BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

IN THE MATTER OF THE JOINT APPLICATION FOR THE LOCATION APPROVAL OF THE EXPANDED CORONA WIND PROJECTS AND THE REVISED CORONA GEN-TIE SYSTEM AND FOR RIGHT-OF-WAY WIDTH APPROVAL PURSUANT TO THE PUBLIC UTILITY ACT, NMSA 1978, §62-9-3	)	**Case No. 22-00___-UT**
ANCHO WIND LLC, COWBOY MESA LLC, , GALLINAS MOUNTAIN WIND LLC, MESA CANYONS WIND, LLC, PATTERN SC HOLDINGS LLC, VIENTO LOCO LLC,	)	
JOINT APPLICANTS.	)	

DIRECT TESTIMONY OF ADAM CERNEA CLARK

I. INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Adam Cernea Clark. My business address is 1088 Sansome St., San Francisco, CA 94111.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

I am employed by Pattern Energy Group LP ("Pattern Energy"). I hold the position of Senior Environmental and Natural Resources Manager of Pattern Energy. I am the project lead on environmental and permitting issues for the approximately 3,200 ("MW") of wind generation projects ("Corona Wind Project").

Q. PLEASE DESCRIBE YOUR EDUCATIONAL AND WORK BACKGROUND.

A. I am a 2005 graduate of Kenyon College with a B.A. in English and an Integrated Program in Humane Studies concentration. I am also a 2014 graduate of both Northeastern University School of Law and Vermont Law School, where I earned a Juris Doctor and Master's Degree in Environmental Law and Policy, respectively. In 2015, I was admitted as an attorney to the New York State Bar but am not a practicing attorney. I have been working in the wind industry since 2015, when I joined Pattern Energy as an associate of environmental and natural resources. My previous work experience includes fellowships at an international development organization and a local legal aid service, as well as corporate transactional work at a law firm in Europe. In the course of my employment with Pattern Energy, I am responsible for environmental, permitting, and non-permitting development issues related to the development of wind, solar, and transmission projects, as well as non-project-specific regulatory and policy matters. In my capacity as a representative of renewable projects such as the Corona Wind Project, I am in charge of assessing and mitigating environmental impacts of Pattern Energy's projects and securing

all requisite permits prior to project construction and financing. In this capacity, I work closely with federal regulatory and environmental agencies, such as the Bureau of Land Management, National Park Service, the U.S. Army Corps of Engineers ("USACE"), and the U.S. Fish and Wildlife Service ("USFWS"), as well as state and local officials in communities where Pattern Energy builds its projects. I also engage with federal agencies, other renewable companies, and non -profit organizations as a representative of Pattern Energy more generally to advance progress in environmental policy and research.

Q. ON WHOSE BEHALF ARE YOU APPEARING IN THIS PROCEEDING?

A. I am appearing on behalf of Ancho Wind LLC, Cowboy Mesa LLC, Gallinas Mountain Wind LLC, Mesa Canyons Wind, LLC, Pattern SC Holdings LLC, and Viento Loco LLC (collectively referred to as the "Joint Applicants") in support of this Application for approval of changes to the Corona Wind Project consisting of the approval to expand the area for the wind turbines beyond that previously approved in NMPRC Case Nos. 17-00221-UT, 18-00065-UT, and 21-00281-UT. NMPRC Case No. 20-00008-UT also involved a request for approval of the location of the Gen-Tie System associated with the Corona Wind Project, but did not involve a request for any location approval for generation. Collectively, all of these cases are referred to in my testimony as the "Prior Location Approval Proceedings."

The expanded area for wind turbines for which Commission approval is sought in this Joint Application is hereafter referred to as the "2022 Corona Generation Expansion" and is more specifically described in Exhibit JA-1 attached to the Joint Application.

Q. ARE YOU SPONSORING ANY EXHIBITS WITH YOUR TESTIMONY?

A. Yes. I am sponsoring or co-sponsoring several exhibits in my testimony. However, the primary exhibit in support of the Joint Application is Exhibit ACC-1, the supplemental

Corona Environmental Report (the "Supplemental Environmental Report"). The Supplemental Environmental Report was prepared under my supervision. I was the primary contact on behalf of the Joint Applicants with the Burns & McDonnell team and have reviewed and am familiar with all the work performed and the conclusions reached. The remaining exhibits are discussed later in my testimony in more detail.

Q. PLEASE PROVIDE A SUMMARY OF YOUR TESTIMONY.

I am submitting testimony explaining that the Corona Wind Project has been modified by adding some areas that were not previously included in the description of the generation areas authorized in any of the Prior Location Approval Proceedings. I describe the area where wind turbines might be located and explain that this area and the location of these generation facilities therein is in compliance with all applicable laws and regulations in New Mexico, as well as the comprehensive environmental protections agreed upon by the Joint Applicants and Commission Staff and intervenors in the Prior Location Approval Proceedings. I also describe how the 2022 Corona Generation Expansion has been analyzed in the Supplemental Environmental Report consistent with prior environmental review of the Corona Wind Project.

POTENTIAL ENVIRONMENTAL IMPACTS

A. EXISTING ENVIRONMENT OF THE 2022 CORONA GENERATION EXPANSION

Q. PLEASE DESCRIBE THE CHANGES TO THE CORONA WIND PROJECT RELATING TO THE 2022 CORONA GENERATION EXPANSION RELATIVE TO THAT WHICH WAS DESCRIBED IN THE PRIOR LOCATION APPROVAL PROCEEDINGS.

A. The Joint Applicants have or will secure agreements to locate wind turbines on some additional lands which are the subject of the Joint Application in this proceeding. This

additional land area includes both private and state lands. Although additional land area is being sought for the location of wind generation, the Joint Applicants do not contemplate adding more turbines than the approximate 950 referenced in earlier in the Prior Location Approval Proceedings. Nor does the location approval sought in this proceeding involve any additional land area for transmission facilities.

The changes which are reflected in the 2022 Corona Generation Expansion which are the subject of this location approval request are shown in detail in Exhibit JA-1 to the Joint Application, which I am co-sponsoring in this proceeding. These changes essentially include the addition of some lands with very good wind resources to the generation area for the Corona Wind Project. While the addition of the lands reflected in the 2022 Corona Generation Expansion is not necessary for the successful development of the Corona Wind Project, it does allow for the inclusion of additional high quality wind generation land located on both private and state trust lands to the projects thereby resulting in a greater optimization of the Corona Wind Project.

Q. **WHAT IS THE BENEFIT OF HAVING PERFORMED THE DETAILED ENVIRONMENTAL ANALYSIS OVER THE ENTIRE 2022 CORONA GENERATION EXPANSION AREA?**

A. The 2022 Corona Generation Expansion Area has been studied holistically in the Supplemental Environmental Report to be consistent with the previous approach to environmental review of the Corona Wind Project taken by the Joint Applicants in the Prior Location Approval Proceedings. This approach has entailed not only a comprehensive environmental review of the proposed transmission line project areas but also the broader wind generation areas of the Corona Wind Project. The extensive

environmental review and protection measures of the overall Corona Wind Project are used to refine project design to avoid and minimize potential project impacts and to provide significant environmental information about the 2022 Corona Generation Expansion for the New Mexico Public Regulation Commission, the public, and the State of New Mexico. to analyze.

Q. WHEN IS THE 2021 REVISED CORONA GEN-TIE SYSTEM EXPECTED TO BE IN SERVICE?

A. The 2022 Corona Generation Expansion is expected to be in service by the end of 2026.

Q. **WHAT IS THE EXISTING ENVIRONMENT OF THE 2022 CORONA GENERATION EXPANSION AREA?**

A. As detailed in the Supplemental Environmental Report, the existing environment within the 2022 Corona Generation Expansion area is quite similar to the existing environment within the rest of the Corona Wind Project and largely consists of a mosaic of open savannah and pinon juniper habitat subject to ranching activities.

III. PATTERN ENERGY AND ITS APPROACH TO PROJECT DEVELOPMENT AND ENVIRONMENTAL ISSUES.

A. PATTERN ENERGY'S ENVIRONMENTAL VALUES IN PROJECT DEVELOPMENT

Q. **PLEASE PROVIDE THE COMMISSION WITH SOME BACKGROUND ON PATTERN ENERGY IN TERMS OF THEIR ENVIRONMENTAL VALUES AND TRACK RECORD.**

A. Pattern Energy has taken a leadership role in tackling the modest environmental impacts of the wind industry. We actively participate and provide funding in wind industry efforts

to understand, study, and minimize the environmental impacts of wind energy and to advance the development of impact minimization technology and industry best management practices ("BMPs"). Pattern Energy personnel participated in the public-private collaboration that led to the development of the USFWS Land-Based Voluntary Wind Energy Guidelines ("WEGs"). See Exhibit ACC-2. We have funded research into novel technologies for understanding and minimizing the environmental impacts of our projects. We are a founding and sustaining member of the Renewable Energy Wildlife Institute, formerly known as the American Wind Wildlife Institute, a coalition of wind industry companies and non-governmental organizations working to advance conservation values, scientific research, and wind energy development. We also routinely implement voluntary BMPs and mitigation strategies that further our environmental values. For example, Pattern Energy plays a leadership role in the American Clean Power organization's efforts to raise funding for scientific research for understanding the impacts of wind-wildlife interactions, supporting the implementation of bat mitigation measures during the autumn bat migration that have proven to substantially decrease bat mortality at the cost of reduced renewable energy generation, and working with leading environmental non-profit organizations to advance practical solutions to wildlife permitting that both promote renewable energy and wildlife conservation. Pattern Energy recently released our latest sustainability report that describes our management approach to developing our renewable energy projects in a safe and environmentally responsible manner and with respect for the communities and cultures where we have a presence. These practices have been and will continue to be implemented at the Corona Wind Project to ensure that project development occurs in a way that is socially and environmentally responsible. In fact, the

funding of pinyon-juniper management practices and potential impacts to sensitive birds that the Western Spirit Wind Projects made in early 2021 is referenced in our recent 2020 Sustainability Report published in September of 2021.

Q. DOES PATTERN ENERGY HAVE A FORMAL POLICY RELATING DIRECTLY TO THE PROTECTION OF THE ENVIRONMENT?

A. Yes. Pattern Energy developed and followed the Statement of Environmental Commitments that outlines an iterative process for identifying, avoiding, minimizing, and addressing potential environmental impacts of renewable energy development and operations. See the Pattern Energy Statements of Commitments, which includes our Statement of Environmental Commitments, in Exhibit ACC-3.

Q. **PLEASE DESCRIBE HOW THE STATEMENT OF ENVIRONEMENTAL COMMITMENTS AFFECTS HOW PATTERN ENERGY ADDRESSES THE ENVIRONMENTAL BENEFITS AND IMPACTS OF RENEWABLE ENERGY GENERATION AND TRANSMISSION DEVELOPMENT?**

A. The Statement of Environmental Commitments outlines the following principles that guide our approach to environmental protection and renewable energy development:

- Identify and assess potential environmental impacts at all stages of the life cycle of our projects, incorporate them in our decision making, and explore creative mitigations to minimize any adverse impacts.
- Comply with all applicable environmental laws and regulations. Where there are limited regulations, we apply our more stringent standards.
- Engage relevant stakeholders, including community representatives and national resource agencies, during the planning process of our projects.

- Site and design projects in such a manner as to respect wildlife and their habitat.
- Construct and operate projects using best practices to prevent pollution and conserve natural resources.
- Work to continually improve overall environmental performance and ensure we are stewards of the environment.

Pattern Group strives to fulfill these principles in the construction and operation of all our projects by implementing the Statement of Environmental Commitments as standard practice on how we address environmental impacts in the United States. This dynamic ensures that a long-term approach is implemented from the earliest stage of development for addressing potential environmental concerns arising in the course of project development, construction, and operation. Building Wildlife-Friendly Wind, an infographic, explains how Pattern implements this approach to develop and operate its projects in an environmentally responsible way. Exhibit ACC-4 illustrates this stepwise approach.

Q. PLEASE DESCRIBE HOW PATTERN ENERGY HAS IMPLEMENTED AND APPLIED THESE ENVIRONMENTAL VALUES IN NEW MEXICO, INCLUDING AT THE PORTIONS OF THE CORONA WIND PROJECTS CURRENTLY UNDER CONSTRUCTION?

A. Pattern Energy has consistently sought to meet or exceed environmental BMPs and to go over and above statutory and regulatory requirements. Our New Mexico wind projects currently in operation and under construction exemplify this policy. At our Broadview and Grady wind projects in Curry County, New Mexico, we funded research into the interactions between the lesser-prairie chicken and wind energy facilities and committed

substantial resources to in perpetuity habitat conservation for the species on a voluntary basis. At the Western Spirit Wind Project (comprised of the Clines Corners Wind Farm as well as the first phase of the Corona Wind Project) we successfully implemented BMPs developed in partnership with the New Mexico Public Regulation Commission Staff, the New Mexico State Land Office and the Claunch-Pinto Soil and Water Conservation District that were committed to in previous filings. See Exhibit ACC-5. We have also partnered with the Audubon Society, Defenders of Wildlife, and the Nature Conservancy to provide substantial funding to the New Mexico Avian Conservation Partners and the Bird Conservancy of the Rockies to study the relationship between tree clearing practices in pinyon-juniper habitats and sensitive bird species. In the next phase of the Corona Wind Project, we will be partnering again with the New Mexico State Land Office and Claunch-Pinto Soil and Water Conservation District to study the efficacy of different vegetative reclamation practices in the arid southwest to identify potential improvements to standard best practices in reclamation that are tailored to the environment where the wind projects are located.

Q. ARE THERE OTHER IMPORTANT VOLUNTARY GUIDELINES THAT EFFECT HOW PATTERN ENERGY ADDRESSES ENVIRONMENTAL PROTECTION AND STEWARDSHIP IN PROJECT DEVELOPMENT?

A. Yes. Pattern Energy also follows the WEGs (Exhibit ACC-2) at all its projects across the United States and integrates into powerline siting decisions the Avian Powerline Interaction Committee ("APLIC") collision guidelines for reducing avian mortality from powerlines.

Q. WHAT ARE THE WEGS?

A. The WEGs follow a tiered approach identifying, understanding, and addressing potential impacts of wind energy projects to the surrounding environment. Tier One entails an initial landscape-level site characterization relying on satellite imagery and publicly available databases. Tier Two identifies species and habitats of potential concern and different habitat types within a prospective project area that could be impacted by project development. The Tier Two phase often corresponds to the initiation of informal consultation with the USFWS about the proposed project. In Tier Three, biological field studies are initiated and reviewed with USFWS, and site-specific data is used to understand potential risks of impacts to sensitive species. These first three tiers of the WEGs cover the development and construction of a project. The subsequent tiers involve post-construction studies to understand potential and actual impacts of a project to be incorporated into project operations.

Q. **HOW DO THE WEGS AFFECT THE WAY PATTERN ENERGY APPROACHES ENVRIONMENTAL ISSUES IN DEVELOPMENT?**

A. The WEGs' stepwise approach forms the basis of how we address environmental issues in renewable energy development, construction, and operations. Our Statement of Environmental Commitments, also structured around an iterative process, provides a natural complement to the WEGs and allows us to apply our own internal standards in addition to the industry-wide standards delineated in the WEGs.

B. PATTERN ENERGY ENVIRONMENTAL VALUES IN DEVELOPMENT OF THE 2022 CORONA GENERATION EXPANSION

Q. PLEASE DESCRIBE HOW PATTERN ENERGY HAS DEVELOPED AND DESIGNED THE 2022 CORONA GENERATION EXPANSION WITH RESPECT TO IMPACTS TO THE ENVIRONMENT?

A. As discussed earlier, Pattern Energy has implemented its Statement of Environmental Commitments as well as the WEGS and the APLIC Collision Guidelines in developing the Corona Wind Project. I have previously discussed the APLIC Collision Guidelines in the prior proceedings but because this Joint Application relates only to additional generation lands, I do not go into any additional detail. When we began work on the Corona Wind Project in 2016, we also began an analysis of the project and engaged Western Ecosystem Technology, Inc. ("WEST") to complete initial site assessments. As land has been added to the Corona Wind Project over the course of development, including the 2022 Corona Generation Expansion, site assessment review has been extended to these new lands. In December 2016, we completed limited construction work at 30 preliminary turbine locations for the purpose of qualifying the projects for the federal production tax credit ("PTC"). Additional such work occurred in 2017. Some of these sites were used as part of the Western Spirit Wind Project and some will be used for the remainder of the Corona Wind Project. These site assessments included surveys of cultural resources, wetlands and streams, and threatened and endangered species. Tier 1 and Tier 2 followed these initial studies in early 2017 and thereafter and, most recently, in 2021 for the areas of the 2022 Corona Generation Expansion that were not previously analyzed. These studies allowed us to understand not only the existing environment and possible species of concern within the Corona Wind Project Area, but also the likelihood of their presence or absence. Avian Use Surveys in the broader Corona Wind Project Area were conducted over the course of 2017

through today, which includes coverage of the 2022 Corona Generation Expansion. Eagle and raptor nest surveys also began in 2017 and are ongoing for the Corona Wind Project. Additionally, bat feature surveys have occurred and are continuing in the overall Corona Wind Project Area. Overall, thousands of hours of biological field surveys have already occurred and are ongoing throughout the Corona Wind Project area, including specifically areas in the 2022 Corona Generation Expansion.

We have consulted with both the USFWS, and New Mexico Department of Game and Fish relating to our survey efforts and findings and will continue to do so through the course of project development. Since the most recent approval of the Corona Wind Project in NMPRC Case No. 21-00281-UT, the results of the additional survey work that has been completed are consistent with the findings I discussed in my previous testimony The approach to identifying potential resources has been refined over time. This has included a combination of desktop and field surveys to identify potential occurrence sensitive resources such as surface waters, cultural resources, and avian nests. The USACE has approved such an approach for identifying potentially jurisdictional waters and upland areas that requires field verification. We have elected to conduct this analysis across all project areas ahead of actual proposed infrastructure. We have taken a similar approach to cultural resources, not only on public lands but also on private lands. We are similarly developing an approach for identifying occurrence of nesting bird sites. This allows us to identify potential resource conflicts before, during, and after designing project infrastructure to minimize impacts to the maximum extent practicable.

IV. REQUESTED COMMISSION APPROVALS

Q. WHAT COMMISSION APPROVALS ARE THE JOINT APPLICANTS REQUESTING?

A. The Joint Applicants request that the Commission approve the location of the 2022 Corona Generation Expansion pursuant to NMSA 1978, §62-9-3, ("Siting Statute") and Commission Rule 17.9.592 NMAC, ("Location Rule

Q. **PLEASE EXPLAIN WHY PATTERN ENERGY PERFORMED AN EXTENSIVE ENVIRONMENTAL ANALYSIS OF THE ENTIRE CORONA WIND PROJECT STUDY AREA.**

A. As I mentioned earlier in my testimony the common practice in project development of this nature is to adjust proposed locations for wind turbines and the associated Gen -Tie System as more information is obtained during site preparation and analysis phases of a project. In the past, when Pattern Energy determined that it was necessary to adjust a proposed route for the Corona Gen-Tie System outside of the initial one-mile study corridor, it was necessary to perform a subsequent environmental analysis and seek formal location approval through a proceeding before the Commission. In part, this occurred with respect to the subject matter of the proceeding in NMPRC Case No. 20 -00008-UT. Additionally, the more robust environmental review of the generation areas within the Corona Wind Project, including the 2022 Corona Generation Expansion, is significant in setting the standard for best practices in generation project review at the Commission. We performed a detailed analysis throughout the entire area where the 2022 Corona Generation Expansion will be located.

A. <u>SITING STATUTE, NMSA 1978, §62-9-3</u>

Q. **WHY DOES THE 2022 CORONA GENERATION EXPANSION REQUIRE LOCATION APPROVAL?**

A. My understanding is that New Mexico's Siting Statute, specifically NMSA 1978, §62 -9-3(B) requires prior approval by the Commission for construction within New Mexico of any generating plant designed for or capable of operation at a capacity of 300 MW or more and for transmission lines and associated facilities designed for or capable of operations at a nominal voltage of 230-kV or more to be constructed in connection with said plant. The Commission's location approval is required because the Corona Wind Project generation facilities proposed for construction are collectively designed for or capable of operating up to 2,650 MW of wind generation. Although our wind turbines will be spread over a relatively large area, the Joint Applicants are not attempting to bypass Commission approval by characterizing these as numerous smaller projects, but have treated this as a single large, generating facility.

Q. **PLEASE EXPLAIN YOUR UNDERSTANDING OF THE NEED TO COMPLY WITH STATE, COUNTY OR MUNICIPAL LAND USE.**

A. I understand that NMSA 1978, §62-9-3(G) prohibits the Commission from approving a location control application that violates an existing state, county, or municipal land use statutory or administrative regulation unless the Commission finds the regulation is unreasonably restrictive.

Q. **PLEASE EXPLAIN YOUR UNDERSTANDING OF THE STATUTORY REQUIREMENTS FOR LOCATION APPROVAL FOR THE 2022 CORONA GENERATION EXPANSION.**

A. My understanding is that NMSA 1978, §62-9-3(E) requires the Commission to approve an application for location of a generating plant unless the Commission finds that the operation of the facilities will not comply with all applicable air and water pollution control standards existing and established by the New Mexico agency having jurisdiction over a particular pollution source. I understand that the New Mexico Environment has jurisdiction over air and water pollution.

Q. **DOES THE 2022 CORONA GENERATION EXPANSION COMPLY WITH THE REQUIREMENTS OF THE SITING STATUTE?**

A. Yes, the Joint Application and supporting testimony and exhibits demonstrate that the 2022 Corona Generation Expansion complies with these requirements. As the Joint Applicants' other witnesses and I explain in our testimonies, the 2022 Corona Generation Expansion will comply with all applicable air and water pollution control standards. Moreover, the existing state, county, and municipal land use statutory and administrative regulations allow for the installation of the 2022 Corona Generation Expansion.

B. LOCATION RULE, 17.9.592 NMAC

Q. WHAT IS YOUR UNDERSTANDING OF THE REQUIREMENTS OF THE COMMISSION'S LOCATION RULE, 17.9.592 NMAC, REGARDING APPLICATIONS FOR LOCATION OF GENERATION PLANTS?

A. Under the Location Rule, 17.9.592.9 NMAC for generating facilities ("Generation Location Rule") an applicant must file an application supported by written testimony and exhibits that contain the following information for generating plants for which location approval is required:

A. a description of the large capacity plant, including, but not limited to:

(1) a legal description of the property upon which the large capacity plant will be located;

(2) the size of the large capacity plant;

(3) fuel specifications including, but not limited to, the type of fuel to be used; and,

(4) a map showing the location of the large capacity plant;

B. identification of all applicable land use statutes and administrative regulations and proof of compliance or a statement of noncompliance with each;

C. identification of all applicable air and water pollution control standards and regulations and proof of compliance or a statement of noncompliance with each;

D. all written air and water quality authorizations necessary to begin construction of the large capacity plant;

E. all written air and water quality authorizations necessary to begin operation of the large capacity plant; if any such authorization cannot be obtained until after construction of the large capacity plant, proof of application for such authorization;

F. the expected date that the large capacity plant will be online;

G. proof that the application has been served on all local authorities in each county and township where the large capacity plant will be located, the New Mexico Attorney General, the New Mexico Environment Department, and the New Mexico State Engineer;

H. any other information, including photographs, which the applicant wishes to submit in support of the application.

V. COMPLIANCE WITH NEW MEXICO'S STATUTES AND REGULATIONS.

Q. PLEASE CHARACTERIZE THE 2021 CORONA GENERATION EXPANSION'S EXPECTED IMPACTS ON AIR QUALITY.

A. The Joint Applicants comply with all applicable air quality laws and regulations. This is further discussed in the Supplemental Environmental Report.

Q. PLEASE CHARACTERIZE THE 2022 CORONA GENERATION EXPANSION'S EXPECTED IMPACTS ON WATER RESOURCES?

A. The Joint Applicants will comply with all applicable water quality and water resource laws and regulations and will not unduly impair water quality and water resources. This is further discussed in the Supplemental Environmental Report.

Q. PLEASE SUMMARIZE YOUR FINDINGS WITH RESPECT TO AIR QUALITY.

A. The 2022 Corona Generation Expansion will not unduly impair air quality and the Joint Applicants will comply with all applicable air quality laws and regulations. This is further discussed in the Supplemental Environmental Report.

Q. DOES THE JOINT APPLICATION COMPLY WITH THE COMMISSION'S GENERATION LOCATION RULE?

A. Yes, as follows:

A. We have provided a description of the proposed generating plants, their size, and the fact that they are wind generating facilities. A legal description of the property and a map showing the location of the 2022 Corona Generation Expansion is provided in Exhibit JA-1.

B. My testimony explains Pattern Energy's compliance with all applicable land use statutes and administrative regulations.

C. My testimony identifies all applicable air and water pollution control standards and regulations that apply to the Corona Wind Project.

D. My testimony identifies all written air and water quality authorizations necessary to begin operation of the Corona Wind Project, which are all construction phase permits typically issued shortly before construction. The Joint Applicants will provide notification of receipt of these permits as they are obtained.

E. I have further stated that there are no air or water quality authorizations necessary for operation of the Corona Wind Project.

F. I have also testified that the 2022 Corona Generation Expansion is expected to be in service by the end of 2026.

G. The Joint Application has been served on all local authorities in Lincoln County in New Mexico, the New Mexico Attorney General, the New Mexico Environment Department, and the New Mexico Office of the State Engineer.

H. The Joint Application provides additional information to inform the Commission's decision-making on the Joint Applicants' request for location approval of the 2022 Corona Generation Expansion.

VI. CONCLUSION

Q. PLEASE SUMMARIZE YOUR CONCLUSION.

A. The Joint Applicants previously provided a comprehensive environmental impact analysis for the initial proposed Corona Wind Project and Corona Gen-Tie System. The Commission approved that filing, as well as a subsequent filing revising and extending the Corona Gen-Tie System route. Subsequently, a decision was made to further modify the proposed route for the Corona Gen-Tie System and add generation lands. In this

Application, the Joint Applicants are expanding the potential area for locating wind turbines beyond that which was previously approved. We have performed a comprehensive environmental analysis of the new areas being added to the Corona Wind Project in the 2022 Corona Generation Expansion and demonstrated that these additions will still be compliant with all statutes, regulations, and orders of the Commission.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

IN THE MATTER OF THE JOINT APPLICATION FOR THE LOCATION APPROVAL OF THE 2022 CORONA GENERATION EXPANSION PURSUANT TO THE PUBLIC UTILITY ACT, NMSA 1978, §62-9-3	)	
	)	**Case No. 22-00___-UT**
ANCHO WIND LLC, COWBOY MESA LLC, GALLINAS MOUNTAIN WIND LLC, MESA CANYONS WIND, LLC, PATTERN SC HOLDINGS LLC, VIENTO LOCO LLC,	)	
JOINT APPLICANTS.	)	

AFFIDAVIT OF ADAM CERNEA CLARK

THE STATE OF TEXAS)
)
COUNTY OF HARRIS)

Adam Cernea Clark hereby deposes and states under oath that the foregoing Direct Testimony of Adam Cernea Clark and supporting Exhibits were prepared under my direct supervision and the statements therein are true and accurate based on my personal knowledge and belief.

Adam Cernea Clark

SUBSCRIBED AND SWORN TO BEFORE ME, notary public, on this the 13 day of July, 2022.

