential Nesting Habitat at the Project Site
Northern beardless-tyrannulet *(Camptostoma imberbe)*	Year-round	N/A	Riparian forest in clay soils of the Lower Rio Grande Valley and the live oak-dominated forest in sandy soil of Kenedy County.	No
Peregrine falcon *(Falco peregrinus)*	Wintering	N/A	Prefers very tall sheer cliff faces with a commanding view, a nearby water source, and a good prey base.	No
Red knot *(Calidris canutus rufa)*	Wintering	N/A	Nests typically built on dry, rocky arctic tundra at high elevations. Occurs year-round in coastal habitats. FWS confirmed the species does not nest in Texas.	No
Red-billed pigeon *(Patagioenas flavirostris)*	Year-round	N/A	Nests typically built on horizontal branches or crotches of trees or bushes; often found in dead and live trees, shrubs, saplings, and fence posts.	No
Red-crowned parrot *(Amazona viridigenalis)*	Year-round	N/A	Prefers large, thick leafy trees for roosting.	No
Reddish egret *(Egretta rufescens)*	Year-round	N/A	Nests on ground or in vegetation or trees less than 32 feet above the ground.	No
Rose-throated becard *(Pachyramphus aglaiae)*	Breeding, Wintering	May-July	Nests usually suspended at the end of a long hanging branch, under the shady canopy of a large tree (sycamore or cottonwood), up to 50 feet above the ground.	Yes
Sandwich tern *(Thalasseus sandvicensis)*	Year-round	N/A	Nest colonially on flat, sandy islands close to shore.	No
Seaside sparrow *(Ammodramus maritimus)*	Year-round	N/A	Nests at or near sea level along the Texas coast in tall spartina grass, rushes, and reeds growing in brackish or saltwater in tidal marshes.	No
Sedge wren *(Cistothorus platensis)*	Wintering	N/A	Nests in wet meadows, hayfields, old fields, and at upland edges of ponds, marshes, and sphagnum bogs with tall growth of sedges and grasses.	No
Short-billed dowitcher *(Limnodromus griseus)*	Wintering	N/A	Nests are usually located on the ground near water. The nest is a shallow scrape in a clump of moss or grass, lined with twigs, leaves, or grass.	No
Short-eared owl *(Asio flammeus)*	Wintering	N/A	Usually nests on dry sites such as small knolls, ridges, or hummocks.	No
Snowy plover *(Charadrius alexandrinus)*	Breeding	March-September	Bare areas such as salt flats, levees, dredge spoil piles and sand bars in rivers. Nests are often placed near a conspicuous object such as dried kelp, a shell driftwood, cow dung, or tumbleweed.	Yes
Solitary sandpiper *(Tringa solitaria)*	Wintering	N/A	Breeds in taiga, nesting in trees in deserted songbird nests.	No
Sprague's pipit *(Anthus spragueii)*	Wintering	N/A	Breeds and winters in open grassland with good drainage and no shrubs or trees.	No
Swainson's warbler *(Limnothlypis swainsonii)*	Migrating	N/A	Thick undergrowth in creek and river bottoms	No
Tropical parula *(Setophaga pitiayumi)*	Breeding	April-July	Nests in trees with epiphytic bromeliads, typically 6 to 42 feet off the ground, often near the ends of branches.	Yes

TABLE D-1 (continued)

Migratory Birds in Cameron County

Species	**Potential Occurrence in the Project Area**	**Nesting Season in the Project Area**	**Description of Nesting Habitat**	**Potential Nesting Habitat at the Project Site**
Verdin *(Auriparus flaviceps)*	Year-round	N/A	Nests often located along desert washes or at edges of vegetative boundaries, typically in dense foliage.	No
Whimbrel *(Numenius phaeopus)*	Wintering	N/A	Lives on the tundra in breeding season.	No
White-collared seedeater *(Sporophila torqueola)*	Year-round	N/A	Riparian areas, especially in floodplains where herbaceous vegetation is dense. Nest sites include small trees and bushes (black willow, anacua, catclaw acacia).	No
White-tailed hawk *(Buteo albicaudatus)*	Year-round	N/A	Nests typically found within areas of low woody cover, and sometimes near standing water.	No
Wilson's plover *(Charadrius wilsonia)*	Breeding	April-August	Nests typically found on bare soil or pavement near clumps of vegetation; typically near edges of road surfaced with rock, shells, or gravel.	Yes
Worm-eating warbler *(Helmitheros vermivorum)*	Migrating	N/A	Large tracts of deciduous or mixed deciduous-coniferous forests on moderate or steep slopes with patches of dense understory.	No

N/A = Not applicable because there is no nesting habitat on site, or species does not occur on site during the nesting season.

a/ Does not include federal threatened and endangered species. See section 4.7 of this EIS.

Sources:

Cornell Lab of Ornithology. 2017. Whooping Crane. Website: https://www.allaboutbirds.org/guide/Whooping_Crane/lifehistory

Alsop, F.J. III. 2001. *Smithsonian Birds of North America.* Southern Lights Custom Publishing.

Sibley, D.A. 2003. *The Sibley Field Guide to Birds of Eastern North America.* Andrew Stewart Publishing, Inc.

FWS (U.S. Fish and Wildlife Service). 2015. Information, Planning, and Conservation System (IPaC). Website: http://ecos.fws.gov/ipac/wizard/trustResourceList!prepare.action (accessed April 9, 2015).

APPENDIX E
VISUAL SIMULATIONS OF THE PROJECT AREA FROM KEY OBSERVATION POINTS

Photo Information

View looking northeast from the Historical Marker on Boca Chica Boulevard.

Longitude (W): -97.301718
Latitude (N): 25.961577
Elevation: 43 feet
Distance to Project Area: approx. 3.09 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: NE
Height of Camera: 5 ft.

Date: 9/3/2015
Time: 9:40 a.m.
Weather: Cloudy, storm approaching from east
Visibility: Fair

Annova LNG Visual Simulations

KOP 1. Palmito Ranch Battlefield Historical Marker

Figure E-1a
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

View looking northeast from the Historical Marker on Boca Chica Boulevard.

Longitude (W): -97.301718
Latitude (N): 25.961577
Elevation: 43 feet
Distance to Project Area: approx. 3.09 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: NE
Height of Camera: 5 ft.

Date: 9/3/2015
Time: 9:40 a.m.
Weather: Cloudy, storm approaching from east
Visibility: Fair

Annova LNG Visual Simulations

KOP 1. Palmito Ranch Battlefield Historical Marker

Figure **E-1b** Marine Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

View looking northeast from the Historical Marker on Boca Chica Boulevard.

Longitude (W): -97.301718
Latitude (N): 25.961577
Elevation: 43 feet
Distance to Project Area: approx. 3.09 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: NE
Height of Camera: 5 ft.

Date: 9/3/2015
Time: 9:40 a.m.
Weather: Cloudy, storm approaching from east
Visibility: Fair

Annova LNG Visual Simulations

KOP 1. Palmito Ranch Battlefield Historical Marker

Figure **E-1c** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Note: The proposed project would not be seen behind vegetation from this location. The tan wireframe above shows the facility as it would appear behind the vegetation.

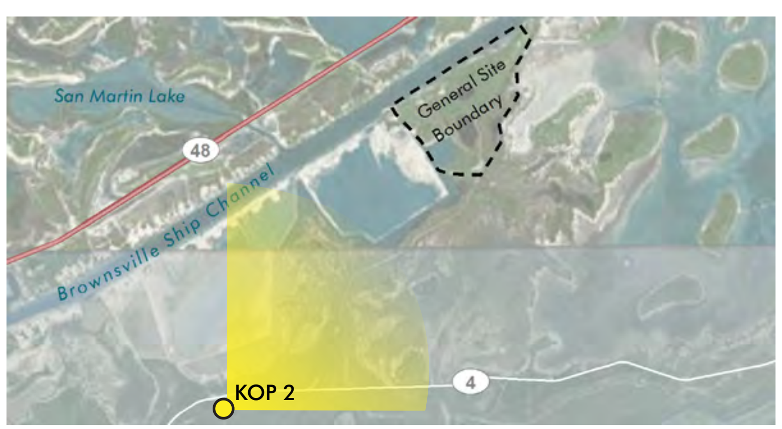


Photo Information

View looking northeast from observation platform at the Palmito Ranch Battlefield, south of Boca Chica Boulevard.

Longitude (W): -97.301958
Latitude (N): 25.956080
Elevation: 30.2 feet
Distance to Project Area: approx. 3.39 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 28mm (Equivalent to 45mm on film camera)
Camera Bearing: NE
Height of Camera: 5 ft plus 1.5 ft above surrounding ground level

Date: 9/3/2015
Time: 9:25 a.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 2. Palmito Ranch Battlefield National Historic Landmark (Observation Platform)

Figure E-2
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only.

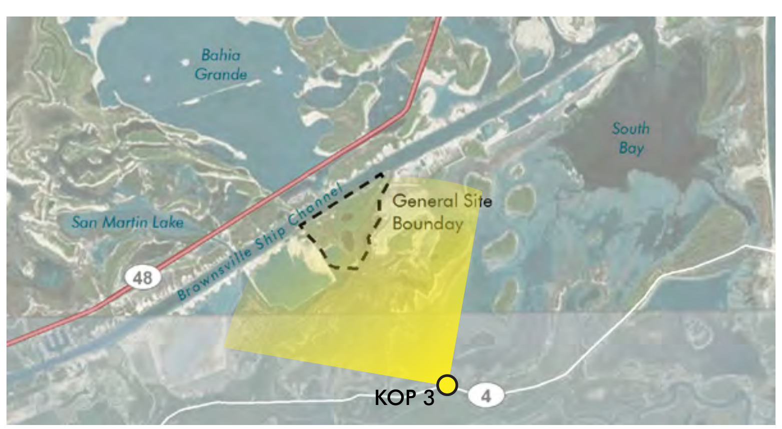


Photo Information

View looking northwest from a pull-off along Boca Chica Blvd. with views across the Lower Rio Grande Valley National Wildlife Refuge.

Longitude (W): -97.237855
Latitude (N): 25.965884
Elevation: 18.7 feet
Distance to Project Area: approx. 2.4 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: NW
Height of Camera: 5 ft.

Date: 9/3/2015
Time: 12:30 p.m.
Weather: Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 3. Lower Rio Grande Valley National Wildlife Refuge (Pull-off along Boca Chica Boulevard)

Figure E-3a
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

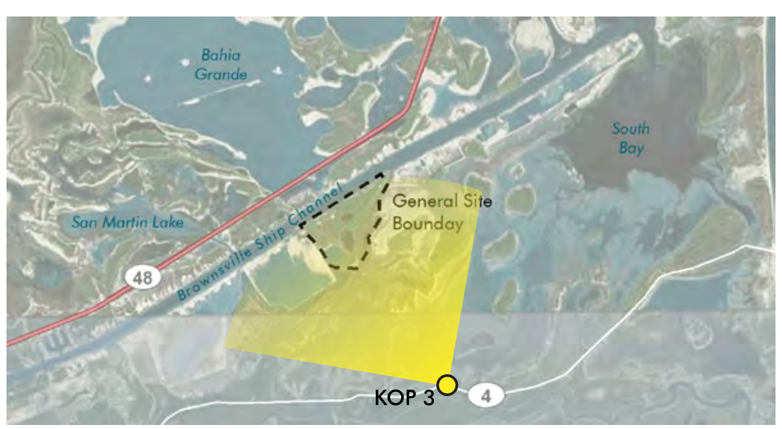


Photo Information

View looking northwest from a pull-off along Boca Chica Blvd. with views across the Lower Rio Grande Valley National Wildlife Refuge.

Longitude (W): -97.237855
Latitude (N): 25.965884
Elevation: 18.7 feet
Distance to Project Area: approx. 2.4 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: NW
Height of Camera: 5 ft.

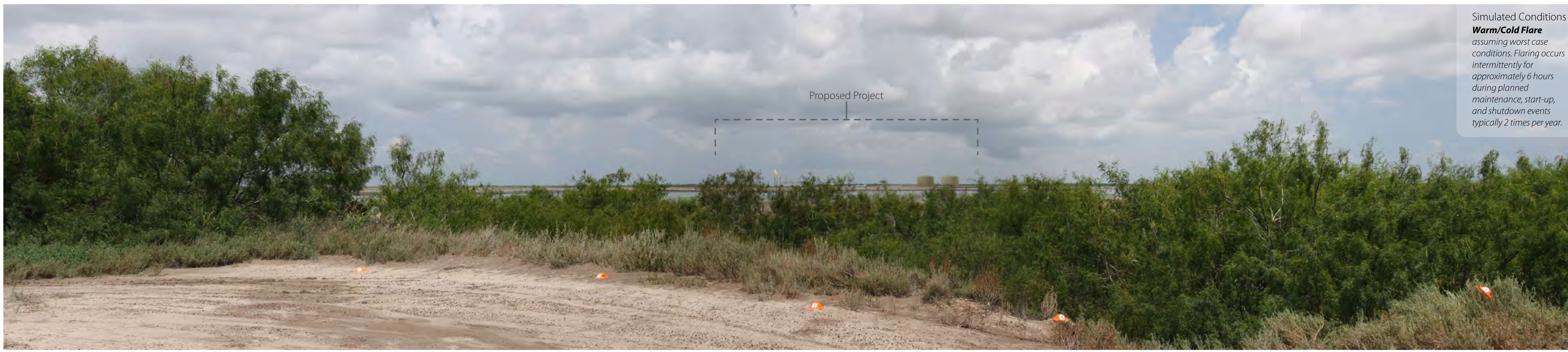
Date: 9/3/2015
Time: 12:30 p.m.
Weather: Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 3. Lower Rio Grande Valley National Wildlife Refuge (Pull-off along Boca Chica Boulevard)

Figure **E-3b** Marine Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.



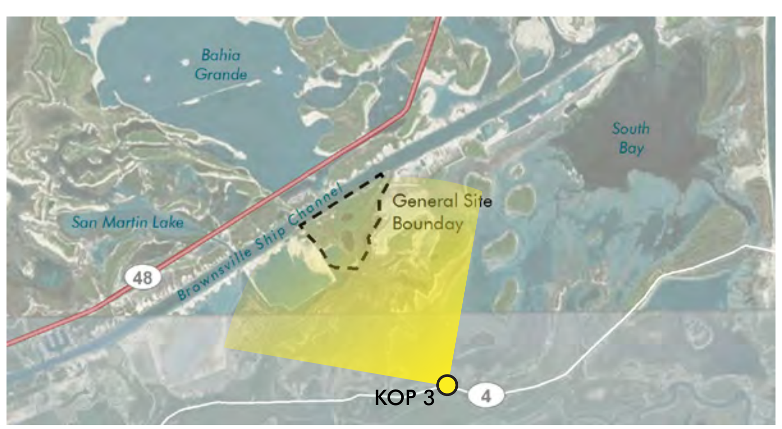


Photo Information

View looking northwest from a pull-off along Boca Chica Blvd. with views across the Lower Rio Grande Valley National Wildlife Refuge.

Longitude (W): -97.237855
Latitude (N): 25.965884
Elevation: 18.7 feet
Distance to Project Area: approx. 2.4 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: NW
Height of Camera: 5 ft.

Date: 9/3/2015
Time: 12:30 p.m.
Weather: Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 3. Lower Rio Grande Valley National Wildlife Refuge (Pull-off along Boca Chica Boulevard)

Figure **E-3c** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

View looking west from the Palmetto Pilings Historical Marker on Boca Chica Boulevard.

LLongitude (W): -97.158690
Latitude (N): 25.998294
Elevation: 6.9 feet
Distance to Project Area: approx. 5.94 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: W
Height of Camera: 5 ft.

Date: 9/3/2015
Time: 11:45 a.m.
Weather: Cloudy
Visibility: Fair

Annova LNG Visual Simulations

KOP 4. Palmetto Pilings Historical Marker

Figure E-4a
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

02:009110.0001.03.03\Figure 8A-2_Annova_KOP 4_Palmetto Pilings Historical Marker.ai-3/9/18-GRA

Photo Information

View looking west from the Palmetto Pilings Historical Marker on Boca Chica Boulevard.

LLongitude (W): -97.158690
Latitude (N): 25.998294
Elevation: 6.9 feet
Distance to Project Area: approx. 5.94 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: W
Height of Camera: 5 ft.

Date: 9/3/2015
Time: 11:45 a.m.
Weather: Cloudy
Visibility: Fair

Annova LNG Visual Simulations

KOP 4. Palmetto Pilings Historical Marker

Figure **E-4b** Marine Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

View looking west from the Palmetto Pilings Historical Marker on Boca Chica Boulevard.

LLongitude (W): -97.158690
Latitude (N): 25.998294
Elevation: 6.9 feet
Distance to Project Area: approx. 5.94 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: W
Height of Camera: 5 ft.

Date: 9/3/2015
Time: 11:45 a.m.
Weather: Cloudy
Visibility: Fair

Annova LNG Visual Simulations

KOP 4. Palmetto Pilings Historical Marker

Figure **E-4c** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

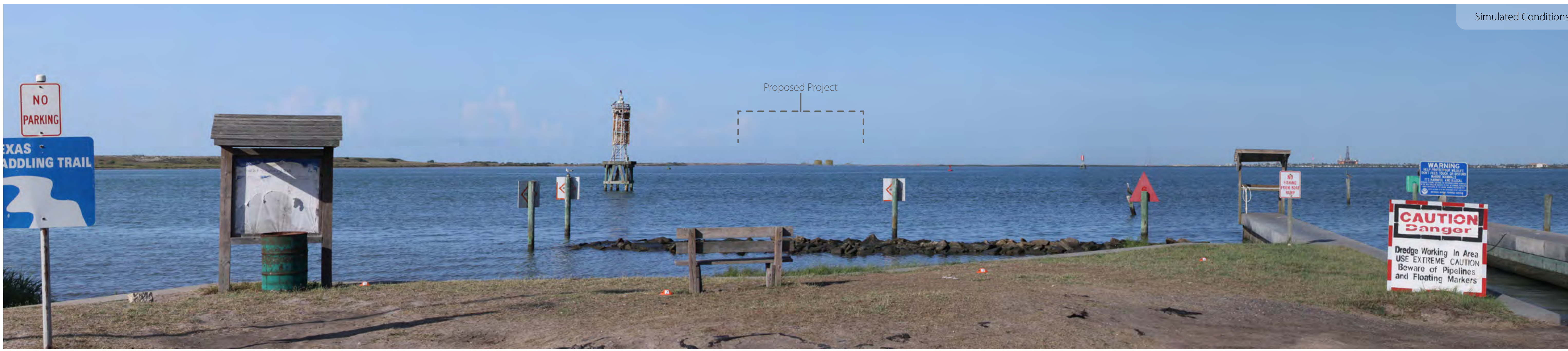


Photo Information

View looking southwest from the Isla Blanca Park Boat Ramp on South Padre Island.

Longitude (W): -97.162703
Latitude (N): 26.068794
Elevation: 18.4 feet
Distance to Project Area: approx. 6.74 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SW
Height of Camera: 5 ft.

Date: 9/2/2015
Time: 9:20 a.m.
Weather: Sunny, clear
Visibility: Good

Annova LNG Visual Simulations

KOP 5. Isla Blanca Park Boat Ramp

Figure **E-5a**
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

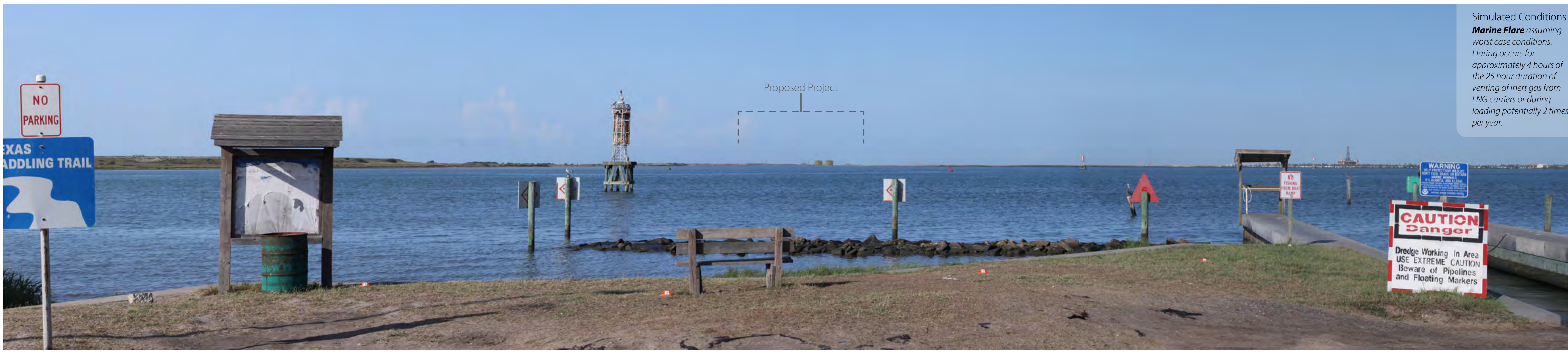


Photo Information

View looking southwest from the Isla Blanca Park Boat Ramp on South Padre Island.

Longitude (W): -97.162703
Latitude (N): 26.068794
Elevation: 18.4 feet
Distance to Project Area: approx. 6.74 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SW
Height of Camera: 5 ft.

Date: 9/2/2015
Time: 9:20 a.m.
Weather: Sunny, clear
Visibility: Good

Annova LNG Visual Simulations

KOP 5. Isla Blanca Park Boat Ramp

Figure **E-5b** Marine Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

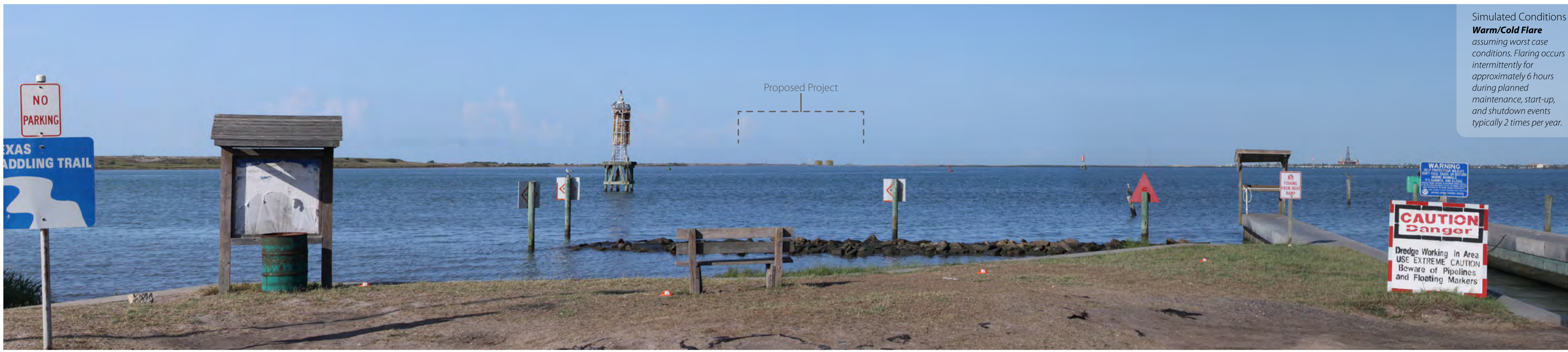


Photo Information

View looking southwest from the Isla Blanca Park Boat Ramp on South Padre Island.

Longitude (W): -97.162703
Latitude (N): 26.068794
Elevation: 18.4 feet
Distance to Project Area: approx. 6.74 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SW
Height of Camera: 5 ft.

Date: 9/2/2015
Time: 9:20 a.m.
Weather: Sunny, clear
Visibility: Good

Annova LNG Visual Simulations

KOP 5. Isla Blanca Park Boat Ramp

Figure **E-5c** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

02:009110.0001.03.03\Figure 8A-7_Annova_KOP 5b-NIGHT_Isla Blanca Park Boat Ramp – Nighttime.ai-4/10/18-GRA

Photo Information

Nighttime view looking southwest from the Isla Blanca Park Boat Ramp on South Padre Island.

Longitude (W): -97.162703
Latitude (N): 26.068794
Elevation: 18.4 feet
Distance to Project Area: approx. 6.74 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SW
Height of Camera: 5 ft.

Date: 9/2/2015
Time: 8:45 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 5. Isla Blanca Park Boat Ramp – Nighttime

Figure **E-5d**
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

Nighttime view looking southwest from the Isla Blanca Park Boat Ramp on South Padre Island.

Longitude (W): -97.162703
Latitude (N): 26.068794
Elevation: 18.4 feet
Distance to Project Area: approx. 6.74 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SW
Height of Camera: 5 ft.

Date: 9/2/2015
Time: 8:45 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 5. Isla Blanca Park Boat Ramp – Nighttime

Figure **E-5e** Marine Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

Nighttime view looking southwest from the Isla Blanca Park Boat Ramp on South Padre Island.

Longitude (W): -97.162703
Latitude (N): 26.068794
Elevation: 18.4 feet
Distance to Project Area: approx. 6.74 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SW
Height of Camera: 5 ft.

Date: 9/2/2015
Time: 8:45 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 5. Isla Blanca Park Boat Ramp – Nighttime

Figure **E-5f** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

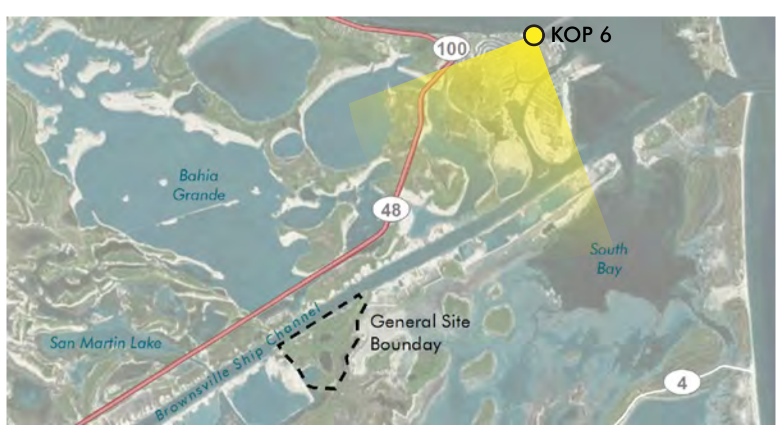


Photo Information

View looking southwest from the Port Isabel Lighthouse observation deck.

Longitude (W): -97.207585
Latitude (N): 26.077768
Elevation: 32.8 feet
Distance to Project Area: approx. 5.13 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SW
Height of Camera: 5 ft plus 73 ft. high at top of lighthouse

Date: 9/2/2015
Time: 11:30 a.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 6. Port Isabel Lighthouse

Figure E-6a
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

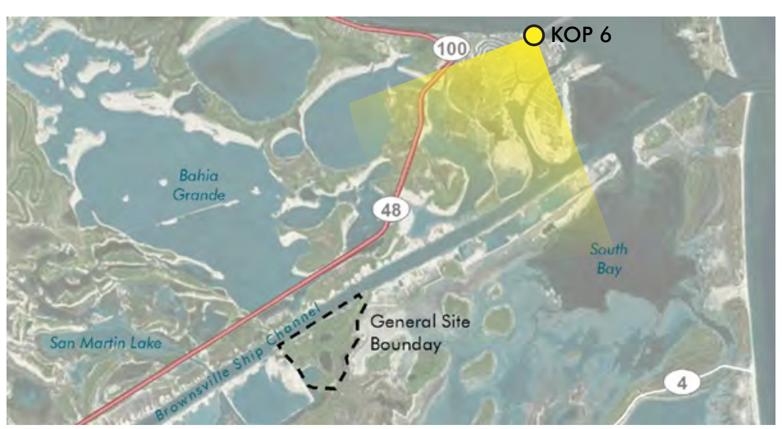


Photo Information

View looking southwest from the Port Isabel Lighthouse observation deck.

Longitude (W): -97.207585
Latitude (N): 26.077768
Elevation: 32.8 feet
Distance to Project Area: approx. 5.13 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SW
Height of Camera: 5 ft plus 73 ft. high at top of lighthouse

Date: 9/2/2015
Time: 11:30 a.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 6. Port Isabel Lighthouse

Figure **E-6b** Marine Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

02:009110.0001.02.03\Figure 8A-8_Annova_KOP 6_Port Isabel Lighthouse.ai-3/6/18-GRA

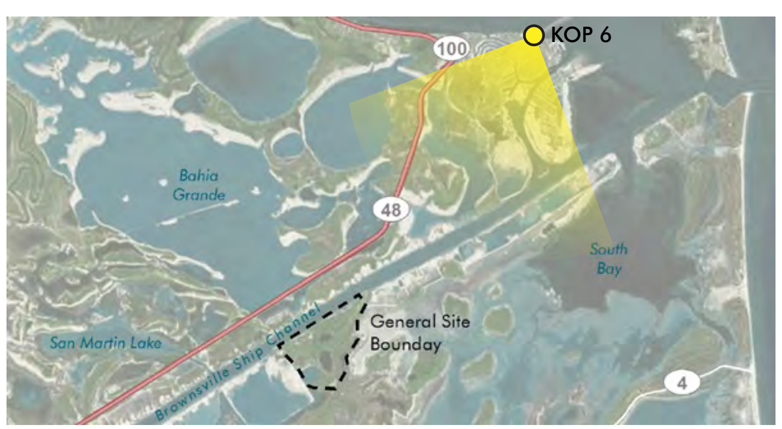


Photo Information

View looking southwest from the Port Isabel Lighthouse observation deck.

Longitude (W): -97.207585
Latitude (N): 26.077768
Elevation: 32.8 feet
Distance to Project Area: approx. 5.13 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SW
Height of Camera: 5 ft plus 73 ft. high at top of lighthouse

Date: 9/2/2015
Time: 11:30 a.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 6. Port Isabel Lighthouse

Figure **E-6c** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

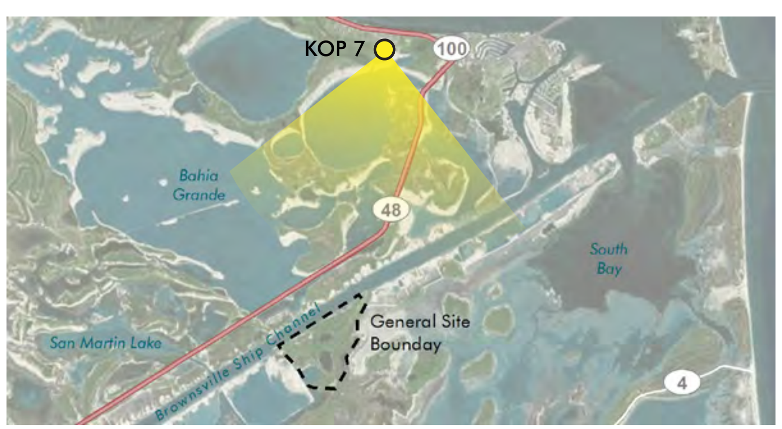


Photo Information

View looking south from the elevated stadium seating

Longitude (W): -97.246986
Latitude (N): 26.074919
Elevation: 31.5 feet
Distance to Project Area: approx. 4.06 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: S
Height of Camera: 5 ft plus 36 ft. at top of stadium seating

Date: 9/3/2015
Time: 6:15 p.m.
Weather: Partly cloudy
Visibility: Fair

Annova LNG Visual Simulations

KOP 7. Port Isabel High School Tarpon Stadium

Figure E-7a
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

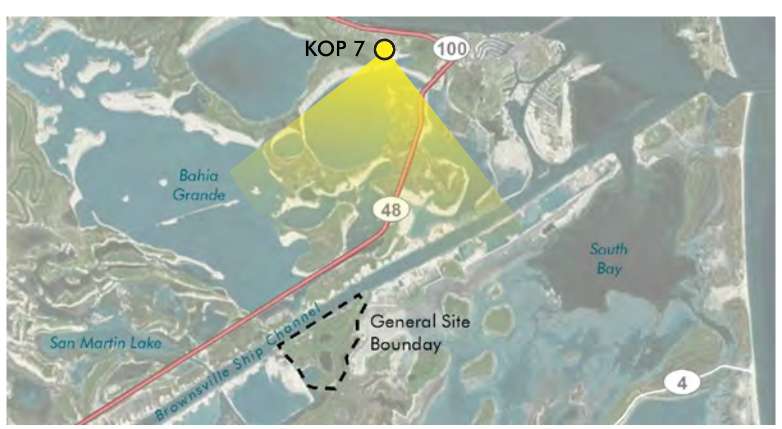


Photo Information

View looking south from the elevated stadium seating

Longitude (W): -97.246986
Latitude (N): 26.074919
Elevation: 31.5 feet
Distance to Project Area: approx. 4.06 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: S
Height of Camera: 5 ft plus 36 ft. at top of stadium seating

Date: 9/3/2015
Time: 6:15 p.m.
Weather: Partly cloudy
Visibility: Fair

Annova LNG Visual Simulations

KOP 7. Port Isabel High School Tarpon Stadium

Figure **E-7b** Marine Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

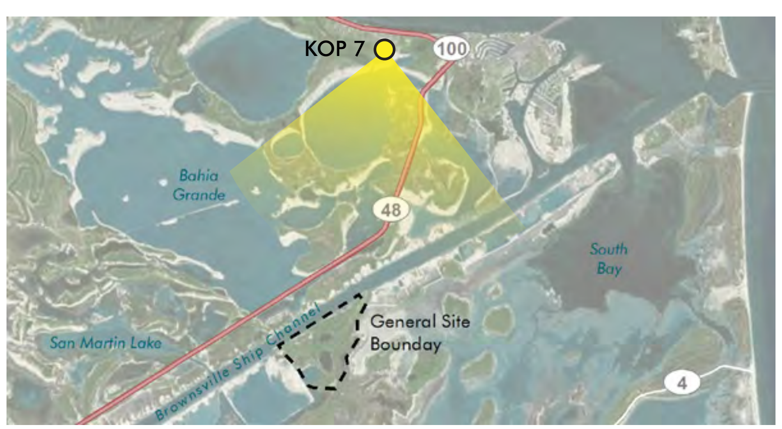


Photo Information

View looking south from the elevated stadium seating

Longitude (W): -97.246986
Latitude (N): 26.074919
Elevation: 31.5 feet
Distance to Project Area: approx. 4.06 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: S
Height of Camera: 5 ft plus 36 ft. at top of stadium seating

Date: 9/3/2015
Time: 6:15 p.m.
Weather: Partly cloudy
Visibility: Fair

Annova LNG Visual Simulations

KOP 7. Port Isabel High School Tarpon Stadium

Figure **E-7c** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Existing Conditions

Simulated Conditions

Proposed Project

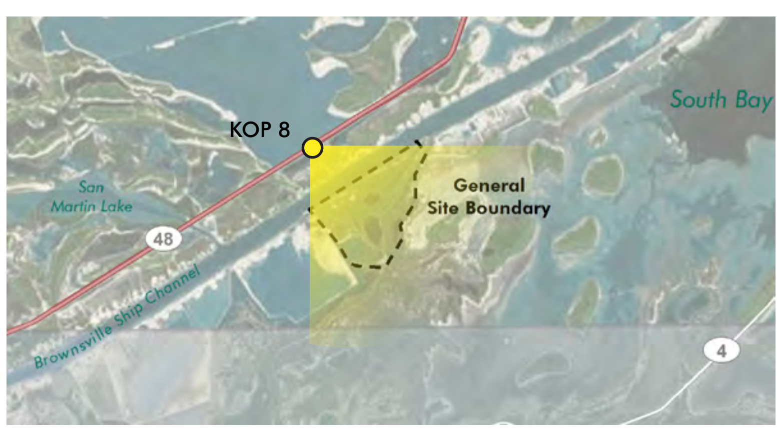


Photo Information

View looking southeast from a pull-off along the south side of SH 48 near the Bahia Grande Channel.

Longitude (W): -97.275384
Latitude (N): 26.015456
Elevation: 6.2 feet
Distance to Project Area: approx. 0.64 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SE
Height of Camera: 5 ft.

Date: 9/2/2015
Time: 5:45 p.m.
Weather: Sunny, few clouds
Visibility: Good

Annova LNG Visual Simulations

KOP 8. State Highway 48 Pull-off near Bahia Grande Channel - DAYTIME

Figure E-8a
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

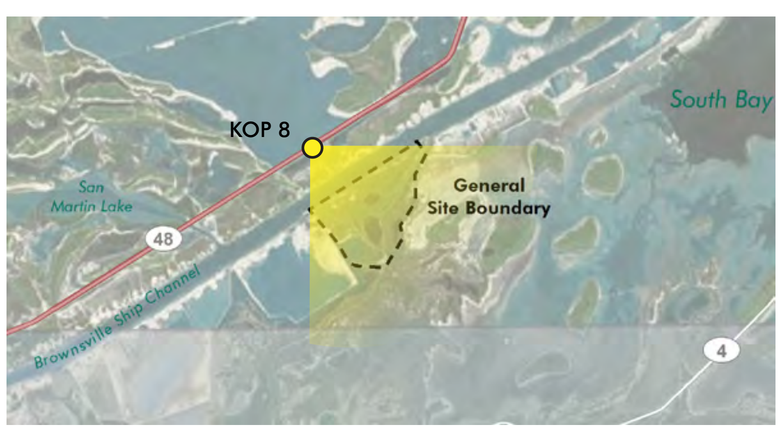


Photo Information

View looking southeast from a pull-off along the south side of SH 48 while an LNG carrier is docked in the Annova berth.

Longitude (W): -97.275384
Latitude (N): 26.015456
Elevation: 6.2 feet
Distance to Project Area: approx. 0.64 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SE
Height of Camera: 5 ft.

