Potential Impacts of Proposed Liquefied Natural Gas Facilities On Ocelot Recovery In Texas

Defenders of Wildlife is a national, nonprofit membership organization dedicated to the protection of all native wild animals and plants in their natural communities.

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Table of Contents

Executive Summary

Energy companies are planning three large LNG (liquefied natural gas) terminals along the Brownsville Ship Channel (BSC) in south Texas adjacent to Laguna Atascosa National Wildlife Refuge, home to one of the two remaining ocelot populations in the United States. With a total population of 60 or fewer divided into two populations 20 miles apart, ocelots are critically imperiled and federally listed as endangered.

The cumulative impacts of the Texas, Rio Grande and Annova LNG terminals would be a major setback to ocelot recovery, a goal in which the U.S. Fish and Wildlife Service (FWS) and cooperating organizations have invested millions of dollars and decades of work. The final environmental impact statement (FEIS) prepared by the Federal Energy Regulatory Commission (FERC) for the Texas LNG, includes the determination that cumulative impacts on ocelots would be "permanent and significant."

Each of the LNG terminals would occupy more than 600 acres, destroying habitat for ocelots. The terminals would greatly increase human activity in or near ocelot habitat, including lights, noise and vehicle traffic, the leading cause of death for ocelots in the United States. Associated construction, including access roads and multi-mile pipelines to feed natural gas to the terminals, would cause additional disruption and habitat loss.

In addition to these immediate effects on ocelots and their habitat, the location of the terminals on the BSC would block or at least severely restrict the ability of ocelots to disperse north and south. This would make it difficult or impossible to meet one of the most important criteria for recovery laid out in FWS's recovery plan for the ocelot: connection and natural genetic exchange between U.S. ocelots and the larger ocelot population in Tamaulipas, Mexico. According to the FEIS for the Texas LNG, "the current remaining habitat corridor in the region to connect U.S. and Mexico populations of these federally listed species is adjacent to and within the proposed Rio Grande LNG and Texas LNG project sites north of the Brownsville Ship Channel and within and adjacent to the proposed Annova LNG Project site south of the Brownsville Ship Channel."

The magnitude of the harm done by cutting the only remaining possible international connection is underscored by what the recovery plan specifies as a remedy if the U.S.-Mexico connection is cut. In that event, an additional U.S. population of 75 ocelots would need to be established, requiring the creation or preservation of more than an additional 100,000 acres.

Current commitments to mitigation by the companies developing the projects are inadequate to offset harm to ocelots, and there is no indication in the draft environmental

Radio-collared ocelot captured by a motion-activated camera at Laguna Atascosa National Wildlife Refuge.

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impact statement (DEIS) for the Rio Grande project and the FEISs for the Annova and Texas projects of plans to mitigate the loss of north-south connectivity. Neither Rio Grande nor Texas LNG currently propose any off-site mitigation specific for ocelots. Both FEISs and the Rio Grande DEIS "recommend" that no construction begin until Section 7 Endangered Species Act (ESA) consultation with FWS and the National Marine Fisheries Service is finalized, but there is no guarantee that meaningful mitigation will result.

Of the three companies, Annova LNG comes closest to providing acceptable mitigation with conceptual plans for several off-site mitigation measures, but in total these measures seem unlikely to offset harm to ocelot recovery caused by cutting connectivity between habitat north and south of the BSC. For example, Annova LNG proposes to shift its terminal slightly to the east to leave a protected corridor for ocelots along the west side. However, given that felids avoid traffic, noise, lights and other human activity, ocelots are not likely to use this relatively narrow corridor. Moreover, the company plans to create a conservation easement on this corridor only for the life of the project, which would not ensure its long-term availability to ocelots.

The collective failure of the companies to provide mitigation commensurate with the harm to ocelot conservation would shift the burden of creating the additional population of 75 ocelots specified in the recovery plan to the U.S. government and partners, with a possible price tag of over a billion dollars.

Given the magnitude of needed mitigation, the best solution would be to shift the LNG plants to sites where they would not jeopardize ocelot survival. FERC should require that LNG production facilities, including pretreatment and/or liquefaction, be located away from the water and the product piped to the terminals, thereby decreasing the amount of land occupied along the channel. Such a split between production and distribution facilities has precedent in terminals constructed in Freeport, Texas and Cove Point, Md.

In light of the possibility of decreasing the terminal footprints by locating LNG production off-site, FERC must evaluate alternative sites for the terminals that would do less harm to endangered species and wetlands, including sites that have already been judged too small based on plans to co-locate production and distribution facilities.

In summary, the proposed LNG facilities will have such a disastrous effect on ocelot recovery in the United States that FERC cannot issue permits to build the facilities without jeopardizing the continued existence of the species and should deny the applications to build the terminals along the BSC. Even substantial mitigation may not be sufficient to avoid further threatening the species—especially where FWS has not analyzed the issue in detail in a biological opinion. Accordingly, further analysis is necessary to determine whether construction of these LNG terminals could be authorized without violating the ESA.

Introduction

Applications are pending for three extensive liquefied natural gas (LNG) terminals to bring inland natural gas to the port of Brownsville on the Gulf Coast of southern Texas. Each terminal would cover more than 600 acres that include habitat for ocelots, a federally listed endangered species, and collectively could cut connectivity between ocelot habitat north and south of the Brownsville Ship Channel (BSC), precluding the possibility of eventually reconnecting U.S. and Mexican ocelots. Defenders of Wildlife initiated this report to evaluate these and other impacts of the proposed LNG facilities on ocelots.

The report begins with a brief review of the conservation status and ecology of the ocelot in the United States and northern Mexico. It outlines the development associated with the Rio Grande, Annova and Texas LNG facilities and the pipelines that will supply gas to them, the ecological effects of such development, and mitigation measures either taken or proposed. The report concludes with an evaluation of the impacts of these LNG projects on ocelots, making a science-based case for our recommendation that they not be allowed to proceed. It also addresses the worst-case scenario of one or more of the projects proceeding at the proposed sites by offering mitigation recommendations. While the recommendations could reduce the projects' impacts on the ocelot, FERC and FWS must fully analyze whether additional mitigation is necessary to avoid reducing the ocelot's likelihood of survival and recovery in the wild.

Ocelot Conservation Status and Ecology

The ocelot (*Leopardus pardalis)* was listed as endangered in 1972 under the Endangered Species Conservation Act of 1969 (U.S. Fish and Wildlife Service [FWS] 1972). The first recovery plan for the species was completed in 1990 (FWS 1990) and revised in 2016 (FWS 2016a). The ocelot is considered endangered in Mexico by the Secretariat of the Environment and Natural Resources (Secretaria de Medio Ambiente y Recursos Naturales [SEMARNAT]) (SEMARNAT 2010).

Texas protects the ocelot under state law as a state endangered species (Texas Parks and Wildlife Department [TPWD] 2014), and both Texas and Arizona list the cat as a Species of Greatest Conservation Need (TPWD 2018a, Arizona Game and Fish Department 2012).

Although an occasional ocelot is documented in Arizona, the only known U.S. breeding populations are in south Texas near the border with Mexico. As of August 2015, there were 53 known Texas ocelots in two separate populations on remnant habitat (FWS 2016a, ix), separated from each other by 20 miles. One population is primarily within Laguna Atascosa National Wildlife Refuge in Cameron County (FWS 2016a, 8; Tewes and Hughes 2001, 559). The other occurs primarily on private ranches, such as the Yturria Ranch, in Willacy and Kenedy counties. A much larger population of ocelots occurs some 125 miles south of the Texas-Mexico border near Sierra de Tamaulipas, a mountain range in the Mexican state of Tamaulipas (FWS 2016a, 8). This population is thought to be currently isolated from ocelots in Texas, although wildlife agencies and conservationists hope the two may someday be reconnected.

Although the two Texas populations are separated by 20 miles, natural dispersal between the populations is possible, as evidenced by a male ocelot that traveled back and forth during the period of 1995 to 2009 between the Yturria Ranch in Willacy County and the Arroyo Colorado Unit of the Las Palomas Wildlife Management Area in Cameron County, five miles from the Laguna Atascosa refuge (FWS 2016a, 17). Ocelots have also been observed traveling between the Laguna Atascosa refuge and the Arroyo Colorado Unit (FWS 2016a, 17). This suggests the theoretical possibility of genetic exchange between the Laguna Atascosa refuge population and the ranches in Kenedy and Willacy counties via the

Arroyo Colorado Unit, although the FWS recovery plan cites evidence suggesting a lack of gene flow (FWS 2016a, 17; Janečka et al. 2011).

In Texas, ocelots predominantly occur in dense thornscrub, a mix of dryland thorny trees and shrubs (FWS 2016a). (See photos below.) One study found ocelots to be most common in woodlands with closed tree canopies, high tree canopies and dense vegetation that blocked vision near the ground, preferentially in areas with more than 75 percent canopy cover (Horne et al., 119-122). Other vegetation types may help support ocelots. Rodents from grasslands adjacent to thick cover are an important part of the ocelot diet (Booth-Binczik et al. 2013, 408) and, therefore, grasslands near thornscrub may also be considered ocelot habitat. Moreover, females have been found to den in grass areas interspersed through shrub cover (Laack et al. 2005, 509), and Simpson (2010, 25) concluded that such grassy areas could benefit reproduction.

Grassland between two areas of thornscrub on the Annova site.

Typical thornscrub on the Annova site, photographed at ocelot-eye level. Ocelots can easily move through this dense habitat.

The quality of habitat, as measured by such requirements as food availability, cover and denning sites, determines how big a territory an ocelot needs to survive. Radiotracking studies indicate that typical home ranges for males vary from 2.4 to 7.2 square miles and for females from 1.1 to 6.7 square miles (Jackson 2005, Laack 1991, Navarro-Lopez 1985, Paviolo et al. 2015, Tewes 1986). If the terminals physically occupy ocelot habitat—or through noise, lights or other human activity cause ocelots to abandon habitat—the population could decrease.

How far ocelots disperse from their home sites affects the degree to which corridors can connect nonadjacent populations. Male ocelots typically disperse farther than females—when males leave their birth sites to look for permanent territories they typically travel six to 10 miles. The longest recorded movement, as of 2007, was 31 miles by a male in Tamaulipas, Mexico, 155 miles south of Texas (Booth-Binczik 2007, 111).

Ocelots dispersing in Texas may use narrow corridors approximately 16 to 330 feet wide to travel between thornscrub strongholds (Laack 1991). The corridors may be overgrown banks of irrigation canals, fence lines, brushy road margins and pastures (Tewes et al. 1995). One study observed approximately 50 percent of known Cameron County ocelots using corridors such as drainage ditches and the edges of oxbow lakes (Nordlof 2015, v, ix). Although some of the lands used as corridors may be poor ocelot habit (Nordlof 2015, 20), dispersing individuals can use them temporarily until they reach more suitable permanent habitat.