My Commission expires: 3-15-2025 Notary Public, State of: Texas

EMILY MCCLARY-DAVIS
Notary Public, State of Texas
Comm. Expires 03-15-2025
Notary ID 131046982

Emily McClary Davis

Corona Environmental Report – 2022 Corona Generation Supplement

Ancho Wind LLC, Cowboy Mesa LLC, Gallinas Mountain Wind LLC, Mesa Canyons Wind, LLC, Pattern SC Holdings LLC, and Viento Loco LLC (the "Corona Wind Companies")

Corona Environmental Report – 2022 Corona Generation Supplement
Project No. 131336

7/12/2022

Corona Environmental Report – 2022 Corona Generation Supplement

prepared for

Ancho Wind LLC, Cowboy Mesa LLC, Gallinas Mountain Wind LLC, Mesa Canyons Wind, LLC, Pattern SC Holdings LLC, and Viento Loco LLC (the "Corona Wind Companies")

Corona Environmental Report – 2022 Corona Generation Supplement
New Mexico

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7/12/2022

prepared by

Burns & McDonnell Engineering Company, Inc.
Houston, Texas

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
2021 Corona Wind Update	2021 Corona Generation Expansion and 2021 Revised Corona Gen-Tie System
2022 Corona Generation Expansion	Wind generation land proposed in this Environmental Report as an addition to wind generation land previously approved under Commission Case No. 21-00281-UT (2021 Corona Generation Expansion)
AC	alternating current
ACSR	aluminum conductor steel reinforced
ACSS	aluminum conductor steel supported
APLIC	Avian Power Line Interaction Committee
BCI	Bat Conservation International
BGEPA	Bald and Golden Eagle Protection Act
BIA	Bureau of Indian Affairs
BISON-M	Biota Information System
BLM	U.S. Bureau of Land Management
BLS-SW	Bureau of Labor Statistics, Southwest Information Office
BMPs	Best Management Practices
Burns & McDonnell	Burns & McDonnell Engineering Company, Inc.
CLUP	Comprehensive Land Use Plan
CO	Carbon monoxide
Commission	New Mexico Public Regulation Commission
Corona Wind Companies	Ancho Wind LLC, Cowboy Mesa LLC, Gallinas Mountain Wind LLC, Mesa Canyons Wind, LLC, Pattern SC Holdings LLC, and Viento Loco LLC
Corona Wind Project	Overall wind generation land and generation tie-in transmission system (the "Corona Gen-Tie System"), as approved in Commission Case Nos. 18-00065-UT, 20-0008-UT, and 21-00281-UT, and submitted with this Environmental Report
dBA	A-weighted decibels

Abbreviation	Term/Phrase/Name
DNH	Determination of No Hazard
ECOS	Environmental Conservation Online Service
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FSA	Farm Service Agency
ft	feet
GAP	Gap Analysis Program
GLO	General Land Office
GRT	Gross Receipts Tax
I	interstate
IPaC	Information for Planning and Consultation
IRBs	Industrial Revenue Bonds
kcmil	Thousand Circular Mil
kV	kilovolt
LM	land mobile
m	meters

Abbreviation	Term/Phrase/Name
MBTA	Migratory Bird Treaty Act
MRLC	Multi-Resolution Land Characteristics Consortium
MW	megawatt
NAIP	National Agriculture Imagery Program
NASS	National Agricultural Statistics Service
NESC	National Electrical Safety Code
NHD	National Hydrography Dataset
NLCD	National Land Cover Database
NM CHAT	New Mexico Crucial Habitat Assessment Tool
NMCRIS	New Mexico Cultural Resource Information System
NMDGF	New Mexico Department of Game and Fish
NMDOT	New Mexico Department of Transportation
NMED-AQB	New Mexico Environment Department Air Quality Bureau
NMED-SWQB	New Mexico Environment Department Surface Water Quality Bureau
NM MMD	New Mexico Minerals and Mining Division
NM OCD	New Mexico Oil Conservation Division
NMSA	New Mexico Statutes Annotated
NO_x	nitrogen oxide
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory

Abbreviation	Term/Phrase/Name
NWP	Nationwide Permit
O&M	operations and maintenance
OHWM	ordinary high-water mark
OPGW	optic ground wire
PILOTs	provide payments in-lieu of taxes
PLJV	Playa Lakes Joint Venture
PLSS	Public Land Survey System
PM	particulate matter
PPAs	Power Purchase Agreements
Project	Corona Wind Project, including phases both proposed and previously approved
RETA	Renewable Energy Transmission Authority
ROW	right-of-way
SGP CHAT	Southern Great Plains Crucial Habitat Assessment Tool
SLO	State Land Office
SPCC	Spill Prevention, Containment, and Countermeasures Plan
SPS	Special Protection System
SSURGO	Soil Survey Geographic
Staff	Commission Staff
SO_2	sulfur dioxide
SWCD	Soil and Water Conservation District
SWPPP	Stormwater Pollution Prevention Plan
USDA	U.S. Department of Agriculture

Abbreviation	Term/Phrase/Name
UDP	Unanticipated Discovery Protocol
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOCs	volatile organic compounds

1.0 SUMMARY

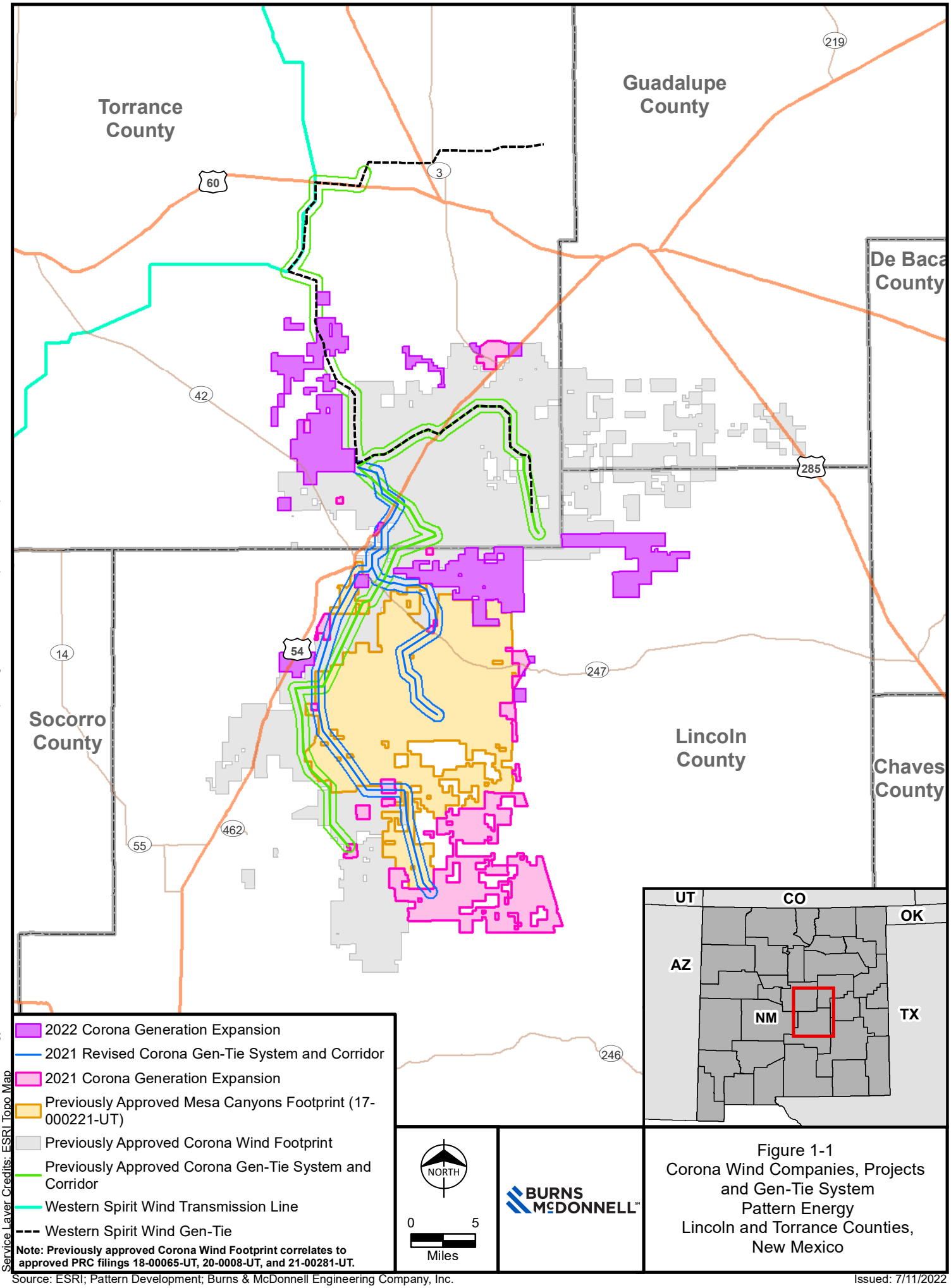
Pattern Energy and its affiliates (Ancho Wind LLC, Cowboy Mesa LLC, Gallinas Mountain Wind LLC, Mesa Canyons Wind, LLC, Pattern SC Holdings LLC, and Viento Loco LLC; collectively the "Corona Wind Companies") are proposing to construct and operate up to 2,650 megawatts (MW) of new wind energy facilities and associated high-voltage transmission lines, as part of the Corona Wind Project (the "Project") and the Mesa Canyons Wind Project, located in Lincoln and Torrance Counties. This supplemental report (the "2022 Corona Generation Supplement") to the 2021 Corona Wind Update Environmental Report (ER) addresses wind generation land proposed as an addition (the "2022 Corona Generation Expansion") to wind generation land previously approved for generation location control by the New Mexico Public Regulation Commission (Commission) under Commission Case No. 21-00281-UT.

1.1 Background

The Commission has previously provided location control approval of a total of 3,200 MW of wind generation for projects owned by the Corona Wind Companies in Lincoln and Torrance Counties in Case Nos. 17-00221-UT, 18-00065-UT, 20-0008-UT, and 21-00281-UT, as well as a large generation tie-in transmission system (the "Corona Gen-Tie System"), which was approved in Case Nos. 18-00065-UT, 20-0008-UT, and 21-00281-UT. The footprint of these wind generation areas and gen-tie systems is shown on Figure 1-1.

Since the time of these approvals, portions of the wind generation and gen-tie system approved in 2018 and 2020 have commenced commercial operations. These wind project areas are comprised of the Duran Mesa, Red Cloud Wind, and Tecolote Wind Projects and associated portions of the approved Corona Gen-Tie System (together with the Clines Corners Wind Farm and the Western Spirit Wind Projects). These three projects will be interconnecting to the Western Spirit Transmission Project in Torrance County and collectively represent 750 MW of wind generation and approximately 30 miles of the approved gen-tie system.

Collectively, the previously approved projects owned by Corona Wind Companies and the 2022 Corona Generation Expansion proposed in this ER are referred to as the "Corona Wind Project." The current proposal included in this ER consists solely of wind generation project analysis for the 2022 Corona Generation Expansion, consisting of 63,549 acres of new wind generation area in Lincoln and Torrance Counties adjacent to the wind generation areas previously approved in the foregoing cases. The proposed


Torrance County
Guadalupe County
De Baca County
Socorro County
Lincoln County
Chaves County
60
3
219
42
285
54
14
247
55
462
246
2022 Corona Generation Expansion
2021 Revised Corona Gen-Tie System and Corridor
2021 Corona Generation Expansion
Previously Approved Mesa Canyons Footprint (17-000221-UT)
Previously Approved Corona Wind Footprint
Previously Approved Corona Gen-Tie System and Corridor
Western Spirit Wind Transmission Line
Western Spirit Wind Gen-Tie
Note: Previously approved Corona Wind Footprint correlates to approved PRC filings 18-00065-UT, 20-0008-UT, and 21-00281-UT.
UT
CO
OK
AZ
NM
TX
NORTH
0
5
Miles
BURNS McDONNELL
Figure 1-1
Corona Wind Companies, Projects and Gen-Tie System
Pattern Energy
Lincoln and Torrance Counties, New Mexico
Path: C:\TEMP WORK\101335 Pattern Energy Corona WindMXD\2022 Corona South\1 PRC South Env Report\Figure1.1 Overall Map.mxd vakarpov 7/11/2022
Service Layer Credits: ESRI Topo Map
Source: ESRI; Pattern Development; Burns & McDonnell Engineering Company, Inc.
Issued: 7/11/2022

acreage does not represent increased power output beyond what has previously been authorized or submitted for approval by the Commission.

1.1.1 Previously Approved and Submitted Projects

Between 2018 and 2022, the Commission approved applications for the Corona Wind Project and the Corona Gen-Tie System in Lincoln, Torrance, and Guadalupe Counties, New Mexico, under Case Nos. 17-00221-UT, 18-00065-UT, 20-0008-UT, and 21-00281-UT. The most recent of these, Case No. 21-00281-UT, obtained Commission approval for updates to the Corona Gen-Tie System including approximately 59.2 miles (312,576 ft) of new 345-kilovolt (kV) transmission line (the 2021 Revised Corona Gen-Tie System) and 50,100 acres of additional wind generation area in Lincoln and Torrance Counties (the 2021 Corona Generation Expansion) adjacent to the previously approved areas of the Corona Wind Project. These updates reflect design improvements and provide connection to the 2021 Corona Generation Expansion and the Mesa Canyons Wind Project.

1.1.2 Update to Previously Submitted Projects

The Corona Wind Companies are proposing the 2022 Corona Generation Expansion, consisting of 63,549 acres of additional wind generation area adjacent to the previously approved areas of the Corona Wind Project. The proposed 2022 Corona Generation Expansion will not increase the number of turbines for the Corona Wind Project, but will increase the acreage within which the Corona Wind Project will be located. Figure 1-1 provides an overview of the proposed 2022 Corona Generation Expansion along with previously approved projects.

This ER provides a review of the existing environment within the footprint of the 2022 Corona Generation Expansion and analyzes the potential environmental impact outside previously approved areas of the Corona Wind Project footprint. The affected environment (existing condition) for the environmental values provided in NMSA 1978 Section 62-9-3.M, Commission Rule 17.9.592 NMAC, and additional resource areas identified to be of interest by Commission Staff (Staff) are evaluated in this ER. The resources addressed in this ER include: air resources; water resources; biological resources; land use (including recreation and schools); visual and scenic; cultural, historic, and archeological resources; religious resources; geology and paleontology; soils; minerals and mining; socioeconomic; roads; noise; communication signals; military activities and aviation; geographic resources; radioactive waste and radiation hazard; hazardous materials; and safety.

The discussion for each resource includes data sources used, current regional conditions, and conditions within the footprint of the 2022 Corona Generation Expansion (63,549 acres). Impact evaluations for each resource are discussed alongside Best Management Practices (BMPs) that can help manage impacts.

2.0 INTRODUCTION AND PURPOSE AND NEED

The Corona Wind Companies are proposing to locate the 2022 Corona Generation Expansion in Lincoln and Torrance Counties, New Mexico. A sum total of 63,549 acres of land within the 2022 Corona Generation Expansion are currently being negotiated with landowners. Although information about the Corona Wind Project as a whole is discussed herein to provide overall project context, the New Mexico statutes only require evaluation of the 2021 Revised Corona Gen-Tie System.

2.1 Purpose and Need

The purpose and need of the 2022 Corona Generation Expansion is to increase design efficiencies of the associated 2021 Revised Corona Gen-Tie System, which would allow renewable energy from the Corona Wind Project to interconnect to the electrical grid. New wind generation area footprint totaling approximately 63,549 acres will be acquired in Lincoln and Torrance Counties. The proposed acreage does not represent increased power output beyond what has previously been authorized or submitted for approval by the Commission.

2.2 Decisions to be Made

The siting statute, NMSA 1978, Section 62-9-3.E provides that the Commission shall approve the location of generating plants with a capacity of three hundred thousand kilowatts [300 MW] or more unless it finds that the operations of the facilities for which approval is sought will not comply with all applicable existing air and water pollution control standards and regulations. This ER addresses the important environmental values the Commission has identified in its location rule 17.9.592 NMAC, as well as other issues identified by Staff.

3.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

3.1 Alternatives Considered

The Corona Wind Companies are planning to construct the 2021 Revised Corona Gen-Tie System, which will consist of an overhead 345-kV transmission line to connect the Corona Wind Project (including the proposed 2022 Corona Generation Expansion) to the existing SunZia Transmission Line System. The final transmission line route will be determined with respect to several factors, such as, the final turbine layout, siting of the step-up substations and switchyards based on the final turbine layout, interconnection requirements, landowner coordination, geographic features, and micro-siting of poles. Measures would be undertaken to reduce impacts to important environmental resources to the extent practicable.

3.2 Proposed Project (Proponent Preferred)

The Corona Wind Companies plan to construct, operate, and maintain a new 345-kV transmission line located within the region of the previously approved areas of the Corona Wind Project and the proposed 2022 Corona Generation Expansion. The proposed 2022 Corona Generation Expansion will not increase the number of turbines for the Corona Wind Project, but will increase the acreage within which the Corona Wind Project will be located. It is anticipated that there will be approximately 59.2 miles (312,576 ft) of 345-kV transmission line along with the related substation facilities that would transport electricity generated at the Corona Wind Project (including the proposed 2022 Corona Generation Expansion to the existing SunZia Transmission Line System. Step-up substations previously approved in Commission Case No. 21-00281-UT would convert lower voltage (34.5-kV) electricity generated at the Corona Wind Project (including the proposed 2022 Corona Generation Expansion) and increase it to higher voltage electricity (345-kV) for interconnection to the transmission line. A switchyard would also be constructed within the 2021 Revised Corona Gen-Tie System to connect individual projects together for interconnection into the SunZia Transmission Project at a single point.

3.2.1 Transmission Line

Section 3.2.1 and subsections are included only to reference the 2021 Revised Corona Gen-Tie System previously approved under Commission Case No. 21-00281-UT. No additional transmission line or revised route is proposed as part of this supplemental report.

Electricity generated by the wind turbines would be gathered via buried electrical collection system lines that will be charged at 34.5-kV. The collection system circuits would be gathered at one of the Corona Wind Project's step-up substations where the voltage would be increased from 34.5-kV to 345-kV via large power transformers. The Corona Wind Project's step-up substations would be connected to each

other via a 345-kV transmission line that could connect to not only the SunZia Transmission Project but also the Western Spirit Transmission Project. The decision on the number of 34.5 to 345-kV step-up substations would be made prior to construction and would be determined by design efficiencies that reduce total electrical infrastructure needed and minimize electrical losses. The transmission line(s) would consist of an overhead line operated at 345-kV. The length of the transmission line would depend on final design. The transmission line would require a right-of-way (ROW) width of about 180 ft.

3.2.1.1 Structures

The transmission structure types for the 345-kV transmission line would be wood or steel monopole, two-pole H-frame, and/or three-pole angle structures. Most structures would be self-supporting; however, in some areas, structures would be guyed to provide additional structural support. In areas that require long spans between structures, such as riparian or stream crossings, a taller, larger structure would typically be used. In areas where the line turns, the transmission line could be supported by three-pole angle transmission structures or a structure with guy wires. Typical transmission structure heights for the tangent (structures that hold the line up, but bear little tension), dead-end (structure that bears tension), and angle transmission structures (structure that supports change in line direction and bears tension) would be approximately 80 to 130 ft above the existing ground, depending on terrain and span length.

Structures spans would typically be 600 to 900 ft in length. In most cases, transmission structures would be directly embedded into the ground. Additional foundation support, such as drilled pier concrete foundations may be used in special design cases depending on geotechnical conditions. The diameter of the transmission structure poles would be approximately 3 to 5 ft, depending on framing configuration and the angle to adjacent transmission structures.

3.2.1.2 Conductors and Associated Hardware

The 345-kV transmission line would consist of three phases with each phase consisting of bundled conductors composed of two 954-Thousand Circular Mil (kcmil) aluminum conductor steel supported (ACSS) cables or conductors of comparable capacity. An ACSS consists of 7 steel wires surrounded by 54 aluminum strands. Each conductor is approximately 1.2 inches in diameter. Minimum conductor height above the ground for the 345-kV transmission line would be 30.3 ft, at 167 degrees Fahrenheit based on National Electrical Safety Code (NESC) standards and Special Protection System (SPS) standards. At road crossings, minimum clearance would typically increase to approximately 37.3 ft above ground. Similar sized aluminum conductor steel reinforced (ACSR) cables or conductors also could be used.

3.2.1.3 Fiber Optics

Fiber optic ground wire (OPGW) cable for substation-to-substation control would be installed on top of each transmission structure in the shield wire. The outer strands would consist of aluminum wire and the entire OPGW would be approximately 0.55 inch in diameter.

3.2.2 Step-Up Substation and Adjacent Switchyard

Section 3.2.2 is included only to reference the 2021 Revised Corona Gen-Tie System previously approved under Commission Case No. 21-00281-UT. No additional substations or switchyards are proposed as part of this supplemental report.

More than one new step-up substation would be constructed within the 2021 Revised Corona Gen-Tie System corridor. The step-up substation(s) would consist of transformers; circuit breakers; switching devices; auxiliary equipment; control enclosure containing equipment for proper control; protection, monitoring; and communications; and associated equipment and facilities. The final location(s) would be determined upon the micrositing and geotechnical examinations of proposed wind turbine locations. The principal function of the substation is to increase the voltage from the collector system (34.5-kV) to the voltage of the 2021 Revised Corona Gen-Tie System transmission line (345-kV). The 2021 Revised Corona Gen-Tie System would allow for the delivery of the electricity of the Corona Wind Project to the SunZia Transmission Project (where the voltage would then be increased to 500-kV). The step-up substation(s) would be located within a fenced area. The fence would be designed in accordance with industry standards to provide safety and security.

A switchyard and 345- to 500-kV step-up substation would be located adjacent to the Western Spirit Transmission Project. The switchyard and step-up substation would connect the electricity to the existing transmission system.

3.2.3 Right-of-Way Acquisition

Section 3.2.3 is included only to reference the 2021 Revised Corona Gen-Tie System previously approved under Commission Case No. 21-00281-UT. No additional transmission line ROW is proposed as part of this supplemental report.

ROW width for the transmission line would be 180 ft (90 ft each side of the transmission line). A 180-foot-wide ROW would accommodate the anticipated structure types, span lengths, and heights for the transmission line; would comply with electrical safety codes; would provide adequate logistical space for construction, operations, and maintenance of the line; and would provide sufficient flexibility for siting structures in the ROW. Final design will determine the structure locations and characteristics. Easements

for the transmission line ROW, temporary work areas, and temporary access roads would be required for the transmission line and substations. Some public road upgrades may be necessary and will be negotiated through the Torrance and Lincoln County Roads Maintenance Departments and private landowners. The 2021 Revised Corona Gen-Tie System on private lands would be obtained as private easements or ROWs.

3.2.4 Access Roads

The Corona Wind Project would use existing roads and overland travel wherever feasible for access in order to reduce new disturbance. Some new permanent or temporary access/short spur roads may be required to access structure locations within the ROW. New access roads within the existing ROW would retain access for maintenance. Portions of existing access roads located outside of the proposed ROW may require improvements as well as new access roads (temporary or permanent). To reduce ground disturbance and/or reduce visual contrast with the landscape, the alignment of any new temporary access roads or cross-country routes would follow landform contours in designated areas where practicable, provided that such alignment does not impact other resource values additionally. All temporary access roads would be revegetated with native or similar grasses and forbs following construction. Where ground disturbance is substantial, surface preparation and reseeding would occur. The method of restoration would normally consist of loosening the soil surface, reseeding, installing cross drains for erosion control, placing water bars in the former access road, and filling temporary ditches and swales. Impacts and protection measures for disturbance resulting from the 2022 Corona Generation Expansion to soils, water resources, flora and fauna, and visual resources are discussed in Sections 5.5, 5.7, 5.8, and 5.11 of Chapter 5.0.

All new access that is not required for maintenance would be closed with concurrence of the landowner. Gates, where present or if installed, would be closed and/or locked, depending on the agreement with each landowner. Access roads on private property may be maintained with mutual consent of the landowner. A discussion of impacts and protection measures related to land use along the 2022 Corona Generation Expansion is included in Section 5.12 of Chapter 5.0.

3.2.5 Laydown / Material Staging Areas

Temporary laydown material staging areas would be required to store materials and equipment and to assemble structures for the duration of construction of the Corona Wind Project. The staging areas would be up to 20 acres in size and located at level areas in close proximity to existing roads within the area. The laydown staging areas would be used to store material and equipment prior to delivery to the structure sites, park vehicles, and, possibly, station a portable construction trailer. The staging areas would be surveyed for potential environmental impacts, and if any are found, the staging areas would be relocated

or shifted to avoid such sensitive areas. The staging areas would be revegetated and reclaimed after completion of construction of the Corona Wind Project. Impacts and protection measures related to micrositing staging areas and impacts due to disturbance are discussed below in Section 5.8 of Chapter 5.0.

3.2.6 Construction Activities

The proposed Corona Wind Project will use standard construction and operation procedures used for other transmission projects in the western United States. Construction is expected to take approximately 12 to 18 months, depending on the results of interconnection studies and final design. The construction schedule forecasts activity commencing late 2022 or early 2023 and concluding by the end of 2025. The Corona Wind Project is expected to be in full operation by the end of 2025.

3.2.6.1 Sequence of Activities

The construction of the Corona Wind Project is expected to follow the sequence of: (1) new structure locations surveyed and staked; (2) laydown/materials yard and work areas cleared, as needed; (3) access roads improved or built where necessary; (4) materials distributed along centerline and at wind turbine locations; (5) structure holes dug and poles framed and erected; (6) conductors installed; and (7) site cleaned-up and reclaimed. The timing of construction activities may occur at different locations throughout the construction process. This may require several crews operating simultaneously at different locations.

Temporary laydown/material staging areas would be located on existing disturbed areas or other areas on private lands along the line route with negotiated access rights from private landowners. The yards would serve as field offices, reporting locations for workers, parking space for vehicles and equipment, or sites for temporary marshalling of construction materials.

3.2.6.2 Surveying

Construction survey work for the proposed Corona Wind Project consists of ascertaining soil and geotechnical conditions for foundations, determining specific pole locations, and delineation of ROW and work area boundaries, and, in some areas, roads to access work areas.

3.2.6.3 Access Road Construction

The Corona Wind Project would be located in close proximity to many public roads in order to facilitate access the ROW, to the extent practicable. The construction of temporary construction access roads or overland travel may be required to allow access of construction equipment in the transmission line

corridor and turbine layout. This may involve clearing vegetation and crushing vegetation for overland travel. In construction areas where re-contouring is not required, disturbance would be limited to overland driving, where feasible, to minimize changes in the original contours. Large rocks and vegetation may be moved within these areas to allow vehicle access. Impacts and protection measures resulting from access road construction to soils, flora and fauna, and visual resources are discussed in Sections 5.5, 5.8, and 5.11 of Chapter 5.0

Equipment to construct the access roads would include hand tools, bulldozers, and graders. Specific BMPs would be implemented to reduce construction impacts. For example, roads would be built at right angles to streams to the extent practicable, to limit the impact of stream crossings; existing public roads would be utilized to the extent possible; appropriately sized culverts would be installed where needed; and road construction would include dust-control measures during construction, as required. Standard design techniques, such as installing water bars and dips to control erosion, would be included in areas with slopes. In addition, measures would be taken to reduce impacts such as rutting and soil compaction in specific locations and during certain periods of the year. Discussion of impacts and protection measures for water resources resulting from construction within the 2022 Corona Generation Expansion area is included in Section 5.7 of Chapter 5.0.

3.2.6.4 Structure Holes

Excavations for structure holes would be generally made with truck-mounted power auger equipment or a standard-sized backhoe or large excavator. Where the soil and geotechnical conditions permit, a truck-mounted power auger would be used. The foundation excavation and installation require equipment access to the foundation sites. Structure hole excavation and installation require access to the site by a power auger or drill, a crane, and material trucks.

Structure holes left temporarily open or unguarded during construction would be covered and/or fenced where practical to protect the public, livestock, and wildlife. Soil removed from foundation holes would be stockpiled on the work area and replaced or disposed, in consultation with landowners.

3.2.6.5 Structure Framing and Assembly

Pole sections, pole framing, and associated hardware would be shipped to each laydown/materials yard site by truck. Structures may be assembled offsite and transported to the appropriate pole locations by truck or helicopter. Insulator strings and stringing sheaves are installed at each ground wire and conductor position while the pole is on the ground. Stringing sheaves (pulleys) are used to guide the conductor

during the stringing process for attachment onto the insulator strings. The assembled pole would then be hoisted into place by a crane. Helicopter assisted construction may be utilized for portions of the line.

3.2.6.6 Conductor Installation

Section 3.2.6.6 is included only to reference the 2021 Revised Corona Gen-Tie System previously approved under Commission Case No. 21-00281-UT.

Once structures are in place, a pilot line would be pulled (strung) from structure to structure and threaded through the stringing sheaves on each insulator. A larger diameter, stronger line would then be attached to the pilot line and strung. This is called the pulling line. This process is repeated until the ground wire and conductor are pulled through all insulator sheaves.

Conductor would be strung using powered pulling equipment at one end and powered braking or tensioning equipment at the other end. For public protection during wire installation, guard structures would be erected over roadways, transmission and distribution lines, structures, and other obstacles. Guard structures would consist of H-frame poles temporarily placed on either side of an obstacle. These structures prevent ground wire, conductor, or equipment from falling on an obstacle. Equipment for erecting guard structures includes augers, line trucks, pole trailers, and cranes. Guard structures may not be required for small roads where other safety measures such as barriers, flagmen, or other traffic control devices would be used. Impacts and protection measures pertaining to safety are included in Section 5.17 of Chapter 5.0.

Conductor splicing would be required at the end of a conductor spool or if a conductor is damaged during stringing. The work would occur on work areas for the poles or pulling tensioning sites.

3.2.6.7 Helicopter Use

Access is required to each transmission structure site for construction activities, and helicopters may be used to support construction activities on unique areas that limit vehicle access. Gen-Tie construction activities potentially facilitated by helicopters may include:

- Transport of equipment and materials to transmission structure sites.
- Transmission structure placement.
- Hardware installation.
- Wire and conductor stringing operations.

All helicopter operations would be coordinated with and approved by the Federal Aviation Administration (FAA).

3.2.6.8 Step-up Substations and Switchyard

Section 3.2.6.8 is included only to reference the 2021 Revised Corona Gen-Tie System previously approved under Commission Case No. 21-00281-UT.

Following survey and staking of the substation and switchyard site, erosion control measures would be installed, as necessary. Site access would be prepared, including installation of culverts in drainages, if needed, to install a gravel driveway. The substation and switchyard site would be graded and fenced. Concrete pads and footing for equipment would be installed. Aggregate would be spread throughout the fenced area. Equipment would be delivered to the site and generally stored inside the fenced area, although some materials may need to be stored on the property outside the fence due to size or safety considerations. Equipment such as circuit breakers, bus work, capacitors, and dead ends would be assembled and installed. Transformers would be delivered to the site and installed. Substation control house and supervisory control and data acquisition equipment would be installed. Upon completion of construction activities, disturbed areas outside the fence would be restored and erosion control measures removed.

3.2.6.9 Construction Waste Disposal

Construction sites, laydown and material storage yards, and access roads would be kept in an orderly condition throughout the construction period. Refuse and trash would be removed from the sites and disposed of in an approved manner, including recycling options. Oils and fuels would be hauled to an approved site for disposal. No open burning of construction trash would occur at any time.

3.2.6.10 Site Reclamation

Work sites would be reclaimed using excess materials, native or similar vegetation, and topsoil stockpiled for that purpose. The contractor would dispose of excess soil materials, rock, and other objectionable materials that cannot be used in reclamation work.

Disturbed areas, with the exception of access roads, would be reclaimed, to the extent possible, to their original contour and reseeded where appropriate. Ripping and other surface scarification on construction roads or other areas would be done as necessary. Depending on the amount of soil compaction and vegetation destruction, ripping may not be required for reclamation. This would be determined on a case-by-case basis. Discussion of impacts and protection measures for disturbance resulting from construction,

operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area to soils and flora and fauna are discussed in Sections 5.5 and 5.8 in Chapter 5.0.

3.2.6.11 Protection of Private Property and Environmental Resources

Existing improvements would be repaired or replaced if they are damaged by construction activities. All existing roads would be left in a condition generally equal to or better than their condition prior to the construction of the transmission line. Fences and gates would be installed or repaired and replaced (if they are damaged by construction activities) to their original conditions as required by the landowner.

Temporary gates would be installed only with the permission of the landowner and would be restored to original condition following construction unless otherwise agreed with the landowner. Gates would be closed and locked, depending on the agreement with the private landowners.

Prior to construction, all supervisory construction personnel would be instructed on the protection of ecological and cultural resources. To assist in this effort, the construction contract would address: (a) federal, state, and local laws regarding wetlands, vegetation, wildlife, and cultural resources; (b) the importance of these resources and the purpose and necessity of protecting them; and (c) methods for protecting sensitive resources.

All waste products, including food garbage, from construction sites would be deposited in a covered waste receptacle, or removed daily. Garbage would be hauled to a suitable and appropriately permitted disposal facility.

To reduce the number of sensitive features disturbed in designated areas, transmission poles would be sited during the engineering design process so as to avoid sensitive features such as, but not limited to, riparian areas and watercourses and/or to allow conductors to clearly span the features, within limits of standard pole design. A discussion of impacts and protection measures for the environmental resources present in the 2022 Corona Generation Expansion area are included in Chapter 5.0.

3.2.7 Operation and Maintenance

Operation and maintenance (O&M) of the Corona Wind Project is anticipated to include the following.