Date: 9/2/2015
Time: 5:45 p.m.
Weather: Sunny, few clouds
Visibility: Good

Annova LNG Visual Simulations

KOP 8. State Highway 48 Pull-off near Bahia Grande Channel – DAYTIME WITH LNG CARRIER

Figure **E-8b**
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

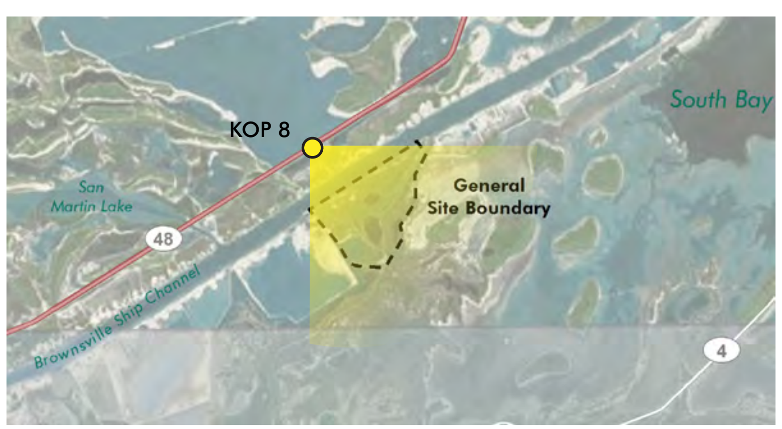


Photo Information

View looking southeast from a pull-off along the south side of SH 48 near the Bahia Grande Channel.

Longitude (W): -97.275384
Latitude (N): 26.015456
Elevation: 6.2 feet
Distance to Project Area: approx. 0.64 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SE
Height of Camera: 5 ft.

Date: 9/2/2015
Time: 5:45 p.m.
Weather: Sunny, few clouds
Visibility: Good

Annova LNG Visual Simulations

KOP 8. State Highway 48 Pull-off near Bahia Grande Channel - DAYTIME

Figure **E-8c** Marine Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Existing Conditions

Simulated Conditions
Warm/Cold Flare
assuming worst case conditions. Flaring occurs intermittently for approximately 6 hours during planned maintenance, start-up, and shutdown events typically 2 times per year.

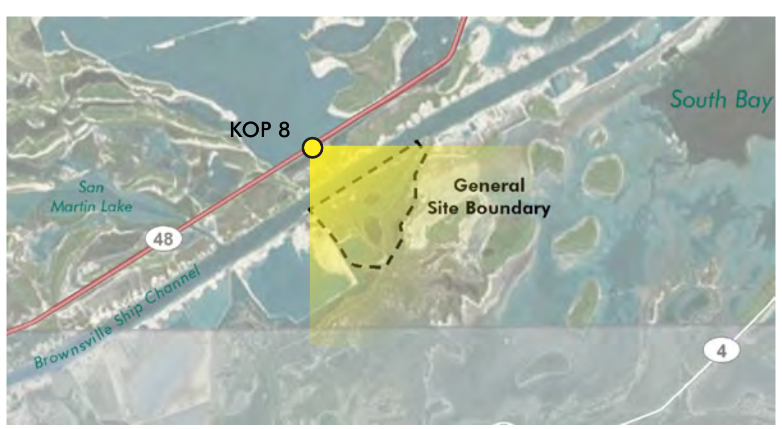


Photo Information

View looking southeast from a pull-off along the south side of SH 48 near the Bahia Grande Channel.

Longitude (W): -97.275384
Latitude (N): 26.015456
Elevation: 6.2 feet
Distance to Project Area: approx. 0.64 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SE
Height of Camera: 5 ft.

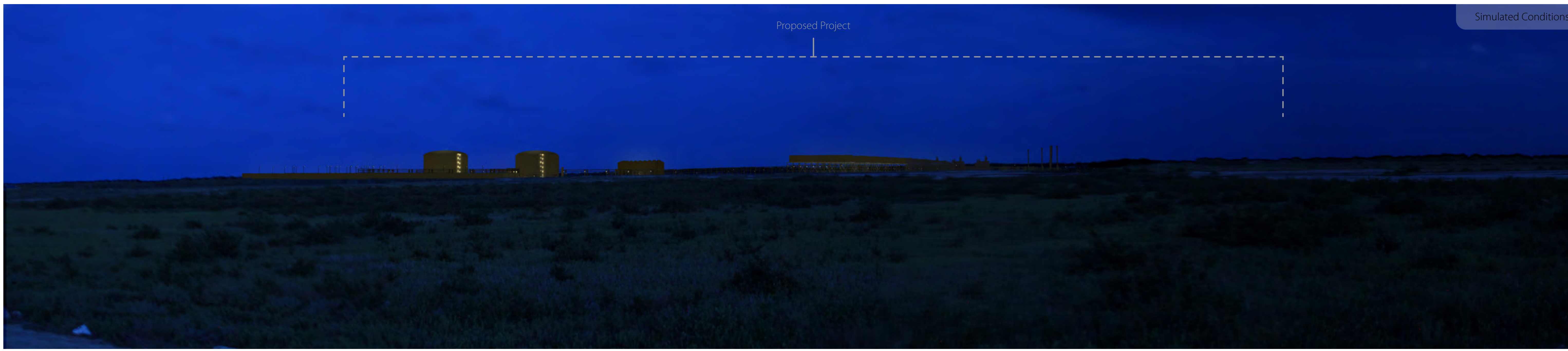
Date: 9/2/2015
Time: 5:45 p.m.
Weather: Sunny, few clouds
Visibility: Good

Annova LNG Visual Simulations

KOP 8. State Highway 48 Pull-off near Bahia Grande Channel - DAYTIME

Figure **E-8d** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.



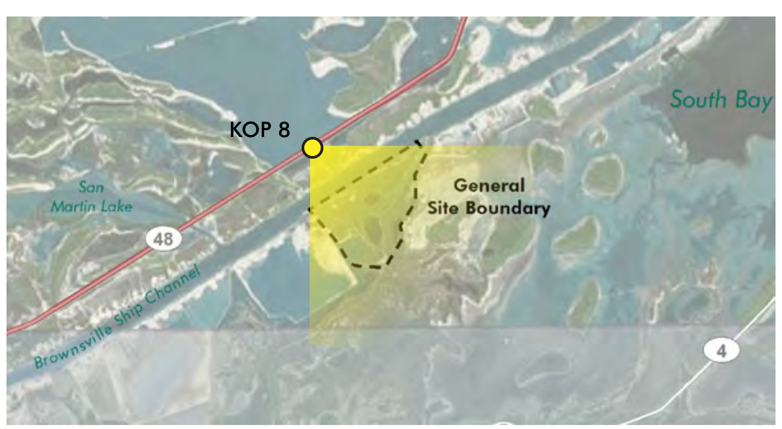


Photo Information

Nighttime view looking southeast from a pull-off along the south side of SH 48 near the Bahia Grande Channel.

Longitude (W): -97.275384
Latitude (N): 26.015456
Elevation: 6.2 feet
Distance to Project Area: approx. 0.64 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SE
Height of Camera: 5 ft.

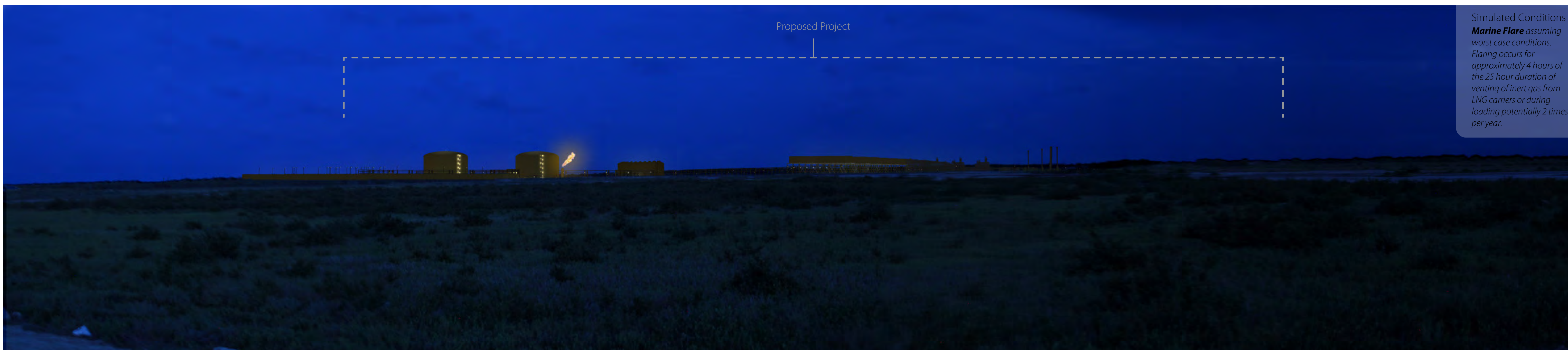
Date: 9/3/2015
Time: 8:21 p.m.
Weather: Overcast
Visibility: Good

Annova LNG Visual Simulations

KOP 8. State Highway 48 Pull-off near Bahia Grande Channel – NIGHTTIME

Figure E-8e
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.



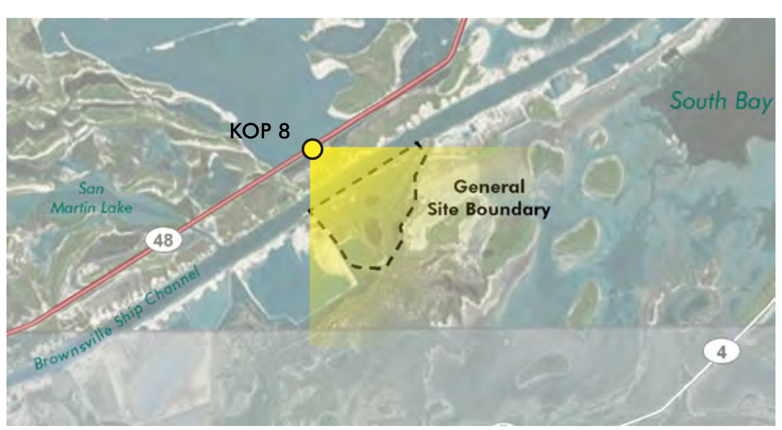


Photo Information

Nighttime view looking southeast from a pull-off along the south side of SH 48 near the Bahia Grande Channel.

Longitude (W): -97.275384
Latitude (N): 26.015456
Elevation: 6.2 feet
Distance to Project Area: approx. 0.64 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SE
Height of Camera: 5 ft.

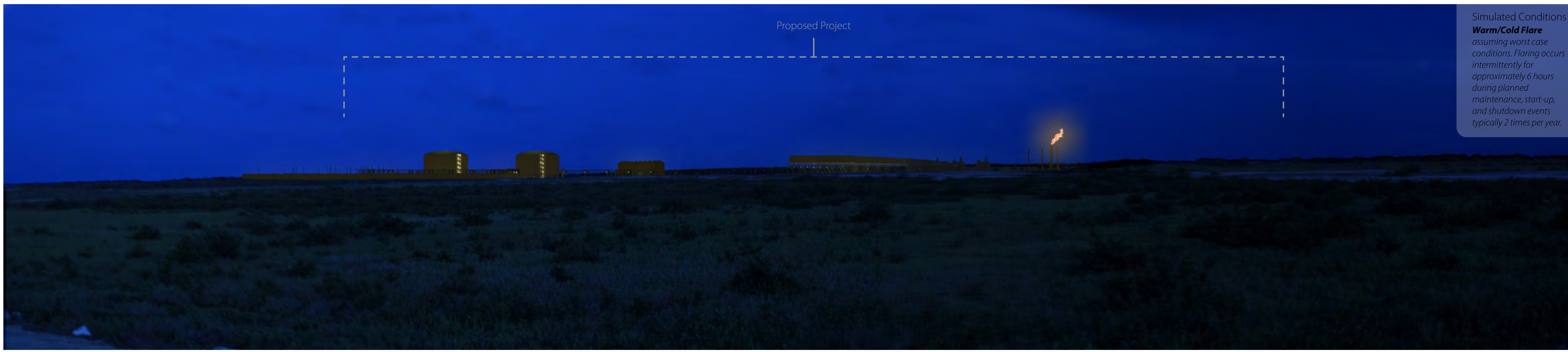
Date: 9/3/2015
Time: 8:21 p.m.
Weather: Overcast
Visibility: Good

Annova LNG Visual Simulations

KOP 8. State Highway 48 Pull-off near Bahia Grande Channel – NIGHTTIME

Figure **E-8f Marine** Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.



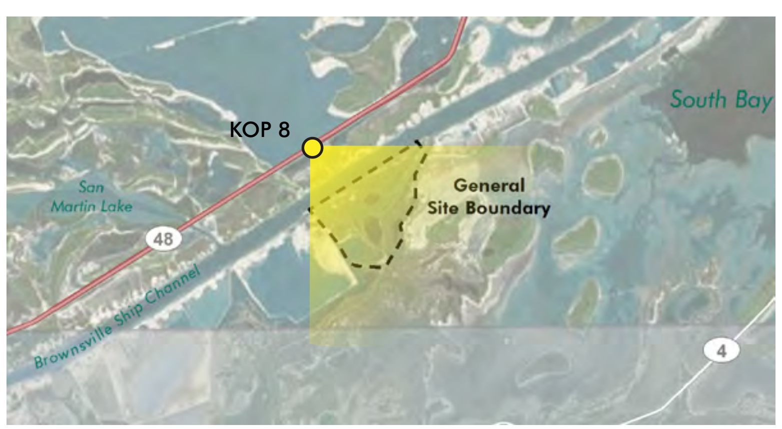


Photo Information

Nighttime view looking southeast from a pull-off along the south side of SH 48 near the Bahia Grande Channel.

Longitude (W): -97.275384
Latitude (N): 26.015456
Elevation: 6.2 feet
Distance to Project Area: approx. 0.64 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: SE
Height of Camera: 5 ft.

Date: 9/3/2015
Time: 8:21 p.m.
Weather: Overcast
Visibility: Good

Annova LNG Visual Simulations

KOP 8. State Highway 48 Pull-off near Bahia Grande Channel – NIGHTTIME

Figure **E-8g** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

02:009110.0001.03.03\Figure 8A-13_Annova_KOP 9a_Jaime J. Zapata Memorial Boat Ramp - DAYTIME.ai-3/1/18-GRA

Photo Information

View looking east from a dock at the boat ramp (located near channel connecting San Martin Lake and Brownsville Ship Channel)

Longitude (W): -97.298535
Latitude (N): 26.001798
Elevation: 17.4 feet
Distance to Project Area: approx. 1.42 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: E
Height of Camera: 5 ft plus on dock about 1.5 ft above surrounding ground level

Date: 9/2/2015
Time: 3:45 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 9. Jaime J. Zapata Memorial Boat Ramp - DAYTIME

Figure E-9a
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

View looking east from the boat ramp while an LNG carrier is docked in the Annova berth

Longitude (W): -97.298535
Latitude (N): 26.001798
Elevation: 17.4 feet
Distance to Project Area: approx. 1.42 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: E
Height of Camera: 5 ft plus on dock about 1.5 ft above surrounding ground level

Date: 9/2/2015
Time: 3:45 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 9. Jaime J. Zapata Memorial Boat Ramp – DAYTIME WITH LNG CARRIER

Figure E-9b
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

View looking east from a dock at the boat ramp (located near channel connecting San Martin Lake and Brownsville Ship Channel)

Longitude (W): -97.298535
Latitude (N): 26.001798
Elevation: 17.4 feet
Distance to Project Area: approx. 1.42 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: E
Height of Camera: 5 ft plus on dock about 1.5 ft above surrounding ground level

Date: 9/2/2015
Time: 3:45 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 9. Jaime J. Zapata Memorial Boat Ramp - DAYTIME

Figure **E-9c** Marine Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

View looking east from a dock at the boat ramp (located near channel connecting San Martin Lake and Brownsville Ship Channel)

Longitude (W): -97.298535
Latitude (N): 26.001798
Elevation: 17.4 feet
Distance to Project Area: approx. 1.42 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: E
Height of Camera: 5 ft plus on dock about 1.5 ft above surrounding ground level

Date: 9/2/2015
Time: 3:45 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 9. Jaime J. Zapata Memorial Boat Ramp - DAYTIME

Figure **E-9d** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

Nighttime view looking east from a dock at the boat ramp.

Longitude (W): -97.298535
Latitude (N): 26.001798
Elevation: 17.4 feet
Distance to Project Area: approx. 1.42 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: E
Height of Camera: 5 ft plus on dock about 1.5 ft above surrounding ground level

Date: 9/2/2015
Time: 9:28 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 9. Jaime J. Zapata Memorial Boat Ramp - NIGHTTIME

Figure E-9e
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

Nighttime view looking east from a dock at the boat ramp.

Longitude (W): -97.298535
Latitude (N): 26.001798
Elevation: 17.4 feet
Distance to Project Area: approx. 1.42 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: E
Height of Camera: 5 ft plus on dock about 1.5 ft above surrounding ground level

Date: 9/2/2015
Time: 9:28 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 9. Jaime J. Zapata Memorial Boat Ramp - NIGHTTIME

Figure **E-9f** Marine Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

Nighttime view looking east from a dock at the boat ramp.

Longitude (W): -97.298535
Latitude (N): 26.001798
Elevation: 17.4 feet
Distance to Project Area: approx. 1.42 miles

Camera: Canon 50D DSLR
Lens: Canon EF 28-135mm
Lens Setting: 35mm (Equivalent to 56mm on film camera)
Camera Bearing: E
Height of Camera: 5 ft plus on dock about 1.5 ft above surrounding ground level

Date: 9/2/2015
Time: 9:28 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 9. Jaime J. Zapata Memorial Boat Ramp - NIGHTTIME

Figure **E-9g** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 10" to 12" from eyes.

Photo Information

View looking east from the visitor overlook at Palo Alto Battlefield National Historical Park.

Longitude (W): -97.473602
Latitude (N): 26.021200
Elevation: 19.7 feet
Distance to Project Area: approx. 12.36 miles

Camera: Canon EOS DSLR
Lens: Canon EFS 18-55mm
Lens Setting: 55mm (Equivalent to 88mm on film camera)
Camera Bearing: E
Height of Camera: 5 ft plus 6.5 ft above surrounding ground level

Date: 1/14/2016
Time: 1:17 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 10. Palo Alto Battlefield National Historical Park (Visitor Overlook)

Figure **E-10a**
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 13-15" from eyes.

Photo Information

View looking east from the visitor overlook at Palo Alto Battlefield National Historical Park.

Longitude (W): -97.473602
Latitude (N): 26.021200
Elevation: 19.7 feet
Distance to Project Area: approx. 12.36 miles

Camera: Canon EOS DSLR
Lens: Canon EFS 18-55mm
Lens Setting: 55mm (Equivalent to 88mm on film camera)
Camera Bearing: E
Height of Camera: 5 ft plus 6.5 ft above surrounding ground level

Date: 1/14/2016
Time: 1:17 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 10. Palo Alto Battlefield National Historical Park (Visitor Overlook)

Figure **E-10b**
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 13-15" from eyes.

Photo Information

View looking east from the visitor overlook at Palo Alto Battlefield National Historical Park.

Longitude (W): -97.473602
Latitude (N): 26.021200
Elevation: 19.7 feet
Distance to Project Area: approx. 12.36 miles

Camera: Canon EOS DSLR
Lens: Canon EFS 18-55mm
Lens Setting: 55mm (Equivalent to 88mm on film camera)
Camera Bearing: E
Height of Camera: 5 ft plus 6.5 ft above surrounding ground level

Date: 1/14/2016
Time: 1:17 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 10. Palo Alto Battlefield National Historical Park (Visitor Overlook)

Figure **E-10c** Marine Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 13-15" from eyes.

Photo Information

View looking east from the visitor overlook at Palo Alto Battlefield National Historical Park.

Longitude (W): -97.473602
Latitude (N): 26.021200
Elevation: 19.7 feet
Distance to Project Area: approx. 12.36 miles

Camera: Canon EOS DSLR
Lens: Canon EFS 18-55mm
Lens Setting: 55mm (Equivalent to 88mm on film camera)
Camera Bearing: E
Height of Camera: 5 ft plus 6.5 ft above surrounding ground level

Date: 1/14/2016
Time: 1:17 p.m.
Weather: Partly Cloudy
Visibility: Good

Annova LNG Visual Simulations

KOP 10. Palo Alto Battlefield National Historical Park (Visitor Overlook)

Figure **E**-10**d** Warm/Cold Flare
Cameron County, TX

Not to scale. Not intended to be an exact representation. Artistic rendering for demonstration purposes only. Facility colors sampled from the 2013 BLM Standard Environmental Color chart.
To properly view this simulation, print on 11"x17" paper at 100% and view 13-15" from eyes.

APPENDIX F
ESSENTIAL FISH HABITAT ASSESSMENT

APPENDIX F
ANNOVA LNG BROWNSVILLE PROJECT
ESSENTIAL FISH HABITAT ASSESSMENT

TABLE OF CONTENTS

Page

1.0 INTRODUCTION AND REGULATORY BACKGROUND F-1
2.0 PROJECT OVERVIEW F-2
3.0 FEDERALLY MANAGED SPECIES AND ESSENTIAL FISH HABITAT F-2
3.1 RED DRUM F-7
3.2 REEF FISH (SNAPPER AND GROUPER) F-8
3.3 SHRIMP F-8
3.4 COASTAL MIGRATORY PELAGICS F-8
3.5 HIGHLY MIGRATORY SPECIES F-9
4.0 POTENTIAL PROJECT IMPACTS F-9
4.1 CONSTRUCTION F-10
4.1.1 Loss of Estuarine Open Water and Vegetated Habitat F-10
4.1.2 Increased Turbidities and Sedimentation F-12
4.1.3 Resuspension of Contaminated Sediments F-15
4.1.4 Loss, Reduction, or Change of the Benthic Assemblage F-15
4.1.5 Entrainment and Impingement During Hydrostatic Testing F-17
4.1.6 Noise Effects on Fish F-18
4.2 OPERATIONS F-24
4.2.1 Ballast Water Discharge F-24
4.2.2 Accidental Spills F-29
5.0 CUMULATIVE IMPACTS AND MITIGATION F-30
5.1 CUMULATIVE IMPACTS F-30
5.2 MITIGATION MEASURES F-30
6.0 CONCLUSION F-32
7.0 REFERENCES F-33

TABLES

Table Page

Table F-1 Managed Taxa with Essential Fish Habitat Potentially Occurring Within the Project Region of Influence F-3
Table F-2 Estuarine Essential Fish Habitats, Species, and Life Stages for Gulf of Mexico Fishery Management Council Ecoregion 5 .... F-6
Table F-3 Highly Migratory Species with EFH in State Waters of Ecoregion 5 in the Project Area F-7
Table F-4 Summary of the Proposed Activities that May Affect Essential Fish Habitat F-10
TABLE F-5 Temporary Impacts to and Permanent Loss of Tidal and Subtidal and Wetland EFH F-11
Table F-6 Unattenuated Sound Pressure Levels Measured for the Benicia-Martinez Bridge F-21
Table F-7 Predicted Pile-Driving Noise Thresholds Limits for Fish F-23

FIGURES

Figure Page

Figure F-1 Essential Fish Habitat for Coastal Migratory Pelagics, Reef Fish, Shrimp, and Red Drum F-4
Figure F-2 Salinity Ranges for Adults of Estuarine Species Compared with Open Gulf Salinities F-26

ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
Annova	Annova LNG Common Infrastructure, LLC; Annova LNG Brownsville A, LLC; Annova LNG Brownsville B, LLC; and Annova LNG Brownsville C, LLC
Annova Plan	Annova's *Upland Erosion Control, Revegetation, and Maintenance Plan*
Annova Procedures	Annova's *Wetland and Waterbody Construction and Mitigation Procedures*
BMP	best management practice
BND	Brownsville Navigation District
BSC	Brownsville Ship Channel
CFR	Code of Federal Regulations
COE	United States Army Corps of Engineers
Coast Guard	United States Coast Guard
dB re 1 μPa	decibels in reference to 1 microPascal
DMPA	dredge material placement area
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	environmental impact statement
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FMP	fishery management plan
GIS	geographical information system
GMFMC	Gulf of Mexico Fishery Management Council
HAPC	habitat area of particular concern
HMS	highly migratory species
HSD	Hydro Sound Damper
Hz	hertz
LNG	liquefied natural gas
μPa	microPascal
mg/L	milligram per liter
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NAISA	National Aquatic Invasive Species Act of 2003
NANPCA	Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990
NEPA	National Environmental Policy Act
NMS	Noise Mitigation Screen
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
PAH	polycyclic aromatic hydrocarbon
PRICO®	Poly Refrigerant Integrated Cycle Operation
ppt	parts per thousand

Project	Annova Liquefied Natural Gas Project
RMS	root-mean-squared
ROI	region of influence
SEL	sound exposure level
SPL	sound pressure level
TCEQ	Texas Commission on Environmental Quality
TL	transmission loss
TSS	total suspended solids
ZOI	zone of influence

1.0 INTRODUCTION AND REGULATORY BACKGROUND

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA; Public Law 94-265 as amended through October 11, 1996) was established, along with other goals, to promote the protection of essential fish habitat (EFH) during the review of projects to be conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. EFH is defined in the MSA as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Federal agencies that authorize, fund, or undertake activities that may adversely affect EFH must consult with the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries). Although absolute criteria have not been established for conducting EFH consultations, NOAA Fisheries recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as the National Environmental Policy Act (NEPA), the Fish and Wildlife Coordination Act, and the Endangered Species Act (ESA), to reduce duplication and improve efficiency (50 Code of Federal Regulations [CFR] 600.920(e)). Generally, the EFH consultation process includes the following steps:

1. Notification – The action agency should clearly state the process being used for EFH consultations (e.g., incorporating EFH consultation into an EIS).
2. EFH Assessment – The action agency should prepare an EFH Assessment that includes both identification of affected EFH and an assessment of impacts. Specifically, the EFH Assessment should include:
   - a description of the proposed action;
   - an analysis of the effects (including cumulative effects) of the proposed action on EFH, managed fish species, and major prey species;
   - the federal agency's views regarding the effects of the action on EFH; and
   - proposed mitigation, if applicable.
3. EFH Conservation Recommendations – After reviewing the EFH Assessment, NOAA Fisheries should provide recommendations to the action agency regarding measures that can be taken by that agency to conserve EFH.
4. Agency Response – Within 30 days of receiving the recommendations, the action agency must respond to NOAA Fisheries. The action agency may notify NOAA Fisheries that a full response to the conservation recommendations would be provided by a specified completion date agreeable to all parties. The response must include a description of measures proposed by the agency to avoid, mitigate, or offset the impact of the activity on EFH. For any conservation recommendation that is not adopted, the action agency must explain its reason to NOAA Fisheries for not following the recommendation.

The Federal Energy Regulatory Commission (FERC) proposes to incorporate EFH consultation for the Annova Liquefied Natural Gas (LNG) Brownsville Project (Project) with the interagency coordination procedures required under NEPA. As such, we requested that NOAA Fisheries consider the draft environmental impact statement (EIS) for the Project as initiation of EFH consultation.

The FERC often issues a final EIS with updated resource information, but consultation between the FERC and other federal resource agencies continues beyond the issuance of the final EIS. FERC practice is not to authorize any construction until all required federal permits and consultations have been completed.

This report is being prepared to facilitate the FERC's review and development of an EIS for the Project. This EFH assessment includes the required elements defined above.

2.0 PROJECT OVERVIEW

Annova LNG Common Infrastructure, LLC; Annova LNG Brownsville A, LLC; Annova LNG Brownsville B, LLC; and Annova LNG Brownsville C, LLC (Annova) is proposing to construct, own, and operate the Project in Cameron County, Texas. Annova would construct the Project on an approximately 731-acre property adjacent to the Brownsville Ship Channel (BSC), which is available to Annova through a real estate lease option agreement with the Brownsville Navigation District (BND). The property is located at approximate mile marker 8.2 on the BSC. The Project includes two principal parts: the LNG facilities and the associated marine transfer facilities. LNG would be stored in two single-containment LNG storage tanks on the site and would be pumped from the storage tanks to the marine transfer facilities. The marine transfer facilities would load LNG carriers that arrive at the berthing dock.

Chapters 1 and 2 of the EIS provide a Project description, including a description of Project components, mapping, land requirements, construction and operation methods, the anticipated construction schedule, and a summary of permits and approvals required and Annova's communications with stakeholders. Chapter 3 of the EIS includes an alternatives analysis, and Chapter 4 provides resource-specific impact analysis as well as analysis of potential cumulative impacts of the Project when combined with the impacts of other past, present, and reasonably foreseeable future actions.

3.0 FEDERALLY MANAGED SPECIES AND ESSENTIAL FISH HABITAT

Commercial and recreational fisheries resources in the federal waters of the Gulf of Mexico are managed by the Gulf of Mexico Fishery Management Council (GMFMC) and NOAA Fisheries. Between 1979 and 1987, the GMFMC prepared fishery management plans (FMPs) for seven marine groups within the Gulf of Mexico: red drum (*Sciaenops oce1latus*), coastal migratory pelagics, reef fish, shrimp, spiny lobster (*Panulirus argus*), stone crab (*Menippe adina* and *Menippe mercenaria*), and corals. Each FMP has been amended at least several times since then. One important amendment that applied to all seven FMPs was implemented in 1998 and involved the identification of EFH for each group. Additionally, the Secretarial FMP developed by NOAA Fisheries for highly migratory species (HMS) included Amendment 1 to the *Atlantic Billfish Fishery Management Plan* and the *Final Fishery Management Plan for Atlantic Tuna, Swordfish, and Sharks*.

All estuarine systems of the Gulf of Mexico, including the BSC, are considered EFH, which is managed by the GMFMC (GMFMC 2010). EFH includes all types of marine and estuarine habitat (e.g., wetlands, coral reefs, seagrasses, and rivers) where fish spawn, breed, feed, or grow to maturity. The MSA requires the GMFMC to identify habitats essential to managed species and implement measures to conserve and enhance this habitat. NOAA Fisheries reviews the EFH

Assessment submitted by federal project proponents and recommends conservation measures designed to minimize, to the extent practicable, any adverse effects the project on EFH for all life stages of managed species using the best available scientific information.

In addition to EFH, NOAA Fisheries and the Fishery Management Councils have identified more than 100 habitat areas of particular concern (HAPCs), which are considered high priority areas for conservation, management, or research because they are rare, sensitive, stressed by development, or important to ecosystem function (NOAA 2016). The GMFMC has designated several HAPCs scattered along the continental shelf in the western section of the northwestern Gulf of Mexico: West Flower Garden Bank, East Flower Garden Bank, Stetson Bank, 29 Fathom Bank, 28 Fathom Bank, MacNeil Bank, Rezak Bank, Sidner Bank, Rankin Bank, Bright Bank, Geyer Bank, McGrail Bank, Bouma Bank, Sonnier Bank, Alderdice Bank, and Jakkula Bank. None of these HAPCs are within the Project region of influence (ROI) for fish resources (defined as the BSC and adjacent connected waterbodies, within 2 miles of the Project, which include South Bay and Bahia Grande), although LNG carriers may transit near these areas. Because LNG transit is not considered to have discernable adverse effects on EFH, the LNG transit aspect of the Project is not discussed further in this assessment.

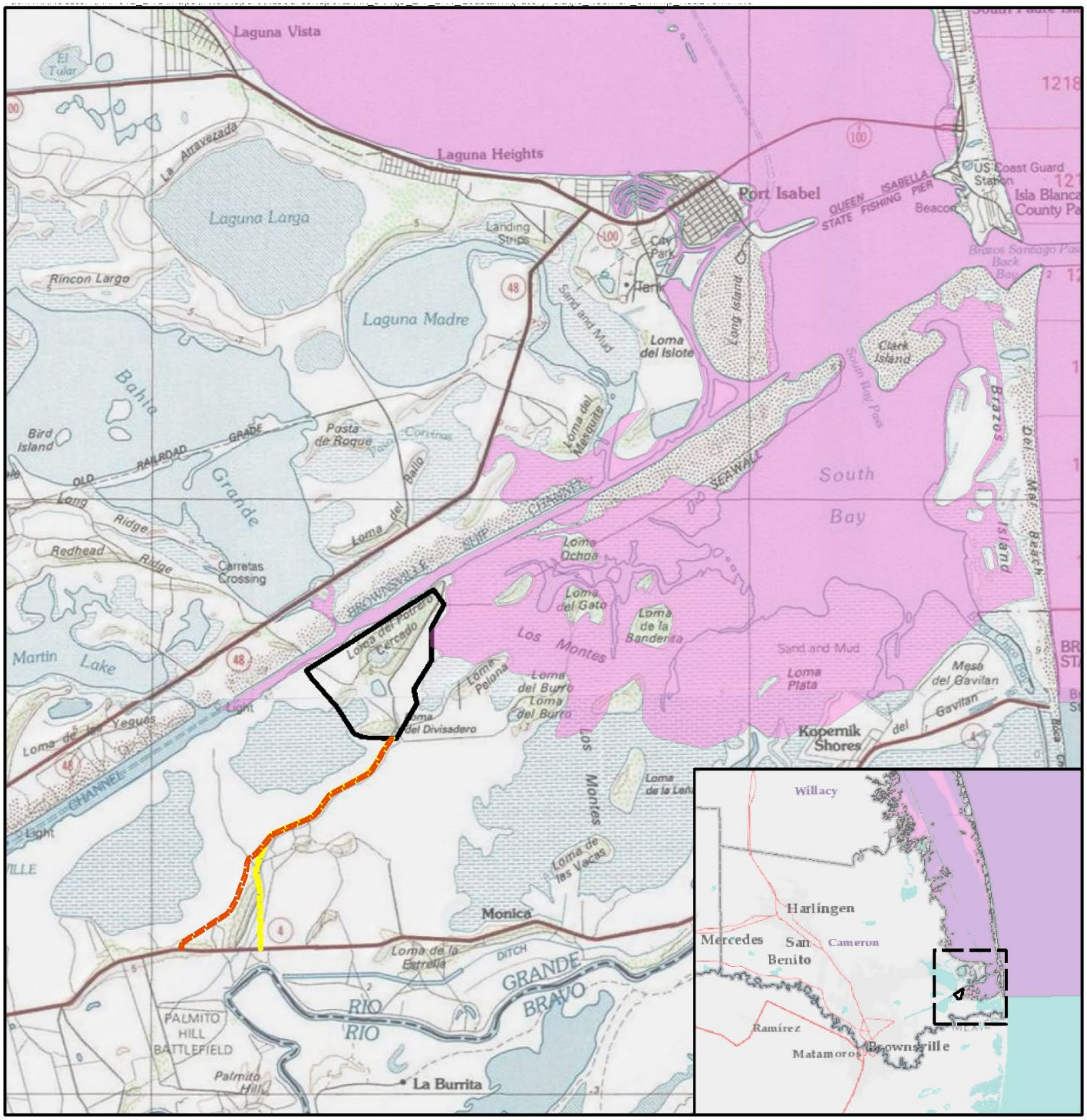
EFH has been designated for several groups of managed fishes in the Gulf of Mexico that occur within the ROI of the Project. Based on correspondence with NOAA Fisheries Habitat Protection personnel (Young 2015), a list of species specific to the Project was developed (see table F-1). Generally, EFH for most of these managed species consists of estuarine waters out to depths of 100 fathoms in the Gulf of Mexico waters (figure F-1).

TABLE F-1

Managed Taxa with Essential Fish Habitat Potentially Occurring Within the Project Region of Influence

Common Name	Scientific Name
Coastal Migratory Pelagics FMP	
king mackerel	*Scomberomorus cavalla*
Spanish mackerel	*Scomberomorus maculates*
cobia	*Rachycentron canadum*
Red Drum FMP	
Red drum	*Sciaenops ocellatus*
Reef Fish FMP	
Snappers	Family Lutjanidae
Gray (mangrove) snapper	*Lutjanus griseus*
Lane snapper	*Lutjanus synagris*
Groupers	Family Serranidae
Goliath grouper	*Epinephelus itajara*
Shrimp FMP	
Brown shrimp	*Penaeus aztecus*
White shrimp	*Penaeus setiferus*

Source: GMFMC 2004; 2015; Young 2015, personal communication



Legend

Coastal Migratory Pelagic Resources, Reef Fish, Shrimp, and Red Drum Essential Fish Habitat (EFH)

Access Road Alternative 1

Access Road Alternative 2 (Preferred Option)

Project Site

SCALE

0 10,000 Feet

SOURCE: GMFMC 2004; NGS 2013

Figure F-1
Essential Fish Habitat for Coastal Migratory Pelagics, Reef Fish, Shrimp, and Red Drum

The two primary physical features that determine the suitability of habitat for supporting managed species are substrate type and water depth. Using a geographical information system (GIS), NOAA Fisheries (2009) mapped and analyzed depth and substrate throughout the Gulf of Mexico and correlated the occurrence of both of these variables with various life stages for each EFH species. For example, if a species and life stage were mapped in GIS according to these preferences, when a particular substrate and depth occurred across the Gulf of Mexico the area was considered potential supporting habitat for that species and its corresponding life stage. The allocation of potential habitat was based on this functional relationship and was mapped out to the 100-fathom contour.

Applying this approach Gulf-wide provided an imprecise representation of the managed species' distribution. It also provided little information on relative density that could be used to distinguish between all habitats occupied by a species and those that should be identified as EFH. In order to refine the analysis, the Gulf of Mexico was divided into five sub-units, or ecoregions. The division between the ecoregions was based primarily on logical ecosystem subdivisions of the Gulf of Mexico. For convenience, the actual lines dividing the ecoregions were selected to coincide with existing boundaries between units in the NOAA Fisheries statistical grid system for depicting fishing effort (GMFMC 2004).