FWS and the Federal Energy Regulatory Commission (FERC) agree that the BSC (see photo on next page and Appendix A, Map 5) is not itself an impassable barrier for ocelots, as evidenced by the presence of an ocelot that was radio-tracked on both sides of the channel in 1998 (Blanton & Associates 2016, 34; FWS 2015, 2). The Texas LNG Final Environmental Impact Statement (FEIS) states that "…relatively small barriers such as the Brownsville Ship Channel… do not create a significant impediment to individual movements (FERC 2018c, 4-316). The FWS ocelot recovery plan notes that "…young cats are capable of swimming the Rio Grande or the Brownsville Ship Channel in search of a home range and breeding partners…" (FWS 2016a, 193).

Habitat loss is the primary reason ocelots have largely

Brownsville Ship Channel looking north from the Annova LNG site to the Rio Grande LNG site across the channel.

disappeared from the U.S.-Mexico borderlands. Rapid population growth in Texas—the state with the second largest population—has created economic motivation for dividing large ranches, which may include good wildlife habitat, into smaller parcels for housing and related infrastructure development (Kjelland et al. 2007, 232). Between 1997 and 2012, Texas lost 1.1 million acres of private forests, farmland and ranches (Wythe 2014), types of land that provide ocelot habitat in Willacy and Kenedy counties.

As a result of agricultural and urban development over the past century, an estimated 95 percent of brushland in the Lower Rio Grande Valley—key habitat for ocelot survival—had been lost by 1988, as well as a large percentage in northern Mexico (Jahrsdoerfer and Leslie 1988, 17). A more recent study showed loss of 91 percent of native woodland in Cameron County, location of Laguna Atascosa National Wildlife Refuge, between the 1930s and 1983 (Tremblay et al. 2005). Map 1 (Appendix A) shows the amount of remaining natural land cover in the Lower Rio Grande Valley.

As detailed below, other factors that depress ocelot populations in the borderlands include roadways and other human activity, likely including night lighting and noise pollution.

Ocelot Recovery Plan

The goal of the FWS's 2016 recovery plan for the ocelot is to "restore and protect the ocelot and its habitat so that its long-term survival is secured, and it can be removed (i.e., delisted) from the list of threatened and endangered species" (FWS 2016a, 55). FWS criteria for delisting include increasing the Texas population from 50 to at least 200 individuals (FWS 2016a, 49), which would only be possible if more territory were made available. Not only must further loss of habitat be halted, but additional thornscrub would have to be restored, a slow, costly and technically challenging undertaking (Vela 2015, 2). Regeneration of thornscrub to a mature state that provides quality ocelot habitat requires decades (Haines, Tewes, Laack, Grant and Young 2005, 516).

Because Texas ocelots have been reduced to two small populations with high mortality, notably from road kill (FWS 2016a, 49), and a low reproductive rate of approximately 1.2 kittens per litter (Laack et al. 2005, 505), the two small populations remaining could easily disappear. Indeed, Haines et al. (2006, 433) modeled that there is a 33-percent chance ocelots in Texas will become extinct within 50 years if existing conditions do not improve, with a 96-percent chance of extinction in 100 years. Extinction could happen more rapidly if there is further loss of habitat, such as that proposed in the development of the LNG terminals. According to the FWS recovery plan, the most immediate concerns for ocelots in Texas are habitat loss (which contributes to the high mortality from road kill) and loss of connectivity with ocelots in Tamaulipas, Mexico (FWS 2016a, 50). This is echoed by Haines et al. (2006, 433) whose modeling indicates the most effective recovery strategies are to reduce road mortality, increase connectivity between habitat patches and protect and restore habitat.

The recovery plan's criteria for removing (delisting) the ocelot from the endangered species list include but are not limited to the following, quoted from the recovery plan (FWS 2016a, 55):

> ***Delisting Criterion 2.*** The TTMU [Texas-Tamaulipas Management Unit] metapopulation is estimated through reliable scientific monitoring to be at least 200 ocelots in Texas and at least 1,000 ocelots in Tamaulipas for at least 10 years. The 200 ocelots in Texas should be distributed as either:
>
> (a) a single metapopulation of at least 150 ocelots with interchange between it and ocelots in Tamaulipas that is sufficient to maintain genetic variability; or
>
> (b) two populations of at least 75 ocelots each, with interchange between the two populations, and between the two populations in Texas and ocelots in Tamaulipas sufficient to maintain genetic variability.
>
> In addition to either Delisting Criterion 2(a) or 2(b), an additional 50 ocelots must be present in Texas, either as additional members of the existing population(s), or as less geographically stable individuals in search of mates and/or new home ranges. Interchange among populations must occur through natural dispersal rather than by translocating ocelots between populations; or
>
> (c) if natural interchange between Texas and Tamaulipas is not occurring, cross-border interchange may be facilitated by moving ocelots to simulate natural dispersal and recruitment, but an additional population of at least 75 ocelots must be established within

> currently unoccupied historical range in Texas to compliment the two populations of 75 ocelots each. The third population of 75 ocelots should be established in a location that would expand the geographical range of the species in Texas to provide sufficient assurance against loss of the entire Texas population from catastrophic weather events or infectious disease.

The plan also presents *downlisting* criteria that must be met to move the ocelot from endangered to threatened status. Although downlisting criteria are less stringent than the delisting criteria, they still require a high degree of recovery that would be hindered by the LNG projects. For example, Downlisting Criterion 2 requires "The metapopulation of the Texas-Tamaulipas Management Unit (TTMU) is estimated through reliable scientific monitoring to be at least 200 ocelots in Texas and 1,000 ocelots in Tamaulipas for at least five years" (FWS 2016a, 55).

The above criteria give top priority to protecting and restoring viable populations in Texas and Tamaulipas that are connected by natural dispersal, as compared to translocation (capturing and moving ocelots). The development of the LNG terminals in their planned locations would likely make this connection impossible.

In the eventuality that the LNG terminals and/or other factors prevent habitat connectivity between Tamaulipas and Texas, the recovery plan envisions that translocations might be necessary to facilitate genetic exchange. In this case, as stated above, delisting would require an additional population of at least 75 ocelots. This safety buffer would be required by the plan because translocation has risks that include mortality from capture and from disruption to local populations caused by removing or introducing individuals (FWS 2016a, 56).

Recovery Steps at Risk

Since 1979 FWS has purchased more than 100 small tracts of land along a 275-mile stretch of the Rio Grande River with the ambitious goal of protecting a wildlife corridor along the river from the Laguna Atascosa refuge ocelot population inland to Santa Ana National Wildlife Refuge—where a female ocelot was observed with kittens in 1992 (FWS 2016a, 9)—and beyond to Falcon Reservoir (FWS 1998, 10). Unfortunately, FWS has not been able to complete this chain of refuge units. Most of the small tracts are isolated and many are compromised by segments of border wall.

Fortunately, a larger amount of habitat—enough for 20 breeding ocelots (Haines, Tewes, Laack, Grant and Young 2005, 515)—exists as Laguna Atascosa and Lower Rio Grande national wildlife refuge units in Cameron County near the coast (Appendix A, Map 3). Some of these units are separated from each other by intervening private land, and, because the available habitat cannot support enough ocelots to ensure long-term survival of this population, (FWS 2016a, 156), FWS and its partners are focused on enlarging and linking these units to increase carrying capacity through purchase or easements.

In 2010, FWS developed a Comprehensive Conservation Plan for the Laguna Atascosa refuge, which prioritized five major wildlife corridors for protection and recommended acquiring 109,000 acres of land for corridors (FWS 2010, H-6). One of the five corridors, the "Ranchland Corridor," for example, would connect the Laguna Atascosa refuge with ocelot habitat on private lands to the north and with Lower Rio Grande Valley National Wildlife Refuge tracts to the south. Map 2 (Appendix A) shows some of the areas that could connect existing FWS units.

As specified in the recovery plan's Delisting Criterion 2 and Downlisting Criterion 2 (FWS 2016a, 55), this ambitious vision would also link the Texas ocelots with the larger population in the Laguna Madre y Delta del Río Bravo Biosphere Reserve in Tamaulipas, Mexico (FWS 2010, 2-10), which encompasses 1.3 million acres managed by Mexico's National Commission of Protected Areas (TCEQ 2014, 1).

Because FWS does not have the resources to acquire all the habitat ocelots need, other organizations are stepping up. The Nature Conservancy (TNC) has acquired thousands of acres to help protect ocelot habitat and create habitat linkages (FWS 2016a, 46). TNC, The Conservation Fund and other organizations are also helping private landowners with ocelot habitat to set up conservation easements—agreements to protect land from development in perpetuity in exchange for federal tax benefits.

A citizen-led initiative, the Bahia Grande Coastal Corridor Project (BGCCP), is helping acquire 6,000 acres of habitat using RESTORE Act funds with the ultimate goal of connecting the southern Texas refuges (Laguna Atascosa and Lower Rio Grande Valley) and Boca Chica State Park to the Laguna Madre in Tamaulipas (TCEQ 2014, 1).

Through these efforts, FWS and other participating organizations are racing to protect habitat before it is developed. The area is experiencing rapid population growth and development of potential ocelot habitat. The population of Cameron County, where the Laguna Atascosa refuge is located, for example, increased 79 percent between 1990 and 2017 (TDS 2011).

Windfarms are spreading through the Rio Grande Valley and a private rocket-launching facility, SpaceX, is being constructed near refuge land. If built, the LNG terminals

could permanently block the connection between the Laguna Atascosa ocelot population and the Mexican Laguna Madre population (FWS 2015, 2). As shown in Map 3 (Appendix A), the LNG terminal sites are in important ocelot habitat mapped by scientists during a three-day workshop organized by Defenders of Wildlife and partners (Grigione et al. 2009). Then there is the threat of the border wall—the Trump administration has plans to put "levee walls" as high as 30 feet along at least an additional 65 miles in the Lower Rio Grande Valley (GAO 2018, 30), making it impossible for ocelots and other wildlife to cross the border.

Designating critical habitat for the ocelot could help prevent habitat loss, but FWS has yet to do so (FWS 2016a, 204). Critical habitat designation does not absolutely protect habitat, but it does require consultation with FWS to determine whether any development that is done, funded or permitted by a federal agency adversely affects critical habitat. If FWS judges that the project would adversely affect critical habitat, the project typically must be modified to minimize harm (FWS 2017).

Ecological Effects of Proposed LNG Facilities

Three companies—Rio Grande, Texas and Annova—propose to build LNG terminals (production and distribution facilities for liquefied natural gas) along the north and south banks of the Brownsville Shipping Channel (BSC), approximately seven miles northeast of Brownsville. The Rio Grande site and the Texas LNG site are adjacent to each other on the north bank of the BSC, while the Annova site is on the south bank, immediately opposite the Rio Grande site (see Appendix A, Map 5, photo page 6). Appendix B summarizes the characteristics of each of the three projects.