3.2.7.1 Operation

After the constructed Corona Wind Project has been energized, land uses compatible with safety regulations and activities associated with O&M would be permitted within and adjacent to the ROW. Existing land uses such as agriculture and grazing are generally permitted within the ROW. Incompatible

land uses include construction of permanent dwellings and any use requiring changes in surface elevation that would affect NESC electrical clearances of existing or planned facilities.

Safety is a primary concern in the planning and design of the Corona Wind Project. An AC transmission line would be protected with power circuit breakers and related line relay protection equipment. If a conductor failure occurs, power would be automatically removed from the line. Lightning protection would be provided by overhead static and grounding wires along the length of the line. All fences, metal gates, pipelines, etc., that cross or are within the Corona Wind Project ROW would be grounded to prevent electrical shock and to meet NESC requirements. A discussion on impacts and protection measures regarding safety are included in Section 5.17 of Chapter 5.0.

3.2.7.2 Maintenance

Maintenance of the transmission line would be performed as needed. When access is required for non-emergency maintenance and repairs, the same precautions taken during construction activities would be implemented to the extent practicable. Landowners would be contacted when access to their lands is required for maintenance activities on transmission lines.

Emergency maintenance would involve prompt movement of crews to repair or replace any damage. Crews would be instructed to protect vegetation, wildlife, and other environmental resources to the extent possible. Reclamation procedures following completion of repair work would be similar to those prescribed for normal construction.

3.2.7.3 Traffic Safety

Minimal additional vehicular traffic would occur on public roads in the area as a result of transmission line construction and O&M of the transmission line. Because of the low number of vehicles accessing the transmission line, minimal impacts are anticipated. The transmission line would cross U.S. Highways 54 in Torrance County and New Mexico State Highway 247 in Lincoln County. County road use and crossings in Torrance and Lincoln Counties would also be required and would be coordinated with the New Mexico Department of Transportation (NMDOT) and the Torrance and Lincoln County Roads Maintenance Departments. Final engineering design would determine specific road crossing requirements (see additional discussion in Section 5.20).

3.2.8 Decommissioning

Decommissioning of the Corona Wind Project will involve removal of all wind facilities. Corona Wind Companies will take appropriate measures to restore the development area to its pre-existing conditions. Removal and restoration efforts will generally involve:

- **Wind turbines (including towers and pad-mount transformers):** Wind turbines will be cleared, cleaned and removed from the Corona Wind Project footprint. Any liquids, greases, etc. contained therein will also be removed safely from the site in accordance with then-existing laws and regulations.

- **Tower foundations and pad mount transformer foundations:** All foundations installed in the ground, the foundations will be cleared, cleaned and removed from the ground to at least four ft below the grade. Holes or cavities created in the ground, as a result of such removal, will be filled with topsoil of the same or similar type found at the site.

- **Overhead power and/or communication lines:** Overhead power and/or communication lines owned by Corona Wind Companies and no longer in use will be cleaned and removed from the Corona Wind Project footprint.

- **Substations:** Substations will be cleared, cleaned and removed from the Corona Wind Project footprint and any liquids, greases, etc. contained in the substations will be removed safely from the site in accordance with then-existing laws and regulations.

- **Buried cables (power and/or communication):** All buried cables (power, fiber-optic, communication, etc.) installed in the ground will be cleared, cleaned at least three ft below the grade of the land affected. Corona Wind Companies will ensure that any holes or cavities created in the ground as a result of such removal are filled with topsoil of the same or similar type found at the Project site.

- **O&M building**: Will be cleared, cleaned and removed from the Corona Wind Project footprint. Corona Wind Companies may request that the O&M building be assigned to a new owner.

- **Restoration of property:** To the extent reasonably practicable, the Project site will be returned to pre-existing conditions. Corona Wind Companies will ensure that any holes or cavities created in the ground are filled with topsoil of the same or similar type found at the Project site and to the extent reasonably practicable, the surface is returned to the same condition as before the holes or cavities were dug.

4.0 AFFECTED ENVIRONMENT

4.1 Introduction

The affected environment is described below for the environmental values provided in NMSA 1978 Section 62-9-3.M, Commission Rule 17.9.592 NMAC, and additional resource areas identified to be of interest by Staff. These are: air resources; noise, geology and mineral resources; soil resources; paleontological resources; water resources; flora and fauna; cultural and historic archaeological resources; religious and cemetery sites; socioeconomics and environmental justice; communication signals; radioactive waste and radiation hazards; hazardous materials; safety; geographic resources; military activities and aviation; and roads. The discussion for each resource includes data sources used, current regional conditions, and conditions within the 2022 Corona Generation Expansion. The 2022 Corona Generation Expansion and the previously approved 2021 Corona Wind Update and Mesa Canyons Wind Project are shown in Exhibit 1. Final siting of transmission facilities will depend upon the results of Southwest Power Pool interconnection studies and other factors such as landowner preferences.

This section of the ER describes the existing conditions of certain relevant resources. The primary focus is on the resources potentially affected by an electric transmission line that will enable certain wind generation systems to connect to electric markets. This area of potentially affected resources is defined as the parcels of land within the 180-foot ROW of the transmission line and associated facilities, including areas of interconnection (substations) and access roads for maintenance or operation of the line, and all areas of previously approved or currently proposed generation footprint that may be utilized for routing of the 2021 Revised Corona Gen-Tie System. This area is shown in Exhibit 1.

4.2 Air Resources

4.2.1 Data Sources

The following data sources were reviewed to assess the existing air quality conditions of Torrance and Lincoln Counties as crossed by the 2022 Corona Generation Expansion.

- AirNow. 2022. *U.S. Air Quality Index*. Accessed June 2022 from: https://www.airnow.gov/.
- New Mexico Environment Department Air Quality Bureau (NMED-AQB). 2013. *Air Resources Manager* (map). Accessed June 2022 from: https://aqi.air.env.nm.gov/
- U.S. Environmental Protection Agency (EPA). 2021a. *Criteria Air Pollutants*. Accessed June 2022 from: https://www.epa.gov/criteria-air-pollutants.

- EPA. 2022. *Nonattainment Areas for Criteria Pollutants (Green Book).* Accessed June 2022 from: https://www.epa.gov/green-book.

4.2.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

The EPA sets National Ambient Air Quality Standards (NAAQS) for the six "criteria air pollutants" and using technical information provided from states designates each county as nonattainment, attainment, or attainment/unclassifiable to describe if the standards are being met (EPA, 2021a). All counties crossed by the 2022 Corona Generation Expansion are currently designated as attainment/unclassifiable for all criteria pollutants (EPA, 2022). An attainment/unclassifiable designation means that EPA has determined that these areas likely meet or are cleaner than the NAAQS based on available data. The attainment/unclassifiable status for these counties is reflective of low population density and land use dominated by agriculture. No unique air quality conditions are known to occur in Torrance or Lincoln County where the 2022 Corona Generation Expansion is located (NMED-AQB, 2013; AirNow, 2022).

4.3 Noise

4.3.1 Data Sources

The following data source was reviewed to assess the existing noise conditions of Lincoln and Torrance Counties and the 2022 Corona Generation Expansion.

- U.S. Census. 2020. Accessed June 2022 from: www.census.gov.

4.3.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

Torrance and Lincoln Counties are rural counties located in central New Mexico with population densities below the state and national averages (U.S. Census, 2020). The counties generally have relatively low ambient noise levels due to the rural setting. Noise in the 2022 Corona Generation Expansion area typically ranges from very quiet with natural sounds and wind dominating to noisy in localized areas near towns, at highway crossings, and in agricultural areas during cultivation activities. Additional noise is also created by existing wind energy generation turbines operating within the proximity and aircraft when operating within nearby airspace.

4.4 Geology and Mineral Resources

4.4.1 Data Sources

The following data sources were reviewed to assess geological and mineral resources of Torrance and Lincoln Counties as crossed by the 2022 Corona Generation Expansion.

- Green, G.N., Jones, G.E., and Anderson, O.J. 1997. *The Digital Geologic Map of New Mexico in ARC/INFO Format: U.S. Geological Survey Open-File Report 97-0052*. Accessed June 2022 from https://mrdata.usgs.gov/geology/state/fips-unit.php?code=f35019.
- New Mexico Mining and Minerals Division (NM MMD). 2022. *Mine Registrations and Permits Search*. Accessed June 2022 from: https://wwwapps.emnrd.state.nm.us/MMD/MMDWebInfo/.
- New Mexico Oil Conservation Division (NM OCD). 2022. *NM OCD Oil and Gas Map* (web application). Accessed June 2022 from: https://nm-emnrd.maps.arcgis.com/apps/webappviewer/index.html?id=4d017f2306164de29fd2fb9f8f35ca75
- The Drillings. 2022. *Lincoln and Torrance Counties, New Mexico*. Accessed June 2022 from https://thedrillings.com/usa/new-mexico.
- U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). 2022. *Web Soil Survey*. Accessed June 2022 from: http://websoilsurvey.nrcs.usda.gov.
- U.S. Geological Survey (USGS). 2011. Mineral Resources Data System (MRDS). Accessed June 2022 from: https://mrdata.usgs.gov/mrds/.

4.4.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

The 2022 Corona Generation Expansion is located on the west side of the Great Plains physiographic province. The signature geologic deposit of the Great Plains is the Ogallala Formation, and it has been largely eroded away in the area by the Pecos River. The resulting landscape is largely a piedmont – thin to non-existent soil over a gently sloping bedrock surface. In places there are remnants of the Ogallala and younger alluvial sediments (Green et al., 1997). The bedrock itself is mostly Permian aged sedimentary rock that had been deposited in the ocean on a continental shelf. Soil type parent materials as mapped by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) are shown on Exhibit 2 (NRCS, 2022).

There are no currently active oil and gas leases on public lands in Torrance or Lincoln County, including lands administered by the U.S. Department of Interior's Bureau of Land Management (BLM) (The Drillings, 2022). According to the New Mexico Oil Conservation Division (NM OCD) Oil and Gas Map,

there are no active hydrocarbon extraction activities within one mile of the 2022 Corona Generation Expansion (NM OCD, 2022) (Exhibit 3). One natural gas pipeline operated by El Paso Corporation crosses the 2022 Corona Generation Expansion's westernmost parcel in Lincoln County. This parcel is adjacent to the El Paso Corporation pipeline's Lincoln compressor station.

According to data obtained in 2022 from the New Mexico Mining and Minerals Division (NM MMD), Lincoln County has had 76 mine registration and/or permit applications and Torrance County has had 43 mine registration and/or permit applications for the extraction of aggregate, caliche, dimension & flagstone, limestone, copper, gold, and silver (NM MMD, 2022). Twenty of these are listed as active mines (5 in Lincoln County and 15 in Torrance County), all for the extraction of aggregate, caliche, dimension & flagstone, or iron. According to the USGS Mineral Resources Data System (MRDS), no current producers occur within the footprint of the 2022 Corona Generation Expansion, although one crushed stone materials pit of unknown development is present within the westernmost parcel in Lincoln County (USGS, 2011; Exhibit 4). Additionally, one iron mine of unknown development is present within one mile of the easternmost parcel in Torrance County. Areas around abandoned mines may contain contaminated soils originating from extraction and processing activities.

4.5 Soil Resources

4.5.1 Data Sources

The following data source was reviewed to assess the existing soil resources of Lincoln and Torrance Counties and the 2022 Corona Generation Expansion.

- USDA NRCS. 2022. *Web Soil Survey*. Accessed June 2022 from: http://websoilsurvey.nrcs.usda.gov.

4.5.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

Table 4-1 summarizes the existing soil resources located within the 2022 Corona Generation Expansion. For a visual representation of the soil locations within the 2022 Corona Generation Expansion, refer to Exhibit 5.

Table 4-1: Soil Coverage Types within 2022 Corona Generation Expansion

Soil Type	Estimated Acreage
Lincoln County	
Deama-Pastura association, moderately sloping	2941.84
Pastura loam, gently sloping	812.71
Pastura-Harvey association, moderately rolling	3452.89
Pastura-Partri association, gently sloping	1249.62
Penistaja-Travessilla association, gently sloping	9695.92
Plack-Dioxice loams, 0 to 8 percent slopes	1193.12
Plack-Dioxice association, gently sloping	2167.12
Plack-Penistaja association, gently sloping	3779.61
Reventon-Sampson association, gently sloping	1148.59
Rock outcrop-Stroupe-Deama association, extremely steep	3386.14
Sampson loam, 0 to 5 percent slopes	132.49
Darvey-Asparas association, gently sloping	108.18
Tortugas-Asparas-Rock outcrop association, moderately sloping	978.75
Darvey-Pastura association, gently sloping	2309.92
Tortugas-Rock outcrop association, moderately sloping	2173.45
Carnero loam, 3 to 8 percent slopes	4.77
Harvey loam, 1 to 9 percent slopes	2.20
Laporte-Rock outcrop complex	0.26
Manzano loam, 1 to 5 percent slopes	3.17
Pinon channery loam, 3 to 20 percent slopes	0.38
Scholle loam, 1 to 5 percent slopes	1.22
Tapia-Dean loams, 0 to 5 percent slopes	0.23
Wilcoxson loam, thick surface, 1 to 6 percent slopes	0.43
Torrance County	
Penistaja-Travessilla association, gently sloping	1.88
Plack-Dioxice association, gently sloping	5.42
Darvey-Asparas association, gently sloping	0.01
Chilton-La Fonda complex, 1 to 9 percent slopes	0.75
Clovis loam, 0 to 5 percent slopes	1059.76
Dean loam, 1 to 9 percent slopes	2370.45
Hagerman fine sandy loam, 1 to 5 percent slopes	338.88
Harvey loam, 1 to 9 percent slopes	636.91
Harvey-Dean loams, 1 to 9 percent slopes	10801.70
Karde-Willard loams, saline	482.12
Kim-Pastura-Tapia loams	979.88
La Fonda loam, 1 to 9 percent slopes	395.89
La Fonda-Rock outcrop complex	1711.84
Laporte-Rock outcrop complex	23.49
Manzano loam, saline substratum, 0 to 1 percent slopes	252.35
Otero and Palma soils	3465.07

Pastura loam, 1 to 9 percent slopes	104.07
Pedrick loamy fine sand	110.14
Penistaja fine sandy loam, 1 to 6 percent slopes	265.93
Penistaja loamy fine sand, hummocky, 1 to 8 percent slopes	6.17
Penistaja-Dean complex, 1 to 5 percent slopes	43.85
Penistaja-Dean fine sandy loams, 1 to 5 percent slopes	620.21
Pinon channery loam, 3 to 20 percent slopes	1.36
Prewitt and Manzano soils	449.94
Rance-Gypsum land complex	320.52
Rock land	25.70
Rock outcrop-Pinon-La Fonda complex	135.64
Stony steep land	78.42
Tapia loam, 0 to 5 percent slopes	451.23
Tapia-Dean loams, 0 to 5 percent slopes	1839.96
Tapia and Dean soils, eroded	85.03
Willard loam, strongly saline	941.56
TOTAL	**63,549.13** [a]

[a] Sum of components may not add up to the total due to the overlap of some geographic integration systems (GIS) data received.
Source: USDA NRCS, 2022

4.6 Paleontological Resources

4.6.1 Data Sources

The following data sources were reviewed to assess paleontological resources of Lincoln and Torrance Counties and the 2022 Corona Generation Expansion.

- Green, G.N., Jones, G.E., and Anderson, O.J. 1997. *The Digital Geologic Map of New Mexico in ARC/INFO Format: U.S. Geological Survey Open-File Report 97-0052*. Accessed June 2022 from https://mrdata.usgs.gov/geology/state/fips-unit.php?code=f35019.
- Hunt, A.P., and Santucci, V.L. 2001. *Paleontological Resources of Lake Meredith National Recreation Area and Alibates Flint Quarries National Monument, West Texas*. New Mexico Geological Society. Guidebook 52nd Field Conference, Geology of Llano Estacado, p. 257–264.
- Leonard, A.B., and Frye, J.C. 1978. *Paleontology of Ogallala Formation, Northeastern New Mexico*. New Mexico Bureau of Mines & Mineral Resources, Circular 161.
- Paleobiology Database. Accessed June 2022 from: https://paleobiodb.org/#/.

4.6.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

No paleontological resources have been identified in the 2022 Corona Generation Expansion (Paleobiology Database, 2022). Geology consists of Middle Proterozoic, Permian, Tertiary, and Quaternary deposits. These geologic units have differing potential for yielding paleontological resources. Any discoveries which may occur during construction would be managed through an Unanticipated Discovery Protocol (UDP).

Middle Proterozoic deposits are approximately 1.8 to 1 billion years old. These granite and metamorphic rocks include the Ortega Quartzite and equivalents in northern New Mexico and quartzites in central New Mexico (Green et al., 1997). North of the 2022 Corona Generation Expansion, these localized deposits cluster in and around Pedernal Mountain, east of McGillivray Draw (approximately 10 miles south of Clines Corner, NM). These deposits do not contain substantive fossils but can include microfossils. Potential for paleontological remains in Middle Proterozoic rocks varies from very low to none.

Permian deposits include the Yeso, Glorieta, and San Andres formations, as well as formations associated with the Artesia Group. These deposits of sandstone and limestone have metamorphosed into dolomite and other types of rocks that are called *textually mature.* Fossils did not survive that metamorphosis. The only fossils that are recovered from the Permian deposits of New Mexico are either in very fine silts or in now-coal formations; neither of which are found in the Project Area (Green et al., 1997). Potential for paleontological remains varies from very low to none.

The Tertiary period is represented by the alluvial and eolian deposits and petrocalcic soils of the Ogallala Formation. This formation has been known to contain scattered unfossiliferous megafaunal elements (such as mastodon/gomphothere bones/teeth), a variety of smaller mammals, turtles, fish, gastropods, plants, and trace fossils (Leonard and Frye, 1978; Hunt and Santucci, 2001). Given the scattered nature of the finds in the unconsolidated Tertiary Ogallala Formation, the potential for paleontological deposits is low.

Quaternary deposits include Late Pleistocene alluvium and older Piedmont alluvial, eolian, and lacustrine deposits of the Tahoka, Double Tanks, Tule, Blanco, Blackwater Draw, and Gatuna formations (Green et al., 1997). Paleontological resources are not fossiliferous and consist of an array of mammals, turtles, fish, gastropods, plants, and trace fossils (Leonard and Frye, 1978; Hunt and Santucci, 2001). Late Pleistocene and Holocene age alluvium is stored in draws and in stream valley landforms. Given the sparse and

scattered nature of the finds in the unconsolidated Quaternary deposits, the potential for paleontological deposits is low.

The alluvial deposits consist of sand and gravels that were deposited during the Lower Pleistocene into the Holocene. A diverse assemblage of not fossiliferous mammals (including bison and mammoths), birds, fish, gastropods, plants, wood, and trace fossils could occur in these deposits (Leonard and Frye, 1978; Hunt and Santucci, 2001). Given that most modern fauna developed by the Early Holocene, the potential of finding now extinct or important paleontological resources in these deposits is low.

4.7 Water Resources

4.7.1 Data Sources

The following data sources were reviewed to assess the existing water resources Lincoln and Torrance Counties and the 2022 Corona Generation Expansion.

- Burns & McDonnell. 2022. "Desktop Wetland Evaluation, Corona Wind Projects, Pattern SC Holdings LLC," letter report to Adam Cernea Clark, Pattern SC Holdings LLC, dated June 10, 2022.
- EPA. 2021b. *Ecoregions of North America*. Accessed June 2022 from: https://www.epa.gov/eco-research/ecoregions-north-america.
- Federal Emergency Management Agency (FEMA). 2022. *Flood Map Service Center*. Accessed June 2022 from: https://msc.fema.gov/portal/search.
- Google Earth. 2022. Publicly available aerial imagery. Accessed June 2022 from: https://www.google.com/earth/download.
- Playa Lakes Joint Venture (PLJV). 2022. *Maps of Probable Playas, Roosevelt, New Mexico*. Accessed June 2022 from: http://pljv.org/for-habitat-partners/maps-and-data/interactive-playa-map/.
- USDA Farm Service Agency (USDA FSA). 2020. *National Agriculture Imagery Program (NAIP).* Accessed June 2022 from: https://gis.apfo.usda.gov/arcgis/rest/services.
- USDA NRCS. 2022. *Web Soil Survey*. Accessed June 2022 from: http://websoilsurvey.nrcs.usda.gov.
- U.S. Fish and Wildlife Service (USFWS). 2022c. *National Wetlands Inventory (NWI) Data Mapper*. Accessed June 2022 from: https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/

- USGS. 2022b. *Historical Topographic Map Explorer*. Accessed June 2022 from https://livingatlas.arcgis.com/topoexplorer/.
- USGS. 2022c. *National Hydrography Dataset (NHD)*. Accessed June 2022 from: https://nhd.usgs.gov/tools.html.
- USGS and USDA NRCS. 2022. *Watershed Boundary Dataset*. Accessed June 2022 from: https://datagateway.nrcs.usda.gov/Catalog/ProductDescription/WBD.html.
- Western Regional Climate Center. 2016. *Climate of New Mexico*. Accessed March 2022 from: https://wrcc.dri.edu/Climate/narrative_nm.php.

4.7.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

The 2022 Corona Generation Expansion is situated in various watersheds throughout the area of development (Exhibit 6; Table 4-2). Surface water features in the vicinity of the 2022 Corona Generation Expansion include ponds, intermittent drainages and stream channels.

Table 4-2: 2022 Corona Generation Expansion Watersheds

Watershed	HUC 10 [a]
Camaleon Draw	1306000302
Bonita Canyon	1306000601
Cola de Gallo Arroyo	1306000602
Headwaters Gallo Arroyo	1306000603
Town of Cedarvale	1305000202
Pueblo Blanca Canyon	1305000107

[a] 10-digit Hydrologic Unit Code
Source: USGS and USDA NRCS, 2022

Wetlands, floodplains, and streams were inventoried for the 2022 Corona Generation Expansion. The National Wetland Inventory (NWI) data documented approximately 400 acres of wetlands within the 2022 Corona Generation Expansion (see Table 4-3) (USFWS, 2022c). The NWI identified wetlands included three wetland types: freshwater emergent wetland, freshwater pond, and riverine (Exhibit 7). According to the USGS National Hydrography Dataset (NHD), 2022 Corona Generation Expansion has approximately 124.6 miles of mostly unnamed intermittent stream features (USGS, 2022c). There are no mapped ephemeral or perennial streams, approximately 7.8 miles of artificial paths and connectors present.

Table 4-3: 2022 Corona Generation Expansion Wetlands Based on the U.S. Fish and Wildlife Service National Wetland Inventory Data

Wetland Type	Sum of Acres	Percentage of 2022 Corona Generation Expansion Land Area
Freshwater Emergent Wetland	17.22	0.03%
Freshwater Pond	8.21	0.01%
Riverine	314.52	0.49%
Total	**339.95**	**0.53%**

Source: USFWS, 2022c

The 2022 Corona Generation Expansion is part of the Southeastern Plains of New Mexico which slope gradually eastward and southeastward. This part of these eastern plains lies within the Pecos River watershed and flows southward through the Southeastern Plains into Texas, and then southeastward to join the Rio Grande. Summer rains fall almost entirely during brief, but frequently intense thunderstorms. July and August are the rainiest months over most of the State, with 30 to 40 percent of the year's total moisture falling at that time. During the warmest six months of the year, May through October, total precipitation averages 80 percent of the annual total.

General floods are seldom widespread in New Mexico. Heavy summer thunderstorms may bring several inches of rain to small areas in a short time. Because of the rough terrain and sparse vegetation in many areas, runoffs from these storms frequently cause local flash floods. Normally dry arroyos may overflow their banks for several hours, halting traffic where water crosses highways; damaging bridges, culverts, and roadways; and if in an urban area, possibly causing considerable property damage. Snowmelt during April to June, especially in combination with a warm rain, and heavy general rains during August to October may occasionally cause flooding of the larger rivers (Western Regional Climate Center, 2016).

Playa lakes are shallow, clay-lined ephemeral rainwater basins occurring throughout the Great Plains ecoregion (EPA, 2021b). There are estimated to be over 4,000 playa lakes in eastern New Mexico, none of which occur within the 2022 Corona Generation Expansion (PLJV, 2022). Approximately 35,545 acres of FEMA mapped floodplain fall within the 2022 Corona Generation Expansion. Approximately 35,099 acres are mapped as FEMA Zone D floodplain (unknown flood risk) and the remainder lies within unmapped or minimal flood hazard FEMA areas (FEMA, 2022) (Exhibit 8).

Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) performed a desktop evaluation to identify locations where wetlands and other waterbodies may exist within the footprint of the Corona

Wind Project, including the 2022 Corona Generation Expansion. During the desktop evaluation, data from multiple map sources were reviewed, then integrated into a single digital layer overlaid on the Project Area. A probability of wetland occurrence was then designated, based on the amount of overlap among the map sources. The following map sources were included:

- NRCS Soil Survey Geographic (SSURGO) digital data (USDA NRCS, 2022);
- USFWS NWI maps (USFWS, 2022c);
- USGS 7.5-minute topographic maps (USGS, 2022b);
- USGS NHD digital data (USGS, 2022c);
- FEMA Flood Insurance Rate Maps (FIRMs) (FEMA, 2022);
- National Agriculture Imagery Program (NAIP) 2020 natural color aerial photography (USDA FSA, 2020); and
- Google Earth aerial imagery (Google Earth, 2022).

The majority of acreage within the footprint of the 2022 Corona Generation Expansion received a designation of "No Probability" of wetland occurrence (Burns & McDonnell, 2022). While the actual location and extent of wetlands and waterbodies as determined by an on-site wetland delineation may differ from the desktop evaluation, the results of the desktop evaluation are useful to indicate areas where impacts to probable wetlands and waterbodies should be avoided or minimized.

4.8 Flora and Fauna

4.8.1 Data Sources

The following data sources were reviewed to assess the existing biological resources of Lincoln and Torrance Counties and the 2022 Corona Generation Expansion.

- Cornell Lab of Ornithology. 2022. *eBird* (online database). Accessed June 2022 from: https://ebird.org/.
- EPA. 2021b. *Ecoregions of North America*. Accessed June 2022 from: https://www.epa.gov/eco-research/ecoregions-north-america.
- Multi-Resolution Land Characteristics Consortium (MRLC). 2021. *2019 National Land Cover Database (NLCD)*. Accessed June 2022 from: https://www.mrlc.gov/
- National Audubon Society. 2022. *Important Bird Areas*. Accessed June 2022 from: http://www.audubon.org/important-bird-areas.

- New Mexico Avian Conservation Partners (NMACP). 2017. *Bald Eagle (Haliaeetus leucocephalus)*. Accessed June 2022 from: http://avianconservationpartners-nm.org/wp-content/uploads/2017/01/Bald-Eagle.pdf.
- New Mexico Department of Game & Fish (NMDGF). 2022. *Biota Information System of New Mexico (BISON-M)*. Accessed June 2022 from: https://bison-m.org/#.
- NMDGF and Natural Heritage New Mexico (NHNM). 2013. *New Mexico Crucial Habitat Assessment Tool (NM CHAT)*. Accessed June 2022 from: http://nmchat.org/data.html.
- Southern Great Plains Crucial Habitat Assessment Tool (SGP CHAT). 2022. Accessed June 2022 from: https://www.sgpchat.org/
- USFWS. 2022a. *Environmental Conservation Online System (ECOS) Species Profiles*. Accessed June 2022 from: https://ecos.fws.gov/ecp/species-reports.
- USFWS. 2022b. *Information for Planning and Consultation (IPaC) web application*. Accessed June 2022 from: https://ecos.fws.gov/ipac/.
- USGS. 2022a. *Gap Analysis Project (GAP) Protected Areas Database of the U.S. (PAD-US)*. Accessed June 2022 from: https://gapanalysis.usgs.gov/padus/.
- WEST, Inc. 2017a. *Critical Issues Analysis for the Proposed Ancho Wind Project*. Report issued March 2017.
- WEST, Inc. 2017b. *Critical Issues Analysis for the Proposed Cowboy Mesa Wind Project*. Report issued March 2017.
- WEST, Inc. 2017c. *Raptor Nest Survey, Pattern Wind Energy Project*. Report issued August 2017.

4.8.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

The New Mexico Crucial Habitat Assessment Tool (NM CHAT) is a habitat classification system for crucial habitat using a relative, six-level prioritization scheme, where 1 represents most crucial areas and 6 represents least crucial areas. The NM CHAT identified approximately 1,805 acres within the 2022 Corona Generation Expansion as Rank 1 for Wildlife Corridors for the cougar (*Puma concolor*), which are defined as areas that link core habitats for sustaining populations across landscapes (NMDGF and NHNM, 2013). Approximately 94 percent of the overall area was either Rank 3 or Rank 4 for crucial habitat, which is defined as areas that may provide high-priority wildlife corridors, mid-level priority wetland/riparian habitat, or mid-level habitat for species of concern.

The 2022 Corona Generation Expansion is within the Central New Mexico Plains, Pinyon-Juniper Woodlands and Savannas, and Pluvial Lake Basins Level IV Ecoregions (Exhibit 9) (EPA, 2021b). Considering the potential habitats present within these ecoregions, the likelihood of a special-status animal or plant species that may occur was determined by considering the species' range, habitat suitability, species' mobility, population size, and records of occurrence within or adjacent to the 2022 Corona Generation Expansion (USFWS, 2022a; USGS, 2022a). Based on these factors, the likelihood of occurrence was defined for each special-status species using the following categories:

- **None** – outside the species known range, no suitable habitat within the 2022 Corona Generation Expansion, restricted mobility and small population size;
- **Not likely** – outside the species known range and suitable habitat appears absent within the 2022 Corona Generation Expansion; however, due to the species mobility and population size, species may occur within the 2022 Corona Generation Expansion during migration or other times of the year;
- **Possible** – is located within the range of the species but contains marginal suitable habitat; species highly mobile and may occur year-round;
- **Likely** – is located within the range of the species and contains suitable habitat; records of species occurrence in the surrounding area but no records from the 2022 Corona Generation Expansion; and
- **Occurs** – records of species occurrence within the 2022 Corona Generation Expansion based on USFWS/NMDGF data or other survey data.

Brief species accounts are written for special-status and other protected species whose likelihood of occurrence was either possible, likely, or occurs.

4.8.2.1 Federally Listed Species

Seven animal species that are federally listed under the Endangered Species Act (ESA) may potentially occur in the 2022 Corona Generation Expansion (USFWS, 2022b). Table 4-4 summarizes the list of federally protected species with potential to occur in Lincoln and Torrance counties and an impact analysis based on a literature review of species' specific habitat requirements (USFWS, 2022a).