The boundary between Ecoregion 4 and Ecoregion 5 represents an approximate boundary between the West Indian and Louisianan biogeographic provinces in the Western Gulf (Cowardin et al. 1979). Ecoregion 5 is named *West Texas*, and extends from Freeport, Texas, to the Texas-Mexico border, encompassing NOAA Statistical Grids 19 to 21 (GMFMC 2004). Generally, Ecoregion 5 has a greater subtropical influence than Ecoregion 4. Ecoregion 5, generally, has higher temperatures and lower rainfall, with accompanying higher salinities, than Ecoregion 4 (Hoese and Moore 1977). Finally, Ecoregion 5 has little marsh habitat, limited seagrass beds, and some hypersaline habitats (Hoese and Moore 1977). The results of field surveys indicate that no vegetation occurs in the open water in the BSC within the Project site (see figure 4.3.2-3 in the EIS). Known seagrass beds are identified in the BCS at Port Isabel and the entrance to South Bay over 3.1 miles (5,000 meters) downstream.

Based on information regarding the general distributions of the life stages of Gulf of Mexico managed species, a density status, chosen to match up with the terminology in the NOAA Gulf of Mexico Coastal and Ocean Zones Strategic Assessment Data Atlas (NOAA 1985), was allocated for each species/life stage in each ecoregion (GMFMC 2004). Egg, larval, and post-larval stages were designated as either "no occurrence," "occurrence," or "common" in an ecoregion, representing increasing levels of abundance. For juveniles, the status of the life stage in an ecoregion was categorized as "no occurrence," "occurrence," or "nursery area." For both adults and spawning adults, the categories used were "no occurrence," "occurrence," "adult area," or "major adult area and commercial fishing ground." In addition to the information recorded in the database, additional literature on ichthyofauna in the Gulf of Mexico was consulted by NMFS to make judgments about the distribution status of species/life stages. If a species/life stage was recorded as present within the ecoregion (i.e., density status greater than "no occurrence"), substrates and depths with documented use for feeding, growth to maturity, or spawning were designated as potential habitat (GMFMC 2004).

For species that may occur in the BSC and other local navigable channels, bay and estuary habitat of the Lower Laguna Madre, areas on or inshore of Padre Island, and within nearshore areas (i.e., marine waters 60 feet [18.3 meters] deep or less) of the Gulf of Mexico, and which therefore may be affected by the Project, EFH includes the water column, estuarine emergent marsh, estuarine submerged aquatic vegetation, estuarine mud/soft bottom, oyster reef, and estuarine sand and shell bottom. EFH for coastal migratory pelagics comprises all the estuarine, nearshore, and offshore areas of the Gulf of Mexico out to the 100-fathom depth contour, including the BSC (GMFMC 2004).

Based on correspondence with NOAA Fisheries Habitat Protection personnel (Young 2015), a list of species (and relevant life stages) specific to the Project was developed. EFH known or expected to occur within the Project area is shown in table F-2. Note that no EFH for spawning adults or eggs is designated within the Project area.

TABLE F-2

Estuarine Essential Fish Habitats, Species, and Life Stages for Gulf of Mexico Fishery Management Council Ecoregion 5

Species Name	Eggs	Larvae	Post-Larvae	Early Juvenile	Late Juvenile	Adult	Spawning Adult
Estuarine Emergent Marsh							
Red drum			•	•		•	
Gray snapper						•	
Brown shrimp		•		•			
White shrimp		•		•			
Mangrove a/							
Goliath grouper			•	•			
Lane snapper				•	•		
Estuarine Submerged Aquatic Vegetation							
Red drum		•	•		•	•	
Goliath grouper				•	•		
Lane snapper			•	•	•		
Brown shrimp		•		•			
Pink shrimp				•			
Estuarine Oyster Reef							
Brown shrimp				•			
Estuarine Sand and Shell Bottom							
Red drum			•			•	
Gray snapper						•	
Lane snapper				•	•		
Brown shrimp		•		•			
Estuarine Mud/Soft Bottom							
Red drum		•	•	•		•	
Gray snapper						•	
Lane snapper				•	•		
Brown shrimp		•		•			
White shrimp		•		•			

Sources: GMFMC 1998, 2004, 2005; NOAA Fisheries 2009, 2011

a/ Mangrove would not be directly affected by the Project but would be adjacent to the Project site.

LNG carriers that visit the Annova LNG terminal would transit through EFH designated for the coastal migratory pelagics and highly migratory species (table F-3). As mentioned previously, LNG transit would have no discernable effect on EFH. No construction or other operational activity including vessel transit would affect EFH for HMS; therefore, effects on EFH for this group are not discussed further in this assessment.

TABLE F-3

Highly Migratory Species with EFH in State Waters of Ecoregion 5 in the Project Area

Species Common Name	Life Stage
Scalloped hammerhead shark (*Sphyrna lewini*)	Neonate and juvenile
Blacktip shark (Carcharhinus melanopterus)	Neonate, juvenile, and adult
Bull shark (Carcharhinus leucas)	Neonate, juvenile, and adult
Lemon shark (Negaprion brevirostris)	Neonate and juvenile
Silky shark (Carcharhinus falciformis)	Neonate, juvenile, and adult
Spinner shark (Carcharhinus brevipinna)	Neonate and juvenile
Tiger shark (Galeocerdo cuvier)	Adult
Bonnethead shark (*Sphyrna tiburo*)	Neonate, juvenile, and adult
Atlantic sharpnose shark (*Rhizoprionodon terraenovae*)	Neonate, juvenile, and adult
Finetooth shark (Carcharhinus isodon)	Neonate

Sources: GMFMC 1998, 2004, 2005; NOAA Fisheries 2009, 2011

The following subsections describe managed species with designated EFH in the ROI: red drum, reef fish, shrimp, coastal migratory pelagics, and highly migratory species.

3.1 RED DRUM

The red drum (*Sciaenops ocellatus*) is a euryhaline fish distributed along the Atlantic and Gulf of Mexico coasts from Cape Cod, Massachusetts, to Tuxpan, Mexico. Red drum, considered a near-shore species, is distributed over a wide range of habitats, including estuaries, river mouths, bays, sandy bottoms, mud flats, seagrass beds, oyster bottoms, surf zones, and continental shelf waters. This fish generally migrates to the Gulf of Mexico in the late fall and moves into the bays and estuaries in the spring. Estuarine wetlands are important to larval and juvenile red drum; while adult red drum use estuaries, they tend to spend more time offshore as they age (GMFMC 1998). Until the age of three to four years, young red drum inhabit mainly estuaries, river mouths, and shallow coastal waters. After this age they tend to leave the protection of estuaries, moving into open coastal waters. They occur both as solitary individuals and in schools. They have been known to school with other species, including black drum and tarpon. Spawning occurs from September through November over deeper waters protected from currents, such as the mouths of bays and inlets, and on the Gulf of Mexico side of barrier islands. They can tolerate temperatures ranging from 39 to 93 degrees Fahrenheit (°F; 4 to 34 degrees Celsius), and can also tolerate a wide range of salinity. Although they have been known to travel into fresh waters as well as into very high saline waters (up to 50 parts per thousand [ppt]), adults usually stay in saltwater of 30 to 35 ppt.

3.2 REEF FISH (SNAPPER AND GROUPER)

Reef fish is a term used by fishery managers to describe several species of fish that tend to live on and are frequently caught on reefs or hard bottoms. Reef fish species are jointly managed by state and federal agencies for the Atlantic Ocean and the Gulf of Mexico. The gray snapper (*Lutjanus griseus*), lane snapper (*Lutjanus synagris)*, and the Goliath grouper (*Epinephelus itajara*), which have EFH that may be affected by the Project, are popular recreational and economically important fish species throughout the Gulf of Mexico. Estuarine emergent marsh habitat, mangrove marsh habitat, sand and shell bottom habitat, and mud/soft bottom habitat in the Project area could potentially function as EFH for these three species.

Juvenile gray snapper commonly occur inshore in tidal creeks, mangroves, and seagrass beds; adults generally occur in nearshore area consisting of coral habitat or rocky reefs to a depth of about 300 feet (NOAA Fisheries 2015a). Inshore, the species is found over smooth bottoms, usually near pilings, seagrass meadows, and mangrove thickets. The lifespan of a gray snapper may be up to 21 years, and individuals may reach a length of 35 inches and weight of 25 pounds. Young gray snapper tend to eat shrimp and other crustaceans, while adults prefer fishes, crabs, or shrimps, and may feed on seagrass flats in the late afternoon or at night.

Juvenile lane snapper are found inshore over seagrass beds or shallow reefs. Adults are typically found offshore and are most common off South Florida. Adult lane snappers live in a variety of habitats, but are most commonly observed over reefs and vegetated sandy bottoms in shallow inshore waters. This species has also been reported in offshore waters to depths of 1,300 feet (400 meters). Once established, adult snappers remain in the same area for their entire lives. Lane snappers also occur in seagrass beds associated with shrimping areas. Juveniles live in protected inshore areas (NOAA Fisheries 2015a).

Goliath grouper occur in shallow, inshore waters to depths of 150 feet (46 meters). They prefer areas with bottoms of rock, coral, and/or mud. Patterned juveniles inhabit mangroves and brackish estuaries, especially near oyster bars. The Goliath grouper is notable as one of the few groupers found in brackish waters. Spawning, which occurs during the months of July, August, and September throughout the species' range, is strongly influenced by the lunar cycle (NOAA Fisheries 2015a).

3.3 SHRIMP

Brown and white shrimp occur over soft, sedimentary bottoms throughout the northern Gulf of Mexico. Both species have similar life history stages, are estuarine-dependent, and vary seasonally in abundance. Young shrimp move into estuaries and spend several months feeding before returning to the Gulf of Mexico to spawn. EFH for shrimp consists of Gulf of Mexico waters and substrates extending from estuarine waters out to depths of 100 fathoms.

3.4 COASTAL MIGRATORY PELAGICS

The Coastal Migratory species range in coastal and continental shelf waters from the northeastern United States through the Gulf of Mexico. Coastal pelagic fish move from one area to another foraging on whatever prey is most abundant and available. Coastal pelagic fish feed throughout the water column on herrings, squid, shrimp, and other fish and crustaceans. Estuaries are considered EFH for coastal migratory species because major prey species of coastal pelagic fishes are estuarine-dependent. Thus, coastal pelagic species are indirectly estuarine-dependent and may be affected by degradation of estuarine habitat quality (GMFMC 2004).

3.5 HIGHLY MIGRATORY SPECIES

EFH for HMS is described in separate FMPs, including the *Final Fishery Management Plan for Atlantic Tuna, Swordfish, and Sharks* (NOAA Fisheries 1999a) and *Amendment 1 to the Atlantic Billfish Fishery Management Plan* (NOAA Fisheries 1999b). Because these species cross domestic and international boundaries, NOAA Fisheries' HMS Management Division is responsible for managing them under the MSA. In cooperation with an advisory panel, NOAA Fisheries develops and implements FMPs for these species, taking into account all domestic and international requirements under the Atlantic Tunas Convention Act, the Marine Mammal Protection Act, the ESA, and the Migratory Bird Treaty Act (NOAA Fisheries 2015b).

For highly mobile pelagic species such as sharks, defining EFH is difficult. Their distributions are usually not correlated with the areas or features commonly considered as fish habitat and for which parameters such as bottom sediment type or vegetative density (e.g., seagrass beds or estuarine subtidal rocky bottoms) can be described. These species most often associate with physiographic structures of the water column (features including oceanic fronts, river plumes, current boundaries, shelf edges, sea mounts, and temperature discontinuities, and the interactions of these); it is these features that must be characterized as habitat for the pelagic life stages of these species. Distributions of juveniles, adults, and especially early life stages (neonates for sharks) may be constrained by tolerance of temperature, salinity, or oxygen levels. These physicochemical properties may be used to define the boundaries of essential habitat in a broad sense. However, even when these parameters and tolerances are well understood and can be used to define the limits of a habitat, the distribution of these characteristics is not fixed in space or time, but varies over seasons and years (NOAA Fisheries 2003).

4.0 POTENTIAL PROJECT IMPACTS

Construction, operation, and decommissioning of the Project could result in impacts on the biological, chemical, or physical properties of the environment (all water column, habitat, and substrate within BSC) that support the designated EFH species listed in section 3.0 of this EFH assessment (see table F-4). The following sections address the potential impacts on EFH, and the species supported by EFH, that could occur as a result of construction of the LNG facility and loading berth (including dredging and pile driving), storage tank hydrostatic testing, stormwater discharge, LNG carrier ballast exchange and uptake and discharge of cooling water while at the Project site, minor spills, and maintenance dredging within the Project turning basin.

TABLE F-4

Summary of the Proposed Activities that May Affect Essential Fish Habitat

Proposed Action Component	Effect on Water Column EFH	Effect on Benthic EFH
Wetlands loss on facility site	• Minor water quality effects – not significant	• No expected effect
Construction/placement of LNG carrier berth components	• Short-term increase in turbidity - not significant with BMPs/controls • Short-term increase in noise – not significant with mitigation	• Displacement of sediments - not significant • Long-term effect on benthic community in dredged area • Secondary effect on prey species - not significant
Storage tank(s) hydrostatic testing	• Temporary increase in turbidity - not significant • Permanent loss (entrainment) of ichthyoplankton - not significant	• Displacement of sediments - not significant • Secondary effect on prey species - not significant
Stormwater discharge	• Impact on water quality - not significant	• Effect on sediment quality - not significant
LNG carrier ballast water discharge	• Short-term water quality changes – not significant	• No expected effect
LNG carrier cooling water intake	• Permanent loss (entrainment) of ichthyoplankton – not significant	• No expected effect
Terminal lighting	• May attract ichthyoplankton – not significant	• No expected effect
Accidental releases	• Minor release – no expected effect • Unlikely catastrophic release – freezing of tissue, localized and significant short-term effects	• Minor release – no expected effect • Unlikely catastrophic release – no expected effect

4.1 CONSTRUCTION

Construction of the Project may cause the following effects on managed species or EFH:

- loss of wetlands, bottom habitat, and benthic community individuals;
- resuspension of sediments during dredging and other substrate-disturbing activities, resulting in increased turbidities, suspended sediment, and subsequent respiratory effects and/or reduced feeding/predation efficiencies;
- smothering, crushing, and/or injury of localized benthic organisms from during dredging;
- toxic effects from hydrocarbon spills during construction;
- entrainment of plankton during tank hydrostatic testing;
- noise-related effects resulting from dredging and pile driving during construction;
- shallow water habitat reduction and modification; and
- loss of tidal and subtidal habitat.

4.1.1 Loss of Estuarine Open Water and Vegetated Habitat

EFH can be affected by land-based projects that remove critical early life stage-dependent habitat, including both emergent tidal and brackish marsh, typically (but not always) dominated by smooth cordgrass (*Spartina alterniflora*) and black needlerush (*Juncus roemerianus*), respectively. These habitats may be affected both by direct destruction and degradation of water quality, or other factors such as hydrologic modification. Elimination or degradation of wetlands not immediately adjacent to EFH also may diminish the quality and productiveness of estuaries.

The precise relationship between fishery production and habitats is undetermined. Similarly, the degree to which habitat alteration can affect fishery production is also unknown, but is thought to be substantial. Turner and Boesch (1987) assembled and examined evidence of the relationship between the extent of wetland habitats and the yield of fishery species that depend on coastal bays and estuaries. Their evidence showed a correlation between fishery stock losses after wetland losses and fishery stock gains following wetland gains. While most of the studies were related to shrimp production, it is expected that other estuarine fisheries will also follow this trend.

During construction there would be direct adverse impacts on estuarine open water, unvegetated tidal flats, and estuarine wetlands from facility construction and berth/turning basin development along the shoreline of the BSC (see table F-5 below, and section 4.4.2 of the EIS for more details). The initial Project footprint also encompassed a small area of mangrove marsh, however Annova has modified the site footprint to avoid direct impact on mangrove marsh, therefore it is not addressed in this EFA assessment.

TABLE F-5

Temporary Impacts to and Permanent Loss of Tidal and Subtidal and Wetland EFH

		Project Site Impacts	
Wetland Type	Cowardin Wetland Classification	Temporary Impacts (Acres)	Permanent Impact (Acres)
Open Water and Non-Vegetated Tidal Flat			
Estuarine open water within Project site a/	E10W	2.0	1.0
Unvegetated tidal flat	E2US3	2.7	1.0
Vegetated Wetlands			
Estuarine emergent marsh	E2EM1	53.0	50.8
Total		**57.7**	**52.8**

a/ Does not include 59 acres within the BSC that would be impacted by dredging for the turning basin.

4.1.1.1 Estuarine Open Waters and Tidal Flats

The Texas Commission on Environmental Quality (TCEQ) designates the BSC (which is part of Texas stream segment 2494) as a warmwater fishery that supports aquatic life, recreational uses, and general use (Texas Administrative Code Title 30, Part 1, Chapter 307). Construction of the marine facilities would permanently alter approximately 5.5 acres of currently open water in the BSC. Direct impacts on fish resources would be limited to the BSC. No impacts on fish in South Bay or Bahia Grande are expected due to limited tidal influx to these resources from the BSC and uncontaminated sediment present in the BSC (see below).

Open waters and tidal mudflats of the BSC in the Project vicinity support numerous invertebrate species that are important prey for managed fishes. Construction would temporarily affect 4.7 acres of estuarine open water and tidal flat, and operation of the Project would permanently convert 2.0 acres of open water and tidal flat EFH to land or built infrastructure. Specific impacts are discussed in section 4.1.2 of this EFH assessment.

4.1.1.2 Estuarine Emergent Marsh (E2EM1)

Six areas of emergent wetlands are located at higher elevations along the BSC within the site. These wetlands are characterized as high salt marsh and are dominated by halophytic plant species, including glassworts (*Salicornia depressa* and *S. bigelovii*), saltwort, cenicilla (*Sesuvium portulacastrum*), sea purslane (*S. verrucosum*), sea blite, with seashore dropseed, shoregrass, sea lavender (*Limonium nashii*), and seaside heliotrope (*Heliotropium curvassivicum*) common above the high tide line. These wetlands are located within slight depressions that slope downward from the bank of the BSC and are bounded by a loma to the south. The depressions collect water from runoff and periodic washover from ship wakes, and may also be influenced by very high tides and a tidal water table. The estuarine emergent wetlands in the study area are considered waters of the United States because they abut the BSC. Construction would temporarily affect 53.0 acres of estuarine emergent marsh, of which 50.8 acres would be permanently converted to non-wetland cover type during Project operation. However, these areas of estuarine emergent marsh are unlikely to be occupied by managed fish during most of the year because they are not permanently connected to waters of the BSC.

4.1.2 Increased Turbidities and Sedimentation

The marine facilities would be developed along the BSC at the Project site through a combination of excavation and dredging. Excavation for the marine berth would occur in two stages: a terrestrial excavation followed by a marine excavation to remove the remaining material below the water surface. A natural earthen berm would be retained to provide a physical barrier between the BSC and construction activities. This construction method would allow most of the excavation and installation of pilings to occur without direct contact with waters of the BSC, which would help to minimize impacts on fisheries. After removal of the earthen berm, any riprap and sheet piling installed along the shoreline would allow terrestrial habitat within the created berth to convert to benthic habitat. In-water construction would include dredging the balance of the berth and LNG carrier turning basin.

Impacts expected from dredging activities in the BSC during construction and maintenance dredging include increased suspension of sediment, potentially affecting water quality and habitat, as well as removal or displacement of bottom-dwelling species. The movement and positioning of floating construction equipment and the marking/identification of work areas and emergent/ submergent obstructions would be performed in accordance with BND requirements. Annova is proposing to place dredge material in the adjacent DMPA 5A on BND property. On July 21, 2016, Annova submitted a request to the U.S. Army Corps of Engineers (COE) for a Department of the Army permit under Section 10/404 permit for dredging and marine construction activities.

As described in section 2 of the EIS, Annova proposes to place dredged material in the Port of Brownsville DMPA 5A, located immediately west of and adjacent to the Project site. Based on a preliminary investigation, use of DMPA 5A would require raising the perimeter levees and possible refurbishment of the outlet. During transport of dredged material, a wye valve would evenly distribute the dredged material into internal partitions. The current configuration of DMPA 5A uses a series of internal berms (dewatering lanes) to guide water through the DMPA from the discharge point to the final outfall point, at a rate that allows the fine particles to settle out, with final discharge through the existing drop outfall structure directly to the BSC. Annova anticipates raising the levee heights using existing material in the DMPA and re-profiling the dewatering lanes prior to the start of dredging operations to allow for appropriate residence time, such that the discharge would be limited to constrain total suspended solids (TSS) to a maximum of 300 milligrams per liter (mg/L). Annova intends to perform column settling tests early in detailed engineering to confirm the settling characteristics of the dredged material to ensure efficient function of the DMPA. This distribution of the deposited material during dredging would ensure that the rate of particle settling upon discharge and the residence time can be appropriately managed without affecting the dredging production rate. The effluent outfall at the drop-outlet structure would be monitored for excessive turbidity and erosion issues.

During dredging activities, direct impacts on EFH may occur from disturbing substrate and suspension of sediments. Dredging is expected to cause major localized mortality and displacement of benthic invertebrates and minor displacement of fish in the dredged area. Impacts of dredging on fish and invertebrates are a function of suspended sediment concentration, duration of exposure, species, and life stage (Newcombe and Jensen 1996). Dredging would suspend sediments in the water column for a period of time depending on the size of the sediment particles. Coarser sediments would fall out and resettle quickly (within hours), while finer sediments could remain suspended longer (up to days or weeks). Although the cutter of the dredge suctions in most of the suspended fine-grained sediments, the increase in turbidity would have a localized effect of reduced light penetration and a corresponding reduction in the primary production of aquatic plants, algae, and phytoplankton. As a result, there may also be lower dissolved oxygen concentrations, causing a displacement of motile organisms or stress and reduction in numbers of sessile benthic organisms (LUMCON 2016; COE 2012). In the absence of best management practices (BMPs) to mitigate levels of suspended solids, turbidity may exceed water quality criteria up to about 2.5 miles (4,000 meters) downstream from the dredge and across the width of the BSC. A small fraction of the total habitat in the BSC would be affected by construction and maintenance dredging of the marine berth.

Dredging activities would result in increased turbidity in the BSC, which could have localized effects. These localized effects may include reduced light penetration and a corresponding reduction in the primary production of aquatic plants, algae, and phytoplankton. As a result, a short-term reduction in dissolved oxygen concentrations in the BSC may occur, resulting in temporary displacement of motile organisms or stress and reduction in numbers of sessile benthic organisms (LUMCON 2016). Increases in turbidity may result in short-term impacts on these organisms (see section 4.6 of the EIS). The results of field surveys indicate that no vegetation occurs in the open water in the BSC within the Project site (see figure 4.3.2-3 in the EIS). Known seagrass beds are identified in the BCS at Port Isabel and the entrance to South Bay over 3.1 miles (5,000 meters) downstream; therefore, increases in turbidity would not likely extend into any important seagrass nursery habitats.

Annova performed turbidity plume modeling using the COE's DREDGE model, plus a "far-field" distribution model of suspended sediment (Black & Veatch 2016). The results were predicted using a maximum velocity of current in the BSC at 0.154 meter/second (0.5 feet/second). To assess the impacts on the Bahia Grande, the lateral movement of particles predicted is more pertinent due to the location of the channel. The model predicted TSS concentration of 4 to 6 mg/L above ambient within the greatest lateral extent of the plume, 328 feet (100 meters) either side of the plume centerline, at the surface of the BSC (Black & Veatch 2016). The outgoing tide would transport the suspended clay particles downstream of the shallow (-3.25 to [proposed] -9 feet mean sea level) Bahia Grande Pilot Channel entrance. This, combined with the tidal flow from the Bahia Grande during an outgoing tide, would prevent particle transport into the Bahia Grande. Particle transport would occur during an incoming tide, with clay particles moving upstream from the Bahia Grande. Effects to the Bahia Grande would likely be greater during an incoming tide with elevated TSS concentrations of 4 to 6 mg/L at the periphery of the plume 328 feet (100 meters) from the cutterhead, and would result in a minor impact on water quality within proximal portions of the Bahia Grande. Similarly, although not directly modeled, particle transport during a slack tide would be limited due to the lack of water movement, which would restrict particle transport from the dredging area. As a result, a slack tide would also limit impacts within the Bahia Grande.

Although benthic invertebrates would be entrained, crushed, or buried by the dredging operation, impacts on juvenile and adult fish in the channel would be minimal because mobile organisms are expected to move away from the area of increased activity and noise during dredging (Nightingale and Simenstad 2001). Increased turbidities could be fatal to larval or post-larval shrimp if dredging occurs during peak abundance in early spring or summer; however, shrimp densities near the Project site are expected to be low.

Increased turbidities from bottom-disturbing activities could temporarily affect predation efficiency for local fish. Extended periods of elevated turbidities have been shown to reduce feeding rates by up to 20 percent and to reduce the efficiency of the foraging process (Utne-Palm 2002; Gardner 1981). However, most species of fish are both predator and prey, making it difficult to predict the net effect of reduced predation on a given species. During periods of increased turbidity, it is expected that adult and juvenile fish and crustaceans in the area would relocate to other similar habitats that are less turbid. The increased turbidities would limit feeding within the area of construction, but prey would still be accessible in nearby unaffected areas. Early life stages are most likely to be directly affected by a temporary increase in turbidity and a potential decrease in dissolved oxygen concentrations (Robertson et al. 2006). Because these life stages are more sensitive to such stresses and are unable to emigrate from the affected area, they are more susceptible to impacts than juveniles and adults. However, short-term elevated turbidities are not likely to cause chronic adverse effects. Section 4.3 of the EIS assesses the downstream movement of particles during dredging activities in detail.

Increases in turbidity can also affect the level of dissolved oxygen in the water. When dredges disturb bottom sediments, the increase in turbidity is caused by both particles and microorganisms, which may respond to the release of nutrients from the disturbed sediment by increasing the rate of reproduction. Microorganism blooms can be followed by population crashes, which lead to localized depletion of dissolved oxygen. Other changes in turbidity are more transient, such as those that occur when storms stir up sediment in a shallow waterbody. Because light is not transmitted as easily in turbid water, phytoplankton may be less able to photosynthesize and produce oxygen that would restore the desired dissolved oxygen concentration.

The potential for direct and indirect adverse impacts on fisheries from substrate disruption (i.e., turbidity and sedimentation) within the Project area would likely differ from species to species, depending on life history, habitat use, distribution, and abundance. Sessile life stages, such as demersal eggs, would likely be buried or destroyed during dredging. However, effects on the juvenile and adult life stages of both pelagic and demersal species would be limited to displacement during the 8 months of dredging activities. Individuals would be expected to move slightly upstream or downstream of the construction area to forage or spawn.

During Project operation, periodic maintenance dredging would maintain depth in the turning basin. Impacts from this activity would be minimal because the maintenance dredging would mirror the maintenance dredging of the BSC currently conducted by the COE. The regular tidal flux and periodic inflow of high rainfall result in a system that continually reflects short-term, sporadic changes to in situ physicochemical conditions. Therefore, these types of systems tend to support species that are tolerant of changing physiochemical conditions and are not conducive to supporting intolerant or sensitive biota. Maintenance dredging may magnify these conditions but would not likely promote a less stable environment for species that exist either permanently or temporarily in the BSC. As described for dredging during construction, maintenance dredging would destroy sessile life stages and displace mobile life stages within the immediate area. Despite the severe effects within the localized area, no population-level effects are expected because the construction area represents a small fraction of marginal habitat within the industrialized BSC. Notwithstanding the potential harm to some individual organisms, no significant impacts on managed species of finfish or shellfish populations are anticipated from the maintenance dredging and placement operations.

The need for regular maintenance dredging indicates that the system is dynamic. This status is further accentuated by regular tidal flux and periodic inflow during periods of high rainfall. All of these conditions result in a system that continually reflects short- term, sporadic changes to in situ physicochemical conditions. These types of systems tend to support species that are tolerant of disturbance. Maintenance dredging may magnify these conditions but would not likely promote a less stable environment for taxa that exist either permanently or temporarily in the BSC. In addition, if maintenance dredging for the proposed Project and the BSC are conducted simultaneously, the likelihood for adverse effects from these actions to fish and invertebrates within the BSC is minimal. Importantly, the BSC has not been shown to provide unique nursery habitat for the various adult fish and invertebrate species that occur there.

4.1.3 Resuspension of Contaminated Sediments

As discussed in section 4.3 of the EIS, no contaminated sediments are known to occur in the BSC. In 2012, the TCEQ sampled and analyzed sediment from the BSC for metals (e.g., mercury, zinc, silver, nickel, lead, copper, chromium, arsenic, and cadmium); all sample results were considered to be of "no concern" (TCEQ 2012). Sediment sampling was also conducted in 2000 in response to a nearby spill of furfural, an organic compound derived from agricultural byproducts, into storm drains in Brownsville, Texas. Although the BSC was one of three possible impact zones, subsequent sediment sampling showed no evidence of furfural contamination (NOAA 2000; FWS 2000). Based on the information above and in section 4.3 of the EIS, dredging is not expected to release any contaminants from sediments in the BSC; however, Annova may conduct additional sediment testing specific to the Project area if warranted or requested by the COE or applicable agencies.

4.1.4 Loss, Reduction, or Change of the Benthic Assemblage

Most benthic organisms occur within the top 6 inches (15 centimeters) of the sediment surface. Therefore, it is expected that removal of sediment and burial from deposition of sediments would result in some loss of these organisms. Generally, disturbance-related impacts on benthos are temporary and reversible because species from adjacent undisturbed areas recolonize the affected area.

Dredging would also remove the soft-bottom habitat of the BSC within the footprint of the dredged area. Disturbance of substrate in the BSC during construction may result in adverse effects to benthic and pelagic organisms that are prey of managed species. Benthic organisms may be crushed, buried, displaced, or injured during construction. Pelagic organisms may experience stress related to increased turbidity and water movement, causing them to relocate temporarily.

Some demersal (bottom-dwelling) species such as mollusks, crustaceans, and demersal shrimp (if present) may be entrained during dredging activities. Larger, more mobile, demersal species (e.g., blue crab) may be temporarily displaced (Nightingale and Simenstad 2001). Although dredging activities would have an effect on species occupying the soft-bottom habitat in the Project area, effects on marine fisheries and the habitat supporting various species are expected to be local, minimal, and temporary. Habitat use by these species is expected to return to pre-construction conditions following dredging operations.

Direct impacts from dredging activities on benthic macroinvertebrates may include localized disruption, removal, turnover, and crushing. Additionally, dredging would result in deposition of sediment in the immediate vicinity of the activities, which may cause direct mortality via burial. As most benthic infauna live on or within the upper 6 inches of the sediment surface, it is expected that removal of sediment and burial from settling of sediments resulting from increased turbidity would result in some loss of these organisms. Germano et al. (1994) found that benthic communities recover to an equilibrium community within approximately 6 months to 1 year after a physical disturbance. Other studies indicate recovery to this stage in 2 years or less (Murray and Saffert 1999; Rhoads et al. 1978). Many physical and biological factors affect the recolonization process, with one of these being the texture of the disturbed sediment. Any change in the texture of the material after the activity is completed may result in changes in the community that was present before activities took place. Additionally, overturned, deeper sediments may be hypoxic, resulting in longer periods to re-establishment of former communities. Disturbance-related impacts on benthos from the proposed Project would be long term but localized within the dredging footprint. Benthic species are likely to recolonize the affected area, but would be disturbed by maintenance dredging at 2-year intervals. As such, long-term localized impacts on benthic marine species are expected.

The potential for direct and indirect adverse impacts on fisheries from substrate disruption within the Project area would likely differ from species to species, depending on life history, habitat use, distribution, and abundance. However, short-term impacts on older life-stages (juvenile and adult) of both pelagic and demersal fish would be limited to temporary displacement during dredging activities.

Germano et al. (1994) found that benthic communities recovered to an equilibrium (Stage III) community in approximately 6 months to 1 year after a physical disturbance. Other studies indicate recovery to this stage in 2 years or less (Murray and Saffert 1999; Rhoads et al. 1978). Many physical and biological factors affect the recolonization process, with one being the texture of the disturbed sediment. Any change in the texture of the material after the activity is completed may result in changes to the community that was present before the activities took place. Additionally, overturned, deeper sediments may be hypoxic, resulting in longer periods of re-establishment of former communities. As noted above, a resident benthic community is generally quite resilient and typically recovers relatively quickly from disturbances. Disturbance-related impacts on benthos from the proposed Project would be long term but localized within the dredging footprint. Benthic species are likely to recolonize the affected area, but would be disturbed by maintenance dredging at 2-year intervals. As such, the Project is expected to result in long-term localized impacts on benthic marine species within the dredge area footprint.

The potential for direct and indirect adverse impacts from substrate disturbance during construction on EFH designated in the Project area would likely differ from species to species, depending on life history and habitat use (demersal vs. pelagic). However, it is anticipated that short-term impacts on the juvenile and adult life- stages of both pelagic and demersal fish species would be limited to temporary displacement during initial installation of Project components.

4.1.5 Entrainment and Impingement During Hydrostatic Testing

During construction, Annova would use water for hydrostatic testing of pipes and LNG storage tanks, drinking water, and dust control. The LNG storage tanks would be hydrostatically tested in accordance with American Petroleum Institute standards. Terminal piping would be tested using hydrostatic (piping carrying natural gas) or pneumatic (cryogenic piping carrying LNG) testing methods as described in section 2.6.1.5 of the EIS. Hydrostatic test water would be discharged to surface waters in compliance with a permit issued by the Railroad Commission of Texas. LNG storage tanks would be hydrostatically tested with surface water to ensure their integrity. See section 2.6.3 of the EIS for discussion of the hydrostatic testing process.

Water withdrawal for hydrostatic testing could entrain fish eggs and juvenile fish near the intake structures in the BSC. In accordance with its Project-specific Procedures, Annova would screen intake hoses to limit the entrainment of larvae and pre-juvenile fish and invertebrates during water withdrawal.

Intake structures located within the BSC would be fitted with appropriate screens to limit entrainment of organisms, in accordance with withdrawal permits. Intake structures with rates of 1,500 gallons per minute (3.34 cubic feet per second) would be placed at the lowest possible elevation to reduce the impingement of organisms and debris on intake screens. The intake of surface water for hydrostatic testing of the LNG storage tanks would be in compliance with the Project's temporary TCEQ water rights permit. The hydrostatic test water for the LNG facility piping would be supplied from the potable water line, with no added treatment chemicals, corrosion inhibitors, or biocides. Upon completion of hydrostatic testing of the first LNG storage tank, the water would be transferred to the second storage tank for reuse.

Annova would not use biocides, detergents, or additives in the hydrostatic test water. Prior to discharge, in accordance with the EPA's Hydrostatic Test Water Discharge Permit and the Railroad Commission of Texas' permit requirements, the water would be tested for total suspended solids, oil and grease, and pH, and treated (if test results indicate that the water would not meet requirements). Hydrostatic test water would first be discharged into a stormwater pond using energy-dissipation devices to minimize erosion and scouring, and from there discharged into the BSC via an overflow structure. The rate of discharge is expected to be approximately 1.8

million gallons per day. Discharge of hydrostatic test water may cause localized, short-term turbidity in the BSC; however, potential impacts on aquatic resources from the discharge of hydrostatic test water would be localized, temporary, and negligible and would be minimized through the use of energy-dissipating devices installed at water discharge points. The BSC may experience localized, short-term turbidity from the discharge of hydrostatic test water, as previously described for marine berth dredging. No long-term impacts on water quality are anticipated due to these discharges.

The withdrawal of water for hydrostatic testing may result in the permanent loss of some larval fish and invertebrates that occur within the BSC. The level of impact would depend on the season in which water is withdrawn. No information was found regarding larval fish densities in the BSC. However, the BSC is not considered EFH for spawning adults or eggs, so abundance of early life stages is assumed to be low. Moreover, annual fecundity of the lane snapper ranges from 347,000 to 995,000 eggs (Rodriguez-Pino 1962) and from 220,000 to 60,000,000 eggs for the red snapper (Gallaway et al. 2009). Considering the fecundity potential for managed species in the context of natural expected mortality, the absence of EFH for eggs in the BSC, and the limited volume and duration of water withdrawal, entrainment of early life stages of managed species during hydrostatic testing would have a negligible effect on fisheries in the Project area.

4.1.6 Noise Effects on Fish

Elevated noise levels associated with pile-driving activities during construction of the LNG carrier berth and basin can affect fish and EFH. Marine fish can be affected by noise both physiologically and behaviorally. The potential effects of exposure to continuous sound on marine fish include temporary threshold shift, physical damage to the ear region, physiological stress responses, and behavioral responses such as startle response, alarm response, avoidance, and potential lack of response due to masking of acoustic cues (Hedges 2011). Much of the research on how noise affects marine species involves studies of the physiological effects of impact pile driving on fish due to changes in water pressure. Fish with swim bladders are more vulnerable to such pressure changes, which can cause capillaries to rupture or the swim bladder to rapidly expand and contract[1] (Caltrans 2001). In marine mammals, temporary loss of hearing (temporary threshold shift or permanent threshold shift) may occur as a result of exposure to noise from impact pile driving; it has long been assumed that similar effects occur in fish (Popper and Hastings 2009; Popper et al. 2005). However, when caged juvenile coho salmon (*Oncorhynchus kisutch*) were placed as close as 6.6 feet (2 meters) to steel piles being impacted, no mortality was observed (Ruggerone et al. 2008). A recent review by leading experts on auditory impacts to fishes and invertebrates suggests that attempts to evaluate effects of pile driving and other impulsive sounds on fish are not well-supported by empirical evidence. Sound thresholds applied to fish have been derived primarily from studies on marine mammals or in studies conducted within enclosed tanks that do not accurately reflect open water settings. Moreover, virtually all studies of effects of underwater sound focus on sound pressure, whereas particle motion is thought to be the more relevant mechanism for injury to fishes. For these reasons, potential effects of pile driving on fishes cannot be accurately predicted (Hawkins and Popper 2016). It is assumed that most fish

[1] Hitting a steel pile with a large hammer produces sound that causes water pressure changes that impact fish. Sudden changes in water pressure can cause gases such as oxygen to come out of fish blood faster than normal, leading to decompression sickness, much like the bends that divers experience when they rise to the surface too quickly. Pressure changes also affect the fish swim bladder, an internal, air-filled sac that helps the fish maintain weightlessness at different water depths. Alternating pressure changes cause the swim bladder to quickly expand and contract, which causes bruising and damage to neighboring organs and can rupture the swim bladder itself (USDOE 2012).

would detect and react to impulsive sounds of pile driving in a species-specific way, either by startling, leaving the area, or accommodating to the sound and continuing their normal behavior. Nevertheless, current practice is to estimate the reactions of fish to pulsive noise using certain assumptions. Such estimates are provided in section 4.1.6.3 below.