To produce the LNG, each production facility must be fed unliquefied gas by pipelines yet to be constructed. The Rio Grande project would be supplied by the Rio Bravo pipeline (FERC 2018b, ES-1), the Texas LNG terminal by a 10.2-mile lateral connection off the Valley Crossing pipeline (FERC 2018c, 4-282), and Annova by an undetermined source (FERC 2018a, ES-1).

Each of the sites would feature many structures including multiple LNG "trains" (giant refrigeration units for liquefying natural gas), LNG storage tanks, and facilities for loading LNG into ships or trucks. Associated infrastructure would include administration and other buildings, roads, lights, water pipes and systems for flaring waste gases. Human activity that could affect ocelots includes arrival of trucks and ships to pick up LNG, use of heavy equipment during construction, and presence of workers—Annova predicts 700 workers will be on its site for a four-year construction period, and 165 workers after construction is completed (Annova 2018a , 4-129).

The ecological effects of the construction and operation of the LNG terminals, discussed in detail below, would make FWS's ocelot recovery plan criteria difficult to achieve in at least three ways: 1) by foreclosing future connection between the Texas and Mexican ocelots; 2) by cutting or hindering connection between potential U.S. ocelot habitat north and south of the Brownsville Ship Channel; and 3) by reducing habitat available to ocelots by either replacing it with terminal facilities or causing ocelots to avoid habitat because of human activity.

Destruction of Habitat

Not counting land needed for the pipelines, the three LNG terminals would collectively convert 2,340 acres to industrial complexes (Appendix B). This land is a mosaic of habitat types that include Gulf Coast salty prairie, South Texas salty thorn scrub, South Texas loma grassland, South Texas loma evergreen shrubland and various types of wetlands. Thorn scrub is primary ocelot habitat, while salty prairie is habitat for the endangered Aplomado falcon, a bird of prey already at risk from encroaching wind farms and other development (Graham 2011, 919; FWS 2016b, Reyes 2018).

The Rio Grande LNG draft environmental impact statement (DEIS) and Texas LNG final environmental impact

Typical loma (clay hill) covered with thornscrub on Annova site.

statement (FEIS) describe the projects' respective sites as suitable ocelot habitat (FERC 2018b, ES-8; FERC 2018c, 4-315). The Rio Grande DEIS states that 189 acres of "upland shrub habitat" would be permanently lost, including a 64-acre loma (a low, broad-topped clay hill), an important habitat type for ocelot (FERC 2018b, 4-150). The DEIS states that "loss of these habitats would result in a potential decrease in foraging habitat for cats within the Laguna Atascosa NWR" (FERC 2018b, 4-150). As a result, the DEIS concludes that because habitat loss "has the potential to result in significant impacts on ocelots and ocelot recovery, we find that the proposed Project *is likely to adversely affect* the ocelot" (FERC 2108b, 4-152) [emphasis in original].

According to the Annova FEIS, the proposed site includes a loma previously leased and protected by FWS as part of the Loma Ecological Reserve before it was leased to Annova LNG by the Brownsville Navigation District (BND) in 2013 (FWS 2015; FERC 2018a, 4-49; Herweck 2017). The essential role of this site is stated in a 2015 letter from FWS to Annova LNG:

> "…because of importance to movement of the cats to and from Mexico preserving the genetic viability of the species in Texas, 575 acres of the project site, the Loma del Potrero Cercado and Loma del Divisadero were leased for 40 years by Brownsville Navigation District (BND) to the Service for conservation. BND recently withdrew the lease agreement with the Service and let the area for this proposed LNG project (FWS 2015)."

The habitat on the LNG sites has added value because it is close or adjacent to other, larger blocks of protected habitat nearby. For example, the Annova site is adjacent to the remainder of the Loma Ecological Preserve (LEP), a unit of Lower Rio Grande Valley National Wildlife Refuge. All three LNG sites are in the path of the corridor for ocelot conservation that FWS has been trying to complete for many years (Blihovde 2018).

Breaking Habitat Connectivity

According to FERC's Texas LNG FEIS, "the current remaining habitat corridor in the region to connect U.S. and Mexico populations of these federally listed species is adjacent to and within the proposed Rio Grande LNG and Texas LNG Project sites north of the Brownsville Ship Channel and within and adjacent to the proposed Annova LNG Project site south of the Brownsville Ship Channel" (FERC 2018c, 4-316). The then acting field supervisor of the FWS Texas Coastal Ecological Services Field Office wrote in a 2015 letter to Annova LNG, "If the Annova site is developed as proposed, we believe the remaining coastal ocelot corridor to the Rio Grande River and Mexico will be severed" (FWS 2015).

Because the LNG terminals will block connectivity between ocelot habitat north and south of the BSC, these terminals are more harmful to ocelots than similar projects would be in more benign locations. The terminals would make impossible one of the ocelot recovery plan's main goals—connecting the Willacy and Kenedy counties ranchland to the Laguna Atascosa and Lower Rio Grande refuges and those refuges to the Laguna Madre reserve in Mexico (FWS 2015; 2016a, 37). Specifically, they would prevent ocelots from moving between the Laguna Atascosa refuge and other reserves south of the BSC, like the LEP.

The loss of connectivity is demonstrated in Maps 4 and 5 (Appendix A), which show that the only significant remaining areas of natural habitat where ocelots can reach the BSC are on the LNG sites, particularly the Annova and Rio Grande sites. Other access to the channel is largely blocked by either development or waste spoils deposited after dredging the channel.

Maps 4 and 5 also show the existing 1,000-foot-wide Redhead Ridge wildlife corridor, an easement leased by FWS until 2023 (Blanton & Associates 2017a, 20) that runs north-south on the north bank of the BSC near the west edge of the Rio Grande LNG site. This easement would be compromised by Texas LNG's plans to traverse it with a gas pipeline and water and electric lines.

Discussions between Annova LNG and FWS have raised the possibility that the Annova site could be moved toward the east, using some land now in the LEP and leaving a strip of habitat along the west side of the Annova development approximately 700 to 1,800 feet wide to function as a corridor for ocelots to access the ship channel (Annova 2018a, 4-50). (See Appendix A, Map 5.) For reasons detailed in the section on mitigation (page 13), it is unlikely that this corridor will maintain sufficient connectivity.

Traffic, Lights, Noise and Other Human Activity

All three projects will require lighting, generate noise, increase traffic and necessitate the presence of people. Many studies have shown that a wide variety of animals interpret moving vehicles, noise and other aspects of human activity as threatening and respond with increased vigilance or flight, which can interfere with foraging, mating and other essential activities (Frid and Dill 2001).

Accordingly, ocelots may change their behavior to avoid the presence of people. For example, one study found that ocelots changed their activity patterns to be more nocturnal in areas with high human activity (Lima Massara et al. 2018). Another found that a female moved a den site 3,248 feet in

response to brush clearing 131 feet away from her original den (Laack et al. 2005, 510). Studies of other felids have shown similar avoidance of humans. For example, Florida panthers increase their use of forested wetlands during hunting season because these areas have less off-road vehicle traffic (McCarthy and Fletcher 2015, 142).

All the LNG sites are adjacent or within a few hundred feet of the Laguna Atascosa or Lower Rio Grande refuges (Appendix A, Map 5), subjecting the refuges' ocelots to noise, lights, road traffic and other human activity. The Texas LNG FEIS states, "Due to the past, present, and proposed future development throughout the geographic scope for assessing cumulative impacts on ocelots and jaguarundis, as well as the associated increases in road traffic, light, and noise, we have determined that cumulative impacts on ocelots and jaguarundis would be permanent and significant" (FERC 2018c,4-317).

The FEIS for the Texas LNG project also states that construction and other activity associated with the LNG terminals will displace any wildlife present, presumably including ocelots not only on but near enough to the site to be affected by noise, lights and other activity—the Laguna Atascosa refuge is only 200 feet away (FERC 2018c, 5-372).

Indirect effects of such displacement would likely include increased mortality. Studies have shown that transient ocelots may have mortality rates as much as 30 percent higher than resident ocelots due to high possibilities of being shot, hit by a vehicle or killed by other animals, including resident ocelots defending their territories (Haines, Tewes and Lack 2005, 258). The FEIS minimizes such effects on wildlife, saying, "During construction and operation, increases in lighting and noise would likely deter wildlife from the area; however, there is abundant available habitat in the surrounding areas" (FERC 2018c, ES-5). But this conclusion is questionable given that the ocelot and other affected threatened and endangered species are in trouble precisely because there is too little suitable habitat and because displaced ocelots are more likely to be killed.

Road traffic

Traffic and its associated noise are likely to displace ocelots away from roads and vehicle yards. For example, a study of ocelots at the Laguna Atascosa refuge found that they were more likely to use habitat farther away from Farm-to-Market Road 106 (Nordloff 2015, iv). Nonetheless, ocelots when present may try to cross roads where they are at risk of being hit by vehicles.

Collisions with vehicles are the most common known cause of ocelot mortality in south Texas (Haines, Tewes and Lack 2005, 259), with seven killed—roughly 10 percent of the total U.S. population—in one year between June 2, 2015 and April 22, 2016 (Miller 2016). Lighting close to roads may make ocelots more susceptible to collisions with cars by suppressing night vision and blinding them as they approach traffic (Beier 2017, 32-33). Roads can also decrease the probability of successful dispersal between patches of suitable habitat and cause ocelots to avoid otherwise suitable habitats (Haines, Tewes, Laack, Grant and Young 2005, 513).

The terminals would greatly increase road traffic during construction and subsequent operation. The Texas LNG FEIS notes that "these projects along with several of the transportation projects could result in increased road traffic and/or additional roads for transiting ocelots and jaguarundis to cross, thus increasing the potential for vehicle strikes" (FERC 2018c, 5-372). Construction for the Rio Grande LNG would require 4,600 round trips per day by commuting workers on SH 48 (adjacent to the Laguna Atascosa refuge), plus an additional 150 truck trips per day for material delivery (FERC 2018b, 4-219). Post construction, the Rio Grande project would require 300 round trips per day for workers, plus approximately 60 roundtrips per day by trucks loading LNG for delivery to refueling stations in south Texas. Such large-scale trucking and commuting will require a host of support businesses such as fuel stations, truck stops, motels and restaurants.

Light

Studies have shown that many animals avoid lit areas and that artificial lighting can cause changes in physiology and behavior (Beier 2006, 20). Physiological changes include

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This dusk photo shows the brightness of a gas flare at an LNG site in Norway, with a crescent moon just above the rise of land to the right for comparison.

disruption of the circannual biological clock that regulates annual changes in body weight and reproduction cycle and suppression of melatonin production, which protects against certain cancers in rodents and humans (Beier 2006, 27-28, 109; Hunter and Figueiro 2017).

Grigione and Mrykalo (2004, 75) reviewed available scientific studies on mammals and concluded that both ocelots and their prey would alter their activity patterns, likely avoiding artificial light by shifting into denser vegetation that acts as a visual shield. In turn, this shift could affect availability of rodent prey, a large proportion of which ocelots hunt in grasslands adjacent to thornscrub on the Laguna Atascosa refuge (Booth-Binczik et al. 2013, 408).