Table 4-4: Federally Listed Species in the 2022 Corona Generation Expansion

Common Name	Scientific Name	Federal Status[a]	Likelihood of Occurrence
Birds			
Mexican spotted owl	*Strix occidentalis lucida*	T	**Possible**. The 2022 Corona Generation Expansion area is located with the elevational and ecological range for the owl. Evergreen forest within the 2022 Corona Generation Expansion area may provide suitable nesting or wintering habitat.
Yellow-billed cuckoo	*Coccyzus americanus*	T	**Not likely**. The 2022 Corona Generation Expansion area is not likely to include riparian, wetlands, riverine, lacustrine, or otherwise suitable habitat. There is at least some potential for the species to migrate through the 2022 Corona Generation Expansion area.
Northern aplomado falcon	*Falco femoralis septentrionalis*	EXPN	**Possible**. This species forages in open terrain with scattered shrubs, which is likely present in portions of the 2022 Corona Generation Expansion area.
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	**Not likely**. The 2022 Corona Generation Expansion area is not likely to include dense riparian, riverine, lacustrine, or otherwise suitable habitat; however, this species may migrate through the region.
Mammals			
Peñasco least chipmunk	*Tamias minimus atristriatus*	PE	**Not likely**. The 2022 Corona Generation Expansion area is outside the known range of this species (White and Sacramento Mountains).
Fishes			
Rio Grande cutthroat trout	*Oncorhynchus clarkia virginalis*	C	**Not likely.** The 2022 Corona Generation Expansion area is not likely to permanently impact linear waterbodies.
Insects			
Monarch butterfly	*Danaus plexippus*	C	**Possible**. The 2022 Corona Generation Expansion area is likely to include suitable habitat.

Source: USFWS, 2022b

[a] E=Endangered, T=Threatened, C=Candidate, EXPN=Experimental Population Non-Essential, PE= Proposed Endangered

4.8.2.2 State Listed Species

State listed endangered or threatened wildlife species are identified for Lincoln and Torrance Counties in which the 2022 Corona Generation Expansion is located (NMDGF, 2022), as shown in Table 4-5. These species include two mammals, eight birds, one amphibian, and one fish.

Table 4-5: State Listed Species in the 2022 Corona Generation Expansion

Common Name	Scientific Name	State Status[a]	Likelihood of Occurrence
Mammals			
Spotted bat	*Euderma maculatum*	T	**Not likely**. The 2022 Corona Generation Expansion area is not likely to affect cliff habitat; however, isolated individuals may forage in pinyon-juniper woodlands near cliffs.
Penasco least chipmunk	*Neotamias minimus atristriatus*[b]	E	**Not likely**. The 2022 Corona Generation Expansion area is outside the known range of this species (White and Sacramento Mountains).
Birds			
Broad-billed hummingbird	*Cynanthus latirostris*	T	**Not likely.** The 2022 Corona Generation Expansion area is not likely to include riparian forest and is located outside of known habitat. This species is typically found in the Guadalupe Canyon in NM east of the 2022 Corona Generation Expansion area.
Brown pelican	*Pelecanus occidentalis*	E	**Not Likely**. Species primarily inhabits marine areas and is a rare visitor to New Mexico. The 2022 Corona Generation Expansion area does not contain large water bodies or major rivers that may attract the species.
Bald eagle	*Haliaeetus leucocephalus*	T	**Likely.** Species likely to occur within the 2022 Corona Generation Expansion area as occasional winter visitor.
Common black hawk	*Buteogallus anthracinus*	T	**Not Likely.** The 2022 Corona Generation Expansion area is not likely to contain suitable riparian woodland habitat.
Peregrine falcon	*Falco peregrinus*	T	**Likely.** Peregrine likely to occur in The 2022 Corona Generation Expansion area as occasional year-round resident and migrant.
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	**Not Likely.** The 2022 Corona Generation Expansion area does not appear to contain suitable riparian breeding habitat.
Gray vireo	*Vireo vicinior*	T	**Possible.** Species may occur in the 2022 Corona Generation Expansion area as summer resident or migrant.
Baird's sparrow	*Centronyx bairdii*	T	**Possible.** Species may occur in the 2022 Corona Generation Expansion area during migration; 2022 Corona Generation Expansion area is outside species' breeding range but presents suitable habitat.
Amphibians			

Common Name	Scientific Name	State Status[a]	Likelihood of Occurrence
Sacramento Mountain salamander	*Aneides hardii*	T	**Not likely.** The 2022 Corona Generation Expansion area is outside of known range for this species (Capitan, Sacramento, and Sierra Blanca Mountains)
Fish			
White Sands pupfish	*Cyprinodon tularosa*	T	**Not likely.** The 2022 Corona Generation Expansion area is not likely to permanently impact linear waterbodies.

Source: NMDGF, 2022
[a] E=Endangered, T=Threatened
[b] NMDGF database lists the Penasco least chipmunk with genus *Neotamias* rather than the USFWS database listing of genus *Tamias*.

Federally- and state-listed species which may be likely or possible to occur within the 2022 Corona Generation Expansion are further discussed in the following subsections.

4.8.2.3 Birds

Passerines, raptors, waterfowl, and waterbirds likely migrate through the footprint of the 2022 Corona Generation Expansion. Grassland and cropland provide stopover habitat during migration or during post breeding dispersal and may attract a broad suite of birds (SGP CHAT, 2022; USGS, 2022a). Waterfowl and waterbirds (including shorebirds) would primarily be attracted to the small emergent wetlands and open water as stopover habitat during migration, these resources comprise less than 1 percent of the footprint of the 2022 Corona Generation Expansion (MRLC, 2021).

The Baird's sparrow is a state-threatened grassland bird species that breeds in the tall grasses of the northern Great Plains and winters in northern Mexico and the southern-most areas of Arizona and New Mexico. The gray vireo is a state-threatened forest bird species that breeds in open woodlands and shrublands featuring evergreen trees and shrubs. While the 2022 Corona Generation Expansion is outside of the breeding range of these species, it does fall within the migratory pathways and there is at least some potential for the species to occur within the area of the 2022 Corona Generation Expansion during migration (Exhibit 10; National Audubon Society, 2022).

4.8.2.3.1 Bald Eagle

Bald eagles are no longer listed as threatened under the ESA; however, they continue to be protected under the Bald and Golden Eagle Protection Act (BGEPA) and are state-listed as threatened. Bald eagles are known to occur in New Mexico year-round, with larger densities during both spring and fall migration, and during the winter (Cornell Lab of Ornithology, 2022). Bald eagles are uncommon breeders in New Mexico, with less than 10 pairs estimated to occur throughout the state as of 2017 (NMACP,

2017). In New Mexico, bald eagle nests are placed in large cottonwoods or ponderosa pines, typically in the vicinity of water and often also in close proximity to concentrations of small mammals such as prairie dogs (NMDGF, 2022), none of which exist in the 2022 Corona Generation Expansion. Bald eagles have been observed near Clines Corners, NM, as well as near the Pecos River, respectively 31 miles north and 48 miles northeast of the 2022 Corona Generation Expansion (Cornell Lab of Ornithology, 2022; WEST, 2017b). Potential bald eagle occurrence within the 2022 Corona Generation Expansion would be infrequent, due to the lack of large trees for perching and lack of optimal foraging habitat. However, bald eagles may occur occasionally as migrants or transient wintering birds, and grasslands and ponds in the footprint of the 2022 Corona Generation Expansion may attract foraging bald eagles.

4.8.2.3.2 Raptors

Based on raptor distribution maps (WEST, 2017c), at least 15 species of diurnal raptors, including the bald eagle, 9 owl species, and 1 vulture species may occur within or near the 2022 Corona Generation Expansion. The 2022 Corona Generation Expansion contains limited breeding habitat for most raptors because it lacks much mature forested area, which is preferred breeding habitat for many tree-nesting raptor species. Tree-nesting species would resort to nesting in man-made structures in open herbaceous areas that encompass the 2022 Corona Generation Expansion. Additionally, there are few topographic features such as ridges and large bodies of water present that would attract migrating raptors. The 2022 Corona Generation Expansion contains foraging habitat for many grassland- and wetland-associated species. Raptors could use open fields and small bodies of water where prey are present for hunting in the 2022 Corona Generation Expansion.

Two state-listed threatened species, the bald eagle and peregrine falcon, and one federally-listed species, the Mexican spotted owl, have potential to occur in the 2022 Corona Generation Expansion. As discussed in Section 4.8.2.3.1 above, bald eagle habitat is lacking, but bald eagles may occur occasionally as migrants or transient wintering birds. The peregrine falcon is one of the largest falcons in North America. Peregrine falcons are associated with habitats from sea level to 13,000 ft (4,000 meters [m]), including plains, grasslands, shrublands, forests, and deserts (WEST, 2017a). Peregrine falcons show little preference for specific ecological communities, but their hunting behavior makes them most adapted to open or partially wooded habitats (WEST, 2017a). In New Mexico, the species may nest in cliffs and hunt in a variety of woodland, grassland, and shrub/scrub habitats (USGS, 2022a). Mexican spotted owls are typically found between 4,100 ft (1,250 m) and 9,000 ft (2,740 m) in elevation. Mexican spotted owls are residents of old growth forests and canyons containing riparian or conifer communities (USFWS, 2022a).

4.8.2.4 Insects

The monarch butterfly, a federally-listed candidate insect species, has the potential to occur in the 2022 Corona Generation Expansion. Monarch butterflies occur through the United States and are known to migrate seasonally between the United States & Canada and Mexico. Monarch butterflies lay eggs primarily on milkweed host plants and seek out a variety of flowering plants for food. The 2022 Corona Generation Expansion appears to be dominated by herbaceous grasslands, shrub/scrub, and evergreen forest. These vegetation communities have high potential to support a diversity of blooming nectar resources, including milkweed which is crucial for the species (USFWS, 2022a). The monarch butterfly is currently listed as a candidate species which does not provide protection under the ESA.

4.9 Archaeological and Historic-Age Cultural Resources

4.9.1 Data Sources

The following data sources were reviewed to assess the archaeological and historic-age cultural resources in Lincoln and Torrance Counties as crossed by the 2022 Corona Generation Expansion.

- BLM. 2022b. *General Land Office (GLO) Records*. Accessed June 2022 from: https://glorecords.blm.gov/.
- Green, G.N., Jones, G.E., and Anderson, O.J. 1997. *The Digital Geologic Map of New Mexico in ARC/INFO Format: U.S. Geological Survey Open-File Report 97-0052*. Accessed June 2022 from https://mrdata.usgs.gov/geology/state/fips-unit.php?code=f35019.
- New Mexico Cultural Resource Information System (NMCRIS). 2022. Accessed June 2022 from: https://nmcris.dca.state.nm.us.
- USGS. 2022b. *Historical Topographic Map Explorer*. Accessed June 2022 from https://livingatlas.arcgis.com/topoexplorer/.

4.9.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

A total of 21 archaeological sites have been previously recorded within the 2022 Corona Generation Expansion (NMCRIS, 2022). There have been 11 prehistoric sites, six historic-age sites, one multicomponent site, and three sites with unknown temporal affiliation recorded within the 2022 Corona Generation Expansion, as shown in Table 4-6. Two of the sites have been determine eligible for inclusion in the National Register of Historic Places (NRHP), one has been determined not eligible for NRHP inclusion, and 18 sites have undetermined NRHP eligibility or have no eligibility determination listed.

One historic-age non-archaeological resource is reported within the 2022 Corona Generation Expansion. HCPI4071 is a historic-age building with unknown NRHP eligibility and may no longer be extant.

Table 4-6: Archeological Sites within the 2022 Corona Generation Expansion

Site	Site Type	NRHP Eligibility
LA1847	Prehistoric	Unknown
LA6913	Unknown	Undetermined
LA86109	Historic	Unknown
LA127402	Historic	Not eligible
LA130457	Prehistoric	Unknown
LA130459	Prehistoric	Unknown
LA131113	Historic	Undetermined
LA131118	Multicomponent	Eligible
LA131119	Historic	Undetermined
LA131120	Historic	Undetermined
LA131150	Historic	Undetermined
LA176560	Unknown	Unknown
LA176561	Prehistoric	Unknown
LA176562	Prehistoric	Unknown
LA176564	Prehistoric	Unknown
LA182192	Unknown	Undetermined
LA182193	Prehistoric	Eligible
LA197090	Prehistoric	Undetermined
LA197091	Prehistoric	Undetermined
LA197092	Prehistoric	Undetermined
LA200601	Prehistoric	Unknown

Source: NMCRIS, 2021

The review of geology and historic-age maps indicates that undocumented cultural materials, both prehistoric and historic-age, may be located within the 2022 Corona Generation Expansion, particularly around the major drainages and their tributaries and in areas where ranches appear on historic-age topographic maps (BLM, 2022b; USGS, 2022b; Green et al., 1997).

4.10 Religious and Cemetery Sites

4.10.1 Data Sources

The following data sources were reviewed to assess the existing religious and cemetery sites in Lincoln and Torrance Counties as crossed by the 2022 Corona Generation Expansion.

- American Cemeteries. 2022a. *Cemeteries of Lincoln County, New Mexico*. Accessed June 2022 from: http://www.americancemeteries.org/new-mexico/Lincoln-county.
- American Cemeteries. 2022b. *Cemeteries of Torrance County, New Mexico*. Accessed June 2022 from: http://www.americancemeteries.org/new-mexico/torrance-county.

- Esri. 2022. GIS data for religious sites and cemeteries in Lincoln and Torrance Counties, New Mexico. Accessed June 2022 from: https://www.esri.com.

4.10.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

One religious institution, San Juan Bautista Catholic Church, was identified within one mile of the 2022 Corona Generation Expansion (Esri, 2022). Two cemeteries, Pinos Well Cemetery and Pinos Well Cemetery #2, are located within the 2022 Corona Generation Expansion. Three additional cemeteries are located within one mile of the 2022 Corona Generation Expansion: Cedarvale Cemetery, Corona Cemetery, and San Juan Bautista Cemetery (Exhibit 11; American Cemeteries, 2022a, 2022b; Esri, 2022). Unknown or abandoned cemeteries could be within the footprint.

4.11 Visual and Scenic Resources

4.11.1 Data Sources

The following data sources were reviewed to assess the existing visual and scenic conditions of Lincoln and Torrance Counties for the 2022 Corona Generation Expansion.

- BLM. 2022a. *Explore Your Public Lands*. Accessed June 2022 from: https://www.blm.gov/visit.
- BLM. 2022c. *National Data Viewer*. Accessed June 2022 from: https://blm-egis.maps.arcgis.com/apps/webappviewer/index.html?id=6f0da4c7931440a8a80bfe20eddd7550
- EPA. 2021b. *Ecoregions of North America*. Accessed June 2022 from: https://www.epa.gov/eco-research/ecoregions-north-america.
- Federal Highway Administration (FHWA). 2022. *America's Byways*. Accessed June 2022 from: https://www.fhwa.dot.gov/byways/.
- National Park Service (NPS). 2022a. *Find A Park: New Mexico*. Accessed June 2022 from: https://www.nps.gov/state/nm/index.htm
- NPS. 2022b. *National Natural Landmarks Directory*. Accessed June 2022 from: https://www.nps.gov/subjects/nnlandmarks/nation.htm
- NMDOT. 2012a. *Explore New Mexico's Scenic Byways*. Accessed June 2022 from: https://www.dot.state.nm.us/content/nmdot/en/byways.html.
- New Mexico Energy, Minerals and Natural Resources Department (NMEMNRD). 2022. *Find A Park*. Accessed June 2022 from: https://www.emnrd.nm.gov/spd/find-a-park/.
- U.S. Census. 2020. Accessed June 2022 from: www.census.gov.

4.11.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

The 2022 Corona Generation Expansion encompasses approximately 63,549 acres of private and state lands within the Southwestern Tablelands Level III Ecoregion (EPA, 2021b) located within Torrance and Lincoln Counties. The EPA Ecoregions description for the Southwestern Tablelands states:

> *The Southwestern Tablelands flank the High Plains with red hued canyons, mesas, badlands, and dissected river breaks. Unlike most adjacent Great Plains ecological regions, little of the Southwestern Tablelands is in cropland. Much of this region is in sub-humid grassland and semiarid range land. The potential natural vegetation is grama-buffalo grass with some mesquite-buffalo grass in the southeast, juniper-scrub oak-midgrass savanna on escarpment bluffs, and shinnery (midgrass prairie with open low and shrubs) along the Canadian River.*

More specifically, the 2022 Corona Generation Expansion occurs within the Central New Mexico Plains, Pinyon-Juniper Woodlands and Savannas, and Pluvial Lake Basins ecoregions containing short-grass prairie and pinyon-juniper woodland plant communities (EPA, 2021b). Common vegetation of the Southwestern Tablelands includes grama grasses (*Bouteloua gracilis*), buffalo grass (*B. dactyloides*), piñon pine (*Pinus* spp.), junipers (*Juniperus* spp.), and scrub oak (*Quercus gambelii*). This combined area is bounded by the Sacramento Mountains to the south, including the Jicarilla, Capitan and Vera Cruz ranges, and the Gallinas Mountains to the west. East and north of the combined area, the landscape transitions to mixed Chihuahuan Desert grassland.

Approximately 30,811 acres of State Trust Lands administered by the New Mexico State Land Office (SLO) are included within the 2022 Corona Generation Expansion. Non-private lands in proximity to the combined area include portions of the Mountainair District of the Cibola National Forest, Smokey Bear District of the Lincoln National Forest, BLM lands, and other State Trust Lands administered by the SLO (Exhibit 12).

Topography within the 2022 Corona Generation Expansion is variable, including relatively flat grassland, gentle slopes, small ridgelines, canyons, hills, mesas, canyons, and steep slopes. Herbaceous/grassland cover types dominate the landscape. Land use within the 2022 Corona Generation Expansion is primarily open range livestock grazing. Elevation within the 2022 Corona Generation Expansion ranges from 5,520 to 7,013 ft (1,682 to 2,137 m) above mean sea level (see Exhibit 13). The 2022 Corona Generation Expansion is located within 6 Public Land Survey System (PLSS) ranges and 3 PLSS townships in Lincoln County, New Mexico, and 4 PLSS ranges and 4 PLSS townships in Torrance County, New Mexico (Exhibit 14).

Lincoln and Torrance Counties are both large and rather sparsely populated counties located in central New Mexico, southeast of the City of Albuquerque. The population density for Lincoln County is approximately 4.2 inhabitants per square mile, with most of the population in the county's southern portion in the Greater Ruidoso Area. Torrance County's population density is approximately 4.5 inhabitants per square mile, with over 95 percent of the population residing in the western half of the county. A few inhabitable residences are within the 2022 Corona Generation Expansion, and other scattered rural residences and small communities are nearby. The village of Corona, New Mexico (2020 population of 129), is the closest incorporated community, located along U.S. Highway 54 roughly one mile north of the 2022 Corona Generation Expansion (U.S. Census, 2020). The next nearest incorporated communities include the village of Encino (2020 population of 51) and the town of Vaughn (2020 population 286), approximately 11 miles north and 11 miles northeast of the 2022 Corona Generation Expansion, respectively. Lincoln Station Airport is an unpaved private landing strip located within the 2022 Corona Generation Expansion's westernmost parcel in Lincoln County. High Desert Ranch Airport is another private landing strip in Lincoln County, located less than 2 miles southeast of the easternmost parcel of the 2022 Corona Generation Expansion. The closest school is the Corona High School and Elementary School (same building), approximately 1 mile north of the 2022 Corona Generation Expansion (Exhibit 18).

Travelers in proximity to the 2022 Corona Generation Expansion would include local traffic along U.S. Highway 54 and New Mexico State Routes 42 and 247, or regional and interstate traffic along U.S. Highway 54 heading to the cities of Alamogordo and Las Cruces from westbound Interstate 40. One existing transmission line (100-kV or above) occurs within the vicinity of the 2022 Corona Generation Expansion. The 115-kV line owned by Central New Mexico Electric Cooperative crosses through the center of the 2022 Corona Generation Expansion along New Mexico State Route 42, Torrance County Road C013, and U.S. Highway 54 north of the village of Corona. One natural gas pipeline operated by El Paso Corporation crosses the 2022 Corona Generation Expansion's westernmost parcel in Lincoln County. This parcel is adjacent to the El Paso Corporation pipeline's Lincoln compressor station.

No designated federal or state scenic routes or byways were identified in the vicinity of the 2022 Corona Generation Expansion (NMDOT, 2012a; FHWA, 2022) (Exhibit 15). The nearest scenic routes are New Mexico's Salt Missions Trail located 23 miles west, Historic Route 66 National Scenic Byway which is co-located with I-40 approximately 31 miles north, and Billy the Kid Trail National Scenic Byway approximately 39 miles south. No national or state parks, preserves, recreation areas, trails, or monuments are in the vicinity of the 2022 Corona Generation Expansion (BLM, 2022a; NPS, 2022a). The closest national park is the Gran Quivira Unit of Salinas Pueblo Missions National Monument, which is

approximately 23 miles west (NPS, 2022a). Fort Stanton-Snowy River Cave National Conservation Area is approximately 41 miles south and Valley of Fires Recreation Area is approximately 32 miles southwest of the 2022 Corona Generation Expansion; both sites are managed by the BLM (BLM, 2022a). Fort Stanton-Snowy River Cave National Conservation Area is also home to Fort Stanton Cave, which is included in the National Parks Service (NPS) National Natural Landmarks Directory (NPS, 2022b). Smokey Bear Historical Park is run by the U.S. Forest Service and is located in the village of Capitan, approximately 39 miles south. The nearest state parks are Manzano Mountains State Park, Villanueva State Park, and Santa Rosa Lake State Park, all of which are located more than 35 miles from the 2022 Corona Generation Expansion (NMEMNRD, 2022).

The BLM National Data Viewer indicates the segment of the 2022 Corona Generation Expansion located in Torrance County has a Visual Resource Inventory (VRI) Scenic Quality Rating of C (indicating low scenic quality), based on a quantitative score of 5.00. The VRI index for Maintenance of Visual Quality in this area of Torrance County indicates low value based on a qualitative analysis of the sensitivity of visual resources, except for the 3-mile-wide corridor around U.S. Highway 54, which is indicated as high value. No other portions of the 2022 Corona Generation Expansion, including all portions in Lincoln County, have been issued a VRI Scenic Quality Rating or Maintenance of Visual Quality value (BLM, 2022c).

Apart from the U.S. Highway 54 corridor, no known visually sensitive cultural resource sites are in the vicinity of the 2022 Corona Generation Expansion. No known organized tourism activities occur in or near the 2022 Corona Generation Expansion.

4.12 Land Use, Including Farm, Range, and Recreational Resources

4.12.1 Data Sources

The following data sources were reviewed to assess the existing land use, including farm, range and recreational resources of Lincoln and Torrance Counties for the 2022 Corona Generation Expansion.

- Carrizozo Soil and Water Conservation District (Carrizozo SWCD). 2015. *Carrizozo Soil and Water Conservation District Land Use Plan*.
- East Torrance SWCD. 2009. *East Torrance Soil and Water Conservation District Long Range Plan, July 1, 2009 - June 30, 2019*. Accessed December 2021 from: http://easttorranceswcd.org/PDF/LongRangePlan0919.pdf.
- Lincoln County Board of Commissioners. 2018. *Comprehensive Land Use Plan*. Accessed June 2022 from: https://www.lincolncountynm.gov/wp-content/uploads/2019/06/LC-Comprehensive-Land-Use-Plan.pdf.

- Mid-Region Council of Governments of New Mexico. 2003. *Comprehensive Land Use Plan for Torrance County, New Mexico, August 2003*. Accessed June 2022 from: https://www.mrcog-nm.gov/DocumentCenter/View/3124/Torrance-County-Comprehensive-Plan-August-2003-PDF.
- Military Bases.com. 2022. *New Mexico Military Bases* (map). Accessed June 2022 from: https://militarybases.com/new-mexico/.
- MRLC. 2021. *2019 NLCD*. Accessed June 2022 from: https://www.mrlc.gov/
- Sites Southwest LLC. 2007. *Lincoln County Comprehensive Plan, August 2007*. Accessed June 2022 from: https://www.lincolncountynm.gov/wp-content/uploads/2017/12/Final_Comp-2.pdf.
- The Board of County Commissioners of Torrance County. 2020. *Torrance County Zoning Ordinance*. Accessed September 2021 from: https://www.torrancecountynm.org/uploads/Downloads/Planning%20and%20Zoning/Ordinances/2020.07.08%20Torrance%20County%20Zoning%20Ordinance%20Revised.pdf.
- U.S. Bureau of Indian Affairs (BIA). 2022. *U.S. Domestic Sovereign Nations: Land Areas of Federally-Recognized Tribes Map*. Accessed June 2022 from: https://biamaps.doi.gov/indianlands/#.

4.12.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

A review of the 2019 National Land Cover Database (NLCD) (MRLC, 2021) identified three major cover types in the 2022 Corona Generation Expansion: shrub/scrub 64 percent, grassland/herbaceous 33 percent, and evergreen forest 4 percent. Table 4-7 below summarizes the NLCD cover types in the 2022 Corona Generation Expansion.

Table 4-7: National Land Cover Data Summary for the 2022 Corona Generation Expansion

Land Cover	Acres	Percent[a]
Developed, Open Space	205.1	< 1%
Developed, Low Intensity	4.8	< 1%
Bare Rock/Sand/Clay	2.5	< 1%
Evergreen Forest	2,278.3	4%
Shrub/Scrub	40,383.7	64%
Grasslands/Herbaceous	20,661.6	33%
Woody Wetlands	3.1	< 1%
Emergent Herbaceous Wetlands	10.0	< 1%
Total	**63,549.1[b]**	**100%[b]**

[a] Percentages are rounded to the nearest whole number.
[b] Sum of components may not add up to the total due to the overlap of some GIS private-owned and state-owned land data received.
Source: MRLC, 2021

4.12.2.1 Torrance County

Torrance County is a sparsely populated county covering approximately 3,345 square miles in central New Mexico, southeast of the City of Albuquerque. Over 95 percent of the population resides in the western half of the county (U.S. Census, 2020). Farming and open-range ranching have been the traditional economic activities of the county but are diminishing as the population grows in the Estancia Valley. Large-scale irrigated agriculture has become a major feature in the central portion of the Estancia Valley. Although these agricultural croplands rely solely on groundwater pumping, there is a reluctance to eliminate such land uses. Much of Torrance County is situated within the "commuter shed" of the Albuquerque metropolitan region and is growing in scattered residential subdivisions and housing developments. As a result, non-agricultural commerce and business sectors are growing as well.

Political jurisdictions and territories within Torrance County include five incorporated municipalities, significant acreage held in state and federal ownership, and a small area in the northwest corner of the county that occurs within the Isleta Reservation (BIA, 2022). The town of Moriarty contains the largest population within Torrance County and is located approximately 38 miles northwest of the 2022 Corona Generation Expansion. The county seat is located in the town of Estancia, approximately 27 miles northwest of the 2022 Corona Generation Expansion. The village of Encino is the closest populated place within Torrance County, roughly 11 miles north of the 2022 Corona Generation Expansion. Other incorporated communities scattered throughout the county include the town of Mountainair and the village of Willard. Major state and federal properties in the county include Manzano Mountains State Park, Gallinas National Forest, Cibola National Forest, and scattered BLM parcels (Exhibits 16, 17, 18,

and 19). No military bases are located in Torrance County (Military Bases.com, 2022). Also, there are all or portions of four Mexican Land Grants in the county.

The principal transportation infrastructure in Torrance County consists of roads and highways. The county is traversed by an interstate highway (I-40) and several state and federal highways forming the base road network for the county. Relatively good east-west and north-south corridors are in the county, although they are widely spaced. Torrance County has three public airports for general aviation and are all designed for small aircraft only: Moriarty Municipal Airport, Estancia Municipal Airport, and Mountainair Municipal Airport. Of these, only Moriarty Municipal Airport has paved runways. There are two railroads in the county: the Burlington Northern & Santa Fe Railroad, situated mostly along the U.S. Highway 60 transportation corridor, and the Union Pacific Railroad, situated along the US. Highway 54 corridor. Neither of these railroads has scheduled stops within Torrance County (Mid-Region Council of Governments of New Mexico, 2003).

The Torrance County Comprehensive Land Use Plan (CLUP) (July 2003) governs all land use planning in the county and provides the rationale and guidance for specific land use regulations and projects developed by the local government (Mid-Region Council of Governments of New Mexico, 2003). It establishes a basis for regulations and programs necessary to manage current and future land development within the jurisdiction of Torrance County. The Torrance County CLUP promotes consistency and continuity in making decisions to carry out the programs, projects, and operations of Torrance County. The county presently administers the comprehensive land use management program supported by regulatory ordinances and enforcement powers. Actual implementation of the Torrance County CLUP is subject to the policy directives and actions of the Board of County Commissioners as deemed appropriate.

In accordance with the Torrance County CLUP, the Torrance County Zoning Ordinance (revised 2020) establishes comprehensive zoning regulations for the unincorporated areas of Torrance County (The Board of County Commissioners of Torrance County, 2020). It is designed to promote health and the general welfare of the county; secure safety from fire, flood, and other dangers; protect local water resources; facilitate adequate provisions for transportation, solid waste management, water and wastewater systems, schools, parks, and other community requirements; conserve the value of property; and provide for the compatible development of land and other natural resources in the county.

The East Torrance Soil and Water Conservation District (SWCD) Long Range Plan (2009-2019) promotes stewardship of natural resources by providing conservation leadership, education, technical, and financial assistance to the residents of the District (East Torrance SWCD, 2009).

Within Torrance County, the Estancia High School is the closest school to the 2022 Corona Generation Expansion, located approximately 28 miles west. As of 2022, the Estancia Municipal School District includes three elementary schools, one middle school, and one high school serving approximately 611 students from pre-kindergarten through 12th grade.

4.12.2.2 Lincoln County

Lincoln County is a sparsely populated county covering 4,831 square miles in south central New Mexico. Land use includes sprawling shrub rangeland used for sheep, goat, and cattle ranching, as well as forested mountain ranges providing forestry, big game hunting, mining and, more recently, tourism. Farming and ranching have been the traditional economic activities of the county but are being replaced by service industries (retail, food service, entertainment), health services and social assistance, and real estate construction as the population grows in the resort communities of the Sierra Blanca Mountain Range. Most of the area where the Corona Wind Project will be developed are in agriculture and ranching use, far from the residential and commercial development occurring in the southern part of the county.