Effects of construction noise (pile driving) on fish would be either temporary or intermittent, and, therefore, would not significantly impact the fish at a population level. Individual fish may relocate to adjacent areas within the BSC where spawning and foraging habitat is available. Pile-driving noise would not adversely affect EFH.

Fish react to underwater noise from vessels and move out of the way, move to deeper depths, or change their schooling behavior. The perceived noise levels at which fish react are not known and seem to be somewhat variable, depending on circumstances and species of fish. To assess the potential effects of underwater noise associated with the Project, noise in relation to continuous noises routinely produced by other projects, activities such as shipping and fishing, and pulsive noises produced by seismic exploration were evaluated (see below).

4.1.6.1 Continuous Noise

Long-term continuous noise associated with the Project would be generated at the loading terminal. Noise levels associated with the loading terminal would be relatively low and unlikely to have any significant adverse effect on EFH in the area. Peak spectral levels for individual commercial ships are in the frequency band of 10 to 50 hertz (Hz) and range from 195 decibels in reference to 1 microPascal^2 (dB re µPa^2)/Hz at 1 meter for fast-moving (greater than 20 knots) supertankers to 140 dB re µPa^2/Hz at 1 meter for small fishing vessels (NRC 2003). Another activity expected to produce short periods of continuous noise is LNG carrier maneuvering at the terminal. Although this activity would be louder, it would be less than the noise levels associated with large ships at cruising speed. Generally, studies have used approximately 190 dB as the expected noise level for an LNG carrier's thrusters (LGL 2006). An LNG carrier maneuvering using thrusters could produce short periods of louder noise (e.g., for 10 to 30 minutes while arriving and again while leaving the terminal, up to about 125 times per year). On average, thruster noises would be heard for about 30 hours per year. Even in the unlikely event that these two activities caused disturbance to marine fish, the effects would be short-term.

4.1.6.2 Pulsive Sounds

The pulsive sounds from in-water pile driving expected during construction would be much less intense than the pulses from the air guns used in Gulf of Mexico offshore seismic surveys by the oil and gas industry. Such surveys routinely have source levels of 250 dB re 1 µPa at 1 meter. The available information suggests that seismic exploration has minor to moderate impacts on fisheries resources and EFH (BOEM 2014). Therefore, it is unlikely that the lower levels of pulsed noise from pile-driving construction activities would have permanent effects on fish populations in the area.

4.1.6.3 Approach for Estimating Pile-Driving Noise Levels

As described above, recent evaluation of methods used to estimate effects of pulsive noise on fish concludes that standard practices are not supported by empirical evidence or biological mechanisms. Nevertheless, current practice is to estimate effects on fishes using methods developed in a cooperative effort between several federal and state transportation and resource agencies along the West Coast of the United States that resulted in the establishment of interim criteria for identifying the onset of physical injury to fish exposed to underwater sounds generated by impact pile driving (Stadler and Woodbury 2009). NOAA Fisheries, in its administration of the ESA and the EFH provisions of the MSA, currently uses these criteria to assess potential impacts on the fishery resources under its purview resulting from pile driving performed in or near aquatic environments. The new criteria use two metrics: the sound pressure level (SPL) and the sound exposure level (SEL). A potential onset of physical injury is determined if either the peak SPL exceeds 206 dB (re: 1 µPa) or the SEL, accumulated over all pile strikes generally occurring within a single day, exceeds 187 dB (re: 1 μPa^2/sec) for fish 2 grams or larger, or 183 dB (re: 1 μPa^2/sec) for smaller fish (Stadler and Woodbury 2009).

The assessment used for this analysis was based on Stadler and Woodbury (2009). They suggest a multi-step process that sequentially estimates: (1) the expected peak SPL and single-strike SEL from the project; (2) the cumulative SEL; (3) the distance from the pile driver where the peak SPL and cumulative SEL drop below the threshold values; and (4) the area that is ensonified above threshold levels. The following describes the step-wise approach from Stadler and Woodbury (2009):

Step 1. Estimate the expected peak SPL and the mean single-strike SEL, at a known distance from the pile, from existing hydroacoustic monitoring data for piles of similar size, and, if possible, driven into the same type of substrate.

Step 2. Estimate the cumulative SEL, at a known distance, using the following equation:

$$\text{Cumulative SEL(dB)} = 10\text{Log}10((\text{Single-strike SE* N})/1\ \mu Pa^2 \bullet \text{sec})$$

or

$$\text{Cumulative SEL(dB)} = \text{Single-strike SEL} + 10\text{Log}10\ (N)$$

where:

single-strike SEL = the mean sound exposure, in μPa^2/sec, for a single pile strike and

N = the number of pile strikes

Step 3. Estimate the distance from the pile driver where the peak SPL and cumulative SEL drop below threshold values. NOAA Fisheries uses the following equation to estimate this distance:

$$TL(dB) = C\text{Log}10(R1/R0)$$

where:

TL = transmission loss, in dB, required to reach the threshold level (calculated by subtracting the threshold level from the known sound level (peak SPL or cumulative SEL) at R0

C = transmission loss constant

R1 = distance from pile driver to the threshold level

R0 = distance from pile driver to the known sound level

The rate of transmission (or propagation) loss can vary widely from site to site, requiring site-specific information to accurately estimate (Stadler and Woodbury 2009). However, in most cases, site-specific data are not available, and NOAA Fisheries assumes a transmission loss constant of 15. Because cumulative SEL increases with increasing numbers of pile strikes, the distance from the pile driver to the threshold level also increases. If the number of pile strikes is high, this distance can be unreasonably large. NOAA Fisheries recognizes that a single-strike SEL below a certain level would not contribute to the overall cumulative SEL because it has limited, if any, effect on a fish. The single-strike SEL that has no effect is referred to as "effective quiet," but there are no data for estimating the SEL of effective quiet. Based on this uncertainty, NOAA Fisheries has adopted a conservative SEL for effective quiet of 150 dB. The distance from the pile driver at which a single-strike SEL drops to 150 dB is the maximum distance from a pile at which fish can be injured, regardless of how many times the pile is struck. While the distance does not increase, the cumulative SEL within this distance does increase, thereby increasing the risk to fish within that distance.

Step 4. Estimate the area that is ensonified above threshold levels. Because pile driving rarely occurs in open water, simply calculating the area of a circle with a radius of R1 often overestimates the area that is ensonified above threshold levels. For computational ease, NOAA Fisheries assumes that geologic features such as islands or bends in a river, or man-made structures such as rock breakwaters, will function as barriers to sound transmission, and only those areas with a direct line-of-sight to the pile driver will be ensonified. Thus, estimating the area that is ensonified above threshold levels will depend on site-specific factors that must be considered on a case-by-case basis.

4.1.6.4 Reference Sound Source Levels

The LNG terminal includes in-water installation of four 96-inch-diameter steel pipe piles. The most applicable source levels available are for 96-inch-diameter steel piles in water depths of approximately 39 to 49 feet (12 to 15 meters) for the Benicia-Martinez Bridge crossing in the Carquinez Strait in Contra Costa County, California (ICF Jones & Stokes, and Illingworth and Rodkin, Inc. 2009). In-water measurements for hydraulic impact-hammer pile driving indicate that installation of the steel piles at the Benicia-Martinez Bridge generated a peak average sound pressure root-mean-squared (RMS) metric, a peak SPL, and an SEL of 220, 205, and 194 dB re 1 μPa_{RMS}, respectively, at a distance of 33 feet (10 meters) (see table F-6).

TABLE F-6

Unattenuated Sound Pressure Levels Measured for the Benicia-Martinez Bridge

	Sound Pressure Levels (dB)		
Approximate Distance a/	SPL	RMS	SEL
5 meters	227	215	201
10 meters	220	205	194
20 meters	214	203	190
50 meters	210	196	184
100 meters	204	192	180
500 meters	188	174	164
1,000 meters	180	165	155

a/ Distance measured from the pile at about mid-depth (10 to 15 meters deep).
Source: ICF Jones & Stokes, and Illingworth and Rodkin, Inc. (2009)

4.1.6.5 Background Noise Levels

Background noise, or ambient noise, is noise that already exists in the environment prior to the introduction of another noise-producing activity. Natural sources of ambient/background noise include biological sources (e.g., animals) and physical sounds (e.g., wind, waves, rain). Human-generated sources include commercial ships, recreational vessels, seismic air guns, and marine construction. One of the major contributors to background noise near the Project area is commercial shipping traffic in the BSC. Although background noise levels were not available for the BSC, data from a similar channelized site in California to predict what the ambient noise level might be without the inclusion of shipping traffic were reviewed. During an evaluation of noise levels produced by a hydraulic cutterhead dredge during maintenance dredging in the Stockton Deepwater Shipping Channel in California, the COE measured background levels at eight channel locations (Reine and Dickerson 2014). Maximum noise sound pressures ranged from 143.1 to 103.8 SPL RMS, with a mean of 119.5 SPL RMS. These values do not include generator noise of ships moored at the port or sounds produced during normal day-to-day activities associated with port operations. All sound sources combined (e.g., generator noise, port activity noise) result in SPLs at the 50th percentile level of 118.3 dB. This was the value that the COE used for comparing underwater sound emitted during the excavation process (Reine and Dickerson 2014).

Knowing the background noise of an area is important to understanding the overall impact that the introduction of more noise could have on the marine fish. If background noise levels in the vicinity of the Project exceed the NOAA Fisheries thresholds, then fish would not be affected by any sound less than the already existing dominant noise levels. For example, if the background noise levels average 150 dB, then levels of sound less than 150 dB would not represent harassment. However, there is no current information regarding measurements of background noise in the vicinity of the Project area. Therefore, it is assumed that while vessel noise associated with the Project would not add greatly to the already existing background vessel noise in the region, it cannot be assumed that the sound produced by pile driving would be completely masked by the vessel noise, especially close to the hammer. For the purposes of this evaluation, background noise levels have been assumed to be 150 dB.

4.1.6.6 Underwater Transmission Loss

To determine how noise could impact marine fishes in the Project area, it is important to understand how the sound is transmitted from the noise source. As sound moves away from its source, there is a loss of acoustic intensity with increasing distance from the source. This is known as transmission loss (TL). How a sound travels away from a source depends on a variety of factors, including the original source level, environmental factors such as local salinity and temperature, and physical factors such as water depth, currents, and composition of bottom sediments (when depth is a limiting factor). Transmission loss also varies based on the depth of the sound source and the receiver. Considering all these factors can aid in better understanding how the sound will travel away from the source; however, it is not always possible to obtain all the information necessary to determine site-specific TL. For this analysis, TL has been set at the NOAA Fisheries default constant of 15.

4.1.6.7 Attenuation to Effects Thresholds

To determine potential impacts on fish from Project pile driving, the ensonified area surrounding the acoustic source and the zones of influence (ZOIs) in the ensonified area that exceed the various threshold levels noted above was determined. Based on this approach, pile driving for the Project is predicted to produce peak sounds above the SPL (206 dB re: 1 $\mu Pa^2/sec$) threshold from approximately 597 to 879 feet (182 to 268 meters) (considering mean and standard deviation) from the source, and above the lesser cumulative SEL (183 dB) up to 777 feet (237 meters) from the source (table F-7). This ensonified area could result in physical injury to fish. However, injury to non-auditory tissues in fish with swim bladders (e.g., juvenile spot [*Leiostomus xanthurus*] and pinfish [*Lagodon rhomboides*]) cannot be assessed using SPLs. These fish are typically affected by continuous sound levels (i.e., SEL) rather than by peak noise levels. Hastings (2007) determined that an SEL as low as 183 dB (re: 1 $\mu Pa^2/sec$) was sufficient to injure the non-auditory tissues of juvenile spot and pinfish having an estimated mass of 0.5 gram. Therefore, combined cumulative SEL sound levels noted for determining effects to fish greater than and less than 2 grams (i.e., 187 dB and 183 dB, respectively) were conservatively determined as likely to occur throughout the BSC (see table F-7).

TABLE F-7

Predicted Pile-Driving Noise Thresholds Limits for Fish

	Distance to Threshold (meters)			
		Onset of Physical Injury		Behavioral
		Cumulative SEL (dB) [a]		
Distance from Pile-Driving Noise Source	Peak (dB)	Fish ≥ 2 g	Fish < 2 g	RMS (dB)
Effect Levels	206	187	183	>150
5 meters	43	4,288	4,288	23,208
10 meters	86	8,577	8,577	46,416
20 meters	172	17,154	17,154	92,832
50 meters	429	42,885	42,885	232,079
Zone of Influence [mean & std. deviation]	182 ± 86.3	18,226 ± 8,643	18,226 ± 8,643	98,633 ± 46,777

a/ Assumes single strike SELs less than 150 dB do not accumulate to cause injury (i.e., effective quiet)

However, for a continuous noise source such as an impact hammer, it is expected that without the application of mitigation measures, disturbance levels resulting in behavioral effects (greater than 150 re 1 μPa_{RMS}) could occur throughout the zone of influence within the BSC from the pile-driving noise source (see table F-7). It is likely that this estimate represents the most conservative and worst-case scenario and that the actual threshold distance(s) (and associated ZOI) may be less than the model suggests. It is also important to note that the uncertainty of the physical factors of the environment, discussed above, cannot be accounted for in desktop analyses but must be understood relative to using the model's output for estimating potential injuries to fish.

It is anticipated that some fish would avoid the area because of levels of sound when the hammer is operating. However, as pile driving would be a short-term, temporary action performed only during construction, the occurrence of these species within the BSC over the long term is not likely to change significantly. Additionally, the area of disturbance would be small and similar habitat surrounds the Project site; therefore, the energy expended by fish to avoid the Project area would be minimal. Disturbance of fish close to an individual pile or within the immediate Project area would be short term and is not expected to result in population-level effects. Annova would protect fish and marine wildlife from noise associated with dredging and pile driving through consideration of and mitigation for thresholds established for marine wildlife by the Fisheries

Hydroacoustic Working Group. Mitigation measures may include noise bubble curtains and on-site monitoring, and would be determined based on consultation with NOAA Fisheries.

4.1.6.8 Summary

With no mitigation measures employed, physical injury (all types) to fish could potentially occur within both the determined SPL and SEL ZOIs. Generally, for the SEL ZOI, noise could affect juveniles, small species, or benthic organisms that typically are less mobile than mid-water or pelagic species. Fish within the RMS ZOI could experience behavioral effects. A small number of studies investigating the possible effects of noise, primarily seismic sound, on fish behavior have been conducted over the years. Studies looking at change in distribution are often conducted at larger spatial and temporal scales than are typical for studies that examine specific behaviors such as startle response, alarm response, and avoidance response. The studies that examine those specific defined responses often involve caged fish rather than free-ranging fish (Hirst and Rodhouse 2000). Masking of natural/ambient sounds (e.g., communication, detection of predators and prey, gleaning of information about the surrounding environment) also has the potential to affect fish behavior (Popper and Hastings 2009).

Cumulative in-water pile-driving activities are expected to occur for less than one week. It is likely that most fish would avoid the area because of disturbing levels of sound when the impact hammer is operating; noise levels exceeding the assumed background of 119 to 150 dB re 1 μPa_{RMS} can cause fish to avoid the immediate area around a pile being driven. However, because of the short timeframe for pile placement, it is predicted that no fish would be permanently deterred from entering the area for foraging. Also, because the area of disturbance would be relatively small, and similar habitat surrounds the site, any avoidance activity would not require extra energy expenditures. Given the sound mitigation measures described in section 5.2 below, it is expected that some acoustic disturbance of fish close to an individual pile being driven, or within the immediate Project area, could occur. These impacts would be short-term and negligible, and are not expected to result in population-level effects to managed species or adverse effects on EFH.

4.2 OPERATIONS

Managed species and EFH may be exposed to stressors associated with operation of the Project, including ballast water and cooling water discharge from LNG carriers (section 4.2.1 of this EFH assessment) and accidental spills of hydrocarbons from the marine terminal and support vessels (section 4.2.2 of this EFH assessment).

4.2.1 Ballast Water Discharge

Large vessels withdraw water and place it in separate onboard ballast tanks to provide additional draft and improve navigational performance. During loading, LNG carriers would discharge ballast water into the BSC. The marine berth would accommodate LNG carriers with cargo capacities up to 177,000 m^3. Assuming that the ballast water is approximately 50 percent of the weight of the LNG cargo to be loaded, approximately 9,950,000 gallons would discharge from a vessel with a capacity of 177,000 cubic meters. Ballast discharge periods would vary, but generally vessels would discharge a volume equal to 10 percent of their capacity each hour. Therefore, a vessel of 177,000 cubic meter capacity would discharge approximately 995,000 gallons per hour. Per the United States Coast Guard (Coast Guard) guidelines discussed in section

4.3 of the EIS, it is expected that ballast water in the LNG carriers entering the BSC would be from the Gulf of Mexico or other open water locations.

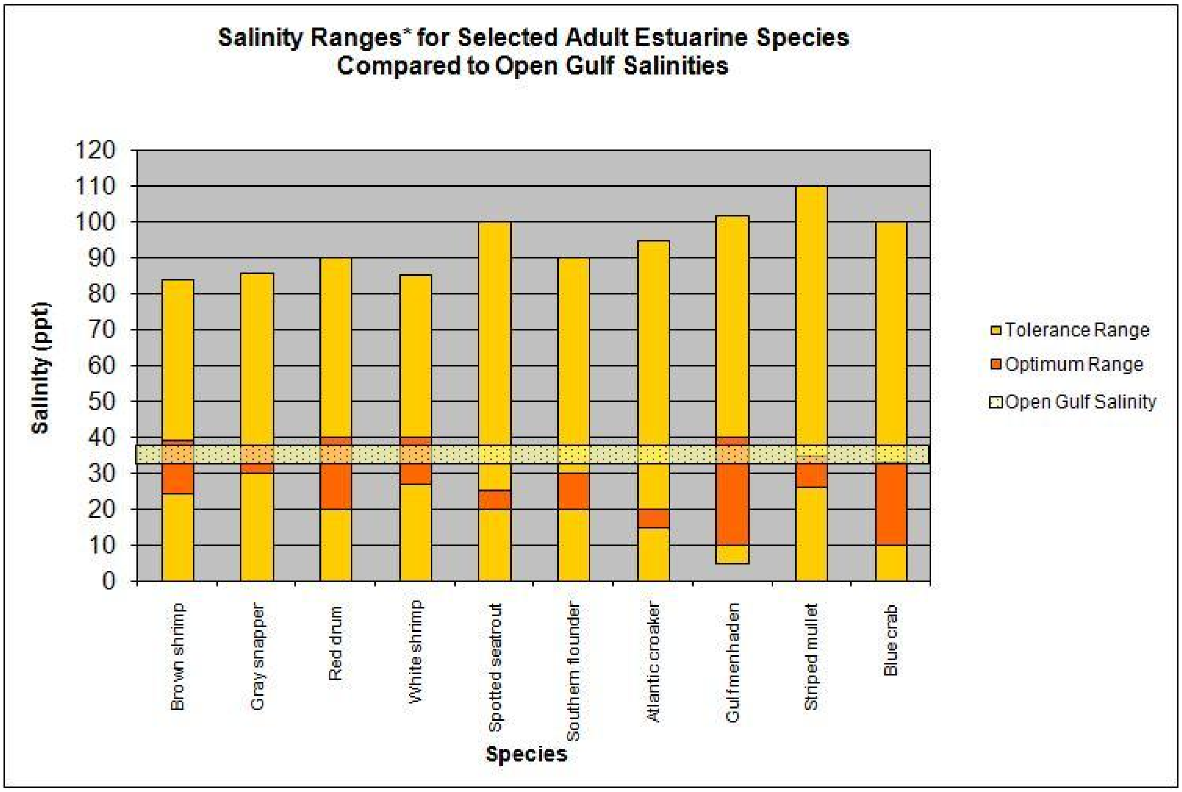
Discharge of large volumes of ballast water can cause changes to the quality of receiving waters by affecting salinity, dissolved oxygen, temperature, and pH. In addition, nonindigenous species transported in ballast water may be introduced to receiving waters during discharge. Each of these variables is discussed in the following paragraphs:

4.2.1.1 Salinity

Ballast water from LNG carriers would consist mainly of open ocean water collected during ballast water exchange activities in the Gulf of Mexico. During ballast water exchange, the water is withdrawn from below the surface where salinities are typically higher than near the surface. Likewise, in the Project's berth, ballast water would be discharged below the surface. Estuarine salinities can naturally range from freshwater (0.5 ppt), near the source of freshwater input, to full seawater (30 to 40 ppt; Patillo et al. 1995). Salinity levels within the BSC naturally vary within this range dependent upon tidal regime and rainfall. During and immediately following ballast water discharges, benthic aquatic species may be affected by higher salinity levels because the higher salinity ballast water would sink to the lower portion of the channel due to its higher specific gravity relative to the ambient water. However, ships moving into and out of the BSC would displace water, circulating it into, around, and out of the berthing area. Therefore, any increased salinity levels resulting from ballast water discharges would be localized and temporary. Resident species within the BSC are euryhaline (able to live in waters with a wide range of salinity), and the salinity of seawater is well within their tolerance range.

Common estuarine species likely to occur within the Project vicinity were evaluated to determine whether changes in salinity from ballast water discharge would cause adverse impacts. Salinity ranges for representative species of fish were obtained and compared with that of open ocean salinities likely to be discharged via ballast water (see figure F-2). Results of this analysis suggest that estuarine species likely to occur within the marine berth area are highly adapted to salinity variations, and any short-term increases from ballast discharge would be well within their tolerance range.

Ballast water discharged into the BSC would have little to no effect on the BSC's salinity regime. In fact, the ballast water salinities may be lower than ambient conditions within the BSC, especially in the summer. Therefore, we have determined that changes in salinity from ballast water discharges would be temporary and negligible.



Source: Patillo et al. 1995

Figure F-2 Salinity Ranges for Adults of Estuarine Species Compared with Open Gulf Salinities

4.2.1.2 Dissolved Oxygen

Dissolved oxygen levels below 4 mg/L are generally considered unhealthy for aquatic life; levels below 2 mg/L are considered hypoxic and inadequate to support most aquatic life. As discussed in section 4.3, ballast water could contain low dissolved oxygen levels and could reduce existing dissolved oxygen levels within the immediate vicinity of the discharge point. Depending on the oxygen levels present in both the ballast and ambient water at the time of discharge, aquatic resources in the vicinity of the discharge point could be exposed to dissolved oxygen levels considered unhealthy for aquatic life. The adaptability of resident species within the BSC to natural variation in oxygen levels would minimize the impacts associated with low dissolved oxygen on mobile species. Bivalves are not able to relocate when oxygen levels drop. Instead, they simply close their valves and wait for more favorable conditions to return.

Dissolved oxygen concentrations in ballast water are influenced by the concentration in the water at the time of uptake, microbial activity in the ballast tanks, and residency time of ballast water in the vessel. Ballast water discharge could have more or less dissolved oxygen than receiving waters. Relative concentrations of dissolved oxygen in ballast water discharge and the BSC are not subject to analysis because of the number of confounding variables that affect dissolved oxygen concentrations in both ballast water discharge and the BSC. For example, dissolved oxygen concentrations in ballast water discharge are affected by water temperature, type of ballast water treatment, location and timing of last water exchange, fullness of ballast water tanks, and others. Dissolved oxygen levels in the BSC are strongly influenced by time of day, season, and recent weather events. The volume of ballast water discharged into the BSC during each LNG carrier visit would make up only a fraction of the approximately volume of the BSC. The volume differential, combined with water movements, would make effects of ballast water discharge on dissolved oxygen insignificant. Impacts on EFH within the BSC from changes in dissolved oxygen are expected to be minor and temporary in nature.

4.2.1.3 Water Temperatures and pH

Ballast water is carried in tanks below the waterline, and ballast water is typically cooled as a vessel transits through open waters. In winter, ballast water would likely conform to surface water temperatures in the BSC; in summer, ballast water discharges would likely be several degrees cooler that ambient temperatures in the BSC. The pH of the ballast water would reflect conditions where open ocean exchange occurred. The pH of the open ocean is 8.1 (NOAA 2016), which is within the acceptable range for the BSC of 6.5 to 9.0 (Title 30 Texas Administrative Code §§307.01-307.10). The volume of ballast water discharge is small relative to the BSC. The expected differential between ballast water discharge and the BSC is not large enough to cause a change in pH or temperature that would significantly impact aquatic organisms. Impacts of temperature and pH in ballast water discharge on EFH would be temporary and negligible (i.e., discountable).

4.2.1.4 Invasive Species

To minimize and avoid potential impacts on wildlife species that could result from ballast water discharges, Annova would ensure that all visiting vessels possess documentation to demonstrate their compliance with ballast water regulations and BMPs prior to allowing any ballast water to be discharged at the marine transfer facilities (see section 4.3 of the EIS). As a result, marine resources in the Project area are not expected to be impacted by the introduction of invasive species in ballast water.

To minimize and avoid impacts on fish and other aquatic organisms resulting from ballast water discharges, the Coast Guard, which has jurisdiction over inspection and regulatory enforcement for all shipping in U.S. waters, would require all LNG carriers calling on the LNG terminal to adhere to all applicable ballast water management rules and regulations. Coast Guard regulations require that all vessels equipped with ballast water tanks which enter or operate in U.S. waters maintain a ballast water management plan that is specific for that vessel and assigns responsibility to the master or appropriate official to understand and execute the ballast water management strategy for that vessel. Under these requirements, vessels must implement strategies to prevent the spread of exotic aquatic nuisance species in U.S. waters. Examples of these strategies include retaining ballast water on board, minimizing discharge or uptake at certain times and locations, and exchanging ballast water with mid-ocean seawater. Ships that have operated outside of the U.S. Exclusive Economic Zone (EEZ) must either retain their ballast water on board or undergo a mid-ocean (greater than 200 nm from shore/water depth greater than 6,500 feet (2,000 meters) ballast water exchange in accordance with applicable regulations. Applicable U.S. laws, regulations, and policy documents related to ballast water include the following:

- the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) established a broad federal program “to prevent introduction of and to control the spread of introduced aquatic nuisance species." The FWS, Coast Guard, EPA, COE, and NOAA Fisheries all were assigned responsibilities.

- the NISA reauthorized and amended the NANPCA because "Nonindigenous invasive species have become established throughout the waters of the U.S. and are causing economic and ecological degradation to the affected near shore regions." The Secretary of Transportation was charged with developing national guidelines to prevent import of invasive species from ballast water of commercial vessels, primarily through mid-ocean ballast water exchange, unless the exchange threatens the safety or stability of the vessel, its crew, or its passengers.
- the NISA, amended in 2005 and again in 2007, established a mandatory National Ballast Water Management Program. The primary requirements established under NAISA are: 1) all ships operating in U.S. waters are required to have on board an Aquatic Invasive Species Management Plan; 2) the Coast Guard was made responsible for the development of standards for mid-ocean ballast water exchange and ballast water treatment for vessels operating outside of the EEZ; and 3) implementing the BMPs and available technology related to ballast water treatment.
- the National Ballast Water Management Program, originally established by NANPCA and further amended by the National Invasive Species Act of 1996 and NAISA, made the ballast water management program mandatory, including ballast water exchange, with reporting to the Coast Guard.
- the Shipboard Technology Evaluation Program, a program authorized under the Coast Guard Ballast Water Management Program and designed to facilitate the development of "effective ballast water treatment technologies, through experimental systems, thus creating more options for vessel owners seeking alternatives to ballast water exchange."
- the Navigation and Vessel Inspection Circular 07-04, Change 1, a program developed by the Coast Guard for the management and enforcement of ballast water discharge into U.S. ports and harbors.
- Vessels Carrying Oil, Noxious Liquid Substances, Garbage, Municipal or Commercial Waste, and Ballast Water, implementing regulations for the Act to Prevent of Pollution from Ships of 1980, which applies to all U.S.-flagged ships anywhere in the world and to all foreign-flagged vessels operating in navigable waters of the U.S. or while at port under U.S. jurisdiction.

4.2.1.5 Cooling Water Uptake and Discharge

In addition to discharging ballast water, LNG carriers would require the intake of water in order to operate the ship and cool the ship's engines. Ship cooling water would be withdrawn and discharged below the water line on the sides of the ship through screened water ports, known as "sea chests". Water intakes could result in the impingement and entrainment of fish. These actions could impact the rates of stress, injury and/or mortality experienced by fish. To minimize these impacts, water intakes would be outfitted with screened sea chests that withdraw and discharge water at a relatively slow velocity.

The cooling water used by LNG carriers would be withdrawn along the vessel transit routes and from the BSC marine facility while loading LNG cargo. Depending upon engine type, LNG carriers would use between 5.5 and 11.7 million gallons of water for engine cooling while they are at the LNG terminal. Early life stages of fish and invertebrates (ichthyoplankton) would be most susceptible to entrainment. Quantitative data for the structure and density of the ichthyoplankton community within the BSC are unavailable, however the BSC is not considered EFH for spawning adults or eggs, so abundance of early life stages is assumed to be low. As a proxy for the density, we refer to sampling data collected within the Calcasieu River near Carlyss, Calcasieu Parish, Louisiana. In that sampling, fish species had a larval density of 522.2 individuals per 1,000 cubic meters and the shrimp larval density was 91.5 individuals per 1,000 cubic meters. Using these estimated densities and estimated range of cooling water use, between 10,900 and 23,100 larval fish, and between 1,900 and 4,100 larval shrimp could be entrained by each LNG carrier while at the Project. At full capacity, Annova would receive up to approximately 125 LNG carriers per year, which would affect between 1.3 and 2.8 million larval fish and 237,000 and 512,000 larval shrimp per year by cooling water intake. Due to the high natural mortality rates in the first year of ichthyoplankton (greater than 90 percent), an incremental loss would not significantly impact the health of the adult fish population. The impact on ichthyoplankton from cooling water uptake would be permanent (for the life of the facility), but we conclude these impacts would not be significant.

Water used for engine cooling would be discharged at a temperature between 2.7°F and 7.2°F warmer than the ambient water temperature (Caterpillar 2007, 2011, 2012). Using the most conservative estimates (assuming the highest ambient temperature generally found within the BSC [86°F], the greatest change in water temperature [7.2°F], and the largest volume of water [11.7 million gallons]), the discharged cooling water temperature would be 95.5°F. Fish and invertebrates within the immediate vicinity of the LNG carrier could be temporarily affected by this increase in temperature; however, many of the species present are mobile and would be expected to relocate to more suitable conditions during discharges. As discussed in section 4.1.4 above, given the volume of cooling water discharged relative to the total volume of water within the BSC, and the expectation that mobile species would temporarily leave the area of increased temperature, we have determined that impacts on marine and aquatic resources would be intermittent and minor.

4.2.2 Accidental Spills

Minor releases of hydrocarbons (e.g., diesel fuel and various lubricants) from equipment at the marine terminal or work vessels could result in negative direct impacts on fish and invertebrates. Evidence of these disturbances is mainly behavioral (e.g., fish excitement, increased activity, scattering in the water). Extended exposure can lead to chronic poisoning, and cumulative effects can occur. These effects depend on the nature of the toxin, exposure time, and environmental conditions. Many factors determine the degree of damage from a spill, including the composition of the organic-based compound, the size and duration of the spill, the geographic location of the spill, and the weathering processes present. Although oil is toxic to all marine organisms at high concentrations, certain species and life history stages of organisms appear to be more sensitive than others. In general, the early life stages are most sensitive, juveniles are less sensitive, and adults least sensitive (Rice et al. 2000). Even concentrations of oil that are diluted sufficiently to not cause acute impacts on marine organisms may alter certain behavior or physiological patterns. Sub-lethal effects that may occur with exposure to polycyclic aromatic hydrocarbons (PAHs) include impairment of feeding mechanisms for benthic fish and shellfish; reduced growth and development rates, energetics, reproductive output, and juvenile recruitment rates; increased susceptibility to disease and other histopathic disorders (Capuzzo 1987); and physical abnormalities in fish larvae (Urho and Hudd 1989). Effects of exposure to PAHs in demersal fish include liver lesions, inhibited gonadal growth, inhibited spawning, reduced egg viability, and reduced growth (Johnson et al. 2002).

Annova would prepare a Project-specific facility response plan that addresses the potential for petroleum-based spills from operational equipment and describes preventive and response measures that would be implemented in the event of a spill. Additionally, Annova would adhere to all requirements as provided in the Coast Guard's Navigation and Vessel Inspection Circular Number 01-2011 for waterfront LNG facilities (Coast Guard 2011).

It is expected that immediate response actions would limit impacts on aquatic populations to temporary, minor disturbances from these unanticipated contaminant releases. An accidental release of LNG could potentially cause direct mortality at the population or individual level, as well as loss or avoidance of habitat. The behavior of LNG in seawater is not well known as the history of LNG shipping has no substantial releases. If released, it would lower the water temperature rapidly at the air/water interface immediately near the release, but the effects would decrease with depth and are predicted to not be significant for fish habitats. All visiting LNG carriers would have independent oil and hazardous materials response requirements, including requirements for shipboard oil spill response plans that are described in 33 CFR 151 and 155. The LNG carriers also have independent requirements for vessels carrying liquefied hazardous gas (mostly safety requirements) per other regulations (see 46 CFR 154 Subpart E).

5.0 CUMULATIVE IMPACTS AND MITIGATION

5.1 CUMULATIVE IMPACTS

Cumulative impact is the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7)." Cumulative impacts on EFH associated with this Project may include similar impacts from other projects within the same geographic region. We have addressed cumulative impacts relative to wetlands, water quality, and fisheries in section 4.13 of the EIS.

5.2 MITIGATION MEASURES

In support of a policy to reduce impacts on EFH, Annova would commit to implementing several mitigation measures to minimize or eliminate impacts on water quality and wetlands, and to reduce the effects from other construction and operational activities.

Due to the general nature of the area surrounding the Project site, wetland impacts cannot be avoided entirely. Construction would temporarily affect 4.7 acres of estuarine open water and tidal flat, and operation of the Project would permanently convert 2.0 acres of open water and tidal flat to upland or built infrastructure. Construction would temporarily affect 53.0 acres of estuarine emergent marsh, of which 50.8 acres would be permanently converted to non-wetland cover type during Project operation. Annova is consulting with the COE and other cooperating agencies as part of the wetland permitting process. In order to obtain a permit under Section 404 of the Clean Water Act from the COE, Annova must first avoid and minimize impacts on waters of the United States to the extent practicable. In addition, the COE will require compliance with the "no net loss" policy through replacement of wetlands to offset the loss of wetlands resulting from construction of the Project. For unavoidable impacts on waters of the United States, Annova is in the process of developing a mitigation plan to offset the loss and/or wetland resource functions within the watershed. The COE will determine the acceptability of the proposed mitigation plan for wetland impacts.

Construction activities have the potential to introduce contaminants to stormwater runoff through excavation, material delivery and storage, and equipment and vehicle use and storage. Stormwater from the site would discharge directly to stormwater retention ponds, with subsequent discharge into the BSC. Annova has developed a Project-specific *Upland Erosion Control, Revegetation, and Maintenance Plan* (Annova *Plan*) and *Wetland and Waterbody Construction and Mitigation Procedures* (Annova *Procedures*) based respectively on FERC's Plan (FERC 2013a) and Procedures (FERC 2013b) for reducing water quality impacts on the BSC. The Annova *Plan and Procedures* include a description of pollution control measures and best management practices that would help to control erosion, sedimentation, and pollutants in runoff from the site. For Project operation, Annova would prepare and implement a stormwater pollution prevention plan and a spill prevention, control, and countermeasures plan to prevent impacts from minor spills. Adherence to the Annova *Plan and Procedures*, as well as the plans listed above, would reduce the potential for spills or impacts on the waterway, and thereby reduce impacts on EFH and fisheries.

Based on the previous analysis, a potential risk exists to managed (and other) fish species as a result of planned pile-driving activities for the Project. To minimize impacts, Annova would institute impact minimization and mitigation measures throughout the course of the Project. Although specific mitigation measures are not yet final, they may include those listed below.

- use of the lowest-noise-producing impact hammer available for pile driving to reduce in-water noise levels;

- various operational procedures, including "soft starts." Prior to operating at full capacity, Annova would implement a "soft start" with several initial hammer strikes at less than full capacity (i.e., approximately 40 to 60 percent energy levels), with no less than a 1-minute interval between each strike;

- bubble Curtain. A bubble curtain functions to restrict sound waves from emanating away from the noise source. Air pumped into a perforated hose lying on the seabed escapes and produces an air bubble curtain as the bubbles rise. Sound generated by pile-driving are attenuated as they pass through the bubbles;

- hydro Sound Damper (HSD). The HSD system consists of a fishing net on which HSD elements of different sizes are mounted at various distances from each other. Using a ballast ring on the seabed and a flotation system on the sea surface, the net, including the HSD elements, can be located a short distance (less than 3.3 feet

[1 meter]) around the pile. The HSD elements can be foam plastic elements or gas-filled balloons. The noise from the pile must cross the HSD elements and is thereby reduced due to reflection and absorption. In principle, the HSD elements act like air bubbles in the water, with the advantages that they cannot be drifted by currents and, because their size can be adjusted, their resonance frequency is adjustable;

- Noise Mitigation Screen (NMS). A NMS system consists of a double-wall steel screen tube. The pile is inserted into this system. The space between the two screens is filled with air, and air bubbles can be fed in between the pile and NMS system (water-air- composite). As the radiated sound crosses the internal bubble curtain and the air-filled double-wall steel screen, it is reduced due to reflection (impedance gap); and

- cofferdam. The cofferdam system consists of a single-wall steel tube. The pile is inserted into this system. Near the seabed a gasket (seal ring) is installed so that water in the space between pile and cofferdam can be evacuated by pumps. In principal, the pile is installed in air and not in water, so sound generated by pile driving radiates into the air and then crosses the steel tube. Due to the different impedances, the pile-driving noise is reduced by reflection.