Additional insight can be gained by looking at other cat species. Dispersing young cougars, for example, avoid lighted areas, sticking to heavy cover and avoiding open spaces (Beier 1995). Beier (1995, 234) observed that one of his subjects consistently moved away from lighted horizons and toward the darkest horizons.

Despite down-shielding some lights, the terminals would emit a general glow. Annova provided FERC with simulated photos that demonstrated significant glow on the horizon from its terminal at a distance of 6.7 miles (Annova 2018c). Three terminals in close proximity would have an additive effect.

Noise

The disturbing effects of human-caused noise on a wide variety of species are well documented (Shannon et al. 2016). Observed effects include disturbance of reproductive behavior and predator-prey interactions. The sound of human activity does not have to be particularly loud to affect felid behavior. For example, a study of cougars found that they spent only half as much time feeding on their kills when exposed to recordings of a person speaking at what the researchers considered a "natural volume of human conversation" (Smith et al. 2017).

The Texas LNG FEIS analyzed cumulative noise from all three LNG terminals and concluded that noise levels would reach 65 decibels near the terminals, and 60 to 65 decibels within the ocelot "corridor" that Annova LNG proposes to leave as mitigation along the west side of its facility (FERC 2018c, 4-355). Sixty decibels is considered the level of "normal conversation" (NIOSH, 2019) and 65 is nearly double that (1.8 times louder). The FEIS concludes, "due to the proximity of the Annova LNG and Rio Grande LNG Projects to the wildlife corridors, facility-generated noise during construction and operation would still be audible to ocelots and jaguarundis utilizing the wildlife corridor" (FERC 2018c4-316).

The FEIS for the Texas LNG and the DEIS for the Rio Grande LNG adopt the FERC and EPA noise standard of 55 dBA (absolute decibels adjusted for human perception) maximum for nearby human communities, termed Noise Sensitive Areas (NSA). The Texas FEIS predicts operational noise levels for three NSAs that are more than 1.5 miles from the project and concludes that sound levels at each due to the noise contribution by Texas LNG would be less than the 55 dBA maximum (FERC 2018c, 4-350). This standard should also apply to areas near the terminal where ocelots and other species could experience operational noise levels of 65 dBA, triple the loudness of the 55-dBA standard. Noise levels would be significantly higher during construction because of pile-driving and earthmoving. For example, the Texas LNG FEIS states that "pile driving would be clearly audible at nearby residences [i.e. approximately 1.6 miles away] when ambient sound levels are low" (FERC 2018c, ES-11).

Pipelines and Other Delivery Infrastructure

Depending on location, pipelines, water delivery and electrical transmission systems could interfere with ocelot movement and habitat occupancy.

The three pipelines would destroy habitat during construction. For example, the FEIS for the Texas LNG site predicts that construction of a 10.2-mile pipeline to connect to the existing Valley Crossing pipeline would require a 100-foot-wide right of way, affecting an estimated 108 acres outside the Texas LNG site (FERC 2018c, 1-17). The DEIS for the Rio Grande project estimates that construction for its 136-mile-long Rio Bravo Pipeline would clear a 75-foot-wide corridor

through ocelot potential habitat, in total disturbing 542 acres of "shrub/forest" habitat (FERC 2018b, 4-149).

Construction of the Rio Bravo Pipeline will require compression stations, staging areas, multiple pipe yards, new access roads and a minimum of 1,356 truck roundtrips per day during the four-year construction period (FERC 2018b, 4-220).

Where the Rio Bravo Pipeline would traverse ocelot habitat, a gas spill could cause fire that harms ocelots and their habitat. Explosions and fires caused by gas distribution systems are not uncommon—1,259 incidents classified as serious caused 306 human fatalities in the United States between 1998 and 2017 (PHMSA 2018). Although the probability of such spills affecting ocelots is difficult to predict, emergency evacuation guidelines for people give an indication of the possible severity should an event occur. In the case of a serious spill from large pipelines like the two 42-inch ones planned for the Rio Bravo (FERC 2018b, 2), guidelines are typically to evacuate people within roughly one mile if there is a chance of ignition (Fortis BC 2017, PAPA 2018). Assuming a similar one-mile-wide area of concern for ocelots, 105 square miles of potential ocelot habitat lies within one mile of the pipeline and are therefore at some risk, based on maps of ocelot Cat Conservation Units (defined in Grigione et al. 2009). Depending on conditions, a fire could burn further than

IMPACTS FROM OTHER PROJECTS

The three LNG projects are not the only threat facing ocelots in southern Texas. FERC concluded that existing and planned projects in the area, with their associated road traffic, light and noise, would also have cumulative impacts that "would be permanent and significant" (FERC 2018c, ES-14), including mortality from roads, habitat loss and inbreeding caused by decreased dispersal of individuals. Existing development and agriculture surrounds remaining ocelot habitat (Appendix A, Map 1).

In addition to the three LNG projects and pipelines needed to serve them, many other projects are planned for the area. Significant non-LNG projects within 20 miles of the LNG sites completed within the past five years or scheduled for completion within the next two years include the San Roman Wind Farm, Cross Valley Project (an electric transmission line), six transportation projects, five waterway improvement projects, five Port of Brownsville projects, the SpaceX Commercial Spaceport Project and the STARGATE radio frequency technology facility (FERC 2018c, 4-274).

The Texas LNG FEIS lists these projects, which on completion will collectively occupy thousands of acres. They will destroy or degrade habitat and create noise, lighting and increased road traffic. They would likely require construction of housing and other amenities for employees, stimulating the region's overall development. Resulting economic growth is likely to make purchase of land for ocelot habitat more difficult and expensive. Continued development in and around Brownsville and across the border into Tamaulipas, Mexico would make it harder to connect populations within Texas and to protect a corridor for ocelots between Texas and Mexico.

one mile from the pipeline. The pipelines for the Texas and Annova sites present similar risks.

The LNG terminals would need substantial amounts of electricity—Texas LNG estimates that their terminal would require construction of a 240-megawatt transmission line that would travel approximately 11 miles to connect to the existing American Electric Power (AEP) Union Carbide Substation west of the project site (FERC 2018c, 1-17). The line would require a 100-foot wide permanent right-of-way where trees and shrubs would be cleared, affecting approximately 120.6 acres outside the project site, including 48.3 acres of wetlands (FERC 2018c, 1-17).

Mitigation

The LNG facilities would destroy habitat for the endangered ocelot, but even more detrimental to cat's survival would be preventing the cats from crossing the BSC as the LNG terminals are likely to do. This would make it difficult or impossible to meet one of the most important criteria for recovery laid out in the FWS ocelot recovery plan: connection and natural genetic exchange between U.S. ocelots and the larger population in Tamaulipas, Mexico. The magnitude of the harm done by cutting the only remaining international connection is indicated by what the recovery plan specifies as a remedy if the connection is cut—an additional U.S. population of 75 ocelots would need to be established (FWS 2016a, 55), requiring the creation or preservation of more than an additional 100,000 acres of habitat if each male ocelot requires five square miles.

To grant approval for the three LNG projects, FERC, which has ultimate permitting authority, must consider these impacts and whether alternative sites for the export terminal would avoid or minimize impacts and whether the projects require mitigation—actions that reduce a project's harm. FERC regulations require that the "siting…of facilities shall be undertaken in a way that avoids or minimizes effects on… wildlife values" (E-CFR 2007). Moreover, the ESA imposes a duty on FERC to ensure that any action it authorizes "is not likely to jeopardize" listed species like the ocelot or adversely affect critical habitat (Endangered Species Act of 1973, 16 U.S.C. § 1536(a)(2)). Whether or not the projects would jeopardize the ocelot and other threatened and endangered species would be determined through mandatory consultations with FWS and the National Marine Fisheries Service required by Section 7(a)(2) of the Endangered Species Act (ESA).

Mitigation can include moving the project to a less sensitive site, changing a project's design to minimize harm, or compensating for harm through actions that can include creating, restoring or protecting habitat. Often these efforts are organized in what is called a mitigation hierarchy, with the first focus on moving the project to a less sensitive location—avoidance—followed by changing the project's design to minimize harm on the chosen site and remediation to restore or repair damage done to the site during construction or operation (Arlidge et al. 2018). Finally, as a last resort, various types of off-site mitigation, such as providing money for restoring habitat, can offset unavoidable impacts remaining after the first steps in the hierarchy.

Avoidance (Alternative Siting)

The first thing to consider when planning mitigation is whether the project can be moved to a location where it would have fewer environmental impacts. Accordingly, as part of the DEIS process, the LNG companies have worked with FERC to evaluate alternative sites on the BSC, although all except those ultimately chosen were discarded for reasons such as lack of industrial support facilities, being too close to residences or recreation areas or being too small for the LNG processing and loading facilities. For example, Rio Grande LNG concluded that one site lacked industrial support facilities and the others were too small for its six-train processing plant (FERC 2018b, 3-14 to 3-18).

None of the companies' analyses seem to have taken a hard look at an option that could decrease the footprint of the terminals so they do less harm to ocelots, endangered shorebirds and wetlands. This option would be to split the LNG production facilities from the distribution facilities, locating the production facilities away from the water. Other companies have split their facilities this way, including terminals in Freeport, Texas, and Cove Point, Maryland, where production facilities are up to five miles from the on-water distribution terminal and the LNG is delivered to the terminal by pipeline. If production facilities for the BSC terminals were likewise built away from the water, then the terminal footprints could be substantially smaller. In turn, this would reopen the possibility of finding entirely different sites for the terminals themselves, including locations already evaluated and rejected by the companies as being too small. Therefore, FERC should take a hard look at moving the production facilities away from the water and locating the remaining water-requiring distribution facilities at alternative sites where they would not block the north-south ocelot corridor.

Annova LNG rejected alternative sites for reasons that included proximity to a house and a recreation area, conflict with an existing Army Corps of Engineers lease for

dredge spoils, and land ownership by an entity other than Brownsville Navigation District (BND) (Annova 2017; FERC 2018a, 3-13 to 3-16). Unfortunately, Annova's response to FERC did not detail whether, for example, they had looked into purchasing the single house and/or purchasing or leasing the land that does not belong to BND. Therefore, it is not clear whether the company merely did a cursory review of alternatives to justify their preferred site.

Annova LNG has presented the possibility of shifting the footprint of its terminal east, which would require moving part of the terminal onto land currently within the Loma Ecological Reserve managed by FWS (FERC 2018a, 4-27 and 4-99). The shift's purpose would be to leave a north-south corridor between 700 and 1,900 feet wide for ocelots along the west side of the Annova terminal, with the idea that ocelots could travel along the corridor to approach or leave the ship channel (Fig. 5). This corridor would be protected for the life of the project by a conservation easement and would be shielded from lights and noise by a 14- to 23-foot high concrete "barrier" wall along the west side of its property (Blanton & Associates 2017a, 104).