Lincoln County land ownership and jurisdictions are a mix of private and government lands. Of the 3,091,840 acres of land in Lincoln County, federally owned land makes up 33.6 percent as of 2018, including ownership by the Bureau of Land Management, United States Forest Service, and U.S. Department of Defense (Exhibit 17). State trust lands make up another 9.2 percent of Lincoln County land ownership (Lincoln County Board of Commissioners, 2018) (Exhibit 16). A very small portion of the Mescalero Apache Reservation occurs in the southernmost part of the county (BIA, 2022).

The Ruidoso/Ruidoso Downs/Alto Micropolitan Statistical Area in the south part of the county is where the great majority of Lincoln County's population resides. This area is a year-round resort and retirement destination, which has been an important economic generator for the county. Beside the towns of Ruidoso and Ruidoso Downs, Lincoln County has four other incorporated communities: the town of Carrizozo (which is the county seat), and the villages of Capitan, Corona, and Lincoln. The village of Corona is the nearest incorporated community to the 2022 Corona Generation Expansion, located approximately 1 mile north. Important natural features in Lincoln County include Lincoln National Forest, Sacramento Mountain Range, Capitan Mountain Range, Bonito Lake, Alto Lake, Grindstone Lake, Snowy River Cave Conservation Area, Rio Ruidoso, Rio Bonito, Rio Hondo, and the Valley of Fires lava fields (Lincoln County Board of Commissioners, 2018). Part of the U.S. Department of Defense White Sands Missile Range is located in the westernmost part of Lincoln County.

The three primary roadways into Lincoln County include: U.S. Route 380, which travels west to east connecting the north- and southbound Interstate 25 with the city of Roswell and west Texas; U.S. Route 70, which connects Las Cruces, Alamogordo, and Tularosa with Ruidoso and joins U.S. Route 380 at the unincorporated community of Hondo in southeast Lincoln County; and U.S. Route 54, which runs from El Paso, Texas, through Carrizozo and Corona, and northeastward through several states. Two small public airports are present in Lincoln County: Carrizozo Municipal Airport and Sierra Blanca Regional Airport. The Union Pacific Railroad passes through Lincoln County along the U.S. Highway 54 corridor, but it does not have scheduled stops within the county (Sites Southwest, 2007).

The Lincoln County Comprehensive Plan (August 2007) analyzes data on existing and anticipated population and economic growth to help set future goals and policies regarding land use, infrastructure, water use, natural resources, and economic development (Sites Southwest, 2007). The plan identifies no current zoning in the unincorporated part of the county, except for a Special Zoning District in the unincorporated community of Alto and several extraterritorial zones in Ruidoso and Ruidoso Downs. The Lincoln County CLUP (February 2018) updates the August 2007 Comprehensive Plan and provides direction from the people of Lincoln County to assist county, private, state, and federal decision makers in planning and management (Lincoln County Board of Commissioners, 2018). The plan promotes the productive use and protection of all essential scarce natural resources throughout the county. It provides an assessment of Lincoln County natural resources conditions and trends and includes goals, policies, and action plans. The Lincoln County CLUP addresses Wind Energy Conversion Systems such as those facilities that may be constructed within the 2022 Corona Generation Expansion, and states that dust generated by wind, drought conditions, unpaved access roads, mining operations, and oil and gas extraction is marginal for Lincoln County.

Historically engineered ditches and irrigation channels known as acequias are present in Lincoln County and are recognized under New Mexico law as political subdivisions of the state. Acequia associations are collectively run local government units that manage the distribution and use of surface water. Acequia water law in New Mexico requires three commissioners and a majordomo to administer irrigation and conservation but gives all citizens holding irrigation rights equal ownership and responsibility in the watershed use plan. Under acequia water law, transference of water for use outside the watershed is prohibited. Acequia systems in Lincoln County include Rio Bonito, Rio Ruidoso, and Rio Hondo, and irrigate approximately 2,230 acres (Lincoln County Board of Commissioners, 2018). All of these acequias are south of the 2022 Corona Generation Expansion.

The Carrizozo Soil and Water Conservation District Long Range Plan (2009-2019) promotes stewardship of natural resources by providing conservation leadership, education, technical, and financial assistance to the residents of the District (Carrizozo SWCD, 2015).

The Corona Elementary/Junior High/High School serves less than 100 students and covers pre-kindergarten through 12th grade, but is a hub for students from surrounding areas up to 40 miles away. This school is the closest school to the 2022 Corona Generation Expansion boundary within Lincoln County, located approximately 1 mile north of the 2022 Corona Generation Expansion.

4.13 Socioeconomics

4.13.1 Data Sources

The following data source was reviewed to assess the existing socioeconomic conditions of Lincoln and Torrance Counties and the 2022 Corona Generation Expansion.

- Arrowhead Center. 2021. *State of New Mexico County-Level Revenue & Expenditure Analysis, 2015-2019*. Accessed June 2022 from: https://www.nmcounties.org/wp-content/uploads/2021/02/New-Mexico-Revenue-Expenditure-Study.pdf.
- City-Data. 2022. Accessed June 2022 from: www.city-data.com.
- New Mexico Economic Development Department (NM EDD). 2021. *County Economic Summaries & Data Profiles*. Accessed June 2022 from: https://edd.newmexico.gov/site-selection/county-profiles/.
- Tysseling, J.C., Ph.D. 2017. *The Economic and Fiscal Impact of the Corona Wind Project in New Mexico*.
- U.S. Bureau of Labor Statistics, Southwest Information Office (BLS-SW). 2022. Accessed June 2022 from: https://www.bls.gov/regions/southwest/
- U.S. Census. 2020. Accessed June 2022 from: www.census.gov.
- USDA National Agricultural Statistics Service (NASS). 2019. 2017 Agricultural Census, published 2019. Accessed June 2022 from: https://www.nass.usda.gov/Publications/AgCensus/2017/index.php#highlights

4.13.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

The area where the Corona Wind Project will be developed is a largely rural region of central New Mexico, dominated by high-desert range lands and forested mountain landforms on the western margins

of the area. The largely rural area has access to major urban economic and cultural centers, with relatively close access to recreation and resort facilities in the Ruidoso and related mountain communities to the south and west, regional trade centers in Roswell and Alamogordo to the south, and the state's largest metropolitan area comprising the Albuquerque and middle Rio Grande suburban communities approximately a 2-hour drive from the 2022 Corona Generation Expansion. These larger population centers, combined with the traditional ranching communities found within the area where the Corona Wind Project will be developed, provide wide ranging economic and cultural resources.

Of the two counties covered by the System, Lincoln County has the largest population and the largest geographic area. Torrance County, however, has the greatest population density of the two counties. An overview of the area's population demographics is shown in Table 4 ~~Table 4~~ 8.

Table 4-8: Population of Study Area Counties

County	2020 Reported Population	Geographic Area (Square Miles)	Population Density (people/square mile)
Torrance	15,045	3,345	4.5
Lincoln	20,269	4,831	4.2
Study Area Total	**35,314**	**8,176**	**4.3 (Avg.)**

Source: U.S. Census, 2020.

Based on 2020 U.S. Census block data, the area where the 2022 Corona Generation Expansion would be developed (Census Blocks 9602.1 and 9637.1) includes a reported 2020 combined population of 931, which comprises 0.04 percent of New Mexico's 2020 Census population of 2,117,522 (U.S. Census, 2020). Lincoln County has a few modestly populated communities — the county seat, Carrizozo (2020 reported population 972); Capitan (2020 reported population 1,391); and the county's commercial center, Ruidoso (2020 reported population 7,679). Torrance County has its primary population center along the I-40 corridor, namely Moriarty (2020 reported population 1,946) and the county seat of Estancia (2020 reported population 1,242), approximately 16 miles south of Moriarty. Between the 2010 census and the 2020 census, communities such as Corona, Capitan, Ruidoso, and Estancia have shown population decreases while towns such as Carrizozo and Moriarty have shown modest population increases (U.S. Census, 2020). These population estimates may indicate migration away from the rural area or a natural decline of the aging population of the area.

Primary, intermediate, and secondary schools near the 2022 Corona Generation Expansion include: Corona Public Schools, approximately 1 mile north and serving less than 100 students from pre-kindergarten through 12th grade; Vaughn Municipal Schools, approximately 11 miles northeast in

Guadalupe County and serving approximately 68 students from pre-kindergarten through 12th grade; and Estancia Municipal Schools, approximately 28 miles west and serving approximately 611 students from pre-kindergarten through 12th grade.

The counties where the 2022 Corona Generation Expansion will be developed had a total labor force of 13,853 and employment of 13,088 (approximately 0.8 percent of statewide employment) during first quarter of 2022 (BLS-SW, 2022). For reference, the annual unemployment rates for 2021 were 7.9 percent in Torrance County and 7.5 percent in Lincoln County, compared to New Mexico's 2021 unemployment rate of 6.8 percent (BLS-SW, 2022).

2021 total wages and salaries for covered employment (non-farm) in the counties where the 2022 Corona Generation Expansion would be developed was an estimated average annual compensation of $42,671 per employee (BLS-SW, 2022). The New Mexico statewide average annual compensation was estimated at $57,044 for 2021, revealing that reported wages and salaries in the area where the 2022 Corona Generation Expansion would be developed are approximately 75 percent of the state average (BLS-SW, 2022).

Agriculture is an important foundation of the area economy but non-agricultural sectors provide the dominant employment and income in the regional economy. The area where the 2022 Corona Generation Expansion will occur is sparsely populated, and land use is dominated by agricultural business enterprises (particularly ranching). Table 4-9 presents an agricultural profile for the area where the 2022 Corona Generation Expansion will be developed.

Table 4-9: 2017 and 2012 2022 Corona Generation Expansion Area Farm Demographics

2017 and 2012 USDA Agricultural Profile for Torrance and Lincoln Counties					
Number of Farms	**2017**	**2012**	**Average Farm Size (acres)**	**2017**	**2012**
	1,170	951		2,587	3,594
2017 Market Value of Agricultural Products Sold ($ millions)					
Crops		**Livestock and Poultry**			**Total**
$11.75		$50.00			$61.75
19.0%		81.0%			
2017 Top Commodity Groups and Values of Sales ($ millions)					
Cattle and Calves	**Hay and Other Crops**	**Sheep, Goats, Wool, Mohair, and Milk**	**Vegetables, Melons, Potatoes, and Sweet Potatoes**	**Horses, Ponies, Mules, Burros, and Donkeys**	

2017 and 2012 USDA Agricultural Profile for Torrance and Lincoln Counties				
$37.98	$3.62	$0.89	$0.86	$0.38

Source: USDA NASS, 2019.

Private firms comprise about 83 percent of the business entities in the area where the 2022 Corona Generation Expansion would be developed (City-Data, 2022). However, the agricultural production sector is excluded, which is recognized to be a significant component of the rural economy in the area where the 2022 Corona Generation Expansion would be developed. Due to the population and predominantly rural nature of the counties' land area, most of the establishments in the area where the 2022 Corona Generation Expansion will be developed are quite small, with a limited number of employees (Tysseling, 2017).

Excluding the agricultural production sector, statistics from 2008 to 2021 suggest that the area economy, where the 2022 Corona Generation Expansion will occur, is largely driven by retail; accommodations and food services; healthcare and social assistance; and public administration (NM EDD, 2021). These four sectors alone comprise around two-thirds of total annual employment by industry for the area where the 2022 Corona Generation Expansion will occur (Tysseling, 2017).

The area where the 2022 Corona Generation Expansion will be developed, had an annual average of approximately $198.4 million in Gross Receipts Tax (GRT) collections over the period of 2015 to 2019, providing 1.4 percent of the total GRT collections in the state of New Mexico (Arrowhead Center, 2021). The economic sector reporting the highest levels of GRT, in the area where the 2022 Corona Generation Expansion will be developed, is the Construction sector, with revenues from the sales in this sector constituting 32 percent of the GRT collections for Torrance and Lincoln Counties in 2021. This is followed by the Retail Trade sector, which boasts 23 percent of the total GRT for Torrance and Lincoln Counties in 2021. The observation that Construction provides 32 percent of the GRTs, but only about 13 percent of the employment in the counties where the 2022 Corona Generation Expansion will be developed, highlights the ready supply of construction firms and workers from the larger population centers surrounding the 2022 Corona Generation Expansion (NM EDD, 2021; BLS-SW, 2022).

4.14 Communication Signals

4.14.1 Data Sources

The following data sources were reviewed to assess the existing communication signals of Lincoln and Torrance Counties for the 2022 Corona Generation Expansion.

- Cavell Mertz & Associates, Inc. 2022. Publicly available Federal Communications Commission (FCC) data. Accessed June 2022 from: http://www.fccinfo.com/

4.14.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

Lincoln and Torrance Counties are rural counties in central New Mexico with population densities below the state and national averages. Table 4-10 presents a review of signaling structures within a 35-mile search radius from the coordinates at the north, south, east, and west endpoints of the 2022 Corona Generation Expansion (Exhibit 20; Cavell Mertz & Associates, 2022).

Table 4-10: Signaling Structures Within 35 Miles of the 2022 Corona Generation Expansion

Structure Type	Number of Structures
Antenna Structure Registration	114
Cellular	38
Land Mobile (LM) – Comm	34
Land Mobile (LM) – Private	495
Microwave	463
Paging	5

4.15 Radioactive Waste and Radiation Hazards

Electric transmission line and substation infrastructure do not generate or contain radioactive waste or radiation hazards. The 2022 Corona Generation Expansion would not generate radioactive waste or radiation hazards and, therefore, they are not addressed further in this ER.

4.16 Hazardous Materials

Prior to construction, a Phase I Environmental Site Assessment will be performed to identify any hazardous materials, substances, or facilities in the vicinity of the 2022 Corona Generation Expansion. Chapter 5, Section 5.16 describes potential hazardous materials associated with construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area as well as protection measures to reduce impacts from hazardous materials.

4.17 Safety

The vicinity of the 2022 Corona Generation Expansion does not contain any known uncommon safety concerns. Chapter 5, Section 5.17 describes potential safety concerns associated with construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area as well as protection measures to reduce safety impacts.

4.18 Geographic Resources

4.18.1 Data Sources

The following data sources were reviewed to assess the existing geographic resources of Lincoln and Torrance Counties and the 2022 Corona Generation Expansion.

- MRLC. 2021. *2019 NLCD*. Accessed June 2022 from: https://www.mrlc.gov/
- NPS. 2017. *Physiographic Provinces*. Accessed June 2022 from: https://www.nps.gov/subjects/geology/physiographic-provinces.htm.
- NPS. 2022a. *Find A Park: New Mexico*. Accessed June 2022 from: https://www.nps.gov/state/nm/index.htm

4.18.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

The area where the Corona Wind Project will be developed is located within the Great Plains physiographic province and the Basin and Range province (NPS, 2017). The Great Plains extend from Texas north to Montana and are bordered to the west by the Rocky Mountains and to the east by the Central Lowlands. The Great Plains slope downward to the east, with maximum heights in the foothills of the Rockies at 5,500 ft, decreasing to 2,000 ft (MRLC, 2021). The bedrock is horizontal beds of sandstones, shales, limestones, conglomerates, and lignite. Coal, petroleum, and natural gas are all mined extensively throughout the Great Plains. National Parks and Monuments of the Great Plains in New Mexico include Carlsbad Caverns National Park, Fort Union National Monument, and Capulin Volcano National Monument. None of these items are within or near the 2022 Corona Generation Expansion.

The Basin and Range province Extends from eastern California to central Utah and from southern Arizona to New Mexico and Texas. Over time, stretching of the Earth's crust created faults from which the mountain ranges were formed. This resulted in the patterns of alternating mountain ranges and valleys characteristic of this province. The southern basin and range province consist of the Sonoran Desert, Salton Trough, Mexican Highland, and the Sacramento sections. This portion of the province mountains have a slightly lower elevation than those found in the northern part of the province. National Parks and Monuments of the Basin and Range province in New Mexico include the Gila Cliff Dwellings National Monument, Pecos National Historical Park, Petroglyph National Monument, Salinas Pueblo National Monument, and White Sands National Monument. None of these items are within or near the 2022 Corona Generation Expansion.

No national or state parks, preserves, recreation areas, trails, or monuments are in the footprint of the 2022 Corona Generation Expansion (NPS, 2022a). Section 4.11.2 identifies other nearby sites managed by the NPS, BLM, or NMEMNRD and their distances from the 2022 Corona Generation Expansion.

4.19 Military Activities and Aviation

4.19.1 Data Sources

The following data sources were reviewed to assess the existing military and aviation conditions of Lincoln and Torrance Counties and the 2022 Corona Generation Expansion.

- Digital Aviation LLC. 2022. *VFR Map*. Accessed June 2022 from: http://vfrmap.com.
- Military Bases.com. 2022. *New Mexico Military Bases* (map). Accessed June 2022 from: https://militarybases.com/new-mexico/.

4.19.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

No military bases occur within the 2022 Corona Generation Expansion. Three military training routes intersect the 2022 Corona Generation Expansion (Exhibit 21; Digital Aviation, 2022; Military Bases.com, 2022). Corona Wind Companies would request Determination of No Hazard (DNH) from the FAA for any transmission line structures over 200 ft (transmission line structures of this height are very unlikely for the Corona Wind Project).

4.20 Roads

4.20.1 Data Sources

The following data sources were reviewed to assess the road conditions of Lincoln and Torrance Counties and the 2022 Corona Generation Expansion.

- NMDOT. 2012b. *Interactive Transportation Maps*. Accessed June 2022 from: https://www.dot.state.nm.us/content/nmdot/en/Maps.html#m_par_text.

4.20.2 Current Conditions and Trends, Regional Overview – 2022 Corona Generation Expansion

Torrance and Lincoln counties are rural counties in central New Mexico with a sparse network of U.S. highways, state highways, county roads, and private roads within the area where the 2022 Corona Generation Expansion will be developed. Corona Wind Companies will work with NMDOT and the

County Road Maintenance Departments of each county to determine current road conditions for construction access prior to the start of any construction. U.S. Highway 54 and several east-west and north-south segments of state routes and county roads traverse the 2022 Corona Generation Expansion (NMDOT, 2012b).

5.0 ENVIRONMENTAL EFFECTS

5.1 Introduction

This chapter provides an overview of potential consequences, or impacts, on the environment that could result from adding the 2022 Corona Generation Expansion to the Corona Wind Project taking into account the protection measures identified in this report. Each of the resource areas provided in NMSA 1978 Section 62-9-3M, Commission Rule 17.9.592.10 NMAC are addressed, as well as additional resource areas identified by Staff. These resources are: air resources; noise; geology and mineral resources; soil resources; paleontological resources; water resources; flora and fauna resources; archaeological and historic-age cultural resources; religious and cemetery sites; socioeconomics and environmental justice; communication signals; radioactive waste and radiation hazards; hazardous materials; safety; geographic resources; military activities and aviation; and roads. Impact evaluations for each resource are discussed below in the context of the Corona Wind Project together with BMPs that can help manage impacts.

Addition of the 2022 Corona Generation Expansion to the Corona Wind Project could affect the existing condition of the environment. Effects can occur directly or indirectly as a result of the 2022 Corona Generation Expansion development. Direct effects are those that occur through direct or immediate interaction of the new proposed transmission line facilities with environmental components. Indirect effects are those that are somewhat distant from the new proposed transmission line facilities in time, space, or both.

Short-term impacts are considered those impacts that occur during construction and are generally anticipated to return to a preconstruction condition, at or within 3 to 5 years following construction. Environmental effects that would be anticipated to remain for the life of the Corona Wind Project (approximately 30 years) were considered long-term impacts. Permanent impacts are those that would be anticipated to remain for the life of the Corona Wind Project and beyond.

For each resource area review below, this report: describes the potential ground disturbance and environmental effects that may occur due to the addition of the 2022 Corona Generation Expansion to the Corona Wind Project, and identifies the protection measures the Corona Wind Companies proposes to avoid and minimize impacts.

5.2 Air Resources

5.2.1 Impact Assessment Methods

Assessment of impacts to air resources resulting from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Section 5.1 above and is discussed below. Construction, operations, and maintenance impacts are generally short term and temporary in nature for air resources.

5.2.2 Impacts Specific to the 2022 Corona Generation Expansion

5.2.2.1 Construction

The large equipment used during construction that is powered by internal combustion (IC) engines would likely use diesel or gasoline as fuel. The products of the combustion of these fuels include pollutants such as nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO_2), volatile organic compounds (VOC), Particulate Matter (PM), small amounts of sulfur dioxide (SO_2), and trace amounts of hazardous air pollutants (HAP). Construction contractors and their equipment are required to comply with all applicable emissions standards. An onsite concrete batch plant is anticipated for project facility construction, and the proper state and county location and air quality permitting would be obtained by Corona Wind Companies prior to construction.

Fugitive dust emissions will also contribute to air quality impacts associated with construction of project infrastructure on the 2022 Corona Generation Expansion area. Fugitive dust arises from land clearing, grading, excavation, and vehicle traffic on unpaved roads. The amount of fugitive dust depends on the amount of vehicular traffic, construction activities, moisture content of the soil, and wind speed. During dry periods with high winds, fugitive dust would be much more prevalent than during wet periods with low winds. Dust suppression methods such as watering are planned to be used in construction zones during dry periods to minimize fugitive dust impacts.

Since the fugitive dust and combustion engine emissions will be temporary (limited to the construction period), limited to the construction area, and controlled with watering, these emissions sources are not expected to significantly impact the air quality in the area of the 2022 Corona Generation Expansion.

5.2.2.2 Operations and Maintenance

During operation of project infrastructure on the 2022 Corona Generation Expansion area, the primary emissions are expected to be fugitive dust from worker and maintenance vehicles traveling intermittently on unpaved roads. In addition, there would be emissions from the vehicles themselves. Such emissions

are not anticipated to be substantial, and, therefore, only minimal impacts to air quality are anticipated during the operation of project infrastructure on the 2022 Corona Generation Expansion area.

5.2.3 Protection Measures

Protection measures would be implemented to reduce potential impacts to air quality from construction activities. Emissions are only anticipated to arise from ground disturbing activities, equipment movement, fuel combustion, and a concrete batch plant, if required. These emissions would be temporary and localized. Protection measures to address construction-related impacts to air quality resources would include:

Air-1: Maintaining all fossil fuel-fired construction equipment in accordance with manufacturers' recommendations to minimize construction-related combustion emissions.

Air-2: Controlling combustion emissions through engine manufacturing requirements for both mobile sources and portable equipment such as air compressors.

Air-3: Limiting the idling time of equipment, unless idling must be maintained for proper operation (e.g., drilling, hoisting, and trenching).

Air-4: Limit the speed of vehicles within construction sites and along the utility ROW during construction to reduce the amount of fugitive dust generated.

Air-5: Water trucks will be utilized as necessary to reduce fugitive dust from construction activities.

5.2.4 Conclusion

Considering the limited and transient nature of emissions resulting from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area, as well as the protection measures detailed above, it is not expected that the proposed location of the new proposed project facilities would materially impair air resources.

5.3 Noise

5.3.1 Impact Assessment Methods

Assessment of impacts to noise conditions anticipated from the construction, operation and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Section 5.1 above and is discussed below. Construction, operations, and maintenance impacts are generally low, short term, and temporary in nature for noise.

5.3.2 Impacts Specific to the 2022 Corona Generation Expansion

The existing noise levels in rural areas surrounding the 2022 Corona Generation Expansion in Torrance and Lincoln Counties is relatively low. The primary existing sources of noise in the 2022 Corona Generation Expansion area are traffic along U.S. and State highways, local county roads, existing wind generation turbines, and some agricultural machinery. Localized noise associated with equipment operation during construction and maintenance activities would increase local noise levels in areas adjacent to the 2022 Corona Generation Expansion area. Noise impacts from construction of the new proposed project infrastructure would be localized, short term, and temporary, and in compliance with all applicable state and local noise regulations.

5.3.3 Protection Measures

Protection measures that would be implemented to reduce any potential negative noise impacts from construction activities include:

Noise-1: Restrict construction activity near residences to normal business hours.

Noise-2: Audible noise due to wind energy facility operations shall not exceed fifty (50) A-weighted decibels (dBA) for any period of time, when measured at any occupied residence, school, hospital, church or public library existing on the date of approval of the wind energy facility.

5.3.4 Conclusion

Based on localized, low-volume, short-duration impacts, compliance with regulated noise limits during operation, negligible impacts to receptors during operation, and the protection measures detailed above, it is not expected that the proposed location of the 2022 Corona Generation Expansion would result in a significant noise burden for the area.

5.4 Geology and Mineral Resources

5.4.1 Impact Assessment Methods

Assessment of impacts to geological and mineral resources anticipated from the construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Section 5.1 above and is discussed below.

5.4.2 Impacts Specific to the 2022 Corona Generation Expansion

There are no identified operational hydrocarbon facilities or unique geological features located within the 2022 Corona Generation Expansion footprint, and impacts from the construction, operation, and

maintenance of project infrastructure on the 2022 Corona Generation Expansion area are not anticipated. There are no known faults or landslide areas in the 2022 Corona Generation Expansion area, and, therefore, adverse impacts resulting from construction, operation, and maintenance of the new proposed facilities are not anticipated.

5.4.3 Protection Measures

No protection measures are needed for geology resources. This is due to the lack of unique geological features, faults, or landslide areas in the 2022 Corona Generation Expansion area.

5.4.4 Conclusion

Due to an absence of unique geological features, faults, or landslides; the types of bedrock in the area; and the proposed activities for the 2022 Corona Generation Expansion, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair geological resources.

5.5 Soil Resources

5.5.1 Impact Assessment Methods

Assessment of impacts to soil resources from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Section 5.1 above and is discussed below. Construction, operations, and maintenance impacts are generally low, short term, and temporary in nature for soil resources. A small amount of soil would be lost due to the permanent footprint of the 2022 Corona Generation Expansion and is discussed below in Section 5.5.2.3.

5.5.2 Impacts Specific to the 2022 Corona Generation Expansion

Construction activities affecting soils include permanent and temporary land-disturbance activities such as structure work areas, wire-pulling, tensioning and splicing sites, construction yards, and temporary and permanent roads.

5.5.2.1 Temporary Erosion

Ground disturbance during construction may increase the potential for erosion. For example, removal of protective vegetation may expose soil to potential wind and water erosion. Certain soils within the 2022 Corona Generation Expansion would be more sensitive to soil erosion impacts. The primary soil erosion factor is water erosion and wind erosion on bare soils.

Potential erosional effects from operations would consist of soil disturbances necessary to maintain the project infrastructure on the 2022 Corona Generation Expansion area in working order and conduct necessary repairs. Potential stormwater BMPs, including erosion and sediment control structures, as well as new culverts, might require inspection, maintenance, and/or repair throughout the operational life of the project infrastructure on the 2022 Corona Generation Expansion area to reduce soil erosion or sedimentation to surface water. Temporary access, not retained for operations, would be seeded with a native grass mix and allowed to revegetate, thereby minimizing the surface exposed to erosive conditions.

The areas used for construction would be reclaimed as soon as possible, which may include regrading to original land contours, topsoil replacement, and revegetation. Implementation of a Stormwater Pollution Prevention Plan (SWPPP)—a stormwater management program from the EPA under National Pollutant Discharge Elimination System that would protect water and soil resources—and use of appropriate soil mitigation measures and BMPs would reduce the effects of erosion.

5.5.2.2 Accidental Spills

During construction, use of trucks, heavy equipment, and stored supplies could result in accidental discharge of fuel, lubricants, and automotive fluids. Although the potential exists, any spills would be accidental, occasional, and of limited extent and would be considered minor to negligible and temporary in duration. BMPs for construction housekeeping, spill prevention, and cleanup would be used to prevent and remediate accidental spills. Therefore, accidental spills would not result in widespread or long-term effects to soils.

5.5.2.3 Permanent Soil Loss

The area within the footprint of the 2022 Corona Generation Expansion would result in minor long-term loss of acreage to other productive soil uses. The total permanent footprint would range from approximately 50 to 60 acres inside the 2022 Corona Generation Expansion, equaling less than one-tenth of 1 percent of the 2022 Corona Generation Expansion footprint.

5.5.3 Protection Measures

Protection measures that would be implemented to reduce any potential negative soil impacts from construction activities include:

Soil-1: Construction crews will reduce the amount of soil compaction by using equipment with more tires and wider tires to distribute the weight of the vehicle and tilling the severely compacted areas after construction is completed or using ground mats when the ground is wet.

Soil-2: To the extent possible, topsoil will be placed separately from sub-soils/bedrock during excavation and not comingled. Corona Wind Companies will replace soil in reverse order, to help preserve topsoil.

Soil-3: Corona Wind Companies will reduce erosion by applying and maintaining standard erosion and sediment control methods. These may include using certified weed-free straw wattles, bale barriers, and silt fencing, which would be placed at construction boundaries and where soil would be disturbed near a wetland or water body. Specific erosion and sediment control measures and locations will be specified in a SWPPP.

5.5.4 Conclusion

Based on BMPs to minimize and stabilize disturbed soils, BMPs to reduce accidental spills, the small amount of permanent soil loss as well as the protection detailed above, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair soil resources.

5.6 Paleontological Resources

5.6.1 Impact Assessment Methods

Assessment of impacts to paleontological resources from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Section 5.1 above and is discussed below.

5.6.2 Impacts Specific to the 2022 Corona Generation Expansion

Construction activities that may affect paleontological resources include excavation, heavy equipment usage and movement, drilling, and trenching for utilities. Grading for access roads could also directly impact paleontological resources. The geology in the area consists of Mesoproterozoic plutonic rocks, Permian deposits of the Yeso, Glorieta, and San Andres formations, the Tertiary Ogallala Formation, and several deposits of the Quaternary Period including piedmont alluvium, eolian deposits, and lacustrine/playa lake deposits, all unconsolidated, all of which would have a low probability for the presence of paleontological deposits. The greatest possibility of discovery of paleontological resources would be from Ogallala Formation, but these would be rare. However, any grading and excavation during site preparation and construction would have potential to impact paleontological resources that may be present within the boundaries of the 2022 Corona Generation Expansion. As previously mentioned, any discoveries which may occur during construction would be managed through a UDP.

5.6.3 Protection Measures

Protection measures that would be implemented to reduce any potential negative impacts from construction activities include:

Paleo-1: Follow a UDP, providing protection for unknown sites.

5.6.4 Conclusion

Due to the low probability for the presence of paleontological deposits in the area and the fact that no ground disturbance activities would be completed prior to paleontological survey work being completed, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair paleontological sites.

5.7 Water Resources

5.7.1 Methods and Impact Types

Assessment of impacts to water resources from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Section 5.1 above and is discussed below. Construction, operations, and maintenance impacts are generally low, avoidable, short term, and temporary in nature for water resources.