6.0 CONCLUSION

Potential impacts resulting from Project construction and operation are expected to be short-term and highly localized, occurring primarily during construction or shortly thereafter. Overall, impacts on managed species and EFH in the Project area would vary depending on the species and different stages of their life cycles. In general, due to their mobility, pelagic species and those with mobile early life stages would avoid the Project area during construction. Any loss of early life stages during hydrostatic testing or dredging activities during construction, and from cooling water uptake and discharge, and ballast water discharge during operation, would be inconsequential to regional fish populations.

Short-term increases in turbidity would occur as a result of disturbance of bottom sediments during construction. These impacts would likely be highly localized and thus are not expected to be significant. Sediment disturbance within the terminal basin is expected to result in mortality of benthic organisms within and adjacent to the Project footprint. This reduction in benthic community densities would eliminate a small amount of the available forage for managed species that occur locally. This impact would be short-term and minor, as the community would re-establish over a relatively short period of time through immigration and translocation. The short-term loss of the benthic community during construction would not be a significant adverse impact.

Impacts from pile driving are expected to be less than significant considering the short in-water work schedule and the implementation of BMPs, mitigation measures, and conservation measured recommended by NOAA Fisheries. The short-term nature of the proposed pile-driving activities would not result in significant adverse effects on EFH or managed species.

7.0 REFERENCES

Black & Veatch. 2016. Hydrodynamic Modeling. Document Number 183169-REFF-0027. Prepared for Annova LNG, LLC. November 30.

BOEM (Bureau of Ocean Energy Management. 2014. *Atlantic OCS – Proposed Geological and Geophysical Activities: Mid-Atlantic and South Atlantic Planning Areas.* Final Programmatic Environmental Impact Statement. OCS EIS/EA, BOEM 2014-001.

Caltrans (California Department of Transportation). 2001. Fisheries impact assessment, pile installation demonstration project, San Francisco-Oakland Bay Bridge, East Span Seismic Safety Project. 59 p.

Capuzzo, J.M. 1987. Biological effects of petroleum hydrocarbons: assessment of experimental results. In: Boesch, D.F., and N.N. Rabelais, eds. *Long-term Environmental Effects of Offshore Oil and Gas Development,* 343–341. London, England: Elsevier Applied Science.

Coast Guard (United States Coast Guard). 2011. Navigation and Vessel Inspection Circular No. 01-2011. Guidance Related to Waterfront Liquefied Natural Gas (LNG) Facilities, COMDTPUB P16700.4.

COE (United States Army Corps of Engineers). 2012. A community-based ecosystem response model for the Resacas (oxbow lakes) of the Lower Rio Grande. Website: http://el.erdc.usace.army.mil/elpubs/pdf/trel12-31.pdf (Accessed in January 2016).

______. 2013. *Brazos Island Harbor, Texas Channel Improvement Project, Draft Integrated Feasibility Study – Environmental Assessment*. Website: http://www.swg.usace.army.mil/Portals/26/docs/Cheryl%20Jaynes/2-BIH%20DIFR-EA%202013.pdf (accessed in June 2015).

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 131 pp.

EPA (United States Environmental Protection Agency). 1999. The Ecological Condition of Estuaries in the Gulf of Mexico. EPA 620-R-98- 004, July 1999. EPA Office of Research and Development, National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, Gulf Breeze, Florida. Website: http://www.epa.gov/ ged/gulf.htm.

FERC (Federal Energy Regulatory Commission). 2013a. *Upland Erosion Control, Revegetation, and Maintenance Plan.* Office of Energy Projects, May 2013. Website: http://www.ferc.gov/industries/gas/enviro/plan.pdf (accessed on April 1, 2015).

______. 2013b. *Wetland and Waterbody Construction and Mitigation Procedures.* Office of Energy Projects, May 2013. Website: http://www.ferc.gov/industries/ gas/enviro/procedures.pdf (Accessed on April 1, 2015).

FWS (United States Fish and Wildlife Service). 2000. News and Activities – Free-for-all with Furfural Kills 9 Million Fish. Website: http://www.fws.gov/contaminants/DisplayNews.cfm?NewsID=E2D4E08E-7448-11D4- A169009027B6B5D3 (accessed in May 2015).

Finucane, J.H., L.A. Collins, H.A. Brusher, and C.H. Saloman. 1986a. Reproductive biology of king mackerel, *Scomberomerus cavalla*, from the southeastern United States. *Fish Bull* 84(4):841–850.

Finucane, J.H., L.A. Collins, H.A. Brusher, and C.H. Saloman. 1986b. Reproductive biology of Spanish mackerel, *Scomberomerus maculatus*, from the Gulf of Mexico and South Atlantic Ocean of the United States. U.S. Natl Mar. Fish. Serv., Panama City, FL. 23 pp. (unpubl. MS).

Gallaway, B.J., S.T. Szedlmayer, and W.J. Gazey. 2009. A life history review for red snapper in the Gulf of Mexico with an evaluation of the importance of offshore petroleum platforms and other artificial reefs, *Reviews in Fisheries Science*, 17(1):48–67.

Gardner, M. B. 1981. Effects of turbidity on feeding rates and selectivity of bluegills. *Transactions of the American Fisheries Society* 110:446–450.

Germano, J., J. Parker, and J. Charles. 1994. Monitoring Cruise at the Massachusetts Bay Disposal Site, August 1990. DAMOS Contribution No. 92. U.S. Army Corps of Engineers, New England Division, Waltham, Massachusetts. 51 pp.

GMFMC (Gulf of Mexico Fishery Management Council). 1998. Generic amendment for addressing essential fish habitat requirements in the Fishery Management plans of the Gulf of Mexico. Tampa, Florida: Gulf of Mexico Fishery Management Council.

______. 2004. Final Environmental Impact Statement for the Generic Essential fish Habitat Amendment to the Gulf of Mexico (GOM): Shrimp Fishery of the GOM; Red Drum Fishery of the GOM; Reef Fish Fishery of the GOM; Stone Crab Fishery of the GOM; Coral and Coral Reef Fishery of the GOM; Spiny Lobster Fishery of the GOM; Coastal Migratory Pelagic Resources of the GOM and South Atlantic.

______. 2005. Generic amendment for addressing essential fish habitat requirements in the Fishery Management plans of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, Florida.

______. 2015. Species Listed in the Fishery Management Plans of the Gulf of Mexico Fishery Management Council. Website: http://gulfcouncil.org/Beta/GMFMCWeb/downloads/species%20managed.pdf. Accessed in March 2016.

Hastings, M.C. 2007. Calculation of SEL for Govoni et al. (2003, 2007) and Popper et al. (2007) studies. Report for Amendment to Project 15218, J&S Working Group, Applied Research Lab, Penn State University. 7 pp.

Hawkins, A.D., and A.N. Popper. 2016. A Sound Approach to Assessing the Impact of Underwater Noise on Marine Fishes and Invertebrates. *ICES Journal of Marine Science* 1-17. doi:0.1093/icesjms/fsw205.

Hedges, C.J. 2011. Hydroacoustic Impacts on Fish from Pile Installation. Website: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rrd_363.pdf (accessed in March 2016).

Hirst, A.G., and P.G. Rodhouse. 2000. Impacts of geophysical seismic surveying on fishing success. *Reviews in Fish Biology and Fisheries* 10:113–118.

Hoese, H.D., and R.H. Moore. 1977. *Fishes of the Gulf of Mexico: Texas, Louisiana, and adjacent waters.* Texas A&M University Press, College Station and London. 327 p.

ICF Jones & Stokes, and Illingworth and Rodkin, Inc. 2009. Final Technical Guidance for Assessment and Mitigation of Hydroacoustic Effect of Pile Driving on Fish. Prepared for California Department of Transportation. February 2009. 298 pp.

Johnson, L.L., T.K. Collier, and J.E. Stein. 2002. An analysis in support of sediment quality thresholds for polycyclic aromatic hydrocarbons (PAH) to protect estuarine fish. *Aquatic Conservation: Marine and Freshwater Ecosystems* 12 (5):517–538.

LGL Limited. 2006. Assessment of the Effects of Underwater Noise from the Proposed Neptune LNG Project – Supplemental Biological Effects Report. LGL Report No. 4200-2a. Prepared for Ecology and Environment, Inc., August 8, 2006. 8 pp.

LUMCON (Louisiana Universities Marine Consortium). 2016. Hypoxia in the Northern Gulf of Mexico. Website: http://www.gulfhypoxia.net/overview/ (accessed January 2016).

Murray, P.M., and H.L. Saffert. 1999. Monitoring Cruises at the Western Long Island Sound Disposal Site, September 1997 and March 1998. DAMOS Contribution No. 125. U.S. Army Corps of Engineers.

Newcombe, C.P., and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. *North American Journal of Fisheries Management* 16:693–727.

Nightingale, B., and C.A. Simenstad. 2001. Dredging activities: marine issues. Washington State Transportation Center (TRAC) Report WA-RD 507.1 for the Washington State Transportation Commission and in cooperation with US Department of Transportation; 2001. 182 pp.

NOAA. 1985. Gulf of Mexico coastal and ocean zones strategic assessment: Data Atlas. U.S. Department of Commerce. NOAA, NOS. December 1985.

______. 2000. Incident News – Furfural Spill. Website: http://incidentnews.noaa.gov/incident/7458/507735 (Accessed in May 2015).

______. 2016. What is Essential Fish Habitat? Website: http://www.habitat.noaa.gov/protection/efh (Accessed May 3, 2016).

NOAA Fisheries (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 1999a. Fishery Management Plan for Atlantic Tunas, Swordfish and Sharks. NOAA, National Marine Fisheries Service, Highly Migratory Species Management Division, Silver Spring, Maryland. Public Document.

______. 1999b. Amendment 1 to the Atlantic Billfish Fishery Management Plan, including Revised Final Supplemental Environmental Impact Statement, Regulatory Impact Review Final Regulatory Flexibility Analysis, and Social Impact Assessment/Fishery Impact Statement. Developed in coordination with the Highly Migratory Species (HMS) Fishery Management Plan for the Atlantic Tuna, Swordfish, and Shark Fisheries. NOAA, National Marine Fisheries Service, Highly Migratory Species Management Division, Silver Spring, Maryland. Public Document.

______. 2003. Final Amendment 1 to the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, Maryland. Public Document. pp. 648.

______. 2009. Final Amendment 1 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan, Essential Fish Habitat. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, Maryland. Public Document. pp. 395.

______. 2011. Fisheries of the United States 2010. National Marine Fisheries Service, Office of Science and Technology, Silver Spring, MD. 118 pages.

______. 2015a. Amendment 35 to the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. September 2015. Website: http://sero.nmfs.noaa.gov/sustainable_fisheries/s_atl/sg/2014/am35/documents/pdfs/sa_sg_am35_ea_091015.pdf.

______. 2015b. Atlantic Highly Migratory Species. Website: http://www.nmfs.noaa.gov/sfa/hms.

NRC (National Research Council). 2003. Ocean Noise and Marine Mammals. NRC, Washington, D.C.

Page, L.M., H. Espinoza-Perez, L.T. Findley, C.R. Gilbert, R.N. Lea, N.E. Mandrak, R.L. Mayden, and J.S. Nelson. 2013. *Common and scientific names of fishes from the United States, Canada, and Mexico*, 7th edition. American Fisheries Society, Special Publication 34, Bethesda, Maryland. 384 p.

Patillo, M., L. P. Rozas, and R. J. Zimmerman. 1995. A Review of Salinity Requirements for Selected Invertebrates and Fishes of U.S. Gulf of Mexico Estuaries. National Marine Fisheries Service. Southeast Fisheries Service Center. Galveston, Texas.

Popper, A.N., M.E. Smith, P.A. Cott, B.W. Hanna, A.O. MacGillivray, M.E. Austin, and D.A. Mann. 2005. Effects of exposure to seismic airgun use on hearing of three fish species. *Journal of the Acoustic Society of America* 117:3958–3971.

Popper, A.N., and M.C. Hastings. 2009. Effects of anthropogenic sources of sound on fishes. *Journal of Fish Biology* 75:455–498.

Reine, K.J., and C. Dickerson. 2014. Characterization of underwater sounds produced by a hydraulic cutterhead dredge during maintenance dredging in the Stockton Deepwater Shipping Channel, California. U.S. Army Corps of Engineers ERDC TN-DOER-E38, March 2014. 24 pp.

Rhoads, D.C., P.L. McCall, and J.Y. Yingst. 1978. Disturbance and production on the estuarine seafloor. *American Scientist* 66:577–586.

Rice, S.D., J.W. Short, R.A. Heintz, M.G. Carls, and A. Mole. 2000. Life-history consequences of oil pollution in fish natal habitat. In: P. Catania, ed. *Energy 2000: the beginning of a new millennium*. Lancaster, PA: Technomic Publishers. pp. 1210-1215.

Robertson, M.J., D.A. Scruton, R.S. Gregory, R.S., and K.D. Clarke. 2006. Effect of Suspended Sediment on Freshwater Fish and Fish Habitat. *Canadian Technical Report of Fisheries and Aquatic Sciences* 2644:37.

Rodriguez-Pino, Z. 1962. Estudios estadisticos y biologicos sobre la biajaiba (*Lutjanus synagris*). Notas Pesqueras, Havana, Cuba. *Nota* 2:1–16.

Ruggerone, G.T., S. Goodman, and R. Miner. 2008. *Behavioral Response and Survival of Juvenile Coho Salmon Exposed to Pile Driving Sounds*. Natural Resources Consultants, Seattle, Washington. July 2008. 46 pp.

Stadler, J.H., and D.P. Woodbury. 2009. Assessing the effects to fishes from pile driving: Application of new hydroacoustic criteria. *Internoise 2009: Innovations in practical noise control.* August 2009, Ottawa, Canada.

TCEQ (Texas Commission on Environmental Quality). 2012. Texas Integrated Report: Assessment Results for Basin 24 – Bays and Estuaries. Accessed May 2015 http://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/12twqi/2012_basin24.pdf.

Turner, R.E., and D.F. Boesch. 1987. Aquatic Animal Production and Wetland Relationships: Insights Gleaned Following Wetland Loss or Gain. *In*: D.D. Hook et al. (eds.), *The Ecology and Management of Wetlands.* Vol. 1: Ecology of wetlands. Timber Press, Portland, OR.

Urho, L., and R. Hudd. 1989. Sub-lethal effects of an oil spill on fish (herring) larvae in the northern Quark, in the Baltic. In: Blaxter, J.H.S., J.C. Gamble, and H.V. Westernhagen, eds., *The Early Life History of Fish*, 1988 Oct. 3-5, Bergen, Norway. Third ICES Symposium: Rapports et Proces-Verbaux Des Reunions 191. Copenhagen: International Council for the Exploration of the Sea. p. 494.

USDOE (United States Department of Energy). 2012. Turning down the dial: Ocean development with less sound. Website: http://www.pnnl.gov/news/ release.aspx?id=930. Accessed in March 2016.

Utne-Palm, A.C. 2002. Visual feeding of fish in a turbid environment: physical and behavioural aspects. *Marine and Freshwater Behaviour and Physiology* 35:111–128.

Young, H. 2015. Personal communications from Heather Young, NOAA NMFS, Habitat Conservation Division.

APPENDIX G
FUGITIVE DUST CONTROL PLAN

Annova LNG Brownsville Project

Draft
Fugitive Dust Control Plan

May 2016

Submitted by:

annova LNG

4 Houston Center
1221 Lamar Street, Suite 750
Houston, TX 77010

Prepared by:

ecology and environment, inc.
Global Environmental Specialists

This page intentionally left blank.

TABLE OF CONTENTS

Section Page

Acronyms and Abbreviations iii

1 INTRODUCTION 1
1.1 Objective 1
1.2 Project Description 1
2 FUGITIVE DUST SOURCES 1
3 APPLICABLE REGULATORY REQUIREMENTS 2
4 FUGITIVE DUST CONTROL MEASURES 2
5 INSPECTION, MONITORING, AND RECORDKEEPING 3

ACRONYMS AND ABBREVIATIONS

Annova	Annova LNG Common Infrastructure, LLC, Annova LNG Brownsville A, LLC, Annova LNG Brownsville B, LLC, and Annova LNG Brownsville C, LLC
LNG	liquefied natural gas
mtpa	million metric tonnes per annum
Project	Annova LNG Brownsville Project

1 INTRODUCTION

1.1 OBJECTIVE

The objective of this fugitive dust control plan is to identify potential dust emission sources and provide guidance to construction and field personnel on measures to control the generation of fugitive dust during construction activities associated with the Annova LNG Project (Project). It will be the responsibility of Project contractors, working with designated environmental inspectors, to identify all activities generating fugitive dust, implement feasible control measures, and ensure compliance with applicable fugitive dust regulations.

1.2 PROJECT DESCRIPTION

Annova is proposing to develop a liquefied natural gas (LNG) facility capable of producing a nominal capacity of approximately 6.0 million (metric) tonnes per annum (mtpa) of LNG. The Project would receive natural gas via a lateral pipeline that would tie-in to an existing interstate pipeline. The natural gas would be treated, liquefied, and stored on-site in two full containment LNG storage tanks with a net pumpable capacity of approximately 160,000 cubic meters (m^3) of LNG each. At full plant capacity, the Project would consist of six LNG trains each with a nominal capacity of 1.0 mtpa of LNG (total nominal capacity of approximately 6.0 mtpa). The LNG would be loaded onto LNG carriers for export overseas.

2 FUGITIVE DUST SOURCES

Fugitive dust could be generated directly from the aboveground facility construction. The following construction activities have been identified as having the potential for generating fugitive dust:

- Vehicle and motorized equipment movement on paved and unpaved access roads;
- Vegetation removal;
- Clearing and grading;
- Topsoil removal;
- Cutting and filling;
- Trenching;
- Backfilling;
- Track-out onto roads;
- Bulk material loading, hauling and unloading;

- Use of material storage piles, and
- Use of parking, staging, and storage areas.

It is the responsibility of the Project contractor(s) and the designated environmental inspector(s) to ensure all sources of dust generation are identified.

3 APPLICABLE REGULATORY REQUIREMENTS

The Texas Commission on Environmental Quality's (TCEQ) fugitive dust regulations with requirements potentially applicable to Project construction activities is presented in Texas Administrative Code (TAC) Title 30, Part 1:

- Chapter 101.4, Nuisance; a general duty regulation that prohibits discharge from any source whatsoever air contaminants that may be injurious or adversely affect human health or welfare, animal life, vegetation, or property or to interfere with the normal use and enjoyment of animal life, vegetation, or property.
- Chapter 111, Subchapter A Visible Emissions and Particulate Matter, addresses visible emissions and various sources of particulate matter.
  - Division I, Chapter 111.111(a) is a general statement prohibiting visible emissions from any source;
  - Division I Chapter 111.111(8) prohibits visible emissions exceeding 30% opacity for any six-minute period from all other sources not previously specified in Chapter 111.
  - Division 4, Chapter 111.141 identifies geographic applicability of specific particulate matter control regulations; Cameron County is not included in the list of areas subject to this rule.

The fugitive dust control measures applicable to the Project that address the general requirements in Chapter 101.4 and Chapter 111 are detailed in Section 4 below.

4 FUGITIVE DUST CONTROL MEASURES

The generation of fugitive dust during construction activities would be reduced through the application of appropriate control measures. Abatement measures will be utilized as needed and appropriate to a particular situation. Based on typical practices for the natural gas industry and the requirements of the TCEQ, the following specific control measures will be used as needed to control fugitive dust emissions for the Project.

- Properly maintain construction equipment and vehicles to minimize particulate matter from exhaust.

- Utilize existing public and private roads and existing ROW for access during construction wherever possible.
- Apply water as needed to all affected unpaved roads, unpaved haul/access roads, and staging areas (when in use).
- When appropriate, apply a water/magnesium chloride mixture as needed as a dust suppressant.
- Reduce vehicle speeds on all unpaved roads, and unpaved haul and access roads. Speed limits would be set to 20 mph for unpaved roads in all areas, or in accordance with posted public speed limits.
- Inspect paved road access points and clean up track-out and/or carry-out areas at paved road access points at a minimum of once every 48 hours.
- Gravel pads may be installed adjacent to paved roadways to limit track-out, and clearly established and enforced traffic patterns may be used to route traffic over track-out control devices.
- For bulk transfer operations, spray handling and transfer points with water at least 15 minutes before use.
- Cover all haul truck loads, or maintain at least six inches of freeboard space in each cargo compartment. Ensure that all haul truck cargo compartments are constructed and maintained to minimize spillage and loss of materials, and clean or wash each cargo compartment at the delivery site after removal of the bulk materials.
- Apply water to active construction areas as needed. Areas should be pre-watered and soils maintained in a stabilized condition where support equipment and vehicles will operate. Water disturbed soils to form a crust.
- For temporary surfaces during periods of inactivity, restrict vehicular access by means of either fencing or signage, and apply water to comply with the stabilized surface requirements.

Water trucks will be the primary means of dust abatement during all phases of construction. Water spray will be controlled so that over-spraying and pooling will be avoided to the extent possible. Where roads are paved, no dust mitigation, other than cleanup of track out, will be used.

5 INSPECTION, MONITORING, AND RECORDKEEPING

The Project contractors will implement the dust control measures specified in this plan. An environmental inspector or other person with construction oversight will be primarily responsible for monitoring and enforcing the implementation of needed dust control measures. The inspector will also be responsible for making sure that dust control is effective and proper documentation is maintained. All construction site personnel will be educated on the measures outlined in this plan.

Field inspection for dust control will occur daily. The Project contractor(s) and the environmental inspector will be responsible for recording the following information on a daily basis:

- Weather conditions (temperature, wind speed, and direction);
- Number of water trucks in use;
- Cases where visible dust was of such a concentration that abatement measures were implemented;
- Condition of project soils (crusted, damp, or unstable);
- Condition of project access roads (crusted, damp, or unstable);
- Presence of track-out and when it was cleaned;
- Overall status of dust control compliance.

This information will be incorporated into the environmental inspector’s daily report.

APPENDIX H
PROJECTS CONSIDERED IN THE CUMULATIVE IMPACT ASSESSMENT

TABLE H-1

Projects Identified within the Geographic Scope for Cumulative Impacts Associated with the Annova LNG Project

Project/Activity (Reference # on Map)	Estimated Timeframe (Construction/ Operation)	Distance from Annova LNG Project (mi)	Project Size	Resources Potentially Affected within Annova LNG Project Geographic Scope
Proposed Project				
Annova LNG Project	2019/2022	0	543 acres	All
Potential Future LNG Export Projects				
Rio Grande LNG Project and Rio Bravo Pipeline (#4)	2019/2026	0.3	1,150 acres (LNG Facility) 2,500 acres (Pipeline)	All resources less geology, soils, and cultural.
Texas LNG and Pipeline (#5)	2019/2020	2.2 miles	311 acres	All resources less geology, soils, and cultural.
Non-jurisdictional Facilities Associated with the Annova LNG Project				
Natural Gas Interconnection (#1)	2019/2021	On site	1.4 acres	All
Electric Transmission Line (#2)	2019/2021	Adjacent	15 miles (100 acres)	All
Potable Water Supply Pipeline (#3)	2019/2021	Adjacent	6 miles (30 acres)	All
Natural Gas Supply Lateral Pipeline (#20)	2021/2021	Adjacent	9 miles (110) b/	All
Non-jurisdictional Facilities Associated with the Rio Grande LNG Project				
LNG Trucking (not mapped)	Unknown	0.5 mile	12 to 15 tanker trucks/day	All resources less geology, soils, and cultural.
Potable Water and Sewer Services Lines (#34,35)	2018/2018	2.7 miles	5-6 miles (est. 3.3 acres)	All resources less geology, soils, and cultural.
Electric Transmission Lines (#32,33)	2019/2020	2.7 miles	12.7 miles (est. 142 acres)	All resources less geology, soils, and cultural.
Road Widening State Highway 48 (#4)	2018/2018	2.0 miles	3 miles (est. 36.4 acres) b/	All resources less geology, soils, and cultural.
Non-jurisdictional Facilities Associated with the Texas LNG Project				
Intrastate Natural Gas Pipeline (not mapped)	2019	0.9 mile	10.2 miles (108.3 acres)	All resources less geology, soils, and cultural.
State Highway 48 Auxiliary Lane (#36)	2018	0.9 mile	0.5 acre	All resources less geology, soils, and cultural.
Electric Transmission Line (#32,33)	2018	0.9 mile	11 miles (120.6 acres)	All resources less geology, soils, and cultural.
Potable Water Line (#34)	2020	0.9 mile	7.4 miles a/	All resources less geology, soils, and cultural.
Pipeline Projects				
Valley Crossing Pipeline (aka Nueces-Brownville Pipeline) (#21)	Operational as of 2018	5 miles	168 miles (est. 2,546 acres) c/	All resources less geology, soils, and cultural.
Rio Bravo Pipeline (included with Rio Grande LNG Project) (#31)	2018/2020	0.3 mile	2,500 acres	All resources less geology, soils, and cultural.

TABLE H-1

Projects Identified within the Geographic Scope for Cumulative Impacts Associated with the Annova LNG Project

Project/Activity (Reference # on Map)	Estimated Timeframe (Construction/ Operation)	Distance from Annova LNG Project (mi)	Project Size	Resources Potentially Affected within Annova LNG Project Geographic Scope
Electric Transmission and Generation Projects				
Tenaska Brownsville Generating Station (#24)	Unknown	15 miles	270 acres	All resources less geology, soils, visuals, noise and cultural.
San Roman Wind Farm (#44)	Operational as of 2016	8 miles	156 acres	All resources less geology, soils, visuals, noise and cultural.
Cameron Wind Farm (#43)	Operational as of 2015	16 miles	15,000 acres	All resources less geology, soils, visuals, noise and cultural.
Cross Valley Project (#23)	Operational as of 2016	6 miles	96 miles (est. 1,746 acres) d/	All resources less geology, soils, visuals, noise and cultural.
Palmas Altas Wind Project (not mapped)	Underway/2019	21 miles	6,500 acres	Land Use, Socioeconomics
Palmas to East Rio Hondo Transmission Line (not mapped)	2019	22 miles	6 miles (est. 73 acres)	Land Use, Socioeconomics
Transportation Projects				
East Loop (State Highway 32) (#29)	2019/Unknown	7.6 miles	6.7 miles (127 acres)	All resources less geology, soils, visuals, noise and cultural.
South Padre Island Second Access (#28)	2019/2022	7.6 miles	17.6 miles (240.6 acres)	All resources less geology, soils, visuals, noise and cultural.
State Highway 4 Upgrade Project (#39)	2018/2020	8.5 miles	Unknown	All resources less geology, soils, visuals, noise and cultural.
State Highway 100 and 106 Wildlife Crossings (#37, 38)	2016/2017	6-14 miles	7.1 miles	All resources less geology, soils, visuals, noise and cultural.
State Highway 550 Direct Connector Project (#27)	Operational	9.4 miles	Approximately 10 miles	All resources less geology, soils, visuals, noise and cultural.
Cameron County West Railroad Relocation Project (#30)	Operational (2015)	15.8 miles	Approximately 6 miles	All resources less geology, soils, visuals, noise and cultural.
Airport Terminal (#22)	2019	15 miles	Unknown	All resources less geology, soils, visuals, noise and cultural.
Port of Brownsville Projects				
Brownsville Liquids Terminal 2 (#15)	Operational as of 2016	7.1 miles	Unknown	All resources less geology, soils, visuals, noise and cultural.
Brownsville Liquids Terminal Facility (#14)	Operational	5 miles	Unknown	All resources less geology, soils, noise and cultural.
GEOTRAC Industrial Hub (not mapped)	Unknown	7.9 miles	1,400 acres	All resources less geology, soils, visuals, noise and cultural.
Port of Brownsville Marine Cargo Dock 16 and Storage Yard (#17)	Operational as of August 2015	6.5 miles	600-foot marine cargo dock	All resources less geology, soils, visuals, noise and cultural.
Centurion Brownsville Terminal Processing and Storage Facility (#16)	Ongoing/2017	9 miles	240 acres	All resources less geology, soils, visuals, noise and cultural.
Big River Steel Mill (not mapped)	Unknown	Unknown	800 acres	All resources less geology, soils, visuals, noise and cultural.

TABLE H-1

Projects Identified within the Geographic Scope for Cumulative Impacts Associated with the Annova LNG Project

Project/Activity (Reference # on Map)	Estimated Timeframe (Construction/ Operation)	Distance from Annova LNG Project (mi)	Project Size	Resources Potentially Affected within Annova LNG Project Geographic Scope
Waterway Improvement Projects				
Brazos Island Harbor Channel Improvement Project (#7)	October 2017/ February 2020	0.14 mile	250-foot wide channel	All resources less geology, soils, visuals, noise and cultural.
Bahia Grande Channel Restoration (#6)	Anticipated 2017/Unknown	0.3 mile	Unknown	All resources less geology, soils, visuals, noise and cultural.
BSC and Turning Basin Maintenance Dredging (#8)	Underway/ Ongoing	Adjacent	Unknown	All resources less geology, soils, visuals, noise and cultural.
Bend Easing BSC Improvement Project (#12)	Unknown	5.8 miles	Unknown	--
Port Isabel Maintenance Dredging (#9)	Underway/ Ongoing	3.5 miles	Unknown	All resources less geology, soils, noise and cultural.
Gulf Intracoastal Waterway Maintenance Dredging (#10)	Underway/ Ongoing	5 miles	Unknown	All resources less geology, soils, noise and cultural.
Other Projects and Activities Considered				
SpaceX Commercial Spaceport Project (#18)	2014/2018	6.3 miles	70 acres	All resources less geology, soils, visuals and cultural.
STARGATE Facility (#48)	Underway	4.3 miles	2.3 acres	All resources less geology, soils and cultural.
South Padre Island Beach Re-nourishment (#13)	Complete/ Periodic	7.1 miles	0.8 mile	All resources less geology, soils, noise and cultural
Palo Alto Battlefield Cultural Landscape Restoration (#53)	Ongoing	9.2 miles	Unknown	All resources less geology, soils, visuals and cultural.
Bahia Grande Coastal Corridor Project (#X)	Ongoing	7.6 miles	2,129 acres (total acquisition is over 7,000 acres)	All resources less geology, soils, visuals and cultural.

a/ The non-jurisdictional potable waterline would be located within the same construction corridor as the non-jurisdictional natural gas supply pipeline and would be constructed concurrently; therefore, the affected area is captured within the natural gas pipeline acreage.
b/ Acreage is estimated based on an assumed 100-foot-wide construction corridor.
c/ Acreage is estimated based on an assumed 125-foot-wide construction corridor.
d/ Acreage is estimated based on an assumed 150-foot-wide construction corridor.

APPENDIX I
CUMULATIVE CONSTRUCTION NOISE IMPACT ASSESSMENT

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 J
LIST OF PREPARERS

APPENDIX J
LIST OF PREPARERS AND REVIEWERS

Federal Energy Regulatory Commission

Tomasi, Eric – Project Manager, Air Quality and Noise, Cumulative Impacts
B.S., Aerospace Engineering, 1994, Boston University

Armbruster, Ellen – Cultural Resources
M.A., Anthropology, 1986, University of Pennsylvania
B.A., Anthropology, 1979, Bryn Mawr College

Dague, Brady – LNG Reliability and Safety
B.S., Civil Engineering, University of Maryland, 2010

Patel, Ghanshyam – LNG Reliability and Safety
B.S., Chemical Engineering, Pennsylvania State University, 2004

Peconom, John – Vegetation and Wildlife, Special Status Species
B.S., Biology and Management, 2000, University of California, Davis

Rana, Anthony – Geology, Soils
M.S., International Development, Tulane University, 2012
Graduate Studies, Hydrogeology and Geochemistry, Oklahoma State University, 1988
B.S., Geology, New Jersey City University, 1984

FERC LNG Consultants

Bachman, Robert – LNG Reliability and Safety
M.S., Structural Engineering, University of California at Berkeley, 1968
B.S., Civil Engineering, University of California at Berkeley, 1967

Bhushan, Kul – LNG Reliability and Safety
Ph.D., Geotechnical Engineering, Duke University, 1970
M.S., Highway Engineering, Panjab University, India, 1963
B.S., Civil Engineering, Panjab University, India, 1962

Stebbing, Roger – LNG Reliability and Safety
B.S., Chemical Engineering, University of Salford, England, 1968

FERC Third-Party Contractor – Tetra Tech, Inc.

Scott, John G. – Project Manager, Alternatives
M.S., Wildlife and Fisheries Science, 1995, Pennsylvania State University
B.S., Natural Resources Management, 1983, Cornell University

Crookston, John – Deputy Project Manager

M.S., Ecology, 2007, San Diego State University
B.A., Biology, 2002, University of California, San Diego

Andrews, Emmy – Noise

M.S., Environmental Management, 2005, University of San Francisco
B.A., Art and Art History, 1998, Duke University

Brimacombe, Karen – Wetlands and Vegetation

M.S., Botany/Ecology/Evolution/Conservation/Biology Specialization, 2003, University of Hawai'i
B.A., Psychology, 1992, Miami University

Cox, Dave – Cumulative Effects

B.S., Environmental & Engineering Geology, 2000, Western Washington University

Dadswell, Matt – Land Use, Socioeconomics, Environmental Justice

Post-Masters Study (ABD), Economic Geography, 1997, University of Washington
M.A., Economic Geography, 1990, University of Cincinnati
B.A., (Joint Honours) Economics and Geography, 1988, Portsmouth Polytechnic, England

Dillon, Peter – Geology, Soils, Groundwater Resources

M.S., Geology (Geochemistry), 1994, Boston College
B.S., Geology, 1983, Boston College

Gravender, David – Technical Editing

M.A., English, 1991, University of Toronto
B.A., English, 1990, University of Washington

King, Erin – Cultural Resources

M.A., Cultural Anthropology, 2005, California State University, Northridge
B.A., Cultural Anthropology, 2001, University of California, Santa Barbara

Kraus, Jennifer – Surface Water Resources

Certificate, Wetlands Science and Management, 2001, University of Washington, College of Continuing Education
B.S., Environmental Science and Biology, 1994, Marist College

Mire, June – Marine Resources, Threatened and Endangered Species

Ph.D., Zoology, 1993, University of California at Berkeley
M.S., Biological Sciences, 1987, University of New Orleans
B.A., Science Education, 1984, University of New Orleans

Ritchie, Annalissa – Visual Resources

M.S., Forest Resources, 2007, University of Washington,
B.S., Zoology, 2003, University of Washington
B.F.A., Photography, 2003, University of Washington

Scheinost, Nikki – Wildlife, Threatened and Endangered Species

B.S., Geography – Resource and Environmental Studies, Minor in Biology, 2002, Texas State University

Williams, Chris – Air Quality

B.S., Chemical Engineering, 1998, Massachusetts Institute of Technology

Tetra Tech, Inc. is a third-party contractor assisting the Commission staff in reviewing the environmental aspects of the project application and preparing the environmental documents required by the National Environmental Policy Act. Third-party contractors are selected by Commission staff and funded by project applicants. Per the procedures in Title 40 Code of Federal Regulations Part 1506.5(c), third-party contractors execute a disclosure statement specifying that they have no financial or other conflicting interest in the outcome of the project. Third-party contractors are required to self-report any changes in financial situation and to refresh their disclosure statements annually. The Commission staff solely directs the scope, content, quality, and schedule of the contractor's work. The Commission staff independently evaluated the results of the third-party contractor's work and the Commission, through its staff, bears ultimate responsibility for full compliance with the requirements of the National Environmental Policy Act.

APPENDIX K
LIST OF REFERENCES

Aaron Economic Consulting. 2015. City of South Padre Island Economic Index. September 2015. Website: http://southpadreislandedc.com/resources-studies (accessed March 16, 2016).

Abbott, R., E. Bing-Sawyer, and R. Blizard. 2002. Assessment of pile driving impacts on the Sacramento blackfish (*Othodon microlepidotus*). Draft report prepared for Caltrans District 4. October 10, 2002. Sacramento, CA.

AIChE CCPS. 1996. *Guidelines for Evaluating Process Plant Buildings for External Explosions and Fires*. September 15. 189 pp.

Alsop, F.J. III. 2001. *Smithsonian Birds of North America.* Southern Lights Custom Publishing.

American Birding Association. 2015. Birding Trails in North America. Website: http://aba.org/resources/birdingtrails.html (accessed February 16, 2016).

Anderson, J.D., D.J. Shaver, and W.J. Karel. 2013. Genetic diversity and natal origins of green turtles *(Chelonia mydas)* in the western Gulf of Mexico. *Journal of Herpetology* 14(2):251–257.

Ashworth, J.B., and J. Hopkins. 1995. Aquifers of Texas. Texas Water Development Board Report 345. Website: http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R345/R345Complete.pdf (accessed August 2016).

Attewell, P.B., and I.W. Farmer. 1973. Attenuation of ground vibrations from pile driving. *Ground Engineering*, July 1973.

Baker, E.T., Jr. 1995. *Stratigraphic Nomenclature and Geologic Sections of the Gulf Coastal Plain of Texas*. USGS Open-File Report 94-461. Website: http://pubs.usgs.gov/of/1994/0461/report.pdf (accessed August 2015).

Barnes, J.D., L.N. Miller, and E.W. Wood (Barnes et al.). 1977. Power Plant Construction Noise Guide, Report No. 3321. Bolt, Beranek, and Newman, Incorporated.

Bartol, S., and I. Bartol. 2011. Hearing Capabilities of Loggerhead Sea Turtles (*Caretta caretta*) throughout Ontogeny: An Integrative Approach involving Behavioral and Electrophysiological Techniques. Final Project Report.