If all three LNG terminals are built as planned, the west side of the Annova complex is probably the best place a corridor could be left because it would be on the opposite side of the channel from the 1,000-foot-wide Redhead Ridge conservation easement (Appendix A, Map 5). In theory, an ocelot could travel through the Annova corridor, swim the channel, and then travel north through the Redhead Ridge corridor, or vice-versa. However, the Redhead Ridge corridor is only protected by a conservation easement leased from BND until 2023 (Blanton & Associates 2017a, 20), at which point the easement could be developed and the Annova corridor would lead nowhere. Other places where ocelots could now cross would be occupied by Rio Grande LNG and Texas LNG (Appendix A, Map 5). As a partial remedy, Annova is negotiating with BND to extend the Redhead Ridge easement for the life of the project as part of its mitigation (Blanton & Associates 2017a), FERC 2018a, 4-72).

Although shifting the Annova site is a small improvement, it seems unlikely that this mitigation would do much to maintain a north-south connection for ocelots, particularly if the corresponding north bank is largely occupied by Rio Grande LNG. To use the corridor, an ocelot in the LEP would have to move east and then north to approach the noisy, lighted area of the Annova terminal, cross an access road, travel several thousand feet along the Annova barrier wall to the channel, swim the channel, cross another access road, arrive at the Redhead Ridge Corridor on the other side near the Rio Grande terminal site, and enter the Laguna Atascosa refuge by crossing heavily-trafficked State Highway 48 where speed limits reach 75 miles per hour. Moreover, the "corridor" running along the west side of the Annova terminal would be interrupted in the middle by a large barren salt flat that ocelots are unlikely to cross and that would likely be impossible to transform into thorn scrub (Map 5). Annova may plant thorn scrub vegetation in a narrow strip between the barren area and the wall, which might give some cover.

From what is known about ocelot behavior, it is improbable that dispersing ocelots would run this gauntlet of inhospitable land. Dispersing ocelots are young, inexperienced animals likely to be cautious and to avoid places without dense thorn scrub to move through—they have much higher mortality rates than ocelots with established territories (Haines, Tewes and Laack 2005, 258). One cougar study suggests this type of cautious behavior in felids—when dispersing juveniles reached highways at night, they would typically wait for morning when they could see across the road (Beier 1995, 234). If the opposite side had good natural cover, they would cross. If it did not, they would turn back.

Moreover, given the amount of industrial activity that would occur near the Annova LNG and Redhead Ridge corridors, they are too narrow. A recent review of conservation corridor design concluded that a corridor should be at least 1.2 miles wide—several times wider than the Annova and Redhead Ridge corridors—to avoid significant effects from noise and other disturbances caused by people outside the corridor (Beier 2018).

Minimization (On-site Adjustments to Reduce Impacts)

Assuming the terminals were to be built in the proposed locations on either side of the BSC, the next step in the mitigation hierarchy would be to minimize harmful effects by altering design characteristics or activities. Possible modifications identified in the EISs and other project documents include down-shielding lights, minimizing lighting of access roads, building sound barriers, and building culverts beneath terminal access roads (Blanton & Associates 2017a, 22; FERC 2018a, 4-72; 2018b, 4-94; 2018c, 4-299). However, these actions may not be effective.

For example, Annova LNG documents provide no evidence that down-shielding lights would decrease night glare enough to allow ocelots to approach the terminals. And there is no evidence as to whether expected decibel levels would be low enough to prevent ocelots from avoiding the area. Neither Annova LNG's Sensitive Species Report nor the Annova FEIS present evidence that the barrier wall they propose to build between their facility and the ocelot "corridor" to the west

would decrease noise levels to the point of no impact. The FEIS merely says that the wall "would be expected to reduce light and noise impacts" (FERC 2018a, 4-73).

A major concern for ocelot mortality is construction of access roads and increased traffic on Highway 48, which runs between the Rio Grande and Texas LNG sites and the southern unit of the Laguna Atascosa refuge (FERC 2018b, 4-149; 2018c, 4-317). At least one ocelot has been killed on this highway in the past (FWS 2013, 40). The companies propose to build culverts so ocelots can pass beneath access roads, but there is no evidence that ocelots use such culverts. In 2007, the Texas Department of Transportation (TxDOT) constructed an ocelot underpass beneath State Highway 48, but although bobcats are known to use the underpass, there are so far no sightings of the much rarer ocelot using it (Brezosky 2014). TxDOT also recently earmarked $8 million for underpasses beneath Highway 100 and Farm-to-Market Road 106, but it is too early to know whether ocelots will use them (Kelley 2018).

On-site Remediation (Restoring Habitat After Construction)

Because the LNG terminals will occupy so much of their respective sites, relatively little land will be available for remediation after construction. For example, the operational footprint of the Rio Grande LNG terminal would be 750 acres out of approximately 984 leased acres (FERC 2018b, 223). What little remediation could be done would be of no use to ocelots because it would be too close to the LNG terminals or be the wrong type of habitat (it takes decades to restore thorn scrub suitable for ocelots).

Off-site Compensatory Mitigation

On-site remediation would do little to offset loss of habitat and connectivity the LNG terminals would cause. Therefore, if the plants are built as planned, the companies should implement compensatory mitigation, the final step in the mitigation hierarchy, to ensure that their projects cause no net loss of habitat across the landscape, and/or there is no net harm to affected species. Note that the preferred goal of compensatory mitigation is often net environmental gain, meaning that each species is better off after mitigation than before the development project started (Bateman 2018, 2; McKenney and Keisecker 2010, 166). Indeed, the FWS stated in a November 21, 2016 notice that "The Service will seek a net gain in conservation outcomes in developing mitigation measures consistent with our mission to identify and promote opportunities to decrease the gap between the current and desired status of a resource" (FWS 2016c, 83450). The agencies responsible for consulting and permitting the terminals should ensure that both wetlands and all species listed under the ESA are individually accounted for to ensure at minimum that there is no net loss and preferably a net gain for each species after mitigation.

Off-site mitigation could take the form of funds to purchase land or conservation easements, to restore habitat in other places or, to a lesser extent, to underwrite ocelot research. Because the acres lost to the LNG sites are some of the most important acres of ocelot habitat in the United States, the loss of which would break the last possible connection to Mexico and U.S. refuges south of the BSC, mitigation should be substantial. As previously discussed, the FWS recovery plan's criteria for delisting would require establishing an extra population of 75 ocelots if the connection to Mexico is cut.

Texas LNG and Rio Grande LNG are not planning off-site mitigation for ocelots. Both projects have proposed compensatory off-site mitigation, but only for wetlands—approximately 825 acres for Rio Grande LNG (Ecology and Environment 2016, 36) and possibly 405 acres for Texas LNG (FERC 2018c, 4-35). This would include minimal, if any, upland ocelot habitat. Ocelot mitigation measures identified in NEPA documents so far would do nothing to make up for the loss of habitat and connectivity between the U.S. and Mexico populations. For example, the Texas LNG FEIS ocelot mitigation section proposes only to a) "concentrate and collocate Project facilities to minimize the Project footprint," b) train staff how to avoid "vehicular impacts" with ocelots, and c) shield lights to "minimize impacts on nocturnal wildlife (e.g., ocelot)" (2018d, C-105). The Rio Grande LNG DEIS specifies no ocelot mitigation measures, although FWS might eventually require some.

FERC has noted this lack of mitigation for ocelots, specifying in the Rio Grande DEIS that prior to construction the company "develop a plan to mitigate for a decrease in the quality of potential habitat within the NWR [Lower Rio Grande National Wildlife Refuge], and finalize the proposed mitigation for direct loss of potential habitat within the LNG Terminal site in a manner that adheres to the Final Recovery Plan for the ocelot" (FERC 2018b, 5-30).

In comparison to the other two terminals, Annova LNG appears more responsive to the needs of ocelots. In addition to evaluating lands for wetland mitigation, it is evaluating off-site lands with ocelot habitat for purchase or conservation easements (Blanton & Associates 2017a; FERC 2018a, 4-72), management of which should include long-term monitoring to ensure compliance and effectiveness. Depending on location, such off-site mitigation for ocelots could help connect the lower and upper tracts of the Laguna Atascosa

refuge (Appendix A, Map 4) or help connect the refuge with the larger ocelot population in Willacy and Kenedy counties to the north. Annova LNG has also proposed contributing to ocelot research and has so far donated $40,000 (Annova LNG 2018b), 0.001 percent of its projected $3 billion construction budget (Annova 2018a).

Given that all three companies must mitigate for ocelots, the other two companies should also protect dedicated ocelot habitat off-site with the aim of enlarging and safeguarding the two existing ocelot populations. This strategy would be most effective if FWS coordinates mitigation across all three companies rather than allow each to proceed on its own.

Is it appropriate to do mitigation within the LEP? Both Rio Grande LNG and Texas LNG have proposed mitigating for wetland destruction by leasing and protecting in perpetuity wetlands already protected within FWS's Loma Ecological Preserve (LEP), currently a leased unit of the Lower Rio Grande Valley National Wildlife Refuge (Ecology and Environment 2016, 32; FERC 2018c, 4-35). Their proposals would protect only a fraction of LEP's total 4,600 acres—in the case of Texas LNG, just 9 percent.

The companies justified their proposals by noting that the FWS lease with BND will run out in 2023, possibly leaving the area unprotected and at risk of development. Their implicit argument is that extending the term of protection adds conservation value worth mitigation credit. But if FWS were able to significantly extend its lease, this proposed additional layer of protection would have little value.

Moreover, it is unusual for agencies to give mitigation credit for additional protection of already protected land because the action would not provide additionality, "genuinely new and additional contributions to conservation" (McKenney and Keisecker 2010, 170). According to FWS, "The Service generally only supports locating compensatory mitigation on (public or private) lands that are already designated for the conservation of natural resources if additionality… is clearly demonstrated and is legally attainable. In particular, the Service usually does not support offsetting impacts to private lands by locating compensatory mitigation on public lands designated for conservation purposes because this practice risks a long-term net loss in landscape capacity to sustain species by relying increasingly on public lands to serve conservation purposes" (FWS 2016c, 83480).

In the case of Texas LNG's proposal, the Army Corps of Engineers at least partly rejected its approach in a 2018 letter saying, "The mitigation plan should include restoration, creation, and/or enhancement of aquatic resources, and should not rely only on preservation of existing aquatic resources...." As of the release of the FEIS for the project in March 2019, Texas LNG had not submitted a revised plan (FERC 2018c, 4-35).

To its credit, Annova LNG has proposed to do its wetland mitigation not by preservation of wetlands in the already protected LEP, but through restoration at an as yet undecided location off-site. (Reyes 2019).

Perpetual versus finite mitigation. Some of the mitigation proposals that Annova LNG outlined in 2016 are questionable because they propose mitigation "for the life of the Project" rather than in perpetuity (Blanton & Associates 2017a, 20; FERC 2018a, 4-72). This includes the Annova ocelot corridor that would run along the west side of the terminal and their proposed extension of the Redhead Ridge Conservation Easement lease, which otherwise would expire in 2023.