5.7.2 Impacts Specific to the 2022 Corona Generation Expansion

5.7.2.1 Surface Water

The potential sources of surface water resource impacts from the project infrastructure on the 2022 Corona Generation Expansion area include permanent and temporary soil-disturbance activities from structure work areas, wire-pulling, tensioning and splicing sites, construction yards, and temporary and permanent roads as well as potential accidental spills of hazardous materials from these activities. Short-term impacts from soil disturbances that increase erosion (or water runoff in areas with compacted soils) would potentially result in an increase in suspended sediments within adjacent waterbodies and accidental spills of hazardous materials that could wash into and pollute surface water. Based on the short construction duration, the small ground disturbance area, and minimal amount of surface water present within the vicinity, low impacts to surface water are anticipated from construction, operation, and maintenance of the project infrastructure on the 2022 Corona Generation Expansion.

In addition to soil-disturbance activities, impacts to surface waters may include stream crossings by transmission lines or access roads. All streams would be spanned by the transmission line, and individual

structures would be located outside the stream bank ordinary high-water mark (OHWM) to avoid potential impacts. Where available, existing road-stream crossings would be utilized for access; however, new stream crossings may be required in certain areas. These activities would be permitted through the applicable agencies. Low impacts to streams would occur based on the low number of streams in the 2022 Corona Generation Expansion and the ability to avoid stream resources through aerial spanning and overall Project avoidance and minimization strategies.

Stormwater BMPs would be used during construction to reduce potential impacts from erosion, sedimentation, and turbidity in surface waters during construction. A SWPPP would be developed and implemented for the 2022 Corona Generation Expansion, which would meet the construction stormwater discharge permit requirements of the New Mexico Environment Department Surface Water Quality Bureau (NMED-SWQB). The SWPPP would include a number of measures to control runoff and to reduce erosion and sedimentation at construction sites. In addition, a Spill Prevention, Containment, and Countermeasures Plan (SPCC) would be implemented to prevent pollution of surface waters from accidental spills of hazardous materials.

5.7.2.2 Floodplains

It is reasonable to assume that all watercourses that convey natural flows, whether or not mapped by FEMA as floodplains or flood hazard areas, present some level of flood hazard. Encroachment of a structure into a flood path could result in flooding of or erosion damage to the encroaching structure and diversion of flows. The project infrastructure on the 2022 Corona Generation Expansion area would be set back from channel banks to avoid impacts (such as channel alteration and flow modification) and, therefore, impacts to floodplains would be low.

5.7.2.3 Groundwater

It is unlikely the project infrastructure on the 2022 Corona Generation Expansion would significantly affect groundwater. Any impacts to groundwater would be for a short duration. Excavations for the project infrastructure on the 2022 Corona Generation Expansion may contact shallow groundwater; however, the groundwater contact would be unlikely to adversely impact this resource, unless an accidental spill of fuel or petroleum from construction equipment (which is very unlikely) occurs near an open excavation or is not cleaned up in a timely manner.

5.7.2.4 Wetlands

A desktop assessment utilizing existing maps and data to identify potentially jurisdictional waters of the U.S., including wetlands that could potentially be affected by construction, was conducted to address

compliance with Sections 404 and 401 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. Based on the desktop assessment using NWI data, potential waters of the U.S., including wetlands, could be present. Wetland presence based only on NWI data cannot be assumed to be an accurate assessment of potentially occurring jurisdictional wetlands and waterbodies. Wetland identification criteria differ between the USFWS and the USACE. As a result, wetlands shown on an NWI map may not be under the jurisdiction of the USACE, and all USACE jurisdictional wetlands are not always included in NWI data.

The NWI data was then overlaid with other digital data, including presence of hydric soils or soils with hydric inclusions, topographic contours, USGS NHD data, FEMA mapped floodplains, and NAIP aerial photography as part of the desktop assessment. Overlapping layers representing multiple characteristics of wetlands provide a degree of probability that wetlands may be present. A review of the overlapping layers indicated that the majority of acreage within the 2022 Corona Generation Expansion footprint exhibited "No Probability" of wetland occurrence (Burns & McDonnell, 2021).

A wetland delineation would be conducted to identify any wetlands or other water bodies that may be present within or near proposed project infrastructure prior to construction. This information would be provided to the design team so direct impact to wetlands can be avoided and minimized.

Wetlands or water bodies are anticipated to be materially impacted by construction within the 2022 Corona Generation Expansion or access roads, as currently designed. All wetlands would be avoided or spanned by the transmission line to avoid direct impacts. Substations and switchyards would not be located in wetlands or playas. Other project sites would be sited to avoid wetlands to the extent practicable. Therefore, a Section 404 permit, Section 10 permit, or Section 401 water quality certification is not expected to be required. However, only the U.S. Army Corps of Engineers can make final official jurisdictional determinations. If wetlands cannot be avoided, matting and other temporary protective measures would be used, and proper permits would be obtained. No permanent loss of wetlands or playas would occur from construction, operation, or maintenance of the project infrastructure on the 2022 Corona Generation Expansion based on the following protection measures.

5.7.3 Protection Measures

Protection measures that would be implemented to reduce potential negative water resource impacts from construction activities include:

Water-1: Develop and implement a SWPPP. The SWPPP will include measures such as: silt barrier fences to control runoff, sediment traps and basins, and minimizing exposed soils by using temporary and permanent seeding and mulching.

Water-2: Disturbed areas will be restored to their original condition to the extent practicable. Seed mix and seeding rates will be developed through consultation with the local agency and landowner preference.

Water-3: Equipment will be properly maintained to avoid fluid leaks.

Water-4: Fuels and petroleum will be stored away from excavated areas.

Water 5: Spills will be cleaned up immediately.

Water-6: Matting and other temporary protective measures will be used on wetlands that cannot be avoided.

Water-7: Impacts will be evaluated against the requirement of the U.S. Army Corps of Engineers for coverage under the Nationwide Permit (NWP) Program.

Water-8: Establish an appropriate buffer zone around wetlands, as necessary to reduce disturbance.

5.7.4 Conclusion

Based on the limited amount of water resources in the vicinity; avoidance of water resources; and the protection measures detailed above, it is expected that the proposed location of the 2022 Corona Generation Expansion would materially impair water resources.

5.8 Flora and Fauna

5.8.1 Methods and Impact Types

Assessment of impacts to biological resources from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Section 5.1 above and is discussed below. Construction and maintenance impacts would be generally short-term and temporary. Operation impacts would be low for biological resources; a small amount of permanent habitat loss would occur due to the permanent footprint of transmission line structures and substation and switchyard components. Some degree of impacts to wildlife would be expected but not to a greater extent than those areas of the Corona Wind Project already approved.

5.8.2 Impacts Specific to the 2022 Corona Generation Expansion

The 2022 Corona Generation Expansion is dominated by open grassland grazing. Plant and wildlife species adapted to shortgrass lands are present within the 2022 Corona Generation Expansion.

Increased noise and equipment movement during construction might temporarily displace wildlife species from the area in which construction is occurring. These impacts are considered low and short-term. Most wildlife movements would be expected to resume to preconstruction levels a short time after construction is completed. Potential long-term impacts include those resulting from habitat modifications and/or fragmentation. Corona Wind Companies would work to minimize potential habitat fragmentation by paralleling the project transmission lines with existing linear features (e.g., road and existing transmission lines) and avoid paralleling water features (such as streams or wetlands) when feasible. Collection lines connecting wind turbines to substations will be buried to the extent practicable to reduce potential for avian electrocution. Construction activities might also impact plants and small, immobile, or fossorial (living underground) animal species through direct impact or from the alteration of local habitats. Direct impact on these species might occur due to equipment or vehicular movement on the ROW or due to the compaction of the soil if the species is fossorial as well as the potential for collision of birds and bats located in the 2022 Corona Generation Expansion. Potential impacts of this type would likely be low and population-level impacts are not likely. Therefore, low impacts to local wildlife populations may occur due to habitat disturbance and localized potential for direct mortality to individuals during construction and operations.

5.8.2.1 Federally and State Listed Species

Seven animal species that are federally listed under the ESA may potentially occur in the 2022 Corona Generation Expansion (USFWS, 2022b), as shown in Table 4-4 above. These include four birds, one mammal, one fish, and one insect. Among them, the federally threatened Mexican spotted owl, the federal candidate monarch butterfly, and the federally designated “experimental population non-essential” northern aplomado falcon are all possible within the 2022 Corona Generation Expansion. The 2022 Corona Generation Expansion is located within the elevational and ecological range for the Mexican spotted owl and everngreen forest within the area may provide suitable nesting or wintering habitat. The 2022 Corona Generation Expansion also presents open terrains with scattered shrubs, which represents suitable habitat for the monarch butterfly and foraging habitat for the northern aplomado falcon.

State-listed endangered or threatened wildlife species are identified for Lincoln and Torrance Counties (NMDGF, 2022), as shown in Table 4-5 above. These species include two mammals, eight birds, one amphibian, and one fish. Among them, the state threatened peregrine falcon is likely to occur in the 2022

Corona Generation Expansion as an occasional year-round resident and migrant. The state threatened bald eagle is also likely to occur within the 2022 Corona Generation Expansion as an occasional winter migrant. Potential bald and golden eagle occurrence within the 2022 Corona Generation Expansion would be infrequent, due to the lack of large trees for perching and lack of optimal foraging habitat. However, bald and golden eagles may occur occasionally as migrants or transient wintering birds, and grasslands and ponds in the 2022 Corona Generation Expansion area may attract foraging bald eagles.

The 2022 Corona Generation Expansion is currently dominated by grazed shortgrass prairie. Unaltered native habitats are sparse due to land use practices. If any species or suitable habitat for threatened and endangered species is identified during a field survey, Corona Wind Companies would further coordinate with USFWS and NMDGF to determine avoidance or minimization strategies, if necessary. Impacts to federal and state protected species would be low based on low potential for species occurrence; the limited amount and quality of species habitat present; and short construction duration for the project infrastructure on the 2022 Corona Generation Expansion.

5.8.2.2 Raptors, Eagles, and Birds

Raptor, eagle, and migratory bird species are known to use the 2022 Corona Generation Expansion area for breeding, foraging, and migration (WEST, 2017b). If construction occurs during bird nesting season, potential impacts could occur to migratory bird eggs and/or nestlings. Increases in noise and equipment activity levels during construction could also potentially disturb breeding or other activities of bird species nesting in adjacent areas. Corona Wind Companies propose to complete all clearing and construction activities to reduce potential impacts and in alignment with the Migratory Bird Treaty Act (MBTA). Pre-construction MBTA surveys would be completed by Corona Wind Companies and/or construction activities would occur outside of breeding seasons for MBTA protected species. Furthermore, in accordance with the BGEPA, Corona Wind Companies would avoid placing transmission lines and wind turbines near active eagle nests. Construction activities would also be limited to a safe distance around active nests. Nests identified during preconstruction surveys and are determined active would be flagged for an established protection buffer.

The project infrastructure on the 2022 Corona Generation Expansion can present additional hazards to birds due to electrocutions and/or collisions. However, no electrocution risk to perching birds would apply to the 345-kV transmission line, given the phase-to-phase and phase-to-ground clearances (Avian Power Line Interaction Committee [APLIC], 2018). Potential water resources are limited to stock ponds and intermittent drainages that may be inundated during wet seasons. A number of birds may migrate through the area, but few waterbirds or waterfowl potentially at risk of overhead line collisions would

occur in the 2022 Corona Generation Expansion (APLIC, 2018). Collision risks to waterbirds or waterfowl would only apply during wet periods during the spring and fall migration as migrating birds may descend or ascend to access stopover habitats.

Corona Wind Companies would follow APLIC guidance to implement measures to minimize collision risk with proper siting, and electrocution risk with proper transmission line engineering design. The electrocution risk to birds should not be significant since the engineering design distance between conductors, conductor to structure, or conductor to ground wire for the proposed transmission line is greater than the wingspan of any bird potentially within the area (i.e., greater than 8 ft). While the conductors are typically thick enough to be seen and avoided by birds in flight, the shield wire (upper most wire) is thinner and can present a risk for avian collision. In areas of greater risk (e.g., near wetlands) for avian collisions, Corona Wind Companies would install bird diverters to minimize collision risk for avian species.

5.8.3 Protection Measures

Protection measures that would be implemented to reduce any potential negative biological resource impacts from construction activities include:

Bio-1: Properly disposing of trash and food debris in secured containers.

Bio-2: Allowing wildlife that has entered the work area to leave the area on their own.

Bio-3: Providing environmental awareness training to all construction personnel working on the Project.

Bio-4: Checking for wildlife under vehicles and equipment that have been stationary for more than 1 hour and each morning prior to moving or operation.

Bio-5: Checking trenches, excavations, and uncapped pipe segments for wildlife.

Bio-6: Complying with posted speed limits.

Bio-7: Conducting tree/vegetation clearing outside the nesting season where feasible, to discourage birds from establishing nests in Project work areas.

Bio-8: Conducting pre-construction nest surveys prior to initiating construction activities, unless vegetation clearing has been completed prior to the nesting season.

Bio-9: Establishing an appropriate buffer zone around occupied raptor nests, as necessary to minimize disturbance.

Bio-10: Design transmission line facilities to APLIC guidance or similar in order to minimize electrocution and collision risk.

Bio-11: Micrositing will be completed during engineering design to avoid sensitive biological resources.

Bio-12: Setbacks from sensitive biological resources will be implemented to protect species habitat and time critical periods (e.g., breeding season).

Bio-13: Install bird diverters near areas with increased risk for avian-collision, to minimize collision risk for avian species.

5.8.4 Conclusion

Based on the amount of disturbed habitat, landscape dominated by grazed grassland, the lack of quality species habitat, and low likelihood for federal and state protected species to occur in the vicinity; as well as the protection measures detailed above, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair biological resources.

5.9 Archaeological and Historic-Age Cultural Resources

This section is intended to support the Application for Location Approval of Transmission Line under NMAC Title 17 Chapter 9 Part 592. The power generation portion of the project, occurring within the 2022 Corona Generation Expansion, would, as a whole, avoid or minimize impacts to environmental resources. Although studies have been conducted on the 2022 Corona Generation Expansion, those portions of the project previously described in the Existing Conditions section are not required by NMAC 17.9.592.10 to be analyzed within this report.

The amount of ground that could be disturbed as a result of construction of the project infrastructure on the 2022 Corona Generation Expansion area was estimated based on the typical design characteristics of this 345-kV line and wind turbine layout. Short-term disturbance estimates included structure work areas for the staging and installation of the wind turbines and transmission line structures as well as the conductor pulling and tensioning sites. Long-term disturbance estimates included structure base areas and associated access roads. Qualitative and quantitative variables of resource sensitivity, resource quantity, and estimated ground disturbance were considered in predicting the extent and magnitude of impacts.

What constitutes an impact level on a resource varies by resource as well as the assumptions for analysis for each resource. Protection measures were identified and include action that will reduce potential impacts to a resource from construction, operation, and maintenance of the project infrastructure on the 2022 Corona Generation Expansion.

5.9.1 Methods and Impact Types

Assessment of impacts to archaeological and historic-age cultural resources from the construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Chapter 5.1 above and is discussed below. Construction, operations, and maintenance impacts are generally low, avoidable, short term, and temporary in nature for archaeological and historic-age cultural resources. Cultural resources surveys would be completed for all areas of anticipated ground disturbance for the 2022 Corona Generation Expansion area prior to any ground disturbance on public as well as private property.

5.9.2 Impacts Specific to the 2022 Corona Generation Expansion

Twenty-one archaeological sites are reported within the 2022 Corona Generation Expansion. Cultural resource field surveys would be completed prior to any construction activity to reduce potential impacts to unlocated sites from the construction of project infrastructure on the 2022 Corona Generation Expansion area. Impacts to known locations of cultural resources would be low because project infrastructure on the 2022 Corona Generation Expansion area is intended to be designed around these areas. Any discoveries which may occur during construction would be managed through an UDP.

5.9.3 Protection Measures

Protection measures that would be implemented to the extent practicable to reduce any potential negative cultural, historic, and archaeological impacts from construction activities include:

Cul-1: Project infrastructure on the 2022 Corona Generation Expansion area will be designed to avoid known sites.

Cul-2: Cultural surveys in known areas of ground disturbance for the 2022 Corona Generation Expansion will be completed ahead of construction. No ground disturbance activities will be completed prior to cultural survey work being completed.

Cul-3: If sites are found at the location of planned infrastructure, micrositing techniques will be used to move around and/or span sites to the greatest extent practicable.

Cul-4: Follow a UDP, providing protection for unknown sites.

5.9.4 Conclusion

Based on the protection measures listed above, the proposed location of the 2022 Corona Generation Expansion would not significantly impair cultural, historic, and archaeological resources. Impacts to cultural resources are expected to be *de minimis,* if at all.

5.10 Religious and Cemetery Sites

5.10.1 Methods and Impact Types

Assessment of impacts to religious and cemetery sites from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Chapter 5.1 above and is discussed below. Construction, operations, and maintenance impacts are generally low, avoidable, short term, and temporary in nature for religious resources.

5.10.2 Impacts Specific to the 2022 Corona Generation Expansion

Within the 2022 Corona Generation Expansion, there are two known cemeteries. One religious institution and three additional cemeteries are located within one mile of the 2022 Corona Generation Expansion. No impacts to known locations of religious resources are expected to occur. Cultural resource field surveys would be completed prior to any construction activity to identify previously unrecorded religious and cemetery site and reduce potential impacts from the construction of project infrastructure on the 2022 Corona Generation Expansion area. Siting of project infrastructure on the 2022 Corona Generation Expansion would follow industry standard siting guidelines.

5.10.3 Protection Measures

Protection measures that would be implemented to reduce any potential negative impacts to religious and cemetery sites from construction activities include:

Rel-1: Follow a UDP, providing protection for unknown sites.

5.10.4 Conclusion

Per industry standard siting guidelines and the protection measure detailed above, no impacts to religious or cemetery sites are anticipated. It is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair religious resources.

5.11 Visual and Scenic Resources

This section is intended to support the Application for Location Approval of Transmission Line under NMAC Title 17 Chapter 9 Part 592. The power generation portion of the project, occurring within the 2022 Corona Generation Expansion footprint, would, as a whole, avoid or minimize impacts to environmental resources. Although studies have been conducted on the 2022 Corona Generation Expansion footprint, that portion of the Project previously described in the Existing Conditions section is not required by NMAC 17.9.592.10 to be analyzed within this report.

Qualitative and quantitative variables of resource sensitivity, resource quantity, and estimated ground disturbance were considered in predicting the extent and magnitude of impacts. What constitutes an impact level on a resource varies by resource as well as the assumptions for analysis for each resource. Protection measures were identified and include action that will reduce potential impacts to a resource from project infrastructure on the 2022 Corona Generation Expansion area.

5.11.1 Methods and Impact Types

Assessment of impacts to visual and scenic resources from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Chapter 5.1 above and is discussed below. Construction, operation, maintenance of project infrastructure on the 2022 Corona Generation Expansion area would introduce new features into the visual landscape. The 2022 Corona Generation Expansion was evaluated to determine whether the following types of impacts would occur:

- Proximity of the 2022 Corona Generation Expansion to residences and residential areas.
- Changes to the visual landscape with respect to scenic resources, such as scenic byways.
- Changes to the visual landscape within or near recreational areas such as state and national parks.

5.11.2 Impacts Specific to the 2022 Corona Generation Expansion

New transmission structures, conductors, substation components, turbines, and cleared ROW areas would change the visual characteristics in the vicinity and the viewshed of the 2022 Corona Generation Expansion. However, the 2022 Corona Generation Expansion would not differ from other wind energy conversion systems in the vicinity. For residences located near the 2022 Corona Generation Expansion and residents traveling area roads, a new man-made feature would be present in the landscape. Residents of homes along the transmission line or within the turbine layout would be most prone to changes in the visual environment around their homes. Impacts would likely be low based on the low population density. However, the visual sensitivity would be highly dependent on the orientation of the transmission line

and/or turbine layout relative to the home (in front, behind, alongside), any screening between the home and the line or turbines (trees, topography), distance, other visual components (existing lines, radio towers), and the general sensitivity of the occupants in the vicinity of the 2022 Corona Generation Expansion.

Visual impacts resulting from the construction and operation of the proposed substations are anticipated to have similar impacts to those associated with the construction and operation of the proposed transmission lines. Each new substation would be an added visual element in the existing landscape.

No designated federal or state scenic routes or byways are in the vicinity of the 2022 Corona Generation Expansion (NMDOT, 2012a; FHWA, 2022) (Exhibit 15). The nearest scenic route is New Mexico's Salt Missions Trail located approximately 23 miles west of the 2022 Corona Generation Expansion. Therefore, the 2022 Corona Generation Expansion is sufficiently far from these routes that it would not be deemed to impact the scenic values of the routes.

Additionally, no national parks or state parks are in the vicinity of the 2022 Corona Generation Expansion. The closest national park is the Gran Quivira Unit of Salinas Pueblo Missions National Monument, which is approximately 23 miles west of the 2022 Corona Generation Expansion (NPS, 2022a). The BLM-managed Valley of Fires Recreation Area is approximately 32 miles southwest of the 2022 Corona Generation Expansion (BLM, 2022a). The nearest state parks are Manzano Mountains State Park, Villanueva State Park, and Santa Rosa Lake State Park, all located more than 35 miles from the 2022 Corona Generation Expansion (NMEMNRD, 2022). The only know visually sensitive resource within proximity to the 2022 Corona Generation Expansion is the 3-mile-wide corridor around U.S. Highway 54 in Torrance County, which is indicated as having a high VRI index value for Maintenance of Visual Quality (BLM, 2022c). No known organized tourism activities are in or near the 2022 Corona Generation Expansion.

5.11.3 Protection Measures

Protection measures that would be implemented to reduce any potential negative visual impacts from construction activities include:

Vis-1: Leave (where possible) plants smaller than 8 ft in height within the 180-foot-wide ROW to help reduce the effect of the ROW of visual and aesthetic resources.

Vis-2: Keep the ROW free of construction debris and other litter during construction to further reduce visual intrusion to the surrounding landscape.

Vis-3: The design of the buildings and related structures shall, to the extent reasonably possible, use materials, colors, textures, screening and landscaping that will blend the facility into the natural setting and existing environment.

Vis-4: No individual tower facility shall be installed at any location that would substantially detract from or block the view of the major portion of a recognized scenic vista, as viewed from any public road ROW or publicly accessible parkland or open space within the County.

Vis-5: As a condition of approval of a special use district for a Wind Energy Facility, within one year of the termination or abandonment of leases, easements or operations of a Wind Energy Facility, the permittee shall cause, at its own expense, the restoration of the land to its pre-facility condition.

5.11.4 Conclusion

Based on low visual impacts due to low population and long distances to sensitive visual areas such as scenic byways and parks, as well as the protection measures detailed above, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair visual resources.

5.12 Land Use, Including Farm, Range, and Recreational Resources

5.12.1 Impact Assessment Methods

Assessment of impacts to land uses from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in in Chapter 5.1 above and is discussed below. A land use impact is one that restricts the future use of land or conflicts with an existing use. Project infrastructure on the 2022 Corona Generation Expansion area tends to restrict certain activities but may or may not change the land use. Construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area would result in both direct and indirect impacts to land use. For schools and recreational resources, impacts are generally low, short term, and temporary in nature. The 2022 Corona Generation Expansion was evaluated to determine whether the following types of impacts would occur:

- Temporary and permanent land use changes.
- Restrictions on activities within the ROW.
- Inconsistency with local land use plans and zoning.
- Removal of land from future development.
- Potential use restrictions or conflicts on public lands.

5.12.2 Impacts Specific to the 2022 Corona Generation Expansion

5.12.2.1 Agricultural Land Use Impacts

The lands crossed by the 2022 Corona Generation Expansion are used for agricultural purposes. Long-term land use impacts to grassland, cropland, and pasture primarily would be the result of structure placement, ROW maintenance, and access roads. Current agricultural practices would be maintained for most of the ROW. Areas of cropland within the ROW could continue to be farmed, and grazing could continue within the ROW. The only land that would be unavailable for agriculture would be the area occupied by actual generation and transmission structures. Structures would be approximately 3 to 5 ft in diameter at ground level depending on the type of structure. The permanent footprint of transmission line structures and wind turbines would be removed from production, and structures would present obstacles that would need to be avoided. Corona Wind Companies would work with landowners to reduce impacts to irrigation facilities. However, overall, the project infrastructure on the 2022 Corona Generation Expansion would result in minimal reduction in agricultural production or land available for agricultural activities.

Easements or ROWs have been or would be obtained from landowners within the 2022 Corona Generation Expansion for constructing and maintaining the wind turbines and appurtenant facilities. The landowner would maintain ownership of the property and continue to pay taxes on the property, but Corona Wind Companies would acquire rights allowing construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area in exchange for a monetary payment to the landowner. The agreement between the landowner and Corona Wind Companies would outline any use restrictions applying to the agreement. The agreement would include certain restrictions on the continued use of the property, such as prohibiting permanent structures and establishment of certain types of vegetation within the ROW that could affect access to the line or safe and reliable operation.

During construction and maintenance activities, agricultural lands would be subject to temporary impacts. Depending on the time of year, access for construction would result in damage to crops, compaction and rutting of soil, restrictions on access to the ROW, and restrictions on general agricultural practices in and around the ROW (such as prescribed burning of grassland pasture). Landowners would be compensated for crop and forage loss, and damaged soils would be restored to arable condition. Cattle may need to be re-located or confined away from the ROW areas of pasture during construction. Following completion of construction, disturbance and disruption to agricultural activities would largely cease. Periodic maintenance activities and emergency repairs would result in impacts similar to those for construction.

However, these activities would be infrequent over the life of the Project. Landowners would be compensated for any damage, and the ROW would be restored to previous conditions.

In addition to the ROW for the 2022 Corona Generation Expansion, approximately four temporary laydown areas for construction material and equipment would be necessary for the duration of construction. These laydown areas each would be up to 20 acres in size each. Where feasible, construction laydown areas are typically located at previously disturbed or developed locations such as vacant lots, existing utility yards, or parking lots to reduce impacts to sensitive resources. If existing yard locations are not available, preferred locations for yards would be undeveloped areas, such as grazing or cropland, that are cleared, flat, have all-weather access, and do not contain streams, wetlands, or other environmentally sensitive resources. Laydown yards would typically consist of flat or gently sloping lands where much of the construction material would be placed on pallets or cribbing. No topsoil would be removed, and minimal, if any, re-grading is expected to take place at these facilities. Laydown areas generally would be returned to a pre-construction condition upon completion of construction of the project infrastructure on the 2022 Corona Generation Expansion area.

Up to five step-up substations and an adjacent switchyard would also be constructed. Construction would take place on up to approximately 20 acres of land per substation/switchyard and would result in the permanent conversion of this area from agricultural land to utility land use.

5.12.2.2 Land Use Plans and Regulations

As part of Torrance County's Goals and Objectives in the Torrance County CLUP, the potential for wind and solar generated power is encouraged in order to improve and expand Torrance County-wide infrastructure to enhance the quality of life and support economic development (Mid-Region Council of Governments of New Mexico, 2003). The Torrance County Zoning Ordinance encourages the development of businesses that harness wind energy (The Board of County Commissioners of Torrance County, 2020). Special Use Districts for Wind Energy Facilities are established to foster the development of the county's wind power resources while preserving traditional land uses.

The Lincoln County Comprehensive Plan also promotes wind and solar generated power to supplement farmers' incomes as well as to expand the regional economic base (Sites Southwest, 2007). The Comprehensive Plan encourages agricultural producers within Lincoln County to apply for USDA Rural Development Section 9006 Grants and Section 9006 Guaranteed Loans which can provide commercial financing of renewable energy and energy efficiency projects.

5.12.2.3 Public Lands

The 2022 Corona Generation Expansion may cross state trust lands, depending on the final arrangement of wind turbines. An easement to cross these state lands would be needed from the New Mexico SLO for these portions of the 2022 Corona Generation Expansion. If an easement is needed across state trust lands, Corona Wind Companies would coordinate with the SLO to develop an agreement that is consistent with the SLO's development of state trust lands, per its planning requirements. Applications have or will be submitted to SLO for all of the 2022 Corona Generation Expansion footprint.

5.12.2.4 Schools

No direct or indirect impacts to schools would occur as a result of the construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area. The Corona Elementary/High School is located about one mile north of the 2022 Corona Generation Expansion boundary. Siting of turbines on the 2022 Corona Generation Expansion would follow industry standard siting guidelines.

5.12.2.5 Recreation

No direct or indirect impacts on state or county recreation lands, local parks, trails, or hunting access lands would occur as a result of the construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area. There are no parks and recreational areas in close proximity to the 2022 Corona Generation Expansion. Existing recreational opportunities would continue as they currently exist with minor, temporary disturbances possible during construction.

5.12.3 Protection Measures

Protection measures that would be implemented to reduce any potential negative land use impacts include:

Land-1: Coordinate with landowners for potential measures, including routing, to reduce Project impacts on uses on specific properties.

Land-2: Coordinate with appropriate state land management agencies to obtain appropriate permits and easements for portions of the transmission line traversing public lands.

Land-3: Plan and conduct construction activities to reduce temporary disturbance, displacement of crops, and interference with agricultural activities.

Land-4: Restore compacted cropland soils as close as possible to pre-construction conditions using tillage.

Land-5: Compensate landowners for any new land rights required for ROW or access road easements.

Rec-1: Plan and conduct construction activities to reduce temporary disturbance, displacement of recreationists, and interference with recreation activities.

5.12.4 Conclusion

Based on the compatibility of project infrastructure on the 2022 Corona Generation Expansion with the current land uses, impacts to land uses would be largely temporary and limited in area during construction. The large majority of the 2022 Corona Generation Expansion would remain in its pre-existing use. With inclusion of the protection measures detailed above, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair land use resources.

Based on no direct or indirect impacts to schools and no direct or indirect impacts on state or county recreation lands, local parks, trails, or hunting access lands as a result of the construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair school or recreation resources.

5.13 Socioeconomics

5.13.1 Impact Assessment Methods

Assessment of impacts to socioeconomic resources from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Chapter 5.1 above and is discussed below. Socioeconomic resources include elements of the human environment, such as population characteristics, employment and other economic factors, public services, and housing. Construction and operation of project infrastructure on the 2022 Corona Generation Expansion would result in both direct and indirect socioeconomic impacts, most of which are positive impacts. Potential socioeconomic impacts include:

- Generation of economic activity from jobs, earnings, and economic output.
- Temporary increase in demand and spending for local goods, services, and construction materials from construction of project infrastructure on the 2022 Corona Generation Expansion.