Bartol, S.M., and D.R. Ketten. 2006. Turtle and tuna hearing. In Y. Swimmer and R. W. Brill (Eds.), Sea Turtle and Pelagic Fish Sensory Biology: Developing Techniques to Reduce Sea Turtle Bycatch in Longline Fisheries. (NOAA Technical Memorandum NMFS-PIFSC-7, pp. 98-103). U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Bartol, S.M., J.A. Musick, and M.L. Lenhardt. 1999. Auditory evoked potentials of the loggerhead sea turtle (*Caretta caretta*). *Copeia* 3: 836-840.

Bearden, S. 2015. Port Director, Port Isabel-San Benito Navigation District. Personal communication with K. Welder, Ecology and Environment, Inc., on July 17, 2015.

Beier, P. 2005. Effects of artificial night lighting on terrestrial mammals. In: *Ecological Consequences of Artificial Night Lighting*, C. Rich and T. Longcore (eds.), 19–42.

Black & Veatch. 2016a. *Seismic Ground Motion Hazard Study, Annova LNG Brownsville Project*. Document Number 183169-STDY-0008. March 21, 2016.

Black & Veatch. 2016b. *Geotechnical Investigation Report, Annova LNG Brownsville Project*. Document Number 183169-STDY-0006. March 21, 2016.

Black & Veatch. 2016c. Hydrodynamic Modeling. Document Number 183169-REFF-0027. Prepared for Annova LNG, LLC. November 30.

Black & Veatch. 2016d. Analysis of Turbidity due to Dredging, Annova LNG Brownsville Project. Document Number 183169-REFF-0027. April 28, 2016.

Black & Veatch. 2016e. Sedimentation Modeling. Document Number 183169-REFF-0050. Prepared for Annova LNG, LLC. December 20.

Black & Veatch. 2016f. Beneficial Use Concepts for Dredged Material.

Black and Veatch. 2016g. Brownsville LNG Terminal Ambient Sound Level Survey Report. B&V PROJECT NO. 181108. B&V FILE NO. 42.1000.

Blair, W.F. 1950. The biotic provinces of Texas. *Texas Journal of Science* 2:93-117.

Blanton & Associates, Inc. 2017. Draft Conceptual Mitigation Plan, Annova LNG Brownsville Project, Cameron County, Texas. U.S. Army Corps of Engineers Project Number: SWG-2015-00110. Prepared for Ecology and Environment, Inc. Prepared by Blanton & Associates, Inc. Lakeway, Texas.

BLM (U.S. Department of the Interior, Bureau of Land Management). 1986. Manual 8431 – Visual Contrast Rating. Website: http://blmwyomingvisual.anl.gov/docs/BLM_VCR_H-8431.pdf

BLM. 2008. Standard Environmental Colors Chart CC-001: June 2008. Website: https://www.blm.gov/style/medialib/blm/mt/blm_programs/energy/oil_and_gas/operations/gold_book.Par.82194.File.dat/Stand_Enviro_Color.pdf

BND (Brownsville Navigation District). 2012a. Port of Brownsville Leasing Policies. Date issued November 20, 2012. Website: http://www.portofbrownsville.com/wp-content/uploads/2013/01/Leasing-Policy.pdf (accessed May 13, 2015).

BND. 2012b. Port of Brownsville World Class Facts. Website: http://www.portofbrownsville.com/facts (accessed May 2015).

BND. 2014. Brownsville Navigation District Proposed LNG lease sites figure. Last revision: December 19, 2014.

BND. 2015a. Brownsville Navigation District, Port of Brownsville. Letter to Andre Senenko at Annova LNG, LLC dated September 4, 2015 regarding the availability of land for LNG facility development.

BND. 2015b. Comprehensive Annual Financial Report for Year Ended December 31, 2014. Finance Department. Website: http://www.portofbrownsville.com/wp-content/uploads/2013/06/CAFR-SEC-1.pdf

BND. 2016. Cargo and vessel statistics, 2012-2014. Provided by Deborah Duke, Director of Administrative Services and Public Information Officer, Port of Brownsville, on June 18, 2016, to K. Welder Mollow, Ecology and Environment, Inc.

BND. 2017. Comprehensive Annual Financial Report 2016. http://www.portofbrownsville.com/wp-content/uploads/2017/01/BND-CAFR-2016.pdf. Accessed July 2017.

BOEM (Bureau of Ocean Energy Management). 2011. Outer Continental Shelf Oil and Gas Leasing Program: 2012 – 2017. Draft Programmatic Environmental Impact Statement. November 2011.

Brownsville Economic Development Council. 2015. 2014-2015 Market and Community Profile. Website: http://brownsvillechamber.com/wp-content/uploads/2015/06/Market-Community-Profile-2014-2015-1.pdf (accessed February 26, 2016).

Brownsville Public Utilities Board. 2013. Water and Wastewater Department. Website: http://www.brownsville-pub.com/departments/water-wastewater (accessed by Ecology and Environment, Inc. on April 19, 2016).

Brownsville Public Utilities Board. 2016. Comprehensive Annual Financial Report for the Fiscal Years Ended September 30, 2015 and 2014. Website: http://www.brownsville-pub.com/about-us/financial (accessed by Ecology and Environment, Inc. on April 19, 2016).

Brownsville, Texas Code of Ordinances. n.d. Available at: Brownsville, Texas, Code of Ordinances, Chapter 46, Article III. Accessed November 25, 2014.

Burger, J. 1981. Effect of human activity on birds at a coastal bay. *Biological Conservation* 21:231–241.

Burnham, W., J. P. Jenny, W. R. Heinrich, G. Hunt, A. B. Montoya, B. D. Mutch, and C. E. Sandfort. 2002. Proposal: restoration of the northern aplomado falcon in New Mexico. The Peregrine Fund. Boise, Idaho.

California Department of Transportation. 2001. Fisheries impact assessment, pile installation demonstration project, San Francisco-Oakland Bay Bridge, East Span Seismic Safety Project.

Cameron County Parks and Recreation. 2016. Jaime J. Zapata Memorial Boat Ramp Fishing Pier and Kayak Launch Area. Website: http://www.cameroncountyparks.com/jaime-zapata-hwy-48

Cameron County. 2009. ESD Fire Protection Zone Map. Prepared by the Cameron County GIS Department. Plot Date April 6, 2009. Website: http://www.co.cameron.tx.us/dot/docs/THE_FIRE_ZONES.pdf (accessed August 31, 2016).

Cameron County. 2016. Comprehensive Annual Financial Report for the Fiscal Year Ended September 30, 2015. Prepared by Martha Galarza, CPA, County Auditor. March 30. Website: http://www.co.cameron.tx.us/document_center/FINAL%20CAFR%202015-NEW.pdf (accessed August 3, 2016).

Campbell, Linda. 2003. Endangered and Threatened Animals of Texas, Their Life History and Management. Website: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_0013.pdf (accessed April 2016).

Caso, Arturo. 2013. Spatial Differences and Local Avoidance of Ocelot (*Leopardus pardalis*) and Jaguarundi (*Puma yagouaroundi*) in Northeast Mexico. Website: http://smallcats.org/files/Caso_2013.pdf (accessed April 2016).

Caterpillar. 2007. VM 20 C Project Guide: Generator Set. Caterpillar Motorem Gmblt & Co. KG. Kiel Germany. April 2007.

Caterpillar. 2011. VM 25 C Project Guide: Generator Set. Caterpillar Motorem Gmblt & Co. KG. Kiel Germany. August 2011.

Caterpillar. 2012. VM 32 C Project Guide: Generator Set. Caterpillar Motorem Gmblt & Co. KG. Kiel Germany. August 2012.

CCRAM (Cameron County Regional Mobility Authority). 2015. East Loop. CCRMA: Our Projects. Available online at: https://ccrma.org/project/east-loop/. Accessed September 2018.

CEDA (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 the CEDA Environment Commission. Available at: www.dredgingtoday.org/news_details.asp.

CEQ (Council on Environmental Quality). 1997a. Environmental Justice Guidance under the National Environmental Policy Act. Executive Office of the President. Washington, D.C. December 10. Website: http://www.epa.gov/compliance/resources/ policies/ej/index.html

CEQ. 1997b. Considering Cumulative Effects Under the National Environmental Policy Act. Available online at: https://www.energy.gov/nepa/downloads/considering-cumulative-effects-under-nationalenvironmental-policy-act-ceq-1997. Accessed September 2018.

CEQ. 2005. Guidance on the Consideration of Past Actions in Cumulative Effects Analysis. Available at: http://www.gsa.gov/portal/mediaId/137134/fileName/CEQ_Guidance_Consideration_PastActions_CumulativeEffectsAnalysis.action. Accessed June 26, 2016.

Chapa, S. 2015. School board votes down tax break for LNG project at Port of Brownsville. San Antonio Business Journal. September 17. Website: http://www.bizjournals.com/sanantonio/blog/eagle-ford-shale-insight/2015/09/school-board-votes-down-tax-break-for-lng-project.html

Cheniere Energy, Inc. 2016. Corpus Christi Liquefaction, LLC (Corpus Christi Liquefaction) Project Information Website. Website: http://www.cheniere.com/corpus_christi/corpus_project.shtml (accessed March 13, 2016).

Chowdhury, A.H., and R.E. Mace. 2007. Groundwater resource evaluation and availability model of the Gulf Coast aquifer in the Lower Rio Grande Valley of Texas. LBG-Guyton Association.

Chowdhury, A.H., and M.J. Turco. 2006. Geology of the Gulf Coast Aquifer, Texas. Website: https://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R365/ch02-Geology.pdf (accessed August 2016).

Chron. 2010. Brownsville Ship Channel full of surprises. Website: http://blog.chron.com/saltwater/2010/08/brownsville-ship-channel-full-of-surprises/ (accessed January 2016).

City of Brownsville. 2012. Search results for "Future Land Use Introduction", Brownsville Comprehensive Plan. Website: http://planning.cob.us/system/app/pages/search?scope=search-site&q=future+land+use+introduction (accessed March 24, 2015).

City of Brownsville. 2015. City of Brownsville Zoning Map. Website: https://docs.google.com/a/cob.us/viewer?a=v&pid=sites&srcid=Y29iLnVzfHBsYW5uaW5nfGd4OjQ4OWMzY2ZmMjY3ZDE3NTQ (accessed by Ecology and Environment, Inc. on June 23, 2015).

City of Brownsville Public Works. 2016. The City of Brownsville Municipal Solid Waste Landfill. Website: http://publicworks.cob.us/business (accessed August 31, 2016).

Clarke, D., C. Dickerson, and K. Reine. 2002. Characterization of underwater sounds produced by dredges. Dredging 2002, ASCE, Orlando, Florida, USA, p 64-81.

Clark, Steve. 2018a. Local airport project advances. The Brownsville Herald, April 7, 2018. Available online at: https://www.brownsvilleherald.com/premium/local-airport-projectadvances/article_1ab128b2-3acb-11e8-b0df-3f604257b40e.html. Accessed February 2019.

Clark, Steve. 2018b. Steel company selects local site. The Brownsville Herald, April 25, 2018. Available online at: https://www.brownsvilleherald.com/business/steel-company-selectslocal-site/article_1b693cd6-4a34-11e8-8789-6b734a4d7fa7.html. Accessed February 2019.

Coast Guard (U.S. Coast Guard). 2008. Final Environmental Impact Statement for the Bienville Offshore Energy Terminal Deepwater Port License Application. Docket No. USCG-2006-24644. August 2008. Federal Docket Management system is available at http://www.regulations.gov.

COE (U.S. Army Corps of Engineers). 1982. Department of the Army, Galveston District, Corp of Engineers, letter to Brownsville Navigation District, Subject Permit 13942, October 5, 1982.

COE. 1987. Corps of Engineers Wetland Delineation Manual. Environmental Laboratory. Wetlands Research Program Technical Report Y-87-1 (online edition). U.S. Army Corps of Engineers Waterways Experiment Station. Website: http://www.bwsr.state.mn.us/wetlands/publications/corpsmanual.pdf (accessed August 2016).

COE. 2003. Biological Assessment for Impacts to Endangered and Threatened Species Relative to the Corpus Christi Ship Channel Improvement Project in Nueces and San Patricio Counties, Texas. Volume II, Appendix C of : Corpus Christi Ship Channel, Channel Improvements Project Corpus Christ and Nueces Bays, Nueces and San Patricio Counties, Texas, Final Environmental Impact Statement. Galveston.

COE. 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coast Plain Region (Version 2.0). Environmental Laboratory. ERDC/EL TR-10-20. Website: http://www.usace.army.mil/Portals/2/docs/civilworks/regulatory/reg_supp/AGCP_regsupV2.pdf (accessed August 2016).

COE. 2012. A Community-based Ecosystem Response Model for the Resacas (Oxbow Lakes) of the Lower Rio Grande. Website: http://el.erdc.usace.army.mil/elpubs/pdf/trel12-31.pdf (accessed January 2016).

COE. 2013a. Brazos Island Harbor, Texas, Channel Improvement Project, Draft Integrated Feasibility Study – Environmental Assessment. Website: http://www.swg.usace.army.mil/Portals/26/docs/Cheryl%20Jaynes/2-BIH%20DIFR-EA%202013.pdf (accessed June 2015).

COE. 2013b. Draft Biological Assessment for federally-listed threatened and endangered Species. Brazos Island Harbor Channel Improvement Project, Tentatively Selected Plan (52 feet by 250 feet Project), Cameron County, Texas. June 2013.

COE. 2014. Brazos Island Harbor, Texas Channel Improvement Project, Final Integrated Feasibility Report – Environmental Assessment. Website: http://www.swg.usace.army.mil/Portals/26/docs/Cheryl%20Jaynes/2-BIH%20DIFR-EA%202013.pdf (accessed September 2016).

COE. 2015. USACE Galveston District awards $6.9 million contract to dredge Brownsville Ship Channel, Port Isabel Channel. Available at: http://www.swg.usace.army.mil/Media/News-Releases/Article/606508/usace-galvestondistrict-awards-69-million-contract-to-dredge-brownsville-ship/.

Conant, R., and J.T. Collins. 1998. *Reptiles and Amphibians of Eastern/Central North America,* 3rd edition. Peterson Field Guides. New York, New York: Houghton Mifflin Company.

Cornell Lab of Ornithology. 2015. The Birds of North American Online. Accessed May 2015 http://bna.birds.cornell.edu/bna Eds. M. Simmonds, S. Dolman, and L. Weilgart. Wiltshire, England.

Cornell Lab of Ornithology. 2017. Whooping Crane. Website: https://www.allaboutbirds.org/guide/Whooping_Crane/lifehistory

Countess Environmental. 2006. WRAP Fugitive Dust Handbook. Western Governor's Association, Denver, Colorado. September 7. Website: https://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf

Cowardin, L.M., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service Report No. FWS/OBS/-79/31.

Cox, P., and R. Risi. 2009. Cryogenic Pipeline – How the use of cryogenic piping can reduce the impact of LNG transfer terminals on environment and local communities, while increasing site safety and security. Printed in Offshore Technology Conference. Website: https://www.onepetro.org/conference-paper/OTC-20223-MS

D.K. Shifflet & Associates, Ltd. 2015a. Year-End 2014 Texas Tourism Visitor Profile. Website: http://travel.texas.gov/tti/media/PDFs/2014-Texas-Visitor-Profile.pdf (accessed March 16, 2016).

D.K. Shifflet & Associates, Ltd. 2015b. 2014 Texas Tourism Region and MSA Visitor Profile: Gulf Coast Region. Website: http://travel.texas.gov/tti/media/PDFs/2014-Gulf-Coast-Region.pdf (accessed March 16, 2016).

Dannenbaum Engineering Corporation and URS Corporation. 2004. Feasibility Study. Brownsville Seawater Desalination Demonstration Project. Prepared for Brownsville Public Utilities Board, Port of Brownsville. November 2004.

Dean Runyan Associates. 2015. The Economic Impact of Travel on Texas 1990-2014p. June 2015. Prepared for Texas Tourism Office of the Governor Texas Economic Development & Tourism. Dean Runyan Associates, Portland, Oregon. Website: http://travel.texas.gov/travel-research/economic-impact/ (accessed March 16, 2016).

DOE (United States Department of Energy). 2014. Division of Fossil Energy, Order No. 3394 Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Proposed Annova LNG Terminal in Brownsville, Texas, to Free Trade Agreement Nations. February 20, 2014.

DOE. 2015a. Division of Fossil Energy, Order No. 3638 Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Proposed Corpus Christi Liquefaction Project to be Located in Corpus Christi, Texas, to Free Trade Agreement Nations. May 12, 2015.

DOE. 2015b. Division of Fossil Energy, Order No. 3716 Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Proposed LNG Terminal in Brownsville, Texas, to Free Trade Agreement Nations. September, 2015.

DOE. 2015c. Division of Fossil Energy, Docket No. 15-190-LNG Application for Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas to Free Trade Agreement and Non-Free Trade Agreement Countries. December 23, 2015.

Dow Piniak, W. E., S. A. Eckert, C. A. Harms, and E. M. Stringer. 2012. Underwater Hearing Sensitivity of the Leatherback Sea Turtle (*Dermochelys coriacea*): Assessing the Potential Effect of Anthropogenic Noise. (BOEM 2012-01156, pp. 35). Herndon, VA: U.S. Department of the Interior, Bureau of Ocean and Energy Management.

Duke, D. 2015. Director of Administrative Services and Public Information Officer, Port of Brownsville. Personal communication with K. Welder, Ecology and Environment, Inc., on August 21.

eBird. 2015. Range and Point Maps. Website: http://ebird.org/ebird/map.

Enger, P.S. 1981. Frequency Discrimination in Teleosts - Central or Peripheral. p. 243-255 In: Hearing and Sound Communication in Fishes, eds. W.N. Tavolga and A.N. Popper. New York: Springer-Verlag.

Engle, V.D., J.K. Summers, and J.M. Macauley. 1999. Dissolved oxygen conditions in northern Gulf of Mexico estuaries. *Environmental Monitoring and Assessment* 57:1-20.

EPA (U.S. Environmental Protection Agency). 1971. Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, USEPA Publication NTID300.1, December 1971.

EPA. 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.

EPA. 1998. Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses. April. Website: http://www.epa.gov/compliance/resources/policies/ej/index.html.

EPA. 1999a. The Ecological Condition of Estuaries in the Gulf of Mexico. EPA 620-R-98- 004, July 1999. EPA Office of Research and Development, National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, Gulf Breeze, Florida. http://www.epa.gov/ged/gulf.htm.

EPA. 1999b. Consideration of Cumulative Impacts in EPA Review of NEPA Documents. EPA 315-R-99-002, May 1999. Available online at: https://www.epa.gov/sites/production/files/2014-08/documents/cumulative.pdf Accessed September 2018.

EPA. 2008. Sole Source Aquifer Recharge Area. Website: http://www.rd.usda.gov/files/TX_21SoleSourceAquiferRechargeArea.pdf (accessed August 2016).

EPA. 2011. Ballast Water Self Monitoring EPA 800-R-11-003. Website: http://www3.epa.gov/npdes/pubs/vgp_ballast_water.pdf (accessed January 2016).

EPA. 2016. Surf Your Watershed. South Laguna Madre Watershed – 12110208. Website: https://cfpub.epa.gov/surf/huc.cfm?huc_code=12110208 (accessed August 2016).

EPA. 2017. Sole Source Aquifers for Drinking Water. Intractive map of SSAs. Website: https://www.epa.gov/dwssa (accessed April 2017).

EPA. 2018. Emissions & Generation Resource Integrated Database (eGRID). eGrid2016, released 2/15/18. https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

EPA and COE. 1998. Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual, Inland Testing Manual. EPA-823-B-98-004. February 1998. Available at https://clu-in.org/download/contaminantfocus/sediments/Evaluation-Analytical-methods-USACE-EPA.pdf

ERCOT. 2017. Quick Facts (2/2017). Website: http://www.ercot.com/content/wcm/lists/114739/ERCOT_Quick_Facts_22317.pdf

Ernst & Young. 2015. Project Annova. The Potential Economic Impacts in Texas. Prepared for Exelon. February.

FAA (Federal Aviation Administration). 2014. Final Environmental Impact Statement, SpaceX Texas Launch Site, Volume 1. Website: https://www.faa.gov/about/office_org/headquarters_offices/ast/environmental/nepa_docs/review/launch/spacex_texas_launch_site_environmental_impact_statement/.

FAA. 2016. Obstruction Marking and Lighting. Advisory Circular AC 70/7460-1L, Change 1. October 8, 2016. Website: https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_70_7460-1L_with_chg_1.pdf

Feist, B.E., J.J. Anderson, and R. Miyamoto. 1992. Potential Impacts of Pile Driving on Juvenile Pink (*Oncorhynchus gorbuscha*) and Chum (*O. keta*) Salmon Behavior and Distribution. Seattle, Washington: Fisheries Research Institute, School of Fisheries, and Applied Physics Laboratory, University of Washington.

FEMA (Federal Emergency Management Agency). 2018a. Cameron County FIRM/FEMA Map. FEMA, 2014. Available online at: www.co.cameron.tx.us/dot/docs/Cameron_County_Flood_Map.pdf.

FEMA. 2018b. Flood Insurance Study, Cameron County, Texas. Effective Date February 16, 2018. Flood Insurance Study Number 48061CV001A. Available online at: https://map1.msc.fema.gov/data/48/S/PDF/48061CV001A.pdf?LOC=03264e2c4475a1c64ce1ae71b40d3345.

FERC (Federal Energy Regulatory Commission). 2005. Final Environmental Impact Statement, Golden Pass LNG Terminal and Pipeline Project. OEP/DG2E/Gas Branch 2, Golden Pass LNG Terminal LP, Docket No. CP04-386-000.

FERC. 2007. Draft Seismic Design Guidelines and Data Submittal Requirements for LNG Facilities. Office of Energy Projects, January 23, 2007. Website: https://www.ferc.gov/industries/gas/indus-act/lng/lng-seis-guide.pdf

FERC. 2013a. Upland Erosion Control, Revegetation, and Maintenance Plan. Office of Energy Projects, May 2013. Website: http://www.ferc.gov/industries/gas/enviro/plan.pdf (accessed April 1, 2015).

FERC. 2013b. Wetland and Waterbody Construction and Mitigation Procedures. Office of Energy Projects, May 2013. Website: http://www.ferc.gov/industries/gas/enviro/procedures.pdf (accessed April 1, 2015).

Ferguson, Henry N. 1976. The Port of Brownsville: A Maritime History of the Rio Grande Valley. Brownsville: Springman-King, 1976.

Ferguson, Jason. 2015. Texas Parks and Wildlife Department, Coastal Fisheries Division, Lower Laguna Madre Field Office. Personal communication with K. Welder, Ecology and Environment, Inc., on June 18, 2015.

FireDepartment.net. 2015a. Cameron County, TX Fire Departments. Website: http://www.firedepartment.net/directory/texas/cameron-county (accessed by Ecology and Environment, Inc. on May 30, 2015).

FireDepartment.net. 2015b. Willacy County, TX Fire Departments. Website: http://www.firedepartment.net/directory/texas/willacy-county (accessed by Ecology and Environment, Inc. on May 30, 2015).

Fisher, M. 2015. Texas Parks and Wildlife Department. Personal communication with K. Welder, Ecology and Environment, Inc., on June 17, 2015.

Fisher, M. 2017. Texas Parks and Wildlife Department. Personal communication with M. Dadswell, Tetra Tech. April 24.

Fisheries Hydroacoustic Working Group. 2008. Principle for Interim Criteria for Injury to Fish from Pile Driving. Memorandum from Federal Highway Administration. June 12, 2008.

Freeport LNG. 2018. Freeport LNG Newsroom, Latest News Releases. http://www.newsrouter.com/Newsrouter_uploads/77_New/newsroom.asp (Accessed September 12, 2018).

FWHA. 2006. FHWA Highway Construction Noise Handbook. Federal Highway Administration publication FHWA-HEP-06-015. August 2006.

FWS (United States Fish and Wildlife Service). 1990a. Ocelot Recovery Plan *(Leopardus pardalis)* Draft First Revision. Website: http://www.fws.gov/southwest/es/Documents/R2ES/Draft_Ocelot_Recovery_Plan-First_Revision.pdf (accessed April 2016).

FWS. 1990b. Gulf Coast Jaguarundi Recovery Plan. https://www.fws.gov/southwest/es/Documents/R2ES/GulfCoastJaguarundi_FinalRecoveryPlan_Dec2013.pdf

FWS. 1990b. Northern Aplomado Falcon Recovery Plan. Albuquerque, New Mexico.

FWS. 1999. Lower Rio Grande Valley and Santa Ana National Wildlife Refuges Comprehensive Conservation Plan. Website: http://www.fws.gov/uploadedFiles/LRGV%20CCP_2008.pdf (accessed April 20, 2016).

FWS. 2000. News and Activities – Free-for-all with Furfural Kills 9 Million Fish. Website: http://www.fws.gov/contaminants/DisplayNews.cfm?NewsID=E2D4E08E-7448-11D4-A169009027B6B5D3 (accessed May 2015).

FWS. 2000. Endangered and threatened wildlife and plants: proposed determination of critical habitat for wintering piping plovers. Federal Register 65:41782-41812.

FWS. 2002. Colonial-Nesting Waterbirds, A Glorious and Gregarious Group. Arlington, Virginia. Website: http://www.fws.gov/birds/waterbird-fact-sheet.pdf (accessed May 2014).

FWS. 2003. Laguna Atascosa National Wildlife Refuge, South Texas Refuge Complex, Proposed Re-Flooding and Restoration of Bahia Grande, Final Draft Environmental Assessment. Website: https://www.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/BahiaEA-Final-Draft-with-Public-Notice-2.pdf\ (accessed November 1, 2016).

FWS. 2004. Field Notes Energy. South Bay Coastal Preserve. Website: https://www.fws.gov/fieldnotes/regmap.cfm?arskey=13933 (accessed September 2016).

FWS. 2007. West Indian Manatee (*Trichechus manatu*s) 5-Year Review: Summary and Evaluation. (pp. 86). Southeast Region, Jacksonville Ecological Services Office and Caribbean Field Office.

FWS. 2010a. Texas ayenia (Tamaulipan kidneypetal) *Ayenia limitaris Cristóbal*. 5-year review: summary and evaluation. U.S. Fish and Wildlife Service. Corpus Christi Ecological Services Field Office. Corpus Christi, Texas

FWS. 2010b. Laguna Atascosa National Wildlife Refuge Comprehensive Conservation Plan. September.

FWS. 2010c. Draft Ocelot Recovery Plan. https://www.fws.gov/southwest/es/Documents/R2ES/Draft_Ocelot_Recovery_Plan-First_Revision.pdf.

FWS. 2012a. National Wetlands Inventory - Wetlands. Website: http://www.fws.gov/wetlands (accessed March 24, 2015).

FWS. 2012b. Lower Rio Grande Valley, National Wildlife Refuge, Texas. Wildlife and Habitat. Website: http://www.fws.gov/refuge/Lower_Rio_Grande_Valley/wildlife_habitat.html (accessed August 12, 2016).

FWS. 2012c. Migratory Bird Flyways. Migratory Bird Program. Website: http://www.fws.gov/migratorybirds/flyways.html (accessed May 2015).

FWS. 2012d. Lower Rio Grande Valley NWR - Boca Chica Beach. Available at: http://www.fws.gov/refuge/Lower_Rio_Grande_Valley/visit/boca_chica_beach.html. Accessed on February 3, 2016.

FWS. 2012e. Leatherback Sea Turtle (*Dermochelys coriacea*). (pp. 2). North Florida Ecological Services Office. December 2012.

FWS. 2013a. Lower Rio Grande Valley National Wildlife Refuge, About the Refuge. Available at: http://www.fws.gov/refuge/Lower_Rio_Grande_Valley/about.html (accessed May 22, 2015).

FWS. 2013b. Florida Manatee Recovery Facts. Website: http://www.fws.gov/northflorida/Manatee/manatee-gen-facts.htm (Accessed January 12, 2014).

FWS. 2013c. Gulf Coast Jaguarundi Recovery Plan (*Puma yagouaroundi cacomitli*). Website: http://www.fws.gov/southwest/es/Documents/R2ES/GulfCoastJaguarundi_FinalRecoveryPlan_Dec2013.pdf (accessed April 2016).

FWS. 2013d. SpaceX Texas launch site. Biological and conference opinion. URL = https://www.faa.gov/about/office_org/headquarters_offices/ast/environmental/nepa_docs/review/documents_progress/spacex_texas_launch_site_environmental_impact_statement/media/Final_BO_FAA_SpaceX_sm.pdf.

FWS. 2014a. West Indian Manatee *(Trichechus manatus)*: FLORIDA STOCK (Florida subspecies, *Trichechus manatus latirostris*). Website: https://www.fws.gov/northflorida/manatee/SARS/FR00001606_Final_SAR_WIM_FL_Stock.pdf

FWS. 2014b. Northern aplomado falcon (*Falco femoralis septentrionalis*) 5-year review: summary and evaluation. USFWS New Mexico Ecological Services Field Office, Albuquerque, NM. August 26, 2014. Website: http://ecos.fws.gov/docs/five_year_review/doc4436.pdf (accessed May 2015).

FWS. 2014c. Endangered and threatened wildlife and plants; threatened species status for the rufa red knot. Final Rule. Federal Register 79(238):73706-73748.

FWS. 2014d. Rufa red knot background information and threats assessment. Supplement to Endangered and threatened wildlife and plants; final threatened status for the rufa red knot (*Calidris canutus rufa*). New Jersey Field Office, Pleasantville.

FWS. 2015a. Critical Habitat Portal. Website: http://ecos.fws.gov/crithab (accessed March 24, 2015).

FWS. 2015b. Laguna Atascosa Bahia Grande Unit. Website: http://www.fws.gov/refuge/laguna/about/bahia_grande_unit.html (accessed January 2016).

FWS. 2015c. National Wildlife Refuge System: Cooperative Recovery Initiative. Website: http://www.fws.gov/refuges/whm/cooperativeRecoveryInitiative.html.

FWS. 2015d. Information, Planning, and Conservation System (IPaC). Website: http://ecos.fws.gov/ipac/wizard/trustResourceList!prepare.action (accessed April 9, 2015).

FWS. 2015e. International Affairs, Monarch Butterfly. Website: https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/texas_nature_trackers/monarch/ (accessed July 2015).

FWS. 2015f. Foreign Species, Parrots. Website: http://www.fws.gov/endangered/what-we-do/parrots2.html (accessed March 16, 2016).

FWS. 2015g. Rufa Red Knot (*Calidris canutus rufa*). Website: http://www.fws.gov/northeast/redknot/ (accessed April 2016).

FWS. 2015h. Letter from FWS Corpus Christi Office of the Texas Coastal Ecological Service Field Office to Edward Miller, P.E., Annova LNG, LLC regarding Consultation No. 02ETCC00-2015-TA-0317. May 20.

FWS. 2016a. Pollinators of Texas. Website: https://www.fws.gov/southwest/es/Documents/R2ES/Monarch_Texas_Pollinator_Fact_Sheet_FINAL.pdf

FWS. 2016b. Personal Communication, inter-agency meeting with FWS, TPWD, and the RG Developers. Corpus Christi, Texas. March 3, 2016.

FWS. 2016c. Laguna Atascosa National Wildlife Refuge, Texas. Website: http://www.fws.gov/refuge/Laguna_Atascosa (accessed March 16, 2016).

FWS. 2017. Threats to Birds. Collisions. Website: https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds/collisions.php. Accessed December 2017.

FWS. 2018a. Whooping Crane (*Grus Americana*). Website: http://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B003.

FWS. 2018b. Eastern black rail. https://www.fws.gov/southeast/wildlife/birds/eastern-black-rail. Updated October 5, 2018.

FWS North Florida Ecological Services Office. 2016. Florida Manatee - Issues and Information. Website: https://www.fws.gov/northflorida/manatee/manatees.htm.

FWS and Federal Highway Administration. 2017. Bayside Wildlife Drive Project. Draft Environmental Assessment. September. Available online at: https://www.fws.gov/uploadedFiles/Final%20Draft%20Bayside%20Wildlife%20Drive%20EA_ver2%20(1).pdf.

Gardner, M.B. 1981. Effects of Turbidity on Feeding Rates and Selectivity of Bluegills. *Transactions of the American Fisheries Society* 110: 446–450.

George, P.G., R.E. Mace, and R. Petrossian. 2011. Aquifers of Texas. Report 380, Texas Water Development Board.

Germano, J., J. Parker, and J. Charles. 1994. Monitoring Cruise at the Massachusetts Bay Disposal Site, August 1990. DAMOS Contribution No. 92. U.S. Army Corps of Engineers, New England Division, Waltham, MA.

GMFMC (Gulf of Mexico Fishery Management Council). 1998. Generic amendment for addressing essential fish habitat requirements in the Fishery Management plans of the Gulf of Mexico. Tampa, Florida: Gulf of Mexico Fishery Management Council.

GMFMC. 2004. Final Environmental Impact Statement for the Generic Amendment to the fishery management plans of the Gulf of Mexico. Tampa, Florida: Gulf of Mexico Fishery Management Council.

GMFMC. 2005. Generic amendment for addressing essential fish habitat requirements in the Fishery Management plans of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, Florida.

GMFMC. 2007. Amendment 14 to the Shrimp Fishery Management Plan. Website: http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/Final%20RF%20Amend%2027-%20Shrimp%20Amend%2014.pdf (accessed May 2015).

GMFMC. 2010. Final Report: Gulf of Mexico Fishery Management Council 5-Year Review of the Final Generic Amendment Number 3 Addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and Adverse Effects of Fishing in the Fishery Management Plans of the Gulf of Mexico. (pp. 105). Tampa, FL: Gulf of Mexico FMC.

Grassman, L.I. 2006. Wild cats of Texas. Wildlife. Houston Zoo, Fall, p. 6.

Gulf Coast Ecosystem Restoration Council. 2015. Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act) Initial Funded Priorities List. Website: https://www.restorethegulf.gov/sites/default/files/FPL_FINAL_Dec9Vote_EC_Library_Links.pdf (accessed by Ecology and Environment, Inc. on February 3, 2016).

Guthrie, D.M., and W.R.A. Muntz. 1993. Role of vision in fish behavior. In: *Behaviour of Teleost Fishes*, 89–121, T.P. Pitcher (ed.). 2nd Edition. Chapman and Hall, London, U.K.

Gutierrez, O. 2015. Fire Chief, City of Raymondville, TX. Personal communication with K. Welder, Ecology and Environment, Inc., on June 1, 2015

Haines, A. M., Tewes, M. E., and L. L. Laack. 2005. Survival and sources of mortality in ocelots. *Journal of Wildlife Management* 69(1):255-263.

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.

Hanson, J., M. Helvey, and R. Strach (Eds.). 2004. Non-fishing impacts to essential fish habitat and recommended conservation measures, Version 1. Long Beach, CA: National Marine Fisheries Service, Southwest Region.

Hastings, M.C., and A.N. Popper. 2005. Effects of Sound on Fish. Prepared for California Department of Transportation, Sacramento, California.

Hastings, M.C., A.N. Popper, J.J. Finneran, and P.J. Lanford. 1996. Effects of Low-Frequency Underwater Sound on Hair Cells of the Inner Ear and Lateral Line of the Teleost Fish Astronutus ocellatus. *Journal of the Acoustical Society of America* 99(3):1759-1766.

Hayhoe, K., D.J. Wuebbles, D.R. Easterling, D.W. Fahey, S. Doherty, J. Kossin, W. Sweet, R. Vose, and M. Wehner. 2018. Our Changing Climate. In Impacts, Risks, and Adaptation in the United States:

Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 72–144. doi: 10.7930/NCA4.2018.CH2

Hazel, J., I. R. Lawler, H. Marsh, and S. Robson. 2007. Vessel Speed Increases Collision Risk for the Green Turtle Chelonia Mydas. *Endangered Species Research* 3(2):105-113.

Hector, D.P. 1990. Northern Aplomado Falcon recovery plan. Albuquerque, NM: United States Fish and Wildlife Service.

Hendrickson, D.A., and A.E. Cohen. 2015. Fishes of Texas Project Database (Version 2.0). doi:10.17603/C3WC70. Website: http://www.fishesoftexas.org/data/?submit=Submit&genus=357&species=772 (accessed August 12, 2016).

Hosman, R.L. 1996. Regional Stratigraphy and Subsurface Geology of Cenozoic Deposits, Gulf Coastal Plain, South-Central United States. USGS Professional Paper 1416-G. 1996.

Howard Midstream Energy Partners. 2015. Howard Energy Partners Expands Its Presence in the Port of Brownsville With a New Bulk Liquid Terminal Facility. Available at: http://www.howardenergypartners.com/news/howard-energy-partners-expands-itspresence-in-the-port-of-brownsville-with-a-new-bulk-liquid.

Huijbers, C.M., I. Nagelkerken, P.A.C. Lossbroek, I.E. Schulten, A. Siegenthaler, M.W. Holderied, and S.D. Simpson. 2012. A Test of the Senses: Fish Select Novel Habitats by Responding to Multiple Cues. *Ecology* 93(1):46-55.

Hunt, E.C., G. Bourneuf. 2003. Modern Engineer's Manual, Volume 1, 3rd Edition. Eds. D. Augustine and J. Tiratto. Cornell Maritime Press, Inc. Centreville, Maryland.

ICC (International Code Council Inc.). 2009. International Building Code. February 2009.

ICF Jones & Stokes, and Illingworth and Rodkin, Inc. 2009. Final Technical Guidance for Assessment and Mitigation of Hydroacoustic Effect of Pile Driving on Fish. Prepared for California Department of Transportation. February 2009. 298 pp.

ICUN (International Union for Conservation of Nature). 2015. Website: http://www.iucn.org (accessed April 22, 2015).

iLinks Geosolutions. 2015. Survey Report Hydrographic, Geophysical & Archaeological Surveys, Brownsville Ship Channel, TX, July 6th through July 10th. Conducted on behalf of Audubon, Annova LNG Brownsville Project, Texas.