The fact that both the LEP and the Redhead Ridge Conservation Easement could be developed by BND when their leases expire in 2023 shows that temporary mitigation, e.g. "for the life of the Project," is really no mitigation. If a project destroys habitat in exchange for temporary protection of alternate habitat that is ultimately lost when an easement expires, the project causes net loss of habitat if the accounting is done over years or decades. Ironic in the case of the LEP and Redhead Ridge easements is that both were leased to FWS as temporary mitigation for development activities proposed by the BND (Blanton & Associates 2017, 20).

On the other hand, Annova does plan to permanently protect the land it would dedicate to ocelot mitigation by purchasing land outright or purchasing easements that would then be transferred to FWS. Rio Grande LNG has likewise proposed that its possible easement within the LEP would be perpetual (FERC 2018b, ES-6).

How much mitigation is appropriate? By permanently separating habitat north and south of the BSC, the companies would undermine decades of investment by federal and state agencies and nongovernmental organizations working to create a connected population north and south of the border. Mitigation should include substantial off-site preservation or restoration of ocelot habitat in addition to establishment of a trust fund that would ensure in perpetuity genetic monitoring and translocation as needed to ensure genetic diversity in Texas ocelots.

We can develop a minimum starting point by estimating per-acre cost of mitigation for the number of acres destroyed (this would not include mitigation for the more serious but harder to calculate harm done by disconnecting the coastal ocelot corridor described in the preceding paragraph). Taking Annova LNG as an example, its site will occupy 731 acres. For our calculations, we assume that these 731 acres should be mitigated; although the site is not exclusively thornscrub, even

OCELOT (CAPTIVE) © JOEL SARTORE/NATIONAL GEOGRAPHIC PHOTO ARK

non-scrub areas could function as hunting grounds (Booth-Binczik et al. 2013, 408) or part of dispersal corridors, and thus may qualify as ocelot habitat if adjacent to thornscrub.

What is a reasonable mitigation ratio for acres destroyed to mitigation acres? Looking at other examples for guidance, Texas LNG, as reported in the Texas LNG FEIS, proposed wetland mitigation of 10:1 (FERC 2018c, 4-35). Mitigation for critical habitat of endangered Mojave desert tortoise under California's Desert Renewable Energy Conservation (DRCEP) plan is set at 5:1 (DRECP 2014, H-59).

To purchase, restore, manage and protect habitat elsewhere in the Cameron County ocelot corridor would cost roughly $9,000 per acre (Jones 2018). So, arbitrarily using a 5:1 ratio, the cost of mitigating 732 acres would be $32,895,000. The cost would be substantially higher if some of the acres needed to be restored to thornscrub. For perspective, Annova expects to spend $3 billion to bring its terminal online.

This minimum estimate is only for mitigating lost acres. But a more significant loss is permanently blocking future connectivity to Mexico. As noted, the ocelot recovery plan states that delisting would require creation of an extra population of 75 ocelots to make up for lost U.S.-Mexico connectivity. At five square miles of territory per male, 37 male ocelots would require 185 square miles of habitat, totaling 118,400 acres. At $9,000 per acre, a cost that will likely increase over time, total cost would be at least $1 billion. This is a large, hidden cost of constructing the terminals that is not being recognized by FERC or the companies.

Summary of Impacts

The LNG facilities and their feeder pipelines will significantly hinder ocelot recovery and hasten the cat's extinction in the United States, undercutting decades of investment by FWS, conservation organizations and citizens.

Any activity related to the LNG projects that results in net habitat loss or that increases mortality—road traffic, for example—would increase the probability of extinction predicted by the current ocelot population viability model, which is 33 percent over 50 years (Haines et al. 2006). The plants would not only destroy habitat on the sites where they are built but would also likely cause ocelots to avoid nearby habitat affected by associated lights, noise and other human activity, effectively depriving them of additional habitat.

Impacts on ocelots include:

- Genetic and demographic isolation of populations from each other. By destroying habitat on both banks of the BSC that constitutes the last remaining place ocelots could feasibly cross, the projects would isolate habitat north and south of the channel (Appendix A, Maps 4 and 5), making impossible the long-term goal of connecting U.S. and Mexican populations. Annova LNG's proposal to move the physical structures slightly eastward is unlikely to effectively maintain connectivity.
- Increased road traffic, the most common cause of ocelot mortality.
- Extensive night lighting, which can affect hunting and dispersal and alter sleep and activity patterns.
- Increased noise, which can interfere with reproductive behavior and predator-prey interactions, increase stress and cause physiological changes.
- Cumulative impacts with other development projects in or near ocelot habitat including San Roman Wind Farm and the SpaceX Commercial Spaceport Project.

Mitigation proposed by the LNG companies is inadequate. Neither Rio Grande LNG nor Texas LNG propose off-site mitigation for the ocelot, which would be essential for offsetting lost habitat and connectivity. Annova LNG is analyzing options for purchasing land or easements to protect off-site ocelot habitat, but nothing definite appears in the DEIS or associated documents other than proposals to put time-limited easements on two short corridors on the BSC. Mitigation proposals by all three companies have critical flaws, including conservation easements that would last only for the "life of the project" and easements that would be placed within an already protected area.

Recommendations

For the reasons summarized above, the proposed LNG facilities will have such a disastrous effect on ocelot recovery in the United States that FERC should deny the permits to build in this location entirely. Moreover, before FERC can consider authorizing these projects, FERC and FWS must fully analyze in a formal ESA consultation impacts to the ocelot and whether substantial mitigation measures, including at a very minimum the following recommendations, can offset those impacts.

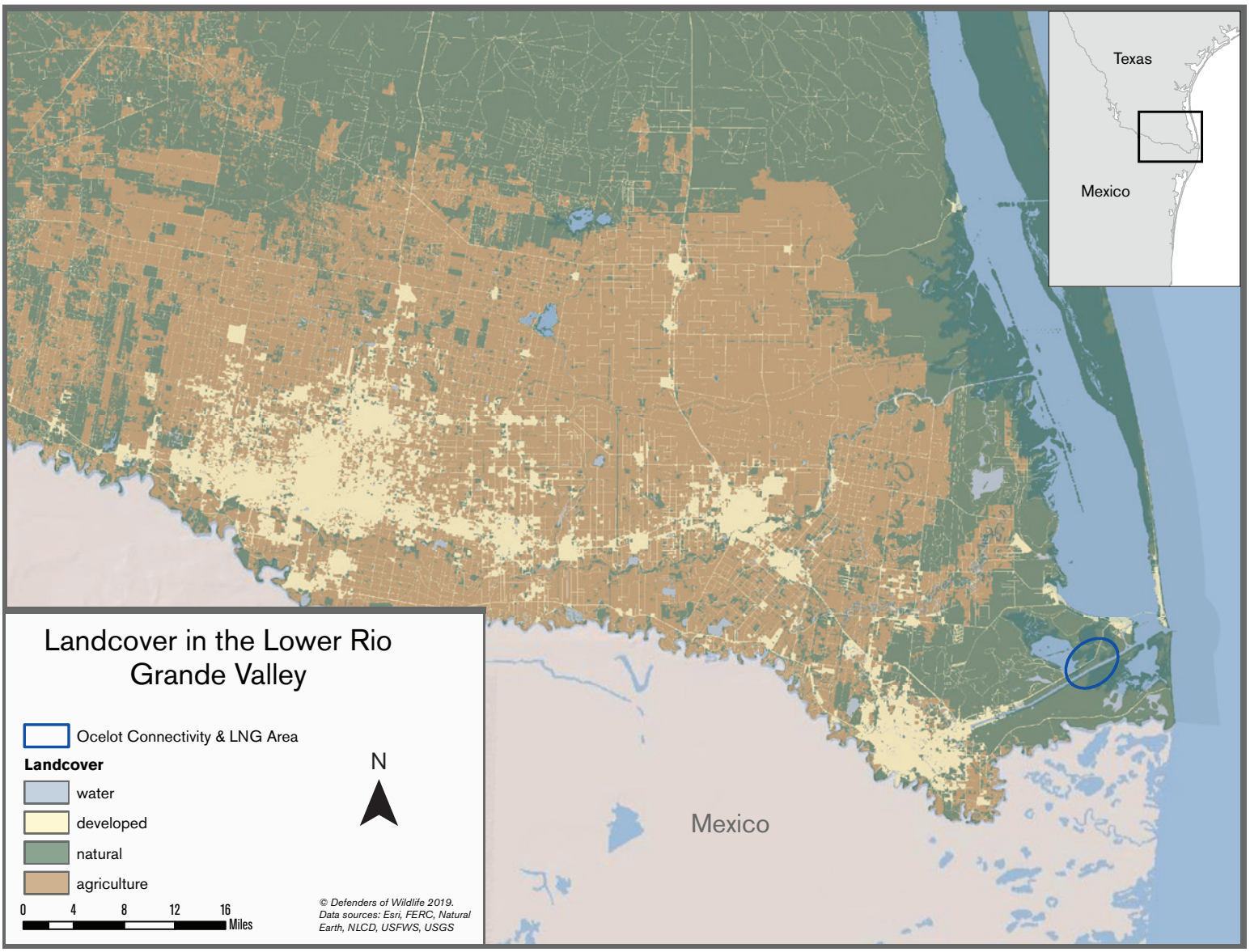
- FERC should consider alternatives that would locate LNG production facilities, including pretreatment and/or liquefaction, away from the water and the product piped to the terminals, thereby decreasing the amount of ocelot habitat occupied by facilities.
- In light of the possibility of decreasing the terminal footprints by locating LNG production off-site, FERC must evaluate alternative sites for the terminals that would do less harm to endangered species and wetlands, including sites that have already been judged too small based on plans to co-locate production and distribution facilities.
- Mitigation for ocelots should include not only mitigation for acres of habitat destroyed, but also compensation for cutting the only remaining corridor connecting habitat north and south of the BSC and subsequent loss of genetic interchange. The scale of the mitigation should consider that the FWS recovery plan for the ocelot specifies that loss of U.S.-Mexico connectivity would require establishment of an additional population with 75 ocelots that we calculate would cost $1 billion. Because all three plants will contribute to cutting connectivity, all three should contribute substantial off-site mitigation.
- In addition to habitat protection, the companies should fund genetic monitoring and translocation programs sufficient to offset impacts of cutting the north-south corridor.
- Calculations of habitat lost to ocelots should include areas that contain not only thornscrub but also those that may provide hunting grounds or dispersal routes, such as coastal prairie or wetland margins.
- Off-site ocelot mitigation should preferentially take place within the FWS-designated Coastal Corridor to connect and enlarge existing units of the Laguna Atascosa and Lower Rio Grande Valley refuges or possibly on ranchland near existing private easements in Willacy and Kenedy counties. The three companies should work with FWS to ensure that their mitigation is coordinated to maximize the benefits of their off-site mitigation.
- For each threatened or endangered species present, including not only ocelots but also Aplomado falcons, piping plovers and red knots, FERC should require species-specific mitigation that ensures at minimum no net loss and preferably net gain for each species.
- The EISs should include more detailed species-specific analysis of how expected decibel levels, lighting, traffic and other human activity would affect threatened and endangered species, including analysis of whether additional actions can be taken to decrease noise and other stresses, for example whether noise levels in the Annova ocelot corridor can be decreased to at least the 55 dBA FERC standard for human communities.
- Where pipelines or other utilities must cross sensitive areas like wildlife corridors, construction should use directional drilling and other measures to minimize surface disturbance.
- Once construction is completed, natural vegetation and wetlands should be restored where possible on each site, regardless of whether this restoration receives mitigation credit from the Army Corps of Engineers.
- In accordance with FWS guidance, off-site mitigation is preferable in areas not already protected, i.e. not within the Loma Ecological Preserve. An option would be wetlands near Lake San Martín.
- Any easements contracted to protect existing habitat should be in perpetuity, not for the life of the project.