- Temporary increase in population from the influx of construction workers.
- Temporary increase in demand for temporary lodging facilities from the influx of construction workers.
- Temporary disruptions (such as temporary traffic changes or noise) to nearby residents during construction.

5.13.2 Impacts Specific to the 2022 Corona Generation Expansion

The economic and fiscal impacts of the Corona Wind Project would make a significant contribution to the economic base of Lincoln and Torrance Counties with both short-term development activities, and long-term contributions to the regional economy.

Over 30 years of operations, the overall Corona Wind Project would produce an estimated $2.6 billion in direct economic impacts, and taking account of economic multiplier impacts, approximately $3.8 billion in direct, indirect and induced economic benefit to the local economy (Tysseling, 2017). Discounting this stream of benefits at a 5 percent annual rate (appropriate for public benefits analysis), and noting that the undiscounted economic impacts are stated in terms of 2018 dollars (i.e., unadjusted for inflation), the present value of the direct economic benefits from the Corona Wind Project are estimated to be nearly $1.4 billion, and the direct, indirect, and induced economic benefits of the Corona Wind Project are estimated to produce a present value of $2.0 billion (Tysseling, 2017). This equates to an estimated $1.44 billion, and the direct, indirect, and induced economic benefits of the Corona Wind Project are estimated to produce a present value of $2.1 billion scaled at a 3-percent increase to account for the updated wind and transmission areas.

The Corona Wind Project align directly with several of the specific goals of the New Mexico State Energy Plan. A significant attribute of the Corona Wind Project is the development of the SunZia Transmission Project transmission facilities. Moreover, several other objectives of the State Energy Plan are achieved by the Corona Wind Project and related developments, including:

- Supporting regional energy policy, infrastructure, and development pathways and solutions.
- Ensuring that sound science and economics, as well as the availability of energy resources drive state energy policy decisions.
- Focus on economic growth, diversification, and private sector job creation.
- Consider appropriate incentives that would increase market potential and competitiveness with other states in the West.
- Accelerate reduction of freshwater consumption in the energy sector.

- Establish the energy foundation of new and improved infrastructure in electric power transmission.

Development of electric generation facilities comprising the 2022 Corona Generation Expansion to be included in the Corona Wind Project, offers New Mexico highly desirable economic development investments. Investments in these wind generation and transmission facilities stimulate substantial growth in the renewable energy sector and foster an economic development climate that broadens the state's long-standing role as a sustainable participant in the energy marketplace. Facilities within the 2022 Corona Generation Expansion would not displace or capture existing commercial energy market activities. Instead, these investments would create new economic development in its exportation of environmentally preferred New Mexico energy resources.

Once operational, the economic benefits and revenue streams would be a stable foundation of economic activity anticipated for at least the 30-year life of the Corona Wind Project and would likely continue beyond that time. Additionally, the Corona Wind Project establishes a new economic infrastructure that would likely foster further developments of a similar nature.

The short-term impacts during the development period would flow from the $2.4 billion capital investment for the Corona Wind Project's facilities (Tysseling, 2017). These developments would occur over approximately 506,463 acres (i.e., 354,649 acres across Torrance, Lincoln, and Guadalupe Counties for the 2018 Approved Projects, and 151,814 acres across Torrance and Lincoln Counties for the 2021 Corona Wind Update and 2022 Corona Generation Expansion) and would introduce significant new economic activities for decades to come.

Corona Wind Companies estimates that of the total capital expenditures during construction of the Corona Wind Project, it is likely that $120 million in contracts would flow to local construction service providers (Tysseling, 2017).

Once construction is completed and operations commence, the Corona Wind Project is expected to employ approximately 94 permanent jobs with a payroll estimated to be approximately $4.5 million and total operating costs of approximately $1.7 million per year (Tysseling, 2017).

The land lease and easement agreements with the private landowners on which the Corona Wind Project would be sited would provide direct new revenues to landowners within the footprint of development. These landowners are expected to realize approximately $12.5 million of new revenues during the

development period, and a minimum of approximately $9.3 to $10.5 million per year during the operations period (Tysseling, 2017).

GRT revenues will increase as a result of the construction projects by an estimated $22.4 million Corona Wind Project development. Fiscal impacts associated with property taxes are muted as a result of the financing through Industrial Revenue Bonds (IRBs), but provision has been made by the developers to provide payments in-lieu of taxes (PILOTs) to several of the municipal and school district beneficiaries of these tax revenues in an amount estimated at approximately $3.6 million per year (Tysseling, 2017).

The direct economic impacts of the Corona Wind Project during the development period are anticipated to be $128.8 million, with direct, indirect and induced (multiplier) impacts suggesting a $211.4 million impact from the development of the Corona Wind Project (Tysseling, 2017). This equates to an estimated $132.7 million, with direct, indirect and induced (multiplier) impacts suggesting a $217.7 million impact from the development at a 3-percent increase to account for the updated wind and transmission areas. Once operational, the Corona Wind Project should generate an annual direct economic impact of approximately $82.7 million, and, when economic multipliers are considered, the annual impact from the Corona Wind Project operation can be estimated to be approximately $118.0 million (Tysseling, 2017).

5.13.3 Protection Measures

Protection measures that would be implemented to reduce potential negative socioeconomic impacts from construction activities include:

Socio-1: Work with individual landowners to coordinate the timing of construction to minimize short-term impacts on agriculture.

5.13.4 Conclusion

The 2022 Corona Generation Expansion would develop a relatively new and under-developed economic resource in the state of New Mexico—wind energy—that would be directly exported from the state along with the overall Corona Wind Project. Aside from the technology, innovation and capital investments developed in conjunction with the Corona Wind Project, this development creates new economic activity, value, and opportunity within New Mexico, which would be exported from the state. This is a highly valuable attribute of the Corona Wind Project, as it would not displace or capture existing commercial activities, but, instead, would create the most desirable form of economic development in its exportation of environmentally preferred New Mexico energy resources. In short, the Corona Wind Project would create new economic value from economic activities that are not currently a part of the New Mexico economy.

5.14 Communication Signals

5.14.1 Impact Assessment Methods

Assessment of impacts to communication signal resources from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Chapter 5.1 above and is discussed below. Construction, operations, and maintenance impacts are generally avoidable for communication signal resources.

5.14.2 Impacts Specific to the 2022 Corona Generation Expansion

Project infrastructure on the 2022 Corona Generation Expansion area is planned to avoid beam paths. Siting of project infrastructure on the 2022 Corona Generation Expansion area would be completed outside of existing, known fresnel zones and would avoid inference with communication pathways. A number of signaling structures was identified within 35 miles of the 2022 Corona Generation Expansion and can be found in Table 4-10. Project infrastructure on the 2022 Corona Generation Expansion area would avoid AM and FM station towers to the extent practicable if new tower facilities are developed.

5.14.3 Protection Measures

Protection measures that would be implemented to reduce potential negative communication signal impacts from construction activities or operation include:

Comm-1: Corona Wind Companies shall minimize or mitigate any interference with electromagnetic communications, such as radio, telephone or television signals caused by any wind energy facility.

Comm-2: No individual tower facility shall be installed in any location where its proximity with fixed broadcast, retransmission or reception antenna for radio, television or wireless phone or other personal communications systems would produce electromagnetic interference with signal transmission or reception.

5.14.4 Conclusion

Microwave path and AM and FM station towers would be avoided to the extent practicable; therefore, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair communication signals.

5.15 Radioactive Waste and Radiation Hazards

Electric transmission line and substation infrastructure do not generate or contain radioactive waste or radiation hazards. Construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion would not generate radioactive waste or radiation hazards, and therefore are not addressed further in this ER.

5.16 Hazardous Materials

5.16.1 Impact Assessment Methods

Assessment of impacts from hazardous materials resulting from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Chapter 5.1 above and is discussed below. Accidental spill of hazardous materials could occur during the construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area. This hazard is described in more detail below.

5.16.2 Impacts Specific to the 2022 Corona Generation Expansion

During construction, use of trucks, heavy equipment, or stored supplies could result in accidental discharge of fuel, lubricants, and automotive fluids. Although the potential exists, any spills would be accidental, occasional, and of limited extent, and would be considered minor to negligible and temporary in duration. A SPCC Plan would be prepared by Corona Wind Companies and would contain information regarding training, equipment inspections, maintenance and repair, spill prevention kits, and refueling operations for construction vehicles, with an emphasis on preventing spills. Hazardous materials would not be drained onto the ground or into streams or drainage areas. All construction waste including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials would be removed to a disposal facility authorized to accept such materials weekly.

5.16.3 Protection Measures

Protection measures that would be implemented to reduce any potential negative hazardous materials impacts include:

Haz-1: Prepare a SPCC Plan.

Haz-2: Hazardous materials will not be drained onto the ground or into streams or drainage areas.

Haz-3: Construction waste including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials will be removed to a disposal facility authorized to accept such materials weekly.

5.16.4 Conclusion

Impacts from hazardous materials would be avoided through the implementation of proper construction practices, development and implementation of a SPCC Plan, as well as the protection measures detailed above; therefore, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair important environmental resources from hazardous materials.

5.17 Safety

5.17.1 Impact Assessment Methods

Assessment of impacts to safety from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Chapter 5.1 above and is discussed below. Safety concerns that can arise from construction, operation, and maintenance are described in more detail below.

5.17.2 Impacts Specific to the 2022 Corona Generation Expansion

Corona Wind Companies would develop a safety plan prior to construction to manage and reduce safety risk. Speed limits would be posted and followed to reduce traffic safety concerns on roadways. Proper construction practices would be followed to reduce injury to personnel and damage to property. In the unforeseen event that a safety issue arises, Corona Wind Companies' safety plan would have procedures in place to address most safety situations. Corona Wind Companies will comply with all manufacturer specifications and relevant Occupation Safety and Health Administration requirements to ensure the safety of residents, employees, contractors, livestock, the public, and other users of the land.

Construction of project infrastructure on the 2022 Corona Generation Expansion area could cause wildfire ignition. O&M activities (e.g., welding, vehicle ignition), and the presence of energized transmission line facilities (e.g., arc ignition) could also cause wildfire ignition. Corona Wind Companies and/or their contractors would notify federal, state, and local agencies of any fires and comply with all rules and regulations administered by the federal, state, and local land management agencies concerning the use, prevention, and suppression of fires, including any fire prevention orders that may be in effect at the time of the construction, operation, or maintenance activity. Additionally, Lincoln and Torrance County emergency responders and fire districts will be contacted to ensure appropriate plans are in place at the

Corona Wind Project to quickly respond to any emergencies. Corona Wind Companies will work with the departments to ensure the safety of the firefighters, Corona Wind Project employees, landowners, neighbors, livestock, and other users of the land. The Corona Wind Project will have emergency response plans in place to respond to various natural disasters, even though the 2022 Corona Generation Expansion generally is not considered to be a high-risk site. An annual emergency response drill, in which local responders will be invited to participate, will be completed onsite to test the Corona Wind Project's emergency preparedness.

Within the2022 Corona Generation Expansion, safety risks will be reduced as electrical substations and transformers will be located inside locked fences or enclosures and will be clearly marked to show that energized electrical equipment is located inside. In addition, Corona Wind Companies will man a 24/7 monitoring center to monitor the substation and turbines. There will be signage on the substation fences with the monitoring center's phone number. Modern wind turbines are inherently unclimbable by the general public since there are no exterior ladders or lattice work and interior ladders are secured behind locked doors located at the bases of the turbine towers.

5.17.3 Protection Measures

Protection measures that would be implemented to reduce any potential safety impacts include:

Safe-1: Corona Wind Companies and their contractors, as appropriate, will initiate discussions with local fire districts and regional fire prevention staff prior to construction to discuss emergency procedures and to provide transmission line safety training, including safety procedures for conducting fire suppression activities near a power line.

Safe-2: All vehicles will be equipped with appropriate fire suppression tools and equipment. Fire suppression equipment will include, but not be limited to, shovels, buckets, and fire extinguishers.

Safe-3: Smoking and equipment parking will be restricted to designated areas.

Safe-4: Corona Wind Companies and/or their contractors will fuel all highway-authorized vehicles offsite to minimize the risk of fire. Fueling of construction equipment that is transported to the site via truck and is not highway authorized will be done in accordance with regulated construction practices and federal, state, and local laws.

Safe-5: Corona Wind Companies will develop a safety plan prior to construction. The plan will include items such as medical emergency facilities and procedures, wildlife agency contacts and procedures, and inclement weather procedures.

Safe-6: Appropriate warning signage shall be placed on wind turbine towers, electrical equipment, and wind energy facility entrances.

Safe-7: To the extent practicable, the facility shall connect to existing substations, or if new substations are needed, minimize the number of new substations.

Safe-8: Electrical controls and control wiring and power lines shall be wireless or underground, except where wind farm collector wiring is brought together for connection to the transmission or distribution network, adjacent to that network.

5.17.4 Conclusion

Impacts from unsafe events would be reduced through the implementation of proper construction practices, as well as the protection measures detailed above; therefore, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair important environmental resources because of safety concerns.

5.18 Geographic Resources

5.18.1 Impact Assessment Methods

Assessment of impacts to geographic resources from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Chapter 5.1 above and is discussed below. The Project is in the Great Plains region of New Mexico. Geographic resources identified in the region include state and national parks and monuments. The 2022 Corona Generation Expansion was evaluated to determine whether the following types of impacts would occur:

- Diminishment of scenic resources within and from state or national parks and monuments by the addition of man-made elements to the natural landscape.
- Introduction of noise/air pollution to state or national parks and monuments.

5.18.2 Impacts Specific to the 2022 Corona Generation Expansion

As discussed in Section 5.11, there are no national parks or state parks in the vicinity of the 2022 Corona Generation Expansion. The closest national park is the Gran Quivira Unit of the Salinas Pueblo Missions National Monument, which is approximately 23 miles west of the 2022 Corona Generation Expansion. The closest state parks are the Santa Rosa Lake State Park, Villanueva State Park, and Manzano Mountains State Park, all located more than 35 miles from the 2022 Corona Generation Expansion. Construction of project infrastructure on the 2022 Corona Generation Expansion would result in minor emissions from construction vehicles and activities but would not impact the overall air quality in the region, including the national and state parks. Noise impacts (such as from construction activities) would be highly localized and would not impact noise level at the national or state parks.

Of the 21 archaeological sites discussed in Section 5.9, two NRHP-eligible archaeological resources are reported within the 2022 Corona Generation Expansion. One is a multicomponent site and the second is a small prehistoric lithic scatter. Impacts to known locations of cultural resources would be low because the project infrastructure on the 2022 Corona Generation Expansion area is intended to be designed around these areas. Cultural resource field surveys would be completed prior to any construction activity to reduce potential impacts to unlocated sites. Any discoveries which may occur during construction would be managed through a UDP.

5.18.3 Protection Measures

Due to no anticipated impacts to geographic resources, no protection measures are proposed.

5.18.4 Conclusion

Impacts to geographic resources would be avoided by the 2022 Corona Generation Expansion to the extent practicable; therefore, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair geographic resources.

5.19 Military Activities and Aviation

5.19.1 Impact Assessment Methods

Assessment of impacts to military and aviation activities from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Chapter 5.1 above and is discussed below. Construction, operations, and maintenance impacts are generally avoidable in nature for military activities and aviation.

5.19.2 Impacts Specific to the 2022 Corona Generation Expansion

Three military training routes cross the 2022 Corona Generation Expansion. Corona Wind Companies would work with FAA to request DNH for the 2022 Corona Generation Expansion. Based on the height of the transmission infrastructure and the location of military and aviation resources, the construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area would not impact military activities and aviation.

5.19.3 Protection Measures

Protection measures that would be implemented to reduce any potential negative military or aviation impacts from construction activities include:

Mil-1: Coordinate with military bases and aviation facilities as needed.

Mil-2: Use FAA approved lighting as required.

5.19.4 Conclusion

To the extent practicable, impacts to military activities and aviation resources would be avoided by project infrastructure on the 2022 Corona Generation Expansion; therefore, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair military activities and aviation resources.

5.20 Roads

5.20.1 Impact Assessment Methods

Assessment of impacts to roads from construction, operation, and maintenance of project infrastructure on the 2022 Corona Generation Expansion area follows the impact assessment methodology described in Chapter 5.1 above and is discussed below. Construction, operations, and maintenance impacts are generally low, short term, and temporary in nature for roads.

5.20.2 Impacts Specific to the 2022 Corona Generation Expansion

Potential impacts for roads would be greatest during construction of project infrastructure on the 2022 Corona Generation Expansion. Construction equipment and increased traffic have the potential to degrade existing road conditions. Corona Wind Companies would document pre-construction road conditions and return roads used for construction access to pre-construction condition or better once construction is completed. Increased road traffic from construction would be localized and short term based on where construction is occurring that day or week. Low impacts to roads in the 2022 Corona Generation

Expansion are anticipated based on localized, short-term impacts, and Corona Wind Companies' commitments to return roads used for construction to pre-construction conditions.

5.20.3 Protection Measures

Protection measures that would be implemented to reduce any potential negative road impacts from construction activities include:

Road-1: Pre-construction conditions will be documented, and Corona Wind Companies will develop a road use agreement with NMDOT and Lincoln and Torrance County Road Maintenance Departments, as necessary.

Road-2: Construction speed limits will be established.

5.20.4 Conclusion

Based on localized, low, short-term impacts, and Corona Wind Companies' commitments to return roads used for construction to pre-construction conditions, as well as the protection measures detailed above, it is not expected that the proposed location of the 2022 Corona Generation Expansion would significantly impair roads.

6.0 CONSULTATION AND COORDINATION

The following individuals and materials have contributed to the preparation of the Corona Wind Companies' ER for the 2022 Corona Generation Expansion.

6.1 List of Preparers and Reviewers

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- Crystal Bravo-Cogar, Senior Environmental Scientist
- Gregory Buck, Assistant Environmental Scientist
- Larry Karpov, Geographic Integration Systems Specialist

6.2 Technical Reports Contributing to the Environmental Report

- Burns & McDonnell. 2022. "Desktop Wetland Evaluation, Corona Wind Projects, Pattern SC Holdings LLC," letter report to Adam Cernea Clark, Pattern SC Holdings LLC, dated June 10, 2022.
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- WEST, Inc. 2017b. *Critical Issues Analysis for the Proposed Cowboy Mesa Wind Project*. Report issued March 2017.
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6.3 Recipients of the Environmental Report

- Lincoln/Torrance County Board of County Commissioners
- Lincoln/Torrance County Manager
- Lincoln/Torrance County Road Superintendent
- City of Corona City Council
- Mayor, Corona
- Corona City Manager
- City of Duran City Council
- Mayor, Duran
- Duran City Manager
- Corona Elementary/High School
- Estancia Elementary/Middle/High School
- Vaughn Elementary/High School
- New Mexico Environment Department
- New Mexico State Engineer
- New Mexico Attorney General
- New Mexico SLO

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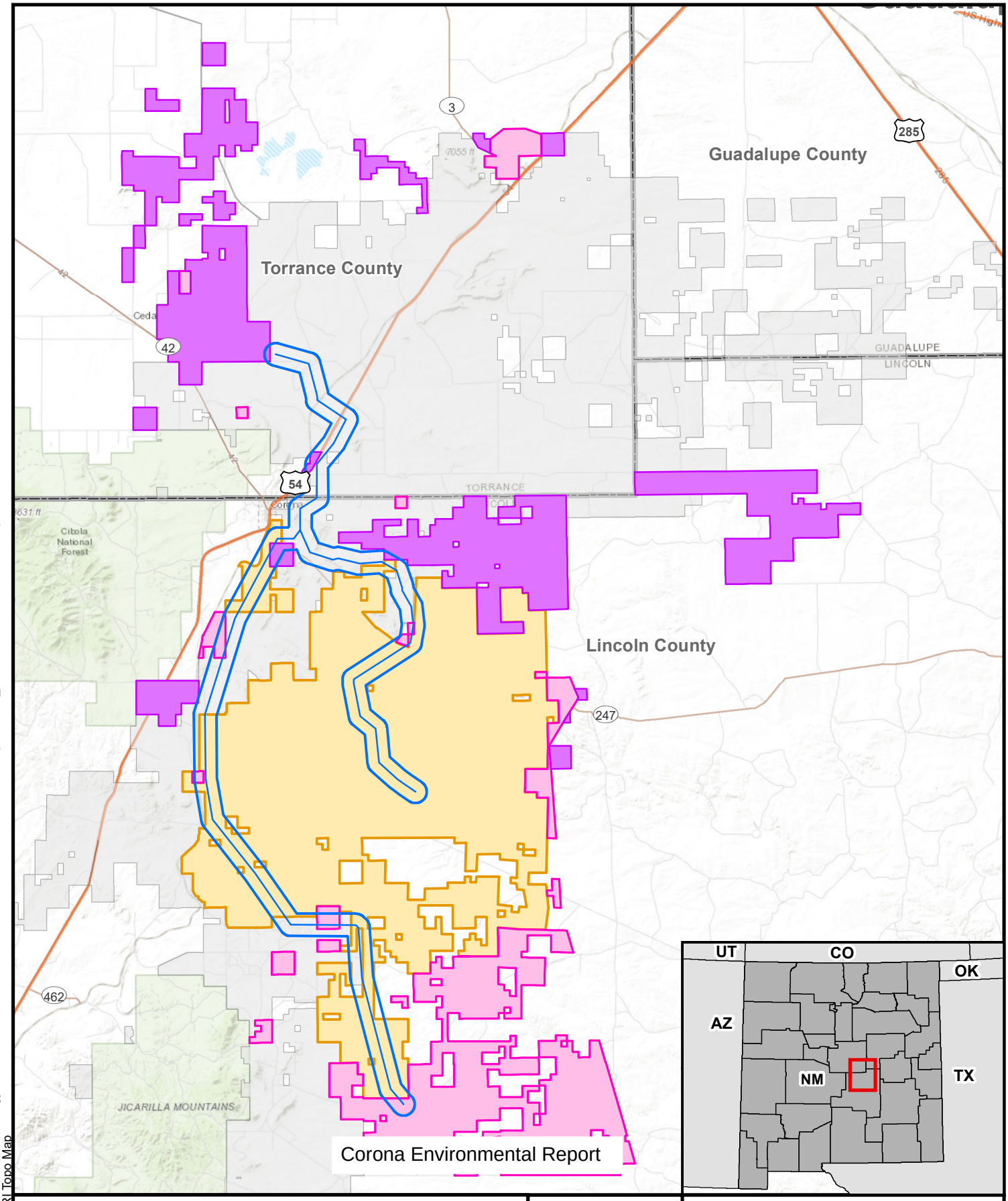
8.0 INDEX

APPENDIX 1 - EXHIBITS



BURNS McDONNELL

Exhibit 1
Assessment Area
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Source: ESRI; Pattern Development; Burns & McDonnell Engineering Company, Inc.

Issued: 7/11/2022

Path: C:\TEMP WORK\101335 Pattern Energy Corona Wind\MXD\2022 Corona South\1 PRC South Env Report\Ex01_AssessmentArea.mxd vakarpov 7/11/2022
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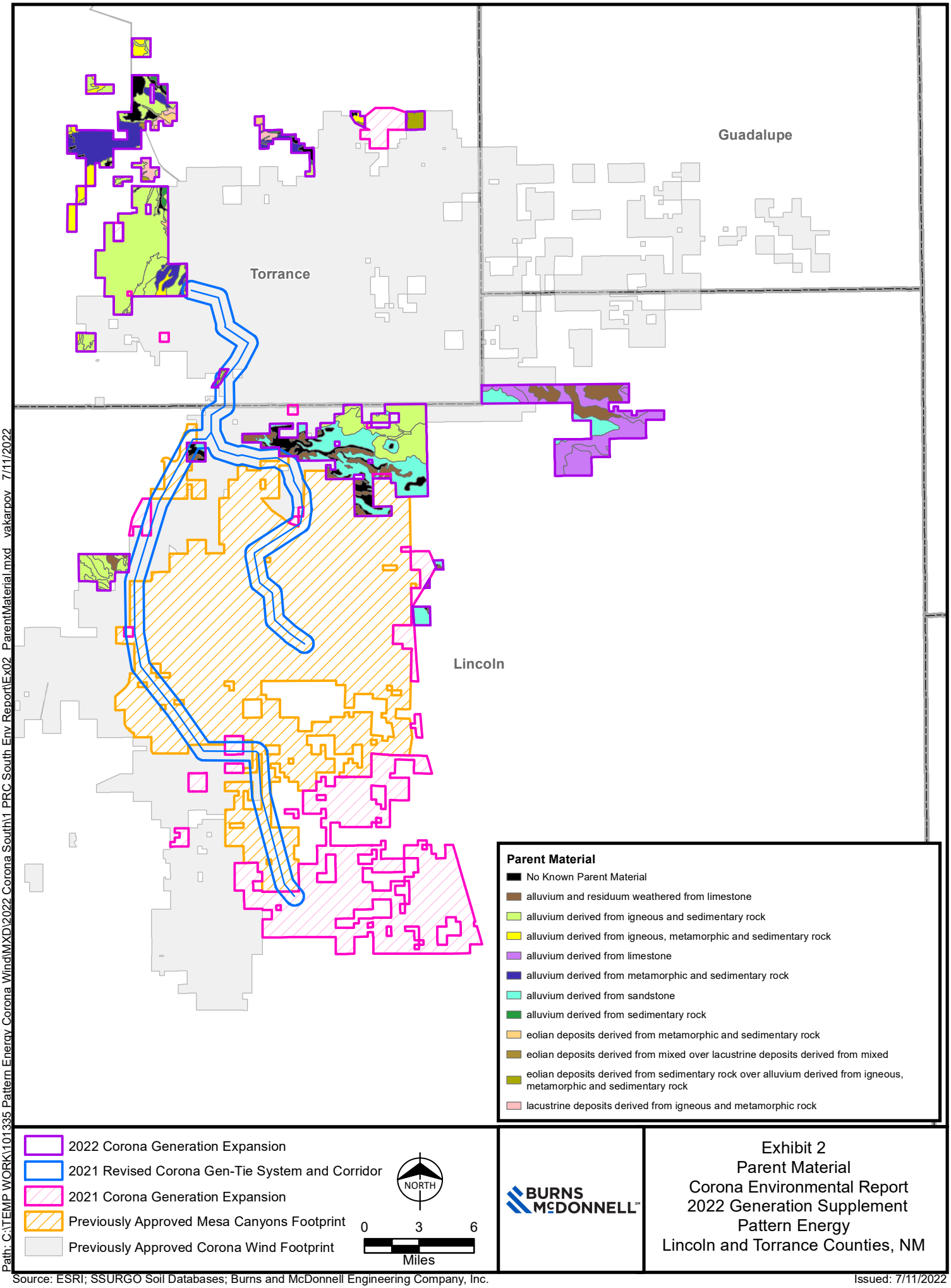

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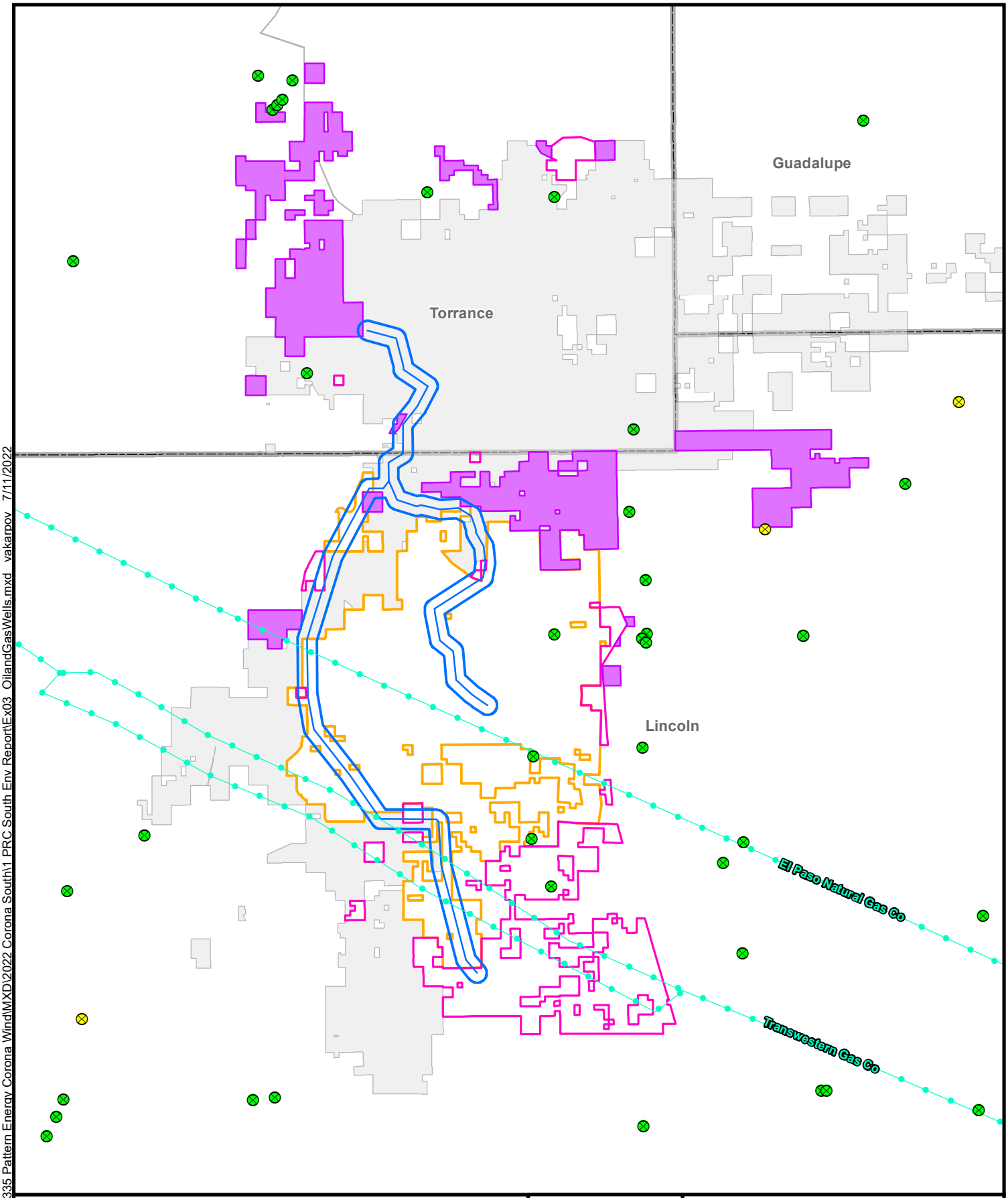
BURNS McDONNELL

Exhibit 2
Parent Material
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Source: ESRI; SSURGO Soil Databases; Burns and McDonnell Engineering Company, Inc.

Issued: 7/11/2022



2022 Corona Generation Supplement
Cancelled Well
Plugged Well
Natural Gas Pipeline
2021 Revised Corona Gen-Tie System and Corridor
2021 Corona Generation Expansion
Previously Approved Mesa Canyons Footprint
Previously Approved Corona Wind Footprint

NORTH

0 3 6
Miles

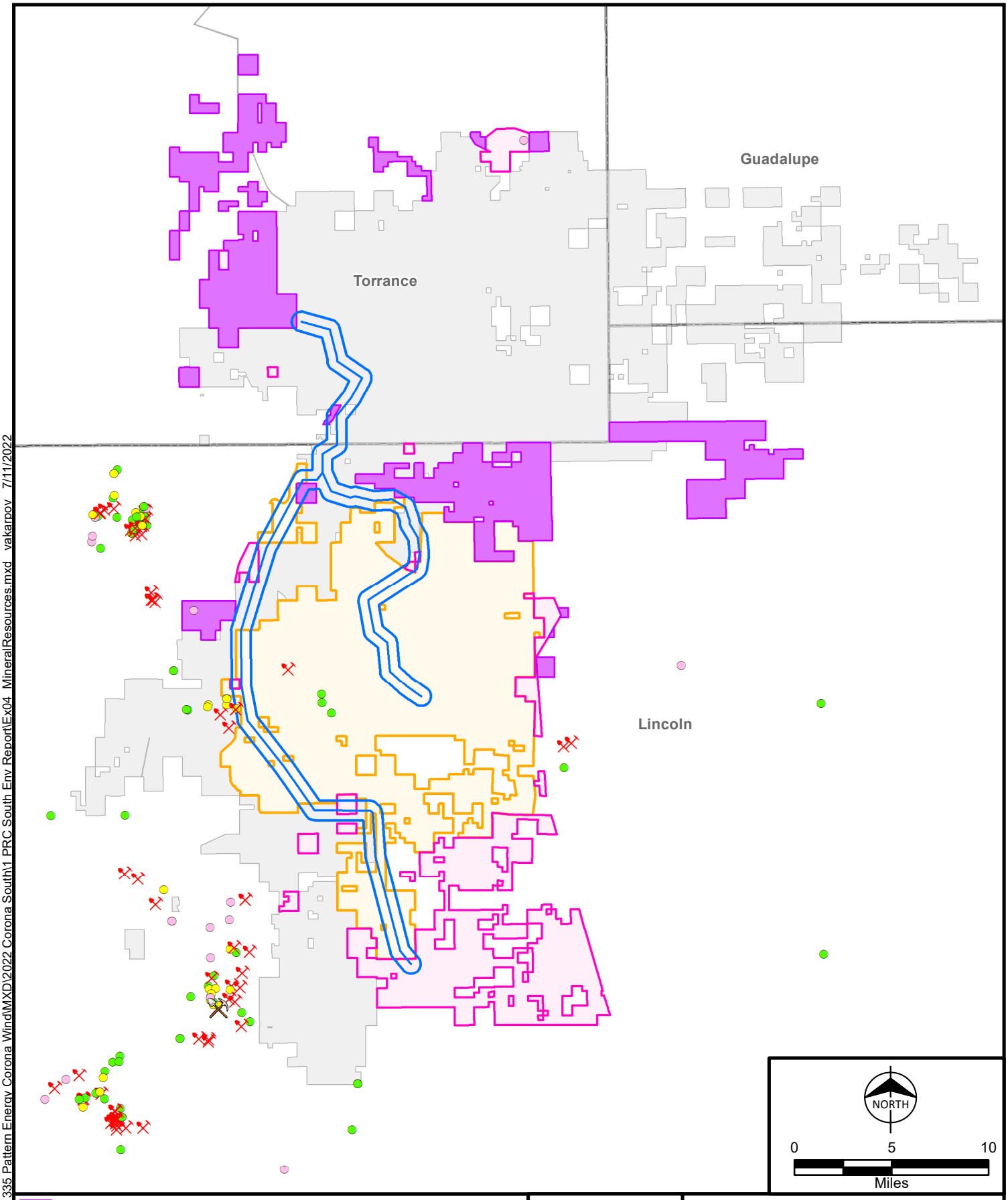
BURNS McDONNELL

Exhibit 3
Oil & Gas Well Summary
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln & Torrance Counties, NM

Path: C:\TEMP WORK\101335 Pattern Energy Corona Wind\MXD\2022 Corona South\1 PRC South Env Report\Ex03_OilandGasWells.mxd vakarpov 7/11/2022

Source: ESRI; SSURGO Soil Databases; Burns and McDonnell Engineering Company, Inc.

Issued: 7/11/2022



2022 Corona Generation Expansion
2021 Revised Corona Gen-Tie System and Corridor
2021 Corona Generation Expansion
Previously Approved Mesa Canyons Footprint
Previously Approved Corona Wind Footprint

Mineral Plant/Producer
Past Mineral Producer
Mineral Resource Occurrence
Mineral Resource Prospect
Unknown Mineral Resource

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Exhibit 4
Mineral Resources Map
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln & Torrance Counties, NM

Source: ESRI; Mineral Resources Data System (MRDS); USGS; Burns and McDonnell Engineering Company, Inc.

Issued: 7/11/2022

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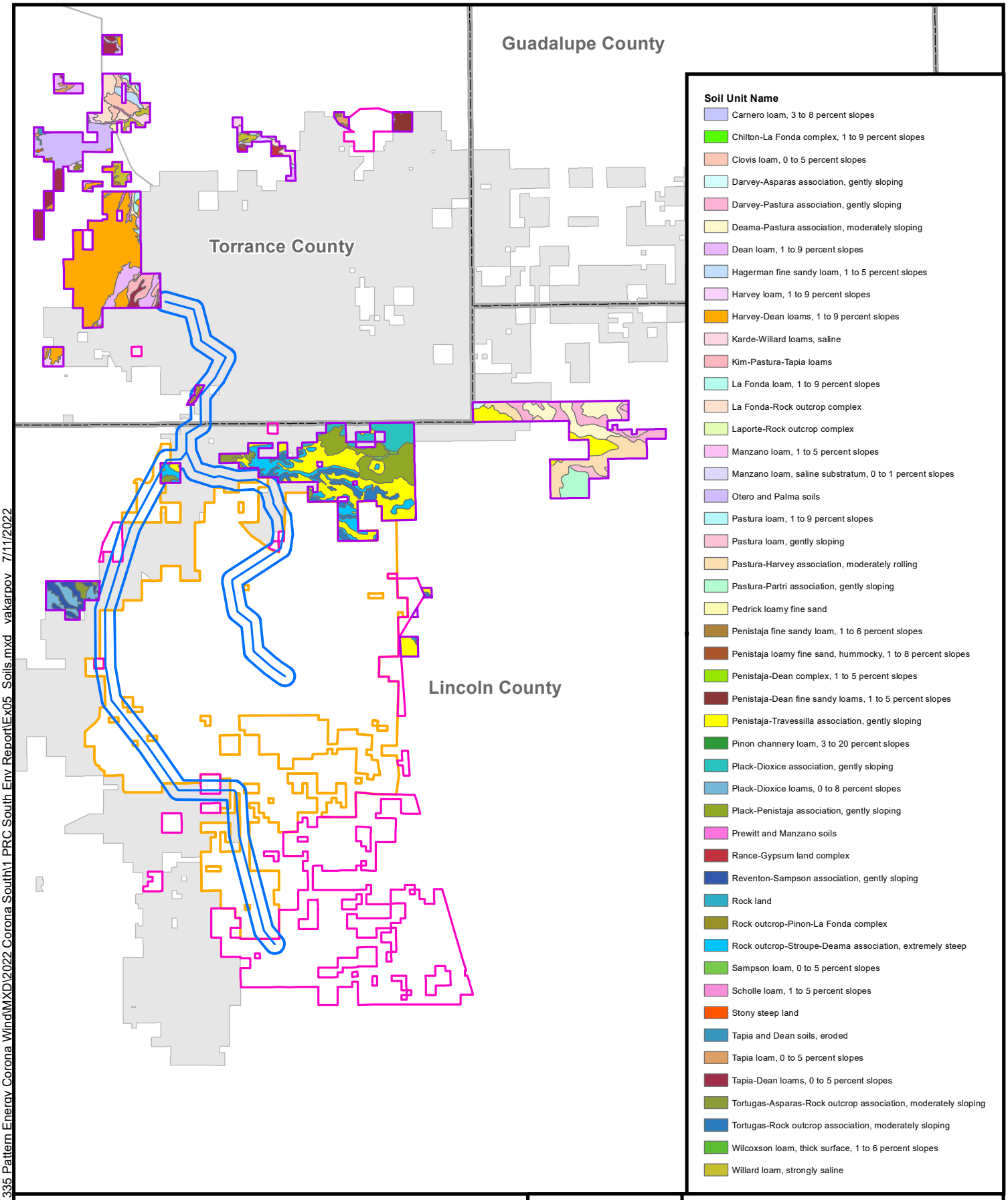

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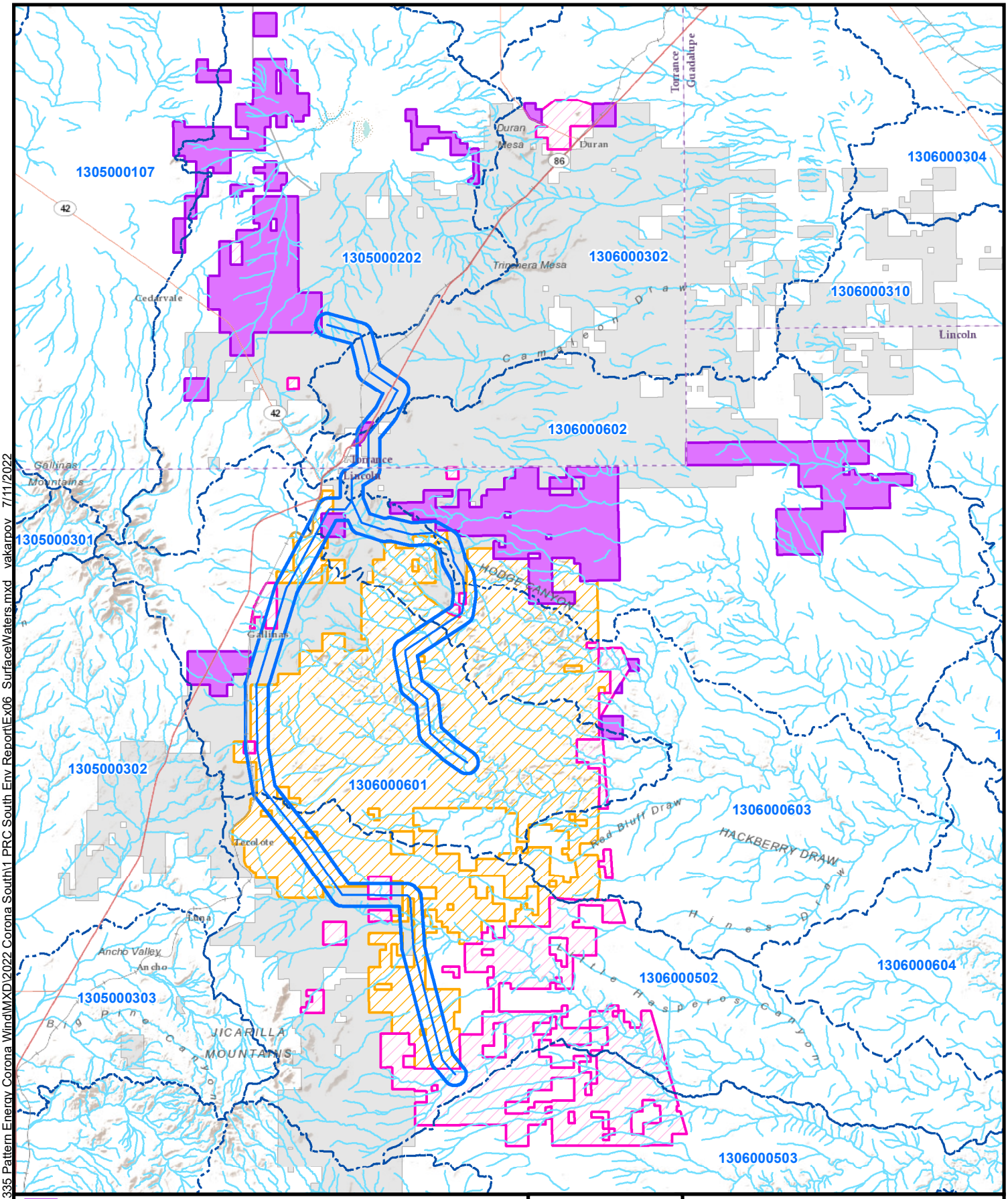
Exhibit 5
Soil Units Summary
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Source: ESRI; NRCS; Burns and McDonnell Engineering Company, Inc.

Issued: 7/11/2022



2022 Corona Generation Expansion
2021 Revised Corona Gen-Tie System and Corridor
2021 Corona Generation Expansion
Previously Approved Mesa Canyons Footprint
Previously Approved Corona Wind Footprint
HUC Boundary
NHD Flowline

NORTH

0 3 6
Miles

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Exhibit 6
Surface Waters
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Path: C:\TEMP WORK\101335 Pattern Energy Corona Wind\MXD\2022 Corona South\1 PRC South Env Report\Ex06_SurfaceWaters.mxd vakarpov 7/11/2022

Source: ESRI; National Hydrography Fataset; USGS; Burns and McDonnell Engineering Company, Inc.

Issued: 7/11/2022

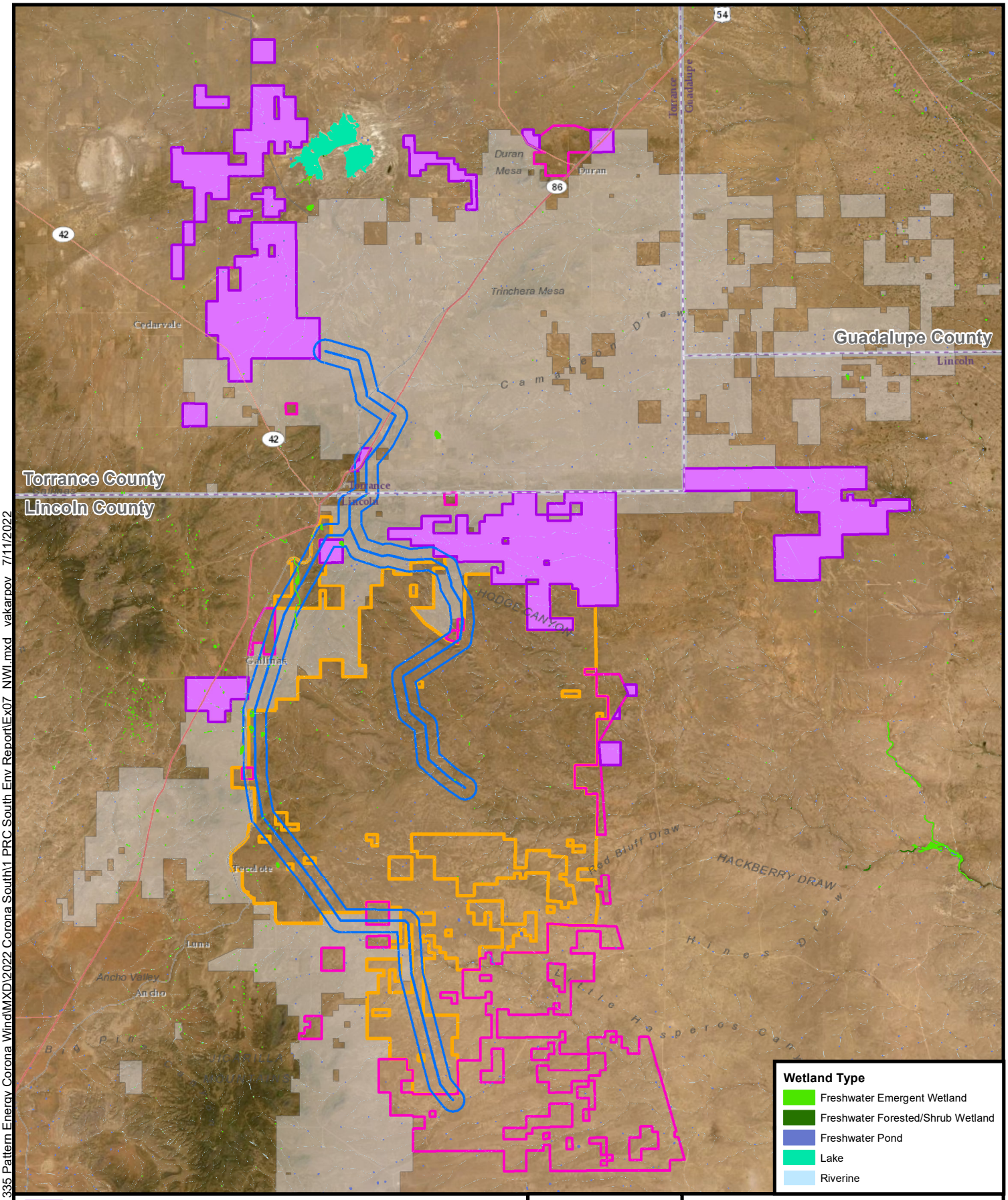

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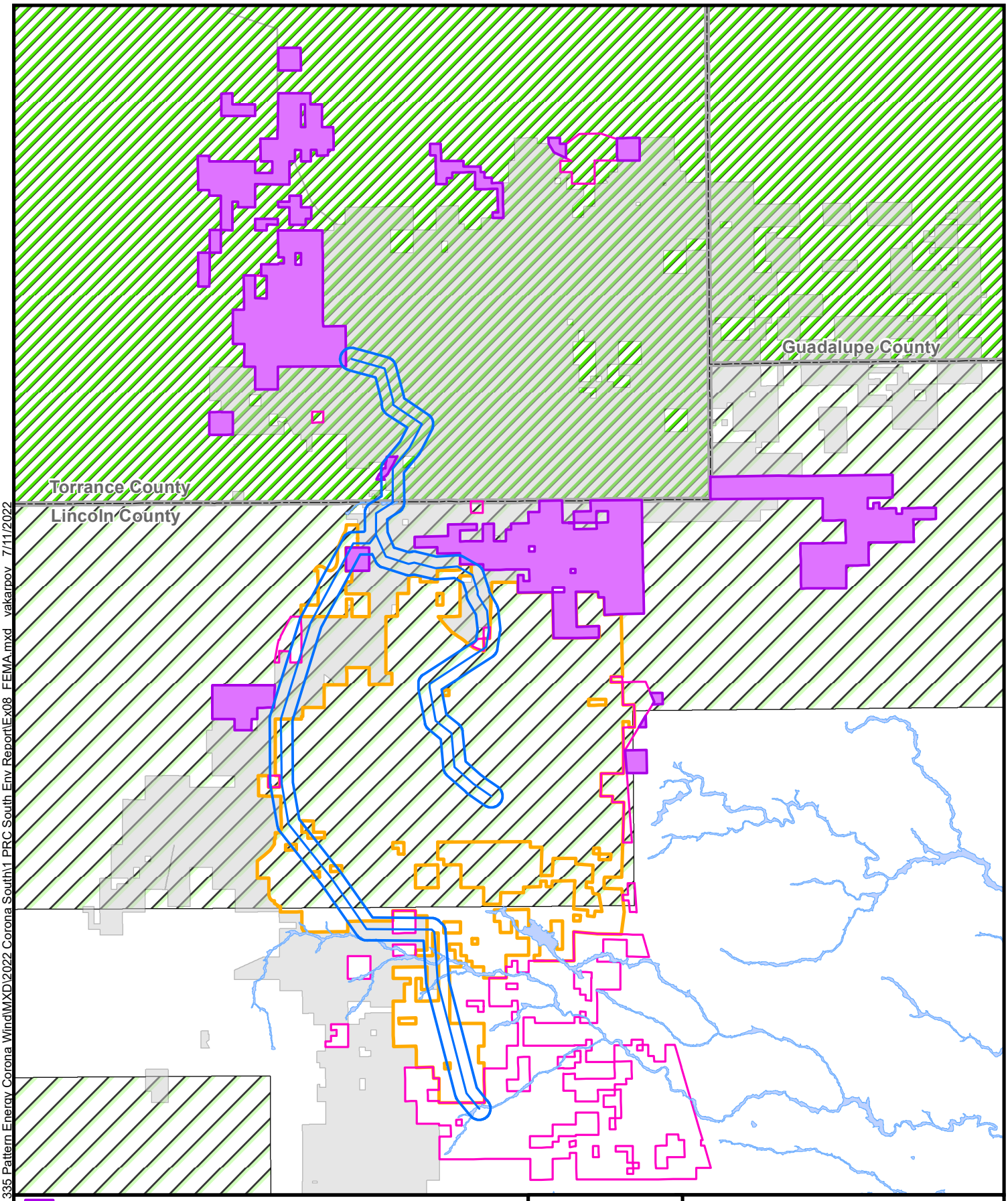
Exhibit 7
NWI Map
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Path: C:\TEMP WORK\101335 Pattern Energy Corona Wind\MXD\2022 Corona South\1 PRC South Env Report\Ex07_NWI.mxd vakarpov 7/11/2022

Source: ESRI; USFWS - National Wetland Inventory (NWI); Burns and McDonnell Engineering Company, Inc.

Issued: 7/11/2022



2022 Corona Generation Expansion
2021 Revised Corona Gen-Tie System and Corridor
2021 Corona Generation Expansion
Previously Approved Mesa Canyons Footprint
FEMA - Zone A
Unmapped Area
FEMA Designated Zone D
Previously Approved Corona Wind Footprint

NORTH

0 3 6
Miles

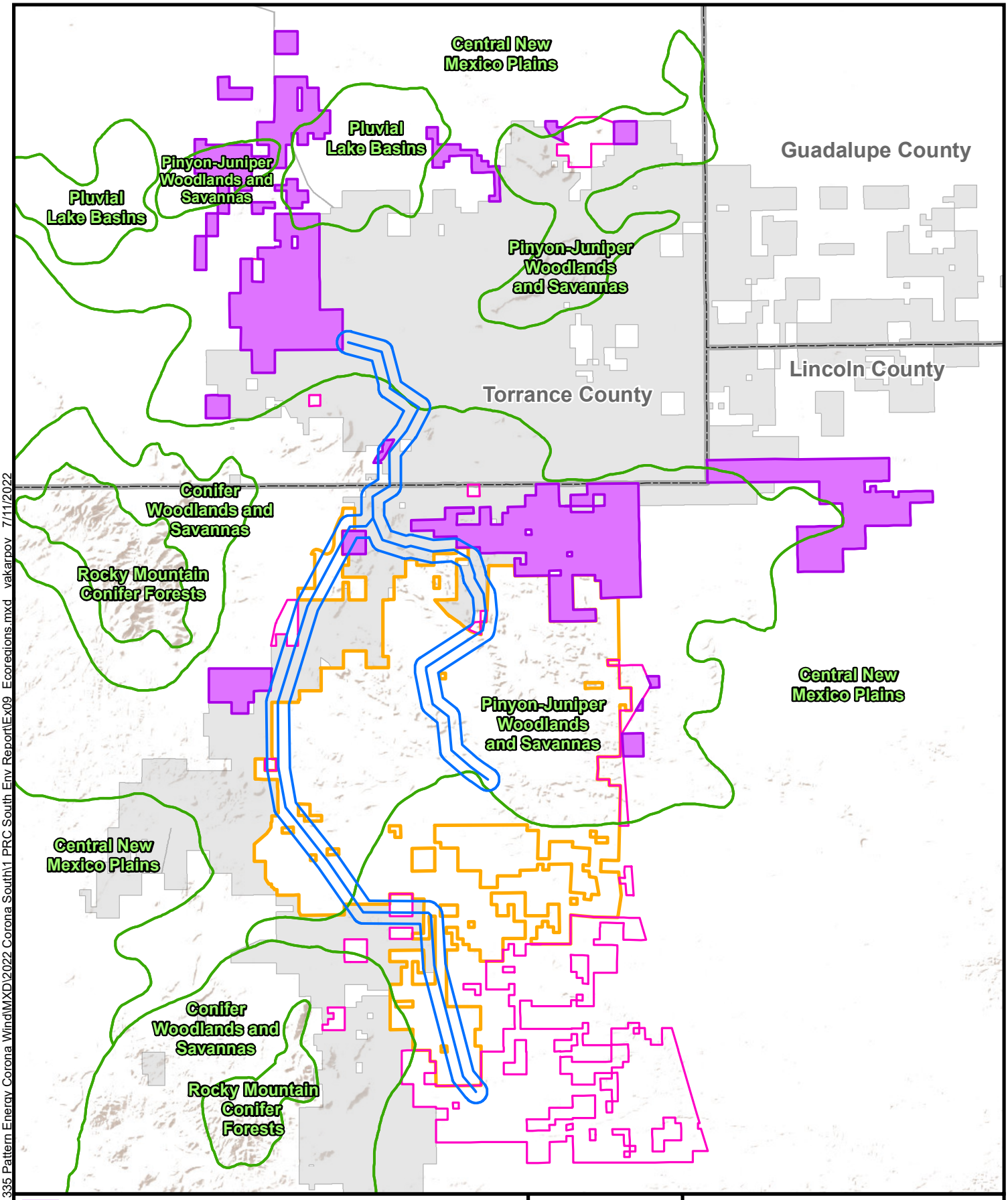
BURNS McDONNELL

Exhibit 8
Floodplain Summary
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Path: C:\TEMP WORK\101335 Pattern Energy Corona WindMXD\2022 Corona South\1 PRC South Env Report\Ex08_FEMA.mxd vakarpov 7/11/2022

Source: ESRI; FEMA; Burns and McDonnell Engineering Company, Inc.

Issued: 7/11/2022


Central New Mexico Plains
Pluvial Lake Basins
Pinyon-Juniper Woodlands and Savannas
Pluvial Lake Basins
Guadalupe County
Pinyon-Juniper Woodlands and Savannas
Lincoln County
Torrance County
Conifer Woodlands and Savannas
Rocky Mountain Conifer Forests
Central New Mexico Plains
Pinyon-Juniper Woodlands and Savannas
Central New Mexico Plains
Conifer Woodlands and Savannas
Rocky Mountain Conifer Forests
2022 Corona Generation Expansion
2021 Revised Corona Gen-Tie System and Corridor
2021 Corona Generation Expansion
Previously Approved Mesa Canyons Footprint
Previously Approved Corona Wind Footprint
Ecoregion Boundary
NORTH
0 3 6
Miles
BURNS McDONNELL
Exhibit 9
EPA Level IV Ecoregions
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM
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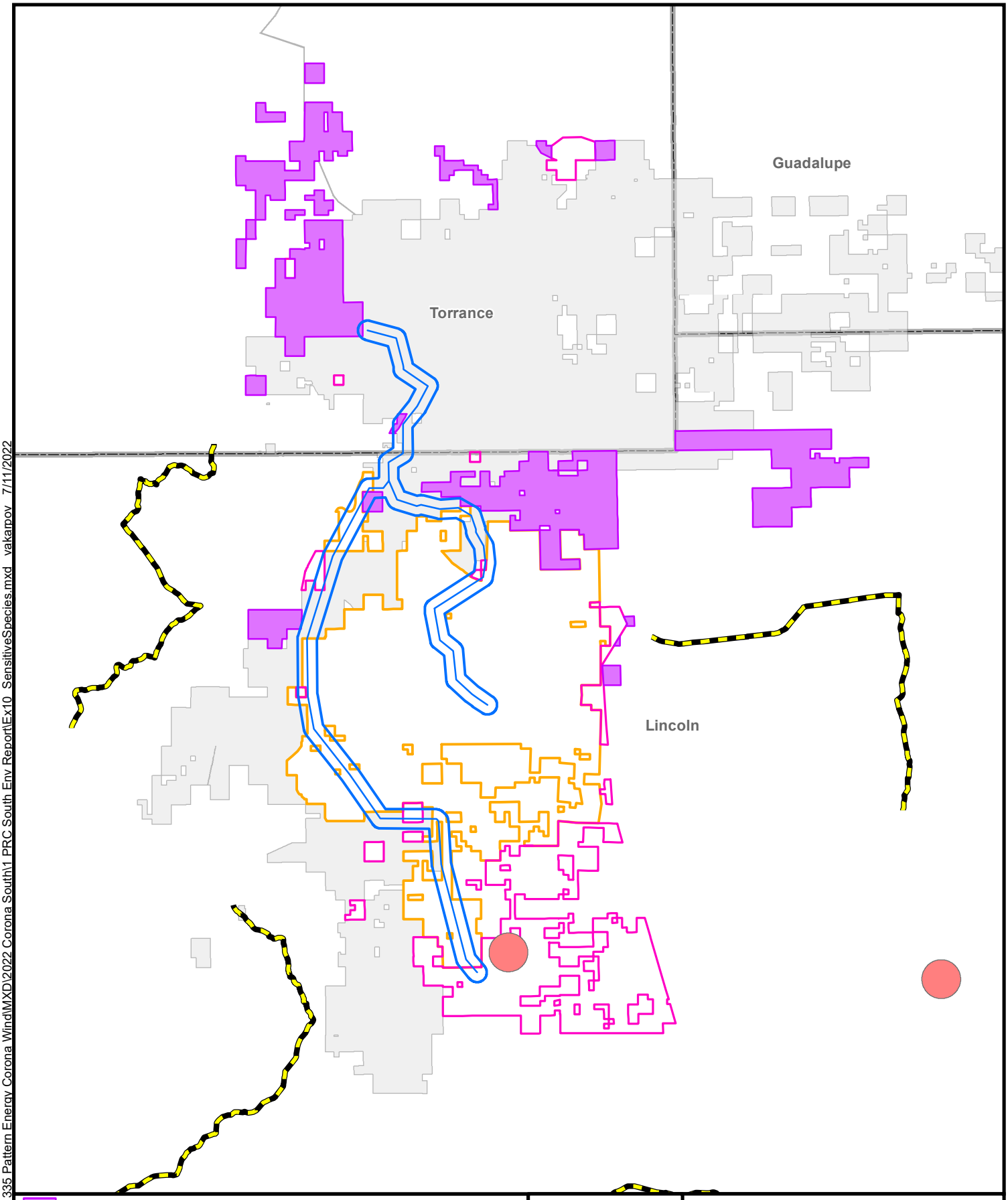

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