Jefferson, T.A., and A.J. Shiro. 1997. Distribution of cetaceans in the offshore Gulf of Mexico. Mammal Society. *Mammal Rev.* 27:27–50.

Jones, S. L. 2010. Sprague's Pipit (*Anthus spragueii)* conservation plan. U.S. Department of Interior, Fish and Wildlife Service, Washington, D.C.

Kloesel, K., B. Bartush, J. Banner, D. Brown, J. Lemory, X. Lin, G. McManus, E. Mullens, J. Nielsen-Gammon, M. Shafer, C. Sorenson, S. Sperry, D. Wildcat, and J. Ziolkowska. 2018. Southern Great Plains. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate

Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 987–1035. doi: 10.7930/NCA4.2018.CH23.

Koropchak, S., W. Daniels, A. Wick, G. Whittecar, and N. Haus. 2016. Beneficial Use of Dredge Material for Soil Reconstruction and Development of Dredge Screening Protocols. *Journal of Environmental Quality* 45(1):62-73. Available online at https://www.ncbi.nlm.nih.gov/pubmed/26828161.

Laack L.L., M.E. Tewes, A.M. Haines, and J.H. Rappole. 2005. Reproductive life history of ocelots *Leopardus pardalis* in southern Texas. *Acta Theriologica* 50:505–514.

Lande, R. 1988. Genetic and demography in biological conservation. Science 241(4872):1455–1460.

Landry, A. M., D. T. Costa, F. L. Kenyon and M. S. Coyne. 2005. Population Characteristics of Kemp's Ridley Sea Turtles in Nearshore Waters of the Upper Texas and Louisiana Coasts. *Chelonian Conservation and Biology* 4(4):801–807.

Lenhardt, M.L. 1982. Bone Conduction Hearing in Turtles. *Journal of Auditory Research* 22:153-160.

Lenhardt, M.L. 1994. Seismic and Very Low Frequency Sound Induced Behaviors in Captive Loggerhead Marine Turtles (*Caretta caretta*). Presented at the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation, Hilton Head, SC.

Lenhardt, M.L. 2002. Sea Turtle Auditory Behavior (A). *Journal of the Acoustical Society of America* 112(5):2314.

Lenhardt, M.L., S. Bellmund, R.A. Byles, S.W. Harkins, and J.A. Musick. 1983. Marine Turtle Reception of Bone Conducted Sound. *Journal of Auditory Research* 23:119-125.

Long Island Village. 2019. Long Island Village Seaside Living at Port Isabel, TX. Website: https://www.longislandvillage.com/default.php. Accessed on March 19, 2019.

Ludeke, K., D. German, and J. Scott. 2010. Texas Vegetation Classification Project: Interpretative Booklet for Phase 3. Texas Parks and Wildlife Department and Texas Natural Resources Information System.

LUMC (Louisiana Universities Marine Consortium). 2016. Hypoxia in the Northern Gulf of Mexico. Website: http://www.gulfhypoxia.net/overview/ (accessed January 2016).

LUMCON (Louisiana Universities Marine Consortium). 2016. Hypoxia in the Northern Gulf of Mexico. Website: http://www.gulfhypoxia.net/overview/ (accessed January 2016).

Mace, R.E., S.C. Davidson, E.S. Angle, and W.F. Mullican III. 2006. Aquifers of the Gulf Coast. Texas Water Development Board Report 365. Website: http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R365/R365_Composite.pdf (accessed August 2016).

MARAD (U.S. Department of Transportation Maritime Administration). 2015. MARAD Open Data Portal, Maritime Data &Statistics. Website: https://www.marad.dot.gov/resources/data-statistics/ (Accessed November 11, 2016).

Marchex, Inc. 2015. Yellow.com: Yellow pages made simple. Website: http://www.yellow.com (accessed by Ecology and Environment, Inc. on May 31, 2015).

Martin Associates/John C. Martin Associates, LLC. 2012. The Local and Regional Economic Impacts of the Port of Brownsville. Prepared for the Port of Brownsville/Brownsville Navigation District. September 25, 2012.

Martin, K.J., S.C. Alessi, J. C. Gaspard, A.D. Tucker, G.B. Bauer, and D.A. Mann. 2012. Underwater hearing in the loggerhead turtle (*Caretta caretta*): a comparison of behavioral and auditory evoked potential audiograms. *Journal of Experimental Biology* 215(17): 3001–3009.

Mathis, M., and D. Matisoff. 2004. A Characterization of Ecotourism in the Texas Lower Rio Grande Valley. Discussion Paper VNT-04-01. March.

McKenna, K.K., P.G. 2014. Texas Coastwide Erosion Response Plan. Texas General Land office. Available online at: http://www.glo.texas.gov/coast/coastalmanagement/forms/files/coastwide-erosion-response-plan.pdf. Accessed September 2018.

Mennitt, D., K. Sherrill, and K. Fristrip. 2014. A geospatial model of ambient sound pressure levels in the contiguous United States. *Journal of the Acoustical Society of America* 135(5):2746–64.

Metz, T.L. and A.M. Landrey, Jr. 2013. An assessment of green turtle *(Chelonia mydas)* stacks along the Texas coast, with emphasis on the lower Laguna Madre. *Chelonian Conservation and Biology* 12(2):293–302.

Mikkelsen, O.A., and M. Pejrup. 2000. In situ particle size spectra and density of particle aggregates in a dredging plume. *Marine Geology* 170:443–459.

Murray, P.M., and H.L. Saffert. 1999. Monitoring Cruises at the Western Long Island Sound Disposal Site, September 1997 and March 1998. DAMOS Contribution No. 125. U.S. Army Corps of Engineers, New England District, Concord, MA.

National Ocean Economics Program. 2016a. Top Commercial Fishing Ports for the Gulf of Mexico in 2014. Website: http://www.oceaneconomics.org/default.aspx (accessed March 21, 2016).

National Ocean Economics Program. 2016b. "Landing History for Brownsville-Port Isabel, Texas: Commercial Fish Landings." Website: http://www.oceaneconomics.org/default.aspx (accessed March 21, 2016).

Nelsen, Aaron. 2008. "Vanishing Fleet." *The Brownsville Herald*. Posted August 4, 2008. Website: http://www.brownsvilleherald.com/business/article_3e6a0694-3bea-580c-b509-018c0174d2e7.html (accessed December 28, 2016).

Newcombe, C.P., and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. *North American Journal of Fisheries Management* 16:693–727.

NFWF (National Fish and Wildlife Foundation). 2015. Gulf Environmental Benefit Fund. Texas: Bahia Grande Conservation Corridor – Boswell-Jenkins Tract Acquisition. Website: http://www.nfwf.org/gulf/Documents/tx-boswell%20jenkins-15.pdf

Nightingale, B., and C.A. Simenstad. 2001. Dredging Activities: Marine Issues. Website: http://depts.washington.edu/trac/bulkdisk/pdf/507.1a.pdf (accessed January 2016).

NLCD (National Land Cover Database). 2011. United States Geologic Survey. A comprehensive change detection method for updating the National Land Cover Database to circa 2011.

NOAA (National Oceanic and Atmospheric Administration). 2000. Incident News – Furfural Spill. Website: http://incidentnews.noaa.gov/incident/7458/507735 (accessed May 2015).

NOAA. 2000. Incident News – Furfural Spill. Website: http://incidentnews.noaa.gov/incident/7458/507735 (accessed May 2015).

NOAA. 2012. *Sea Lake and Overland Surge from Hurricanes (SLOSH) model display Program (1.65i)*. December 14, 2012. Website: http://www.nhc.noaa.gov/surge/slosh.php#SDISPLAY (accessed January 2014).

NOAA. 2013. Annual Climatological Summary 2009-2013. Obtained from NOAA's Climate Data Online Search for Annual Summaries for January 1, 2009 through December 31, 2013: Website: http://www.ncdc.noaa.gov/cdo-web/search (accessed September 2016).

NOAA. 2015a. Annual Climatological Summary 2015. Obtained from NOAA's Climate Data Online Search for Annual Summaries for January 1, 2015 through November 1, 2015: Website: http://www.ncdc.noaa.gov/cdo-web/search (accessed September 2016).

NOAA. 2016a. 1981-2010 U.S. Climate Normals. Website: ftp://ftp.ncdc.noaa.gov/pub/data/normals/1981-2010/

NOAA. 2016b. National Hurricane Center, Tropical Cyclone Climatology. Available at: http://www.nhc.noaa.gov/climo/

NOAA. 2017. Global and Regional Sea Level Rise Scenarios for the United States. January.

NOAA Fisheries (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 1999a. Fishery Management Plan for Atlantic Tunas, Swordfish and Sharks. NOAA, National Marine Fisheries Service, Highly Migratory Species Management Division, Silver Spring, MD. Public Document.

NOAA Fisheries. 1999b. Amendment 1 to the Atlantic Billfish Fishery Management Plan. NOAA, National Marine Fisheries Service, Highly Migratory Species Management Division, Silver Spring, MD.

NOAA Fisheries. 2004. Sea Turtle Protection and Conservation. Website: http://www.nmfs.noaa.gov/prot_res/PR3/Turtles.html#species.

NOAA Fisheries. 2008. Vessel Strike Avoidance Measures and Reporting for Mariners. Southeast Regional Office. February. Website: http://sero.nmfs.noaa.gov/protected_resources/section_7/guidance_docs/documents/copy_of_vessel_strike_avoidance_february_2008.pdf

NOAA Fisheries. 2009. Final Amendment 1 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan, Essential Fish Habitat. NOAA, National Marine Fisheries Service, Highly Migratory Species Management Division, Silver Spring, MD. Public Document.

NOAA Fisheries. 2011a. Fisheries of the United States 2010. National Marine Fisheries Service, Office of Science and Technology, Silver Spring, MD. 118 pages.

NOAA Fisheries. 2011b. Marine Mammals. Website: http://www.nmfs.noaa.gov/pre/special/mammals/cetaceans.htm

NOAA Fisheries. 2012. An Overview of Protected Species in the Gulf of Mexico. Southeast Regional Office Protected Resources Division. February. Website: https://www.boem.gov/Oil-and-Gas-Energy-Program/GOMR/NMFS-Protected-Species-In-GOM-Feb2012.aspx

NOAA Fisheries. 2013. Biological Opinion on the Programmatic Geological and Geophysical Activities in the Mid- and South Atlantic Planning Areas from 2013 to 2020 (pp. 370). Prepared by NMFS for The Bureau of Ocean Energy Management and The Bureau of Safety and Environmental Enforcement.

NOAA Fisheries. 2014. Loggerhead Sea Turtle Critical Habitat in the Northwest Atlantic Ocean. Website: http://www.nmfs.noaa.gov/pr/species/turtles/criticalhabitat_loggerhead.htm (last updated September 18, 2014).

NOAA Fisheries. 2015a. Atlantic Spotted Dolphin. Website: http://www.fisheries.noaa.gov/pr/species/mammals/dolphins/atlantic-spotted-dolphin.html (accessed February 2016).

NOAA Fisheries. 2015b. Bottlenose Dolphin. Website: http://www.fisheries.noaa.gov/pr/species/mammals/dolphins/bottlenose-dolphin.html (accessed February 2016).

NOAA Fisheries. 2015c. EFH Text Descriptions and GIS Data Inventory. Website: http://www.habitat.noaa.gov/protection/efh/newInv (accessed May 2015).

NOAA Fisheries. 2015d. Personal Communications with Heather Young, NOAA NMFS, Habitat Conservation Division, Southeast Region.

NOAA Fisheries. 2015e. Kemp's Ridley Turtle. National Marine Fisheries Service. Website: http://www.nmfs.noaa.gov/pr/species/turtles/kempsridley.htm (accessed June 2015).

NOAA Fisheries. 2016a. Sperm Whale (*Physeter macrocephalus*): Northern Gulf of Mexico Stock. May. Website: http://www.fisheries.noaa.gov/pr/sars/pdf/stocks/atlantic/2015/f2015_spermgmex.pdf

NOAA Fisheries. 2016b. Green Turtle: *Chelonia mydas.* Website: http://www.fisheries.noaa.gov/pr/species/turtles/green.html

NOAA Fisheries. 2016c. Loggerhead Turtle (*Caretta caretta*). Website: http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.html

NOAA Fisheries. 2016d. Hawksbill Turtle (*Eretmochelys imbricata*). Website: http://www.fisheries.noaa.gov/pr/species/turtles/hawksbill.html

NOAA Fisheries. 2016e. Leatherback Turtle (*Dermochelys coriacea).* Website: http://www.fisheries.noaa.gov/pr/species/turtles/leatherback.html

NOAA Fisheries. 2016f. Southeast Regional Office. "Rebirth of the Bahia Grande, Texas." Website: http://sero.nmfs.noaa.gov/habitat_conservation/hcd_headlines/bahia_grande_tx.html (accessed November 1, 2016).

NOAA Fisheries. 2018. North Atlantic Right Whale Sighting Survey and Early Earning System. Website: http://sero.nmfs.noaa.gov/protected_resources/right_whale/seus_sightings/index.html (Accessed March 8, 2018).

NOAA Fisheries and FWS. 2013a. Hawksbill sea turtle (*Eretmochelys imbricata*). 5-year review: summary and evaluation. June 2013.

NOAA Fisheries and FWS. 2013b. Leatherback sea turtle (*Dermochelys coriacea*). 5-year review: summary and evaluation. November 2013.

NOAA Fisheries and FWS. 2015. Kemp's Ridley Sea Turtle *(Lepidochelys kempii)* 5-year Review: Summary and Evaluation (pp. 63). Silver Spring, MD. Website: http://www.nmfs.noaa.gov/pr/listing/final_july_2015_kemp_s_5_year_review.pdf

NOAA Fisheries, FWS, and Secretary of Environment and Natural Resources, Mexico (SEMARNAT). 2011. Draft Bi-National Recovery Plan for the Kemp's ridley Sea Turtle *(Lepidochelys kempii),* Second Revision. National Marine Fisheries Service. Silver Spring, MD.

NoiseQuest. 2015. What does noise affect? Wildlife section. Website: http://www.noisequest.psu.edu/noiseeffects-wildlife.html (accessed January 2016).

NPS (U.S. Department of the Interior, National Park Service). 2006. Management Policies 2006. United States Department of the Interior, National Park Service, Washington, DC. Website: http://www.nps.gov/policy/MP2006.pdf (accessed August 9, 2016).

NPS. 2010a. Update to the Civil War Sites Advisory Commission Report on the Nation's Civil War Battlefields, State of Texas. Website: http://www.nps.gov/abpp/cwsii/cwsacreporttexasupdate.pdf (accessed by Ecology and Environment, Inc. on May 26, 2015).

NPS. 2010b. National Wild and Scenic River Inventory Texas Segments. U.S. Department of the Interior, National Park Service, Washington D.C. Website: http://www.nps.gov/ncrc/programs/rtca/nri/states/tx.html. Accessed on May 19, 2015.

NPS. 2010c. National Parks and National Trail Systems Map. U.S. Department of the Interior, National Parks Service, Washington D.C. Website: http://www.nps.gov/nts/maps/National%20Trails%20map.pdf. Accessed on May 19, 2015.

NPS. 2012. National Natural Landmarks Program. Texas. Website: http://www.nature.nps.gov/nnl/state.cfm?State=TX. Accessed May 19, 2015.

NPS. 2015. National Register of Historic Places. Website: http://nrhp.focus.nps.gov/natreg docs/ Download.html (accessed March 24, 2015).

NPS. 2016a. Padre Island National Seashore. Website: https://www.nps.gov/pais/index.htm (accessed August 9, 2016).

NPS. 2016b. State of the Park Report for Palo Alto Battlefield National Historical Park. Updated July 15, 2016. https://www.nps.gov/stateoftheparks/paal/naturalresources/vegetation.cfm. Accessed 3/15 2017.

NPS. 2017. Palo Alto Battlefield. National Historic Park – Texas. Management. Website: https://www.nps.gov/paal/learn/management/index.htm.

NPS. 2017b. On the Laguna Madre. Website: https://www.nps.gov/pais/planyourvisit/laguna-madre.htm. Last updated June 22, 2017. Accessed online on March 18, 2019.

NRC (U.S. Nuclear Regulatory Commission). 2007. Tornado Climatology of the Contiguous United States. NUREG/CR-4461, Revision 2. PNNL-15112, Revision 2. Prepared by J.V. Ramsdell, Jr., and J.P. Rishel. Pacific Northwest National Laboratory. February. Available at: https://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr4461/#pub-info

NRCS (Natural Resources Conservation Service). 2010. Natural Resources Conservation Service Invasive Species Policy GM_190_414 - Part 414 - Invasive Species. Website: http://directives.sc.egov.usda.gov/ViewRollUp.aspx?hid=17018 (accessed August 31, 2016).

NRCS. 2015a. United States Department of Agriculture. Web Soil Survey. Website: http://websoilsurvey.nrcs.usda.gov (accessed March 24, 2015).

NRCS. 2015b. Soil Survey Geographic (SSURGO) database for Cameron County, Texas. Published by the U.S. Department of Agriculture, NRCS. Survey Area Version Date: September 22, 2015. Website: https://gdg.sc.egov.usda.gov

NRCS. 2016. PLANTS database. Introduced, Invasive, and Noxious Plants. U.S. Department of Agriculture, Natural Resources Conservation Service website. Website: http://plants.usda.gov/java/noxiousDriver (accessed September 7, 2016).

NRS Engineering. 2008. Final Pilot Study Report - Texas Seawater Desalination Demonstration Project. Prepared for the Texas Water Development Board, Brownsville Public Utilities Board, and Port of Brownsville. October 2008. Website: http://www.twdb.texas.gov/innovativewater/desal/projects/brownsville/doc/BPUBPilot_Final_Report.pdf (accessed September 2016).

Oberholser, H.C. 1974. *The Bird Life of Texas.* University of Texas Press, Austin.

OCIMF (Oil Companies International Marine Forum). 2008. *Mooring Equipment Guidelines.* 3rd edition.

Onuf, C.P. 2002. Laguna Madre. United States Geological Survey, National Wetlands Research Center. Website: http://pubs.usgs.gov/sir/2006/5287/pdf/LagunaMadre.pdf (accessed May 2015).

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. Website: http://www.data.boem.gov/PI/PDFImages/ESPIS/5/5298.pdf (accessed April 2014).

Page, W.R., D. VanSistine, and K. Turner. 2005. Preliminary Geologic Map of Southernmost Texas, United States, and Parts of Tamaulipas and Nuevo Leon, Mexico: Environmental Health Investigations in the United States-Mexico Border Region. USGS Open File Report 2005–1409.

Paine, J.G. 2000. Identifying and assessing ground water in the Lower Rio Grande Valley, Texas, using airborne electromagnetic induction: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for Texas Water Development Board under interagency contract no. 99-483-310, 80 p. + CD-ROM. Website: http://www.beg.utexas.edu/staffinfo/paine-pubs/paine_twdb_lrgv_2000.pdf (accessed August 2016).

Patillo, M., L.P. Rozas, and R.J. Zimmerman. 1995. A Review of Salinity Requirements for Selected Invertebrates and Fishes of U.S. Gulf of Mexico Estuaries. National Marine Fisheries Service. Southeast Fisheries Service Center. Galveston, TX.

Patterson, J.W., Jr. 2012. Evaluation of New Obstruction Lighting Techniques to Reduce Avian Fatalities. DOT/FAA/TC-TN12/9. U.S. Department of Transportation, Federal Aviation Administration. May. Website: http://www.tc.faa.gov/its/worldpac/techrpt/tctn12-9.pdf

Peregrine Fund. 2012. Aplomado falcon restoration. Website: http://www.peregrinefund.org/projects/aplomado-falcon.

Peregrine Fund. 2015. Aplomado Falcon Restoration Conserving Birds of Prey Worldwide. Accessed June 2015. Website: http://www.peregrinefund.org/aplomado

Poot, H., B.J. Ens, H. de Vries, M.A.H. Donners, M.R. Wernand, and J.M. Marquenie. 2008. Green light for nocturnally migrating birds. *Ecology and Society* 13(2):47.

Port Isabel Economic Development Corporation. 2015. Community Profile-Environmental and Natural Resources. Website: http://portisabel-texas.com/edc/communityprofile/environmentalnaturalresources.

Port of Brownsville. 2016. Facts. Website: http://www.portofbrownsville.com/facts/ (accessed August 30, 2016).

Port of Oakland. 1999. Oakland Harbor Navigation Improvement (-50 Foot) Project, Revisions to the Final Environmental Impact Report. SCH No. 97072051. Prepared by Port of Oakland State Agency. September.

Prescott, C., J. Zhang, and D. Brower. 2005. New design uses ambient pressure insulted LNG pipeline offshore. Oil and Gas Journal. Website: http://www.ogj.com/articles/print/volume-103/issue-28/transportation/new-design-uses-ambient-pressure-insulated-lng-pipeline-offshore.html

Rhoads, D.C., P.L. McCall, J.Y. Yingst. 1978. Disturbance and production on the estuarine seafloor. *American Scientist* 66:577–586.

Reice, S.R., R.C. Wissmar, and R.J. Naiman. 1990. Disturbance Regimes, Resilience, and Recovery of Animal Communities and Habitats in Lotic Ecosystems. *Journal of Environmental Management* 14(5):647–659.

Ridgway, S.H., E.G. Wever, J.G. McCormick, J. Palin, and J.H. Anderson. 1969. Hearing in the giant sea turtle, *Chelonia mydas*. *Proceedings of the National Academy of Sciences* 64(3):884–890.

Rio Grande LNG, LLC. 2015. Rio Grande LNG, LLC and Rio Bravo Pipeline Company, LLC. Docket No. PF15-____-000, Request to Initiate NEPA Pre-Filing Process for Rio Grande LNG and Rio Bravo Pipeline Projects. March 20, 2015.

Robertson, M.J., D.A. Scruton, R.S. Gregory, and K.D. Clarke. 2006. Effect of Suspended Sediment on Freshwater Fish and Fish Habitat. *Canadian Technical Report of Fisheries and Aquatic Sciences* 2644:37.

Rosenbaum, Beatrice. 2016. Director of Industrial Development, Port of Brownsville. Personal communication with K. Welder Mollow, Ecology and Environment, Inc. on October 26, 2016.

RRC (Railroad Commission of Texas). 2015. *RRC Public GIS Viewer Version: 2.09.* Release Date: May 4, 2015. Website: http://wwwgisp.rrc.state.tx.us/GISViewer2.

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. Accessed September 2018.

Ryder, Paul. 1996. Oklahoma, Texas, in Groundwater Atlas of the United States, United States Geological Survey HA 730-E. Website: http://capp.water.usgs.gov/gwa/ch_e/index.html (accessed April 2015).

Sanchez, J.M., J.J. Dowling, A.S. Burden, and T.B. Griffith. 2015. Draft Intensive Cultural Resources Investigations of the Annova LNG Brownsville Project, Cameron County, Texas. Prepared by, Blanton & Associates, Inc. Austin, Texas.

Sanchez-Cordero, V., D. Stockwell, S. Sarkar, H. Liu, C.R. Stephens and J. Gimenez. 2008. Competitive interactions between felid species may limit the southern distribution of bobcats (*Lynx rufus*). *Ecography* 31:757-764.

Schmidly, D.J. 2004. *The Mammals of Texas.* Revised edition, Vol. 59. University of Texas Press.

Seney, E.E., and J.A. Musick. 2005. Diet analysis of Kemp's ridley sea turtles (*Lepidochelys kempii*) in Virginia. *Chelonian Conservation and Biology* 4(4):864-871.

Seney, E.E., and A.M. Landry. 2011. Movement patterns of immature and adult female Kemp's ridley sea turtles in the northwestern Gulf of Mexico. *Marine Ecology-Progress Series* 440: 241–254.

Sepulveda, P. 2015. Personal communication, telephone call on May 27, 2015, between Peter Sepulveda, County Judge, Cameron County, and Z. Michalk, Ecology and Environment, Inc., regarding proposed developments in the proposed project area.

Sharyland. 2017. Transmission Projects, Sharyland Utilities. http://www.sharyland.com/transmission/ Accessed 2/28/2017.

Sibley, D.A. 2003. *The Sibley Field Guide to Birds of Eastern North America.* Andrew Stewart Publishing, Inc.

Source Strategies, Inc. 2016a. Hotel and motel statistics, Cameron and Willacy counties and respective cities, annually and quarterly 2011-2015. Provided by Doug Sutton, Vice President, Source Strategies, Inc., on February 2, 2016, to K. Welder Mollow, Ecology and Environment, Inc.

Source Strategies, Inc. 2016b. Texas Hotel Report: 4th Quarter YTD 2015. Tables: By County by City, by Metro by City. February 12. Website: http://www.sourcestrategies.org/texas/

SpaceX. 2014. SpaceX Breaks Ground on Private Spaceport in Texas. Available at: http://www.space.com/27234-spacex-texas-spaceport-groundbreaking.html. Accessed July 18, 2016.

Stadler, J.H., and D.P. Woodbury. 2009. Assessing the effects to fishes from pile driving: Application of new hydroacoustic criteria. Inter●noise 2009: Innovations in practical noise control. August 2009, Ottawa, Canada.

Stevenson, D.A., and R. P. McCulloh. 2001. Earthquakes in Louisiana. Louisiana Geological Survey - Public Information Series No. 7.

STSSN (Sea Turtle Stranding and Salvage Network). https://grunt.sefsc.noaa.gov/stssnrep/SeaTurtleReportII.do?action=reportIIqueryp.

TAHC (Texas Animal Health Commission). 2015. Texas Cattle Fever Tick. Available online at: http://www.tahc.texas.gov/news/brochures/TAHCBrochure_FeverTick.pdf.

TAHC. 2016. Inspection, Treatment and Movement Requirements for Nilgai Antelope, White-Tailed Deer or other Free-ranging Wildlife and Exotic Animals capable of hosting fever ticks located in the Cameron County Temporary Preventative Quarantine Area (TPQA) or from Premises Quarantined as Infested, Exposed, Adjacent or Check in the Cameron County Free Area. Available online at: http://www.tahc.state.tx.us/animal_health/fevertick/WildlifeInspection-2014.pdf.

TCEQ (Texas Commission on Environmental Quality). 2012. Texas Integrated Report: Assessment Results for Basin 24 – Bays and Estuaries. Website: http://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/12twqi/2012_basin24.pdf (accessed May 2015).

TCEQ. 2014a. Texas Administrative Code Title 30 Part 1 Chapter 307. Website: https://www.tceq.texas.gov/waterquality/standards/2014standards.html (accessed August 2016).

TCEQ. 2014b. 2012 Texas Integrated Report – Texas 303(d) List (Category 5). Website: https://www.tceq.texas.gov/waterquality/assessment/14twqi/14txir (accessed September 2016).

TCEQ. 2015a. Water Well Report Viewer. Website: http://www.tceq.texas.gov/gis/waterwellview.html (accessed April 2015).

TCEQ. 2015b. Plotted Water Wells for Cameron County, TX. Website: https://gisweb.tceq.texas.gov/waterwellpublic/search.jsp?type=LR&wellCounty=CAMERON%20COUNTY (accessed June 2015).

TCEQ. 2016. Brownsville Ship Channel, Segment ID 2494 dataset. Website: http://www80.tceq.texas.gov/SwqmisPublic/public/default.htm (accessed September 2016).

Tewes, M. E., and D. D. Everett. 1986. Status and distribution of the endangered ocelot and jaguarundi in Texas. In Cats of the World: Biology, Conservation, and Management. National Wildlife Federation. Washington, D.C.

Tewes, M.E., and R.W. Hughes. 2001. Ocelot management and conservation along transportation corridors in Southern Texas. Website: http://escholarship.org/uc/item/6mc7x9mx#page-1 (accessed April 2016).

Tewes, M.E. 2017. Clinging to Survival in the Borderlands. The Wildlife Professional (September/October): 26–29. Website: http://www.eastfoundation.net/media/46869/twp-ocelot-article.pdf

Texas A & M University. 2012. Economic Impact of Nature Tourism on the Rio Grande Valley: Considering Peak and Off-Peak Visitation for 2011. Prepared by Woosnam, K., R. Dudensing, D. Hanselka, and K. Aleshinloye. Website: http://southtexasnature.org/wp-content/uploads/2014/02/STNMC-Final-report-4-16- 12.pdf (accessed March 16, 2016).

Texas Aquatic Science. 2015. Bays and Estuaries – Chapter 11. Website: http://texasaquaticscience.org/ bays-estuaries-aquatic-science-texas/ (accessed January 2016).

Texas Department of Agriculture. 2016. Noxious and Invasive Plant List. Figure: 4 TAC §19.300(a). Website: http://texreg.sos.state.tx.us/fids/200701978-1.html (accessed January 2016).

Texas Education Agency. 2015. Snapshot 2014 District Detail Search. Website: https://rptsvr1.tea.texas.gov/perfreport/snapshot/2014/district.srch.html [Search by "District by County Name," then enter Cameron and Willacy and click individual school districts]. Accessed by Ecology and Environment, Inc. on May 31, 2015.

Texas General Land Office. 2015. Jaime J. Zapata Memorial Boat Ramp Fishing Pier and Kayak Launching Area. Website: http://www.glo.texas.gov/what-we-do/caring-for-the-coast/grants-funding/projects/ 13-045-jaime-zapata-memorial-pier.html (accessed by Ecology and Environment, Inc. on May 20, 2015).

Texas LNG Brownsville, LLC. 2015. Texas LNG Brownsville, LLC, Docket No. PF15-___-000, Request to Initiate NEPA Pre-Filing Process for Texas LNG Brownsville LLC Liquefied Natural Gas Project. March 9, 2015.

Texas State Data Center. 2014. Population Projections for the State of Texas and Counties in one file. Website: http://osd.texas.gov/Data/TPEPP/Projections/ (accessed March 8, 2016).

Texas Tech University. 1997. The Mammals of Texas – Online Edition. http://www.nsrl.ttu.edu/tmot.htm.

Texas Weekend Angler. 2016. Fishing in the Brownsville Ship Channel. Website: http://www.texasweekendangler.com/fishing_the_brownsville_ship_channel.htm (accessed January 2016).

THC (Texas Historical Commission). 2017. Palmito Ranch Battlefield National Historic Landmark. [Internet] Available at http://www.thc.texas.gov/preserve/projects-and-programs/military-sites/palmito-ranch-battlefield-national-historic-landmark

THC. 2017b. Texas Historical Marker – Palmetto Pilings. Travel South Texas Website. Accessed at: http://www.stxmaps.com/go/texas-historical-marker-palmetto-pilings.html

The University of Texas-Pan American. 2014. "Winter Texan: 2013-2014 Survey." College of Business Administration, Valley Markets and Tourism Research Center. Website: http://issuu.com/utpa/docs/winter_texan_2014 (accessed March 8, 2016).

The Winter Texan Connection. 2015. Texas RV Parks, Mobile Home Parks, 55+S Subdivisions, Campgrounds, Retirement Communities and Country Clubs in the Rio Grande Valley of South

Texas. Website: http://wintertexaninfo.com/Mobilehomecommunities.html (accessed by Ecology and Environment, Inc. on May 31, 2015).

TPWD (Texas Parks and Wildlife Department). 1989. Coastal Preserve System, South Bay, Cameron County, Texas – Texas Parks and Wildlife Department. Available at: http://tpwd.texas.gov/landwater/water/conservation/txgems/southbay/index.phtml. Accessed on February 3, 2016.

TPWD. 2002. The Texas Shrimp Fishery Executive Summary. Website: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_rp_v3400_857.pdf (accessed January 2016).

TPWD. 2015a. The Monarch Butterfly. Website: http://www.fws.gov/international/animals/monarch-butterfly.html (accessed July 2015).

TPWD. 2015b. Texas Natural Diversity Database (TXNDD). Received December 29, 2015.

TPWD. 2016a. Texas GEMS – South Bay Coastal Preserve. Website: http://tpwd.texas.gov/landwater/water/conservation/txgems/southbay/index.phtml (accessed January 2016).

TPWD. 2016b. South Bay Paddling Trail. Website: https://tpwd.texas.gov/fishboat/boat/paddlingtrails/coastal/south_bay/ (accessed January 2016).

TPWD. 2016c. Texas Ecoregions. Texas Parks & Wildlife Website. Website: https://tpwd.texas.gov/education/hunter-education/online-course/wildlife-conservation/texas-ecoregions (accessed August 12, 2016).

TPWD. 2016d. Wildlife Habitat Assessment Program: Planning Tools and Best Management Practices (BMPs). Website: http://tpwd.texas.gov/huntwild/wild/wildlife_diversity/habitat_assessment/tools.phtml (accessed February 2016).

TPWD. 2016e. Texas Monarch and Native Pollinator Conservation Plan. Available online at: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_rp_w7000_2070.pdf.

TPWD. 2016e. Marine Fishes and Shellfishes of the Gulf. Website: http://tpwd.texas.gov/landwater/water/aquaticspecies/marine.phtml (accessed January 2016).

TPWD. 2016f. Rare, Threatened, and Endangered Species of Texas. Website: http://tpwd.texas.gov/gis/rtest/ (accessed June 2016).

TPWD. 2017a. Texas State Parks. Website: http://tpwd.texas.gov/state-parks/ (accessed January 19, 2017).

TPWD. 2017b. Texas Ecosystem Analytical Mapper. Available online at: http://tpwd.texas.gov/gis/team/. Accessed March 29, 2017.

TPWD. 2017c. Rare, Threatened, and Endangered Species of Texas. Available online at: http://tpwd.texas.gov/gis/rtest/. Accessed May 2017.

TPWD. 2018. Whooping Crane (*Grus Americana*). Website: http://tpwd.texas.gov/huntwild/wild/species/whooper/

TPWD. n.d. Texas State Parks. Website: https://tpwd.texas.gov/state-parks (Accessed May 19, 2015).

Traffic Impact Group, LLC. 2015. Traffic Impact Analysis. Annova LNG Brownsville Project. Brownsville, Cameron County, Texas. Black & Veatch. August 21.

Trevino, Reuben. 2016. Coastal Resource and Parks Administrator, City of South Padre Island. Personal communication with K. Welder Mollow, Ecology and Environment, Inc., on January 28.

TWDB (Texas Water Development Board). 1990. Report 316: Evaluation of Ground-Water Resource in the Lower Rio Grande Valley, Texas. Website: https://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R316/R316.pdf. (accessed July 2015).

TWDB. 2006. Aquifers of the Gulf Coast of Texas. Report 365. February. Website:t https://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R365/R365_Composite.pdf

TWDB. 2015. Groundwater Conservation Districts of Texas [map]. Website: http://www.twdb.texas.gov/mapping/doc/maps/GCDs_8x11.pdf (accessed August 2016).

TWDB. 2016. Water Data Interactive (WDI) Groundwater Data Viewer. Website: http://www2.twdb.texas.gov/apps/WaterDataInteractive/GroundWaterDataViewer (accessed August 2016).

TxDOT (Texas Department of Transportation). 2016. Project Tracker. Available at: http://apps.dot.state.tx.us/apps-cq/project_tracker/.

Ungar, E.E., D.H. Sturz, and C.H. Amick. 1990. Vibration Control Design of High Technology Facilities. *Sound and Vibration* (July):20–27.

University of Texas-Brownsville. 2015. STARGATE. Available at: http://www.utb.edu/stargate/Pages/default.aspx. Accessed July 18, 2016.

University of Texas-Rio Grande Valley. 2018. The University of Texas Rio Grande Valley. 2018. Boca Chica Beach: STARGATE Technology Center. Available online at: https://www.utrgv.edu/umc/news/building-our-future/stargate/index.htm. Accessed September 29, 2018.

U.S. Bureau of Economic Analysis. 2015a. CA25N Total full-time and part-time employment by industry, 2014. Website: http: www.bea.gov

U.S. Bureau of Economic Analysis. 2015b. CA5N Personal Income by Major Component and Earnings by NAICS Industry, 2014. Website: http: www.bea.gov

U.S. Bureau of Labor Statistics. 2015a. Labor Force Data by County, 2014 Annual Averages. Website: http://www.bls.gov/home.htm

U.S. Bureau of Labor Statistics. 2015b. Regional and State Unemployment – 2014 Annual Averages. News Release. March 4.

U.S. Census Bureau. 2000. DP-1: Profile of General Demographic Characteristics: 2000. Census 2000 Summary File 1 (SF 1) 100-Percent Data. Website: http://factfinder.census.gov/ (accessed March 8, 2016).

U.S. Census Bureau. 2010. QT-P11-Geography-Texas: Households and Families: 2010. Website: http://factfinder.census.gov/

U.S. Census Bureau. 2016a. State and County QuickFacts. Website: http://quickfacts.census.gov/ qfd/index.html (accessed March 8, 2016).

U.S. Census Bureau. 2016b. DP04: Selected Housing. 2010-2014 American Community Survey 5-Year Estimates. Website: http://factfinder.census.gov/faces/nav/jsf/ pages/index.xhtml

U.S. Census Bureau. 2016c. B25004: Vacancy Status. Universe: Vacant Housing Units. 2010-2014 American Community Survey 5-Year Estimates. Website: http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

U.S. Census Bureau. 2016d. Poverty Definitions. Website: http://www.census.gov/hhes/www/poverty/ methods/definitions.html

U.S. Census Bureau. 2016e. B03002: Hispanic or Latino Origin by Race. 2010-2014 American Community Survey 5-Year Estimates. Website: http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

U.S. Census Bureau. 2016f. B17017: Poverty Status in the Past 12 Months by Household Type by Age of Householder. 2010-2014 American Community Survey 5-Year Estimates. Website: http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

U.S. Census Bureau. 2019. BO1003: 2010-2014 American Community Survey 5-Year Estimates. Website: http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

USA Cops. 2015a. Cameron County. Website: http://www.usacops.com/tx/cameron.html (accessed by Ecology and Environment, Inc. on May 31, 2015).