Conclusion

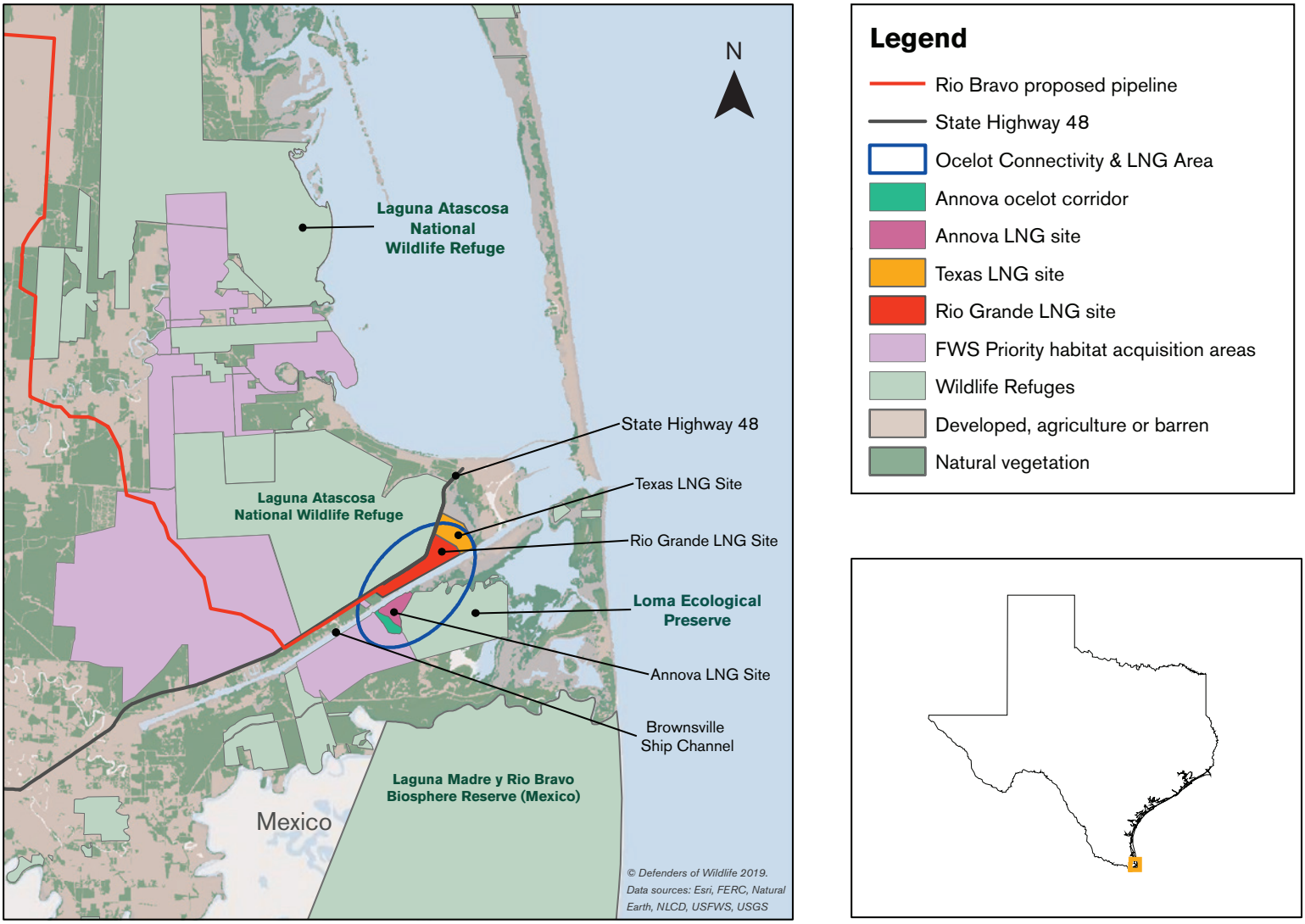
The proposed LNG facilities will have such a disastrous effect on ocelot recovery in the United States that FERC cannot issue permits to build the facilities without jeopardizing the continued existence of the species and should deny the applications to build the terminals along the BSC. While this report seeks to provide recommendations that may reduce adverse effects to the ocelot, even requiring all of the substantial mitigation suggested above may not be sufficient to avoid further threatening the species—especially where FWS has not analyzed the issue in detail in a biological opinion. Accordingly, further analysis is necessary to determine whether construction of these LNG terminals could be authorized without violating the ESA.

Appendix A: Maps

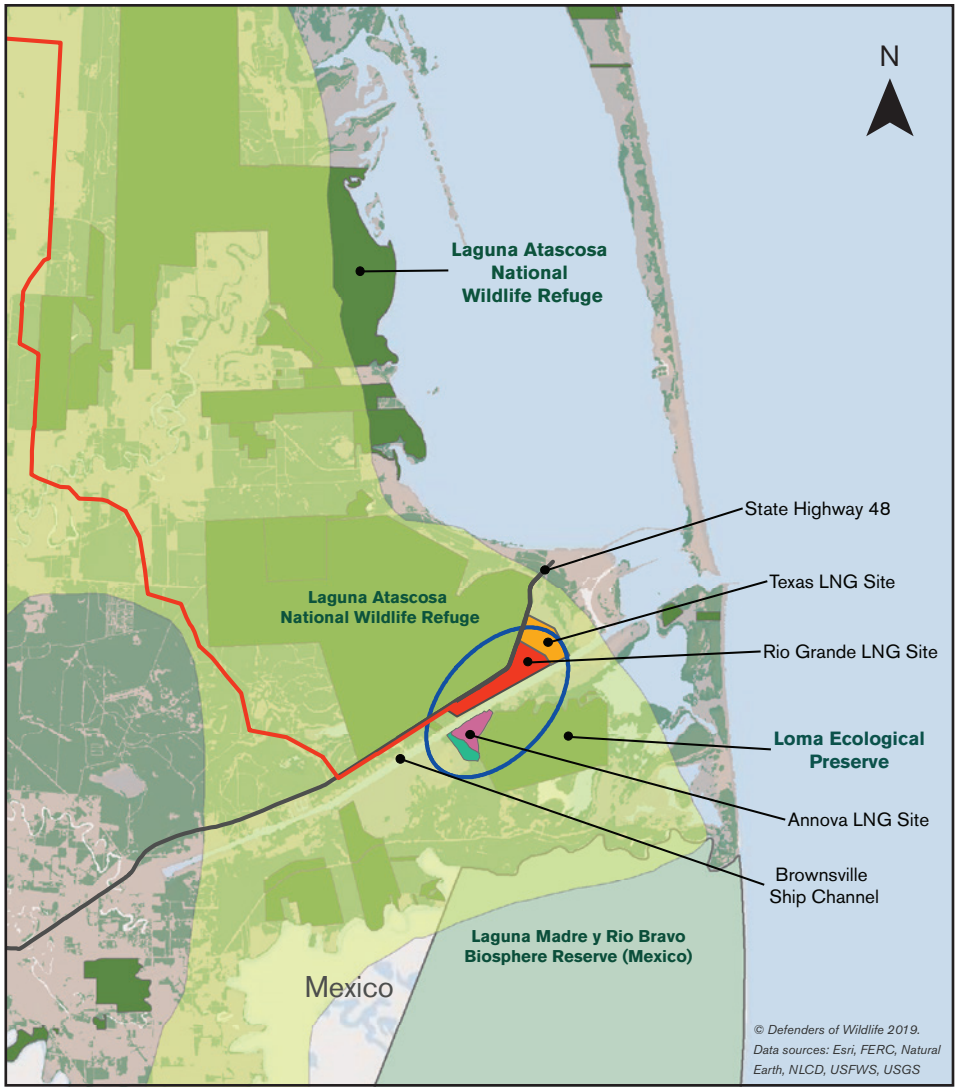
Map 1. Agriculture and urban development surrounding remaining natural vegetation in and around Laguna Atascosa National Wildlife Refuge. Connectivity and LNG Area (area outlined in blue) is the location of the proposed LNG plants.

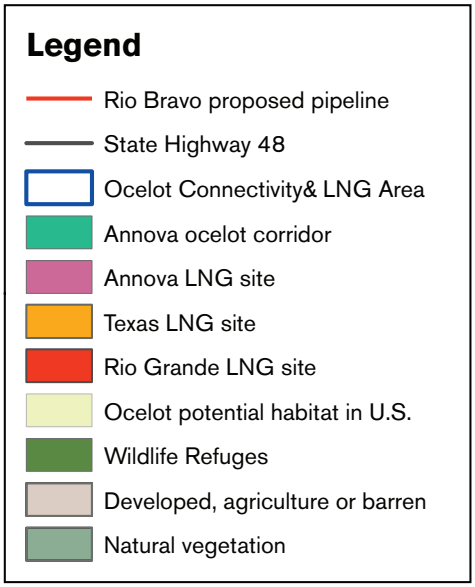


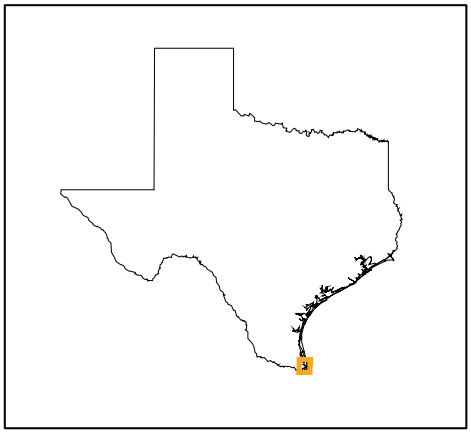
Map 2. Priority habitat acquisition areas (pink) identified by the U.S. Fish and Wildlife Service (FWS) for protection as part of a coastal wildlife corridor. Defenders of Wildlife.



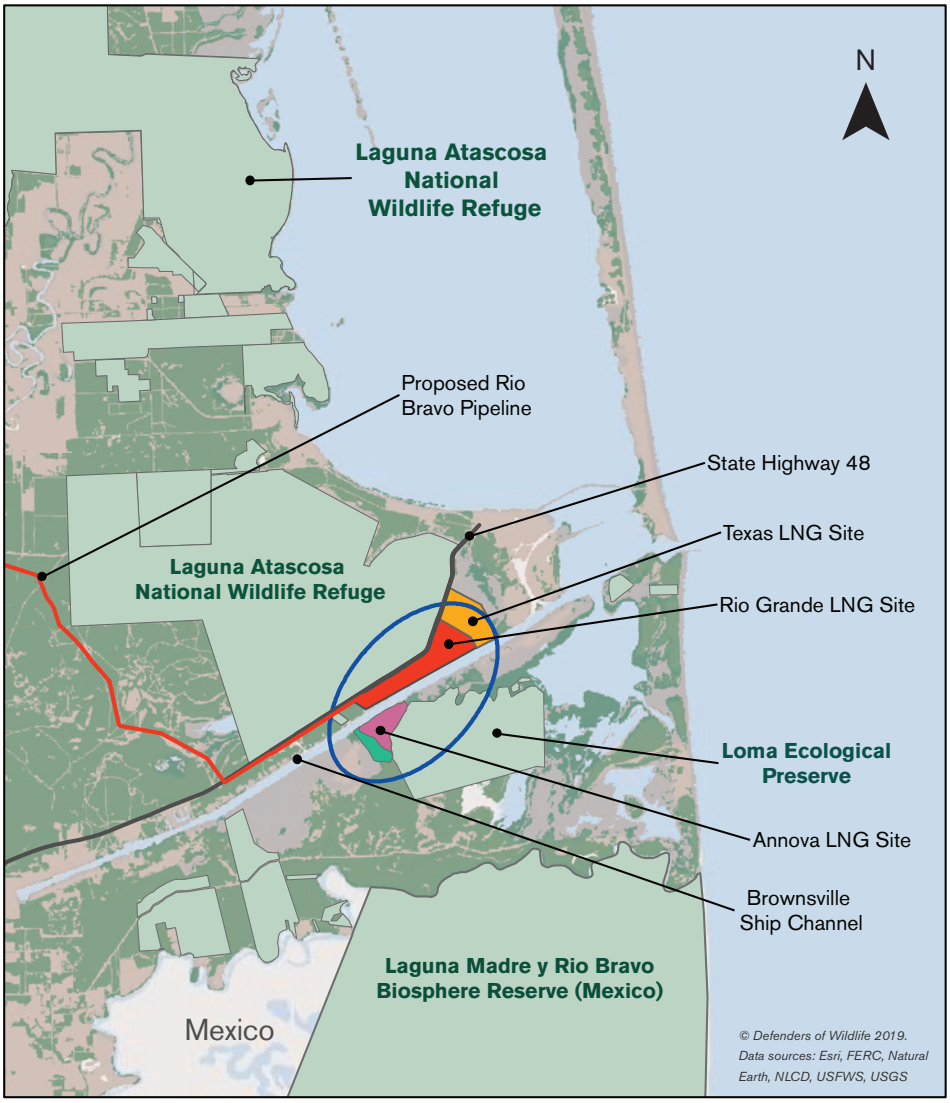
Map 3. Potential ocelot habitat (Ocelot Cat Conservation Units)

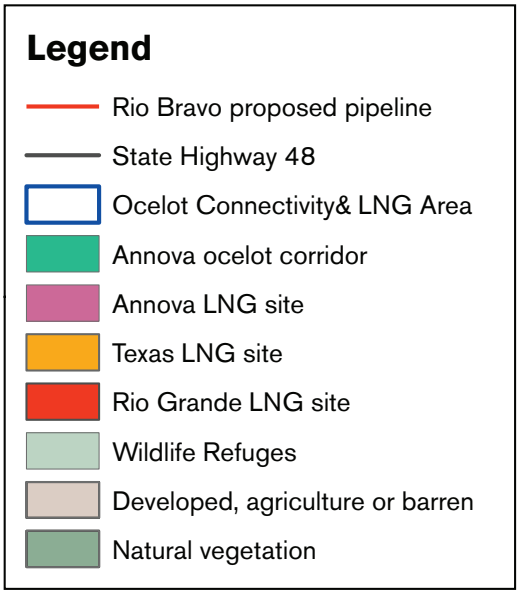


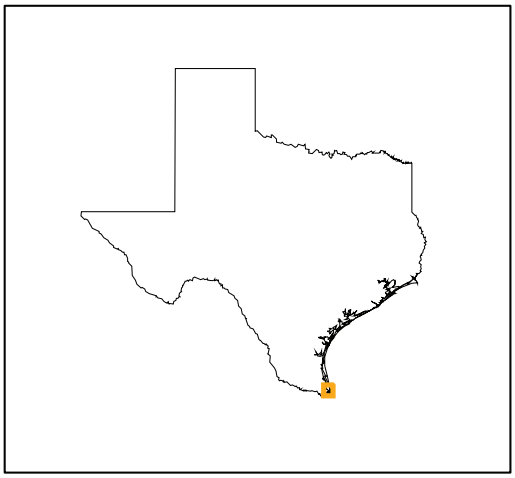




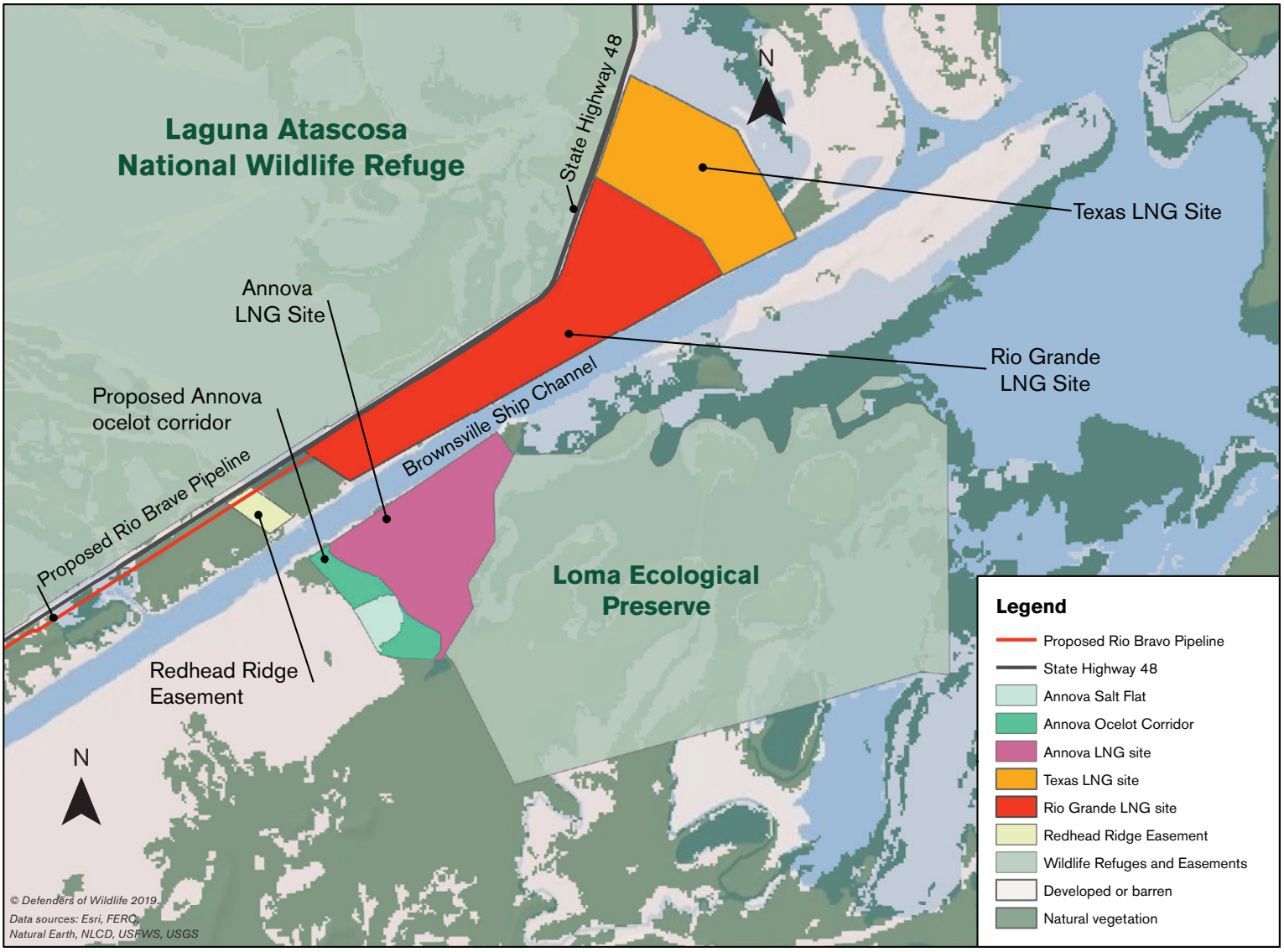
Map 4. Overview of area with proposed LNG sites.







Map 5. Closeup of LNG sites. Bright green area is corridor Annova LNG proposes to leave by shifting the project to the east. Note large white salt flat in center of corridor. Redhead Ridge Conservation Easement is an existing easement that Annova LNG proposes to protect for the life of the LNG terminal project as ocelot mitigation.



Appendix B

Comparison of Texas, Rio Grande and Annova LNG Projects

	Texas	Rio Grande	Annova
Acres	625	984	731
Liquefaction trains	Two	Six, each capable of producing 4.5 million tons of LNG per year	Six, each capable of producing 1 million tons of LNG per year
Annual total liquefaction capacity	2 million tons LNG per year; Phase 2 would add another 2 million tons.	Approximately 27 million tons LNG per year	Maximal output 7 million tons per year
LNG storage tanks	Two 210,00-cubic-meter tanks	Four 180,000-cubic-meter tanks	Two 160,000-cubic-meter tanks
Shipping	One LNG ship berth with dredged slip connected to BSC	Two LNG ship berths with a turning basin and jetties	One LNG ship berth
Trucking	No information	Truck loading facilities for distribution to LNG refueling stations throughout the U.S.	No information
Other	Communication tower, flare system, electric utility lines, AEP substation, water line	Natural gas pretreatment facilities, ground-flare system	Communication tower, flare system, gas treatment equipment. Related development includes areas dredge material, electric lines, water line
Buildings	Administration building and parking lot, warehouse and maintenance building, and access road	Administration building, control room, workshop, warehouse, electrical equipment substations, and enclosures for other support infrastructure	No information
Pipeline	Build 10.2-mile lateral to connect to existing Valley Crossing pipeline	Build Rio Bravo Pipeline: two parallel pipelines running 137 miles from Agua Dulce Market (Kleberg County). Three 180,000-horsepower compressor stations, two 30,000-horse-power interconnect booster stations and a 2.4-mile-long header pipeline	Not selected as of June 2018

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