USA Cops. 2015b. Willacy County. Website: http://www.usacops.com/tx/willacy.html (accessed by Ecology and Environment, Inc. on May 31, 2015).

U.S. Department of Transportation. n.d. America's Byways. Website: http://www.fhwa.dot.gov/byways (accessed on May 20, 2015).

USEIA (United States Energy Information Administration). 2015. Texas State Energy Profile. Website: www.eia.gov/state/print.cfm?sid=TX (Accessed May 2015).

USGCRP (U.S. Global Change Research Program). 2017. Climate Science Special Report: Fourth National Climate Assessment, Volume I, Chapter 3 Detection and Attribution of Climate Change [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 470 pp., doi: 10.7930/J0J964J6.

USGCRP. 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 186 pp.

USGS (U.S. Geological Survey). 2009. Regional Assessment of Tsunami Potential in the Gulf of Mexico. Website: http://nws.weather.gov/nthmp/documents/GoMFinal01regionalAssessment.pdf

USGS. 2014. *Mineral Resources On-Line Spatial Data (MRDS) Online Spatial Data.* September 2014. Website: http://mrdata.usgs.gov/mineral-resources/mrds-us.html (accessed May 2015).

USGS. 2016. National Hydrography Dataset viewer. Website: http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd (accessed August 2016).

USGS. 2018. Mineral Resources Online Spatial Data, Lissie Formation (TXQI: 0). Website: https://mrdata.usgs.gov/geology/state/sgmc-unit.php?unit=TXQl%3B0 (accessed September 28, 2018).

Utne-Palm, A.C. 2001. Visual feeding of fish in a turbid environment: physical and behavioural aspects. *Marine Freshwater Behavior Physiology* 35(1-2):111–128.

Valley Baptist Medical Center. 2015. Emergency Medicine: Overview. Website: http://www.valleybaptist.net/medical-services/emergency-medicine/overview (accessed by Ecology and Environment, Inc. on May 31, 2015).

Valley Regional Medical Center. 2015. Trauma Center ER. Website: http://valleyregionalmedicalcenter.com/service/trauma-center-er (accessed by Ecology and Environment, Inc. on May 31, 2015).

Wallisch, R., and M. Russo. 2015. Draft Non-Archaeological Historic Resources Report [for the] Proposed Annova LNG Brownsville Project, Cameron County, Texas. Prepared for Environment & Ecology, Inc. Prepared by Blanton & Associates, Austin, Texas.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel (eds.). 2010. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments. NOAA Tech Memo NMFS-NE 213, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. Website: http://www.nefsc.noaa.gov/publications/tm/tm219

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2015. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments--2014. NOAA Tech Memo NMFS NE, 231, 361.

Whale and Dolphin Conservation Society. 2004. Oceans of Noise 2004 – A WDCS Science Report. Würsig, B., G. Jefferson, and Thomas A. Schmidly. 2000. The marine mammals of the Gulf of Mexico. No. 599.5 W9.

Williams, Sandy. 2018. Big River Steel Chooses Brownsville for Next Mill. Steel Market Update, April 25, 2018. Available online at: https://bigriversteel.com/wpcontent/uploads/2018/04/Big-River-Steel-Chooses-Brownsville-for-Next-Mill-Steel-Market-Update.pdf. Accessed February 2019.

Wilson, G. 2015. Pilot, Brazos-Santiago Pilots Associates. Personal communication with K. Welder Mollow, Ecology and Environment, Inc., on September 3, 2015.

World Birding Center. 2010. Website: http://www.theworldbirdingcenter.com (accessed July 23, 2015).

WSDOT (Washington State Department of Transportation). 2016. Underwater Sound Level Report: Colman Dock Test Pile Project 2016. Washington State Department of Transportation Pile Driving

Reports. Website: https://www.wsdot.wa.gov/sites/default/files/2017/12/12/ENV-FW-AirPileDrivingNoise.pdf

Wursig, B., T.A. Jefferson, and D.J. Schmidly. 2000. *The Marine Mammals of the Gulf of Mexico*. College Station, TX. Texas A&M University Press. 232 pages.

Wyoming Department of Environmental Quality. 2015. Permit Application Analysis A0000634, Cheyenne Generating Station, September 17, 2015.

Wysocki, L.E., J. P. Dittami, and F. Ladich. 2006. Ship Noise and Cortisol Secretion in European Freshwater Fishes. *Biological Conservation* 128(4):501–508.

Yellow Wood Associates, Inc. 2004. Report on Potential Economic and Fiscal Impacts on the Town of Harpswell, Maine, of the LNG Terminal Proposed by TransCanada Pipelines and ConocoPhillips. Prepared for Fairplay for Harpswell. February 3, 2004. Website: http://pstrust.org/docs/harpswell_econ_impact_study.pdf

Yudhana, A., J. Din, S. Abdullah Sundari, and R.B.R. Hassan. 2010. Green Turtle Hearing Identification Based on Frequency Spectral Analysis. *Applied Physics Research* 2(1):125–134.

APPENDIX M
INDEX

APPENDIX M
SUBJECT INDEX

access road, 1-21, 2-5, 2-7, 2-9, 2-13, 3-1, 3-17, 3-19, 4-30, 4-31, 4-35, 4-36, 4-37, 4-41, 4-43, 4-44, 4-49, 4-66, 4-72, 4-73, 4-75, 4-78, 4-82, 4-87, 4-88, 4-89, 4-90, 4-91, 4-92, 4-93, 4-97, 4-99, 4-105, 4-108, 4-127, 4-149, 4-153, 4-160, 4-161, 4-162, 4-163, 4-167, 4-179, 4-180, 4-181, 4-253, 4-280, 4-323, 5-8, 5-15, 5-16, 5-20

ACHP (Advisory Council on Historic Preservation), 1-8, 4-160, 4-166, 4-167, 5-21

APE (area of potential effect), 1-8, 4-160, 4-161, 4-162, 4-163, 4-165, 5-9, 5-10

API (American Petroleum Institute), 2-15, 4-220, 4-227, 4-231, 4-233, 4-236, 4-237, 4-239, 4-243, 4-268, 4-271, 4-273, 5-27, 5-30, 5-32

ASCE (American Society of Civil Engineers), 4-207, 4-237, 4-242, 4-243, 4-245, 4-246, 4-247, 4-248, 4-249

ASME (American Society of Mechanical Engineers), 2-15, 4-227, 4-273, 5-32

BA (biological assessment), 1-21, 4-4, 4-65

Bahia Grande, 1-12, 3-8, 3-14, 4-12, 4-14, 4-16, 4-17, 4-19, 4-21, 4-23, 4-27, 4-47, 4-48, 4-50, 4-54, 4-70, 4-101, 4-103, 4-109, 4-122, 4-123, 4-126, 4-134, 4-215, 4-279, 4-289, 4-293, 4-294, 4-297, 4-299, 4-301, 4-305, 4-315, 4-323, 5-7, 5-12

BLEVE, 4-222, 4-252, 4-253, 4-255

BMP (best management practice), 2-19, 4-7, 4-304, 4-311

BND (Brownsville Navigation District), 1-18, 2-7, 2-8, 2-18, 2-23, 2-25, 3-17, 3-19, 3-24, 4-12, 4-14, 4-23, 4-28, 4-33, 4-49, 4-50, 4-57, 4-69, 4-72, 4-74, 4-76, 4-96, 4-97, 4-99, 4-104, 4-108, 4-109, 4-127, 4-132, 4-135, 4-136, 4-137, 4-141, 4-142, 4-143, 4-146, 4-156, 4-157, 4-158, 4-192, 4-284, 4-285, 4-288, 4-289, 4-297, 4-306, 4-311, 4-313, 4-314, 4-315, 5-7, 5-8

BOG (boil-off gas), 1-15, 2-3, 2-5, 2-10, 4-182, 4-224, 4-225, 4-227, 4-241, 4-264, 4-266, 4-267, 4-282, 5-25, 5-26, 5-27

Brazos Island, 1-12, 4-6, 4-14, 4-17, 4-101, 4-104, 4-107, 4-289, 4-293, 4-296, 4-310, 5-12

CAA (Clean Air Act), 1-7, 1-21, 1-22, 4-170, 4-171, 4-173, 4-175, 4-176

Cameron County, 1-1, 1-22, 2-1, 2-7, 3-14, 4-4, 4-8, 4-10, 4-11, 4-28, 4-45, 4-50, 4-i, 4-65, 4-66, 4-67, 4-70, 4-74, 4-81, 4-86, 4-87, 4-91, 4-94, 4-96, 4-99, 4-101, 4-106, 4-108, 4-118, 4-124, 4-127, 4-i, 4-128, 4-129, 4-130, 4-131, 4-132, 4-133, 4-136, 4-137, 4-138, 4-139, 4-140, 4-141, 4-142, 4-144, 4-146, 4-148, 4-154, 4-164, 4-192, 4-206, 4-248, 4-249, 4-255, 4-258, 4-278, 4-280, 4-282, 4-284, 4-286, 4-287, 4-291, 4-292, 4-313, 4-314, 4-315, 4-318, 4-321, 4-322, 4-325, 5-6, 5-11

climate change, 4-71, 4-172, 4-326, 4-329, 4-330, 4-331, 4-332, 5-14

Coast Guard, 1-5, 1-6, 1-11, 1-21, 2-8, 2-13, 2-20, 2-24, 2-25, 4-24, 4-59, 4-60, 4-68, 4-108, 4-109, 4-157, 4-158, 4-205, 4-209, 4-210, 4-211, 4-212, 4-213, 4-214, 4-215, 4-217, 4-218, 4-219, 4-220, 4-230, 4-234, 4-243, 4-256, 4-260, 4-262, 4-275, 4-277, 4-298, 4-312, 5-1, 5-3, 5-11, 5-23, 5-33

Coastal Management Program, 4-127

COE (U.S. Army Corps of Engineers), 1-5, 1-15, 1-21, 1-22, 2-16, 2-20, 4-6, 4-8, 4-17, 4-18, 4-19, 4-21, 4-22, 4-23, 4-30, 4-31, 4-33, 4-34, 4-39, 4-49, 4-56, 4-57, 4-59, 4-83, 4-84, 4-85, 4-99, 4-134, 4-249, 4-289, 4-294, 4-297, 4-299, 4-310, 5-1, 5-2, 5-3, 5-4

commercial fisheries, 4-59, 4-83, 4-321

construction noise, 3-21, 4-48, 4-73, 4-103, 4-196, 4-197, 4-204, 4-332, 4-334, 4-337, 4-338, 4-341, 5-13, 5-14

cooling water, 2-24, 4-26, 4-60, 4-61, 4-238, 4-272, 4-298, 4-304, 4-305, 5-5, 5-31

critical habitat, 1-7, 1-8, 3-16, 3-24, 4-65, 4-66, 4-69, 4-74, 4-77, 4-78, 4-79, 4-80, 4-81, 4-84, 4-86, 4-308

CWA (Clean Water Act), 1-5, 1-7, 1-21, 1-22, 4-17, 4-22, 4-30, 4-300

CZMA (Coastal Zone Management Act), 1-21, 4-126, 4-127, 5-7

DMPA (Dredged Material Placement Area), 2-16, 2-17, 2-20, 3-23, 3-24, 4-8, 4-18, 4-22, 4-57, 4-76, 4-77, 4-78, 4-99, 4-297, 4-323, 5-16

DOE (U.S. Department of Energy), 1-3, 1-5, 1-9, 1-10, 1-11, 1-22, 3-3, 3-4, 3-6, 3-7, 3-8, 3-9, 3-10, 3-11, 4-206, 4-248, 4-256, 4-285, 5-1

DOE/FE (U.S. Department of Energy, Office of Fossil Resources), 1-9

DOT (U.S. Department of Transportation), 1-5, 1-6, 2-12, 2-19, 2-24, 2-25, 4-110, 4-205, 4-206, 4-

207, 4-208, 4-209, 4-219, 4-220, 4-228, 4-229, 4-230, 4-231, 4-233, 4-240, 4-242, 4-244, 4-247, 4-248, 4-252, 4-253, 4-254, 4-255, 4-258, 4-259, 4-261, 4-277, 5-1, 5-11, 5-22

dredging, 1-12, 2-9, 2-11, 2-16, 2-17, 2-18, 2-20, 3-12, 3-24, 4-3, 4-4, 4-8, 4-14, 4-18, 4-19, 4-21, 4-22, 4-23, 4-29, 4-48, 4-49, 4-56, 4-57, 4-61, 4-62, 4-63, 4-78, 4-86, 4-97, 4-108, 4-135, 4-165, 4-178, 4-179, 4-195, 4-199, 4-204, 4-289, 4-296, 4-297, 4-304, 4-305, 4-309, 4-310, 4-311, 4-312, 4-313, 4-316, 4-320, 4-332, 4-333, 4-336, 4-337, 4-338, 4-339, 4-341, 5-2, 5-3, 5-5, 5-6, 5-12, 5-14, 5-15

earthquake, 1-13, 4-243, 4-244, 4-245, 4-246, 4-276, 5-35

Eastern black rail, 4-66, 4-74, 4-82, 5-6

EFH (Essential Fish Habitat), 1-8, 1-22, 4-54, 4-55, 4-64, 5-6

emergency response, 4-140, 4-141, 4-223, 4-228, 4-229, 4-253, 4-255, 4-259, 4-260, 4-262, 4-268, 4-273, 4-318, 5-22, 5-23, 5-27, 5-28, 5-32

entrainment, 4-23, 4-58, 4-60, 4-304

environmental justice, 4-143, 4-144, 4-147, 4-322, 5-9

EPA (U.S. Environmental Protection Agency), 1-5, 1-7, 1-11, 1-14, 1-21, 2-11, 2-16, 3-19, 3-20, 3-21, 3-22, 4-10, 4-12, 4-22, 4-27, 4-28, 4-30, 4-54, 4-58, 4-59, 4-63, 4-143, 4-144, 4-146, 4-169, 4-170, 4-171, 4-172, 4-175, 4-176, 4-177, 4-179, 4-187, 4-191, 4-192, 4-195, 4-251, 4-252, 4-254, 4-258, 4-259, 4-279, 4-322, 4-325, 4-326, 4-331, 4-332, 5-1, 5-3, 5-14

ERP (Emergency Response Plan), 2-24, 4-218, 4-259, 4-260, 4-262, 4-263, 5-23

Executive Order, 1-5, 1-9, 2-13, 4-44, 4-143, 4-212

FAA (Federal Aviation Administration), 1-5, 1-9, 1-11, 1-22, 4-46, 4-98, 4-99, 4-255, 4-256, 4-257, 4-261, 4-262, 4-278, 5-1, 5-11, 5-22, 5-23

Facility Lighting Plan, 4-44, 4-46, 4-47, 4-48, 4-49, 4-52, 4-63, 5-5, 5-20

flaring, 2-4, 3-22, 4-44, 4-45, 4-47, 4-75, 4-78, 4-79, 4-82, 4-111, 4-113, 4-116, 4-117, 4-118, 4-119, 4-121, 4-122, 4-126, 4-183, 4-185, 4-187, 4-200, 4-201, 4-202, 4-204, 4-303, 4-309, 4-341, 5-5, 5-10

flooding, 2-10, 4-3, 4-4, 4-27, 4-242, 4-300, 4-301, 4-330, 4-331

Freeport LNG, 3-6, 3-7, 3-9

FTA (Free Trade Agreement), 1-9, 1-10, 1-22, 3-3, 3-4, 3-6, 3-7, 3-8, 3-9, 3-10, 3-11, 4-285

fugitive dust, 4-168, 4-178, 4-179, 4-180, 4-181, 4-324, 4-325, 4-326, 5-10

fugitive emissions, 4-168, 4-325

FWS (U.S. Fish and Wildlife Service), 1-5, 1-7, 1-11, 1-21, 2-7, 3-17, 3-19, 4-14, 4-16, 4-17, 4-26, 4-31, 4-33, 4-35, 4-39, 4-40, 4-41, 4-44, 4-45, 4-46, 4-47, 4-49, 4-50, 4-51, 4-52, 4-54, 4-59, 4-63, 4-65, 4-66, 4-67, 4-68, 4-69, 4-70, 4-71, 4-72, 4-73, 4-74, 4-75, 4-76, 4-77, 4-78, 4-80, 4-81, 4-82, 4-83, 4-85, 4-86, 4-87, 4-91, 4-92, 4-95, 4-97, 4-99, 4-101, 4-103, 4-108, 4-115, 4-116, 4-122, 4-127, 4-299, 4-303, 4-306, 4-307, 4-308, 4-309, 4-313, 5-1, 5-4, 5-5, 5-6, 5-8, 5-13, 5-16, 5-20

Galveston Bay LNG, 3-6, 3-10

geologic hazards, 4-3, 4-294

geotechnical, 2-14, 4-2, 4-3, 4-4, 4-240, 4-241, 4-242, 4-245, 4-246

GHG (greenhouse gases), 3-20, 4-168, 4-169, 4-172, 4-173, 4-175, 4-180, 4-181, 4-182, 4-183, 4-185, 4-280, 4-326, 4-330, 4-331, 4-332, 5-14

Golden Pass LNG, 3-7, 4-23

Great Texas Coastal Birding Trail, 4-109, 4-111

green sea turtle, 4-82, 4-85, 5-6

Gulf Coast jaguarondi, 5-6

Gulf of Mexico, 2-19, 2-21, 4-10, 4-11, 4-12, 4-14, 4-24, 4-35, 4-i, 4-41, 4-45, 4-52, 4-53, 4-54, 4-55, 4-56, 4-57, 4-58, 4-65, 4-66, 4-67, 4-68, 4-82, 4-83, 4-84, 4-85, 4-86, 4-89, 4-96, 4-98, 4-99, 4-106, 4-108, 4-118, 4-134, 4-135, 4-157, 4-158, 4-159, 4-168, 4-169, 4-214, 4-244, 4-246, 4-247, 4-251, 4-280, 4-285, 4-304, 4-310, 4-311, 4-312, 4-313, 4-321, 4-331, 5-6

HAPs (hazardous air pollutants), 4-168, 4-173, 4-175, 4-180, 4-182, 4-183, 4-185, 4-186, 4-190, 4-280, 4-324, 4-326, 4-329

hazardous air pollutants, 4-168, 4-190, 4-326

HAZOP (hazard and operability review), 4-226

historic properties, 4-153, 4-160, 4-161, 4-162, 4-166, 4-167, 5-21

hospitals, 4-141, 4-192, 4-215, 4-246

housing, 4-138, 4-139, 4-144, 4-318

hydrostatic testing, 2-8, 2-15, 2-18, 4-18, 4-28, 4-29, 4-58, 4-273, 4-297, 4-304, 5-2, 5-3, 5-5, 5-32

IMO (International Maritime Organization), 2-24, 4-24, 4-59, 4-211

impingement, 4-28, 4-57

Intergovernmental Panel on Climate Change, 4-

331
internal combustion engine, 4-174, 4-175, 4-179, 4-195
invasive species, 1-12, 4-39, 4-59, 4-81
keeled earless lizard, 4-92, 4-95
KOP (key observation point), 4-48, 4-111, 4-113, 4-114, 4-115, 4-116, 4-117, 4-118, 4-119, 4-120, 4-121, 4-122, 4-123, 4-124, 4-125, 4-126, 4-163, 4-164, 4-165, 4-315, 5-7
Laguna Atascosa NWR, 4-33, 4-40, 4-47, 4-48, 4-50, 4-70, 4-71, 4-73, 4-74, 4-78, 4-79, 4-99, 4-101, 4-103, 4-110, 4-122, 4-124, 4-133, 4-134, 4-309, 4-317, 4-321, 4-336, 4-337, 4-341, 5-4, 5-5, 5-14
Laguna Madre, 4-12, 4-14, 4-16, 4-19, 4-47, 4-54, 4-56, 4-69, 4-77, 4-83, 4-101, 4-104, 4-106, 4-107, 4-118, 4-119, 4-122, 4-321
leatherback sea turtle, 4-84, 4-85, 4-86, 5-6
Letter of Recommendation, 1-6, 1-21, 4-209, 4-213, 4-217
LFL (lower flammable limit), 4-270, 5-29, 5-30
LOD (Letter of Determination), 1-6, 4-205, 4-209, 4-243, 4-247, 4-248, 4-277, 5-11
loggerhead sea turtle, 4-66, 4-83, 4-84, 4-86, 5-6
lomas, 1-12, 4-1, 4-4, 4-35, 4-36, 4-37, 4-40, 4-41, 4-47, 4-50, 4-70, 4-71, 4-72, 4-92, 4-94, 4-99, 4-103, 4-110, 4-116, 4-124, 5-4, 5-5
Lomas, 3-14, 4-35, 4-41, 4-309
Long Island, 4-98, 4-110, 4-128, 4-129, 4-136, 4-146, 4-215
LOR (Letter of Recommendation), 1-6, 1-21, 2-8, 4-68, 4-205, 4-209, 4-213, 4-214, 4-217, 4-218, 4-243, 4-247, 4-248, 4-277, 5-11
Lower Rio Grande Valley NWR, 4-49, 4-50, 4-70, 4-97, 4-99, 4-101, 4-103, 4-104, 4-110, 4-114, 4-115, 4-116, 4-117, 4-127, 4-133, 4-136, 4-146, 4-309
Marine Mammal Protection Act (MMPA), 1-22, 4-52, 4-53, 4-65
MBTA (Migratory Bird Treaty Act), 1-7, 1-8, 4-44, 4-46, 5-5
mean sea level, 3-11, 4-19, 4-246
migratory bird, 1-8, 1-12, 4-44, 4-45, 4-46, 4-47, 4-303, 4-304, 4-309, 5-5, 5-20
minority, 4-143, 4-144, 4-147, 4-322, 5-9
mitigation, 1-4, 1-5, 1-13, 2-10, 2-12, 2-24, 3-24, 4-1, 4-3, 4-7, 4-9, 4-11, 4-19, 4-29, 4-33, 4-34, 4-39, 4-46, 4-49, 4-61, 4-92, 4-94, 4-95, 4-99, 4-113, 4-149, 4-152, 4-167, 4-177, 4-178, 4-198, 4-199, 4-206, 4-218, 4-221, 4-222, 4-223, 4-229, 4-231, 4-232, 4-233, 4-236, 4-238, 4-242, 4-250, 4-251, 4-252, 4-254, 4-256, 4-258, 4-261, 4-272, 4-278, 4-299, 4-325, 5-1, 5-2, 5-3, 5-4, 5-8, 5-10, 5-11, 5-13, 5-16, 5-17, 5-18, 5-20, 5-21, 5-31
mixed refrigerant, 2-2, 4-224, 4-229
MOF (material offloading facility), 2-4, 2-13, 2-17, 2-18, 4-108, 4-195
NAAQS (National Ambient Air Quality Standards), 4-169, 4-170, 4-172, 4-176, 4-187, 4-188, 4-189, 4-324, 4-326, 4-327, 4-328, 4-329, 5-10, 5-13
National Marine Fisheries Service, 1-5, 1-8
National Oceanic and Atmospheric Administration, 1-5, 1-8, 4-252
NEPA (National Environmental Policy Act), 1-1, 1-3, 1-5, 1-7, 1-8, 1-9, 1-10, 1-14, 1-15, 1-21, 3-1, 4-143, 4-147, 4-205, 4-234, 4-251, 4-277, 4-279, 5-15
NESHAP (National Emission Standards for Hazardous Air Pollutants), 4-171, 4-175, 4-178
NFPA (National Fire Protection Association), 1-6, 2-12, 2-23, 2-24, 2-25, 2-26, 4-207, 4-208, 4-209, 4-222, 4-225, 4-227, 4-228, 4-230, 4-231, 4-233, 4-234, 4-235, 4-236, 4-237, 4-238, 4-239, 4-240, 4-242, 4-244, 4-245, 4-252, 4-254, 4-266, 4-268, 4-271, 4-272, 4-274, 5-26, 5-28, 5-30, 5-31, 5-33
NGA (Natural Gas Act), 1-1, 1-3, 1-4, 1-9, 1-10, 1-15, 1-21, 1-22, 2-19, 3-3, 3-11, 4-44, 4-206, 4-260, 4-277
NHL (National Historic Landmark), 1-8, 1-12, 3-15, 3-17, 4-104, 4-105, 4-114, 4-115, 4-116, 4-117, 4-154, 4-160, 4-162, 4-163, 4-164, 4-167, 4-192, 4-196, 4-316, 4-317, 4-323, 5-7, 5-9, 5-10, 5-14
NHP, 4-162, 4-164, 4-323, 5-7
no action alternative, 3-1, 5-15
NOAA Fisheries, 1-5, 1-8, 1-11, 1-22, 4-26, 4-52, 4-53, 4-54, 4-55, 4-58, 4-59, 4-62, 4-64, 4-65, 4-66, 4-67, 4-68, 4-82, 4-83, 4-84, 4-85, 4-86, 4-95, 4-122, 4-304, 4-305, 4-310, 4-311, 4-312, 5-6, 5-20
NOI, 1-10, 4-166
noise sensitive area, 3-14, 4-105, 4-192, 4-194, 4-196, 4-200, 5-11, 5-14
non-jurisdictional, 1-4, 1-15, 1-18, 2-1, 2-8, 4-258, 4-281, 4-284, 4-285, 4-290, 4-294, 4-296, 4-299, 4-300, 4-305, 4-306, 4-308, 4-313, 4-314, 4-315, 4-320, 4-321, 4-323, 4-324, 4-326, 4-332

northern aplomado falcon, 4-40, 4-74, 4-75, 4-76, 4-78, 4-81, 4-82, 4-92, 4-308, 4-309, 5-4, 5-6, 5-13

Northside Site, 3-14, 3-15, 3-16

NPDES (National Pollutant Discharge Elimination System), 1-7, 1-21, 2-11, 2-15, 2-18, 4-22, 4-27, 4-63, 4-305, 5-3

NWR (National Wildlife Refuge), 1-12, 1-21, 3-17, 4-40, 4-47, 4-48, 4-49, 4-50, 4-70, 4-74, 4-80, 4-99, 4-101, 4-103, 4-104, 4-115, 4-116, 4-122, 4-133, 4-134, 4-163, 4-188, 4-189, 4-292, 4-302, 4-333

ocelot, 1-12, 2-7, 3-19, 4-40, 4-41, 4-50, 4-51, 4-69, 4-70, 4-71, 4-72, 4-73, 4-74, 4-95, 4-103, 4-306, 4-307, 4-308, 5-4, 5-6, 5-12

OEP (Office of Energy Projects), 1-1, 4-9, 4-44, 4-95, 4-167, 4-198, 4-261, 4-274, 4-275, 4-277, 5-2, 5-5, 5-10, 5-16, 5-17, 5-18, 5-19, 5-20, 5-21, 5-22, 5-33, 5-35

off-site parking, 4-153, 4-154, 5-8, 5-20

operational noise, 3-21, 4-202, 4-204, 4-302, 4-332, 4-339, 5-14

Palmito Ranch Battlefield NHL, 1-8, 4-99, 4-101, 4-104, 4-105, 4-110, 4-114, 4-115, 4-116, 4-127, 4-152, 4-154, 4-160, 4-161, 4-162, 4-163, 4-167, 4-192, 4-196, 4-197, 4-316, 4-317, 4-323, 4-340, 5-7, 5-9, 5-10

Palo Alto Battlefield NHP, 4-127, 4-163, 4-164, 4-167, 4-317, 4-319, 4-323, 5-7, 5-10

parking, 2-13, 4-7, 4-107, 4-109, 4-115, 4-124, 4-153, 4-154, 4-319, 5-8, 5-20

PHMSA (Pipeline and Hazardous Materials Safety Administration), 2-24, 2-25, 4-209, 4-243, 4-252, 4-253, 4-254, 4-255, 4-258

pile driving, 4-48, 4-49, 4-56, 4-61, 4-62, 4-71, 4-78, 4-81, 4-85, 4-86, 4-195, 4-196, 4-197, 4-198, 4-199, 4-204, 4-304, 4-305, 4-310, 4-311, 4-312, 4-333, 4-336, 4-337, 4-338, 4-339, 5-6, 5-10, 5-13, 5-21

piping plover, 1-12, 3-16, 3-24, 4-66, 4-74, 4-76, 4-77, 4-78, 4-79, 4-308, 4-309, 5-6

Port Arthur LNG, 3-6, 3-9

Port Isabel, 1-11, 1-12, 1-14, 3-16, 3-24, 4-19, 4-45, 4-47, 4-77, 4-98, 4-104, 4-106, 4-108, 4-110, 4-120, 4-121, 4-128, 4-129, 4-132, 4-134, 4-135, 4-136, 4-141, 4-146, 4-147, 4-151, 4-154, 4-156, 4-157, 4-168, 4-192, 4-215, 4-217, 4-255, 4-259, 4-289, 4-293, 4-305, 4-322, 4-327, 5-5

Port of Brownsville, 1-15, 2-11, 3-8, 3-14, 3-15, 3-16, 4-16, 4-18, 4-104, 4-106, 4-107, 4-108, 4-109, 4-ii, 4-132, 4-134, 4-135, 4-136, 4-156, 4-157, 4-158, 4-160, 4-194, 4-217, 4-i, 4-282, 4-285, 4-287, 4-288, 4-292, 4-296, 4-297, 4-298, 4-299, 4-303, 4-306, 4-307, 4-308, 4-309, 4-310, 4-311, 4-312, 4-313, 4-314, 4-320, 4-326, 4-327, 5-8, 5-13

pre-filing process, 1-10, 1-11, 3-2, 3-8, 3-10, 4-147, 4-285

PSD (Prevention of Significant Deterioration), 1-22, 3-20, 4-171, 4-172, 4-173, 4-177, 4-185, 4-188, 4-326

public scoping, 1-11, 4-106, 4-147, 4-322

recommendation, 4-46, 4-48, 4-49, 4-73, 4-76, 4-92, 4-93, 4-153, 4-198, 4-218, 4-241, 4-257, 4-262, 4-274, 4-307, 4-310, 4-312, 5-2, 5-5, 5-8, 5-33

recreational fishing, 1-11, 1-12, 4-108, 4-133, 4-157, 4-158, 5-7

red knot, 4-74, 4-77, 4-78, 4-79, 4-308, 4-309, 5-6

red-crowned parrot, 4-74, 4-79, 4-80, 4-308, 5-6

residences, 3-2, 4-99, 4-110, 4-117, 4-127, 4-136, 4-146, 4-192, 4-313, 4-319, 4-332, 4-333, 5-7, 5-8

Rio Grande LNG, 3-6, 3-8, 3-14, 3-15, 4-80, 4-98, 4-136, 4-215, 4-258, 4-259, 4-284, 4-286, 4-287, 4-289, 4-291, 4-294, 4-296, 4-298, 4-299, 4-301, 4-303, 4-304, 4-305, 4-306, 4-307, 4-308, 4-309, 4-310, 4-311, 4-312, 4-313, 4-314, 4-315, 4-316, 4-317, 4-319, 4-320, 4-322, 4-323, 4-324, 4-325, 4-326, 4-327, 4-328, 4-332, 4-333, 4-336, 4-337, 4-338, 4-339, 4-340, 4-341, 5-12, 5-13, 5-14

RRC (Railroad Commission of Texas), 1-22, 2-15, 4-2, 4-22, 4-28, 4-58, 4-127, 5-3

salinity, 4-6, 4-11, 4-17, 4-24, 4-25, 4-30, 4-36, 4-58, 4-90, 4-298, 4-305, 5-3

San Martin Lake, 4-14, 4-16, 4-33, 4-80, 4-101, 4-103, 4-106

schools, 4-110, 4-141, 4-215, 4-246, 4-318, 4-322

Seagrass, 4-i, 4-19, 4-20, 4-54

Secretary, 1-8, 1-9, 1-10, 4-9, 4-44, 4-46, 4-47, 4-59, 4-127, 4-167, 4-198, 4-200, 4-201, 4-261, 4-275, 5-5, 5-7, 5-16, 5-17, 5-18, 5-19, 5-20, 5-21, 5-22, 5-34

Secretary of the Commission, 4-9

Section 106, 1-22, 4-160, 4-162, 4-167, 5-10

SGCN, 4-94, 4-95

SHPO (State Historic Preservation Office), 4-160, 4-161, 4-162, 4-165, 4-166, 4-167, 4-280, 5-9. 5-21

shrimp, 4-55, 4-56, 4-57, 4-60, 4-132, 4-134, 4-135,

4-157, 4-159, 4-321
shrimpers, 4-135, 4-157
SIP (State Implementation Plan), 4-170, 4-176, 4-177
SOC (species of concern), 4-44, 4-45, 4-54, 4-94, 4-95, 4-308, 4-309
South Bay, 1-12, 3-14, 3-16, 4-12, 4-14, 4-16, 4-17, 4-19, 4-27, 4-28, 4-42, 4-50, 4-54, 4-56, 4-95, 4-99, 4-101, 4-104, 4-107, 4-108, 4-110, 4-133, 5-13, 5-15
South Bay Site, 3-14, 3-16
South Padre Island, 3-16, 4-101, 4-103, 4-106, 4-107, 4-108, 4-109, 4-113, 4-118, 4-119, 4-128, 4-133, 4-134, 4-138, 4-215, 4-250, 4-255, 4-259, 4-287, 4-288, 4-289, 4-292, 4-293, 4-300, 4-301, 4-315
South Texas Coastal Corridor, 4-50, 4-70, 4-71, 4-306
Southside Site, 3-14, 3-15, 3-16
SpaceX, 1-9, 1-12, 1-13, 4-i, 4-98, 4-99, 4-100, 4-217, 4-256, 4-257, 4-262, 4-274, 4-278, 4-289, 4-293, 4-299, 4-306, 4-307, 4-308, 4-313, 4-333, 5-7, 5-11, 5-23, 5-32
SPCC (Spill Prevention, Control, and Countermeasures), 2-11, 2-12, 2-13, 2-19, 4-7, 4-9, 4-11, 4-27, 4-28, 4-63, 4-95, 4-295, 4-297, 4-305, 5-1, 5-3, 5-6, 5-20
species of greatest conservation need, 4-94
spill containment, 2-25, 4-11, 4-220, 4-222, 4-228, 4-229, 4-230, 4-235, 4-237, 4-268, 5-28
SSE (safe shutdown earthquake), 4-244, 4-245
STEC (South Texas Electric Cooperative), 1-17, 2-8, 4-142, 4-282, 4-284, 4-294, 4-314, 4-315, 4-291
tax revenue, 4-137, 4-159, 4-318, 4-322, 5-8
TCEQ (Texas Commission on Environmental Quality), 1-22, 4-10, 4-16, 4-17, 4-22, 4-27, 4-28, 4-30, 4-54, 4-169, 4-171, 4-178, 4-183, 4-185, 4-187, 4-188
Texas LNG, 3-6, 3-8, 3-15, 4-98, 4-136, 4-215, 4-259, 4-284, 4-285, 4-286, 4-287, 4-291, 4-294, 4-296, 4-298, 4-299, 4-301, 4-303, 4-304, 4-305, 4-306, 4-307, 4-308, 4-309, 4-310, 4-311, 4-312, 4-313, 4-314, 4-315, 4-316, 4-317, 4-319, 4-320, 4-322, 4-323, 4-324, 4-325, 4-326, 4-327, 4-328, 4-332, 4-333, 4-336, 4-337, 4-338, 4-339, 4-340, 4-341, 5-12, 5-13, 5-14
threatened and endangered species, 1-22, 3-21, 4-40, 4-65, 4-153, 4-306, 5-6
TPWD (Texas Parks and Wildlife Department), 1-11, 1-22, 2-16, 4-14, 4-16, 4-19, 4-26, 4-35, 4-43, 4-50, 4-51, 4-52, 4-54, 4-55, 4-65, 4-80, 4-86, 4-87, 4-89, 4-90, 4-91, 4-92, 4-93, 4-94, 4-97, 4-104, 4-107, 4-108, 4-110, 4-307, 4-308, 5-5
TSS (total suspended solids), 4-18,4-19, 4-21, 4-22, 4-28, 4-58, 5-2
TxDOT (Texas Department of Transportation), 4-72, 4-148, 4-149, 4-153, 4-154, 4-286, 4-287, 4-292
Valley Crossing, 1-15, 4-258, 4-282, 4-285, 4-299, 4-300, 4-306, 4-307, 4-308, 4-309, 4-312, 4-313, 4-314
Valley Crossing Pipeline System, 1-15, 4-282
vibration, 4-91, 4-199, 4-243, 4-333, 5-10
Visual Impact Assessment, 4-111, 4-126, 4-280, 5-7
water quality, 1-7, 1-12, 4-11, 4-14, 4-16, 4-17, 4-18, 4-19, 4-21, 4-22, 4-23, 4-24, 4-25, 4-27, 4-28, 4-30, 4-40, 4-48, 4-49, 4-50, 4-57, 4-63, 4-86, 4-115, 4-280, 4-296, 4-297, 4-298, 4-300, 4-301, 4-304, 4-305, 4-311, 5-2, 5-3, 5-6, 5-12
West Indian manatee, 4-66, 4-68, 4-87, 4-312, 4-313, 5-6
wetlands, 1-4, 1-5, 1-12, 2-11, 3-2, 3-8, 3-16, 3-19, 4-7, 4-30, 4-31, 4-33, 4-34, 4-35, 4-36, 4-40, 4-41, 4-49, 4-52, 4-54, 4-81, 4-89, 4-93, 4-97, 4-110, 4-115, 4-125, 4-127, 4-153, 4-280, 4-298, 4-299, 4-300, 4-309, 4-313, 4-331, 5-1, 5-3, 5-4
whooping crane, 4-80, 5-6
workforce, 1-13, 2-9, 4-141, 4-148, 4-149, 4-257, 4-317, 4-318, 5-8
WSA (Waterway Suitability Assessmen), 1-6, 1-21, 2-8, 4-212, 4-213, 4-214, 4-217, 4-277, 5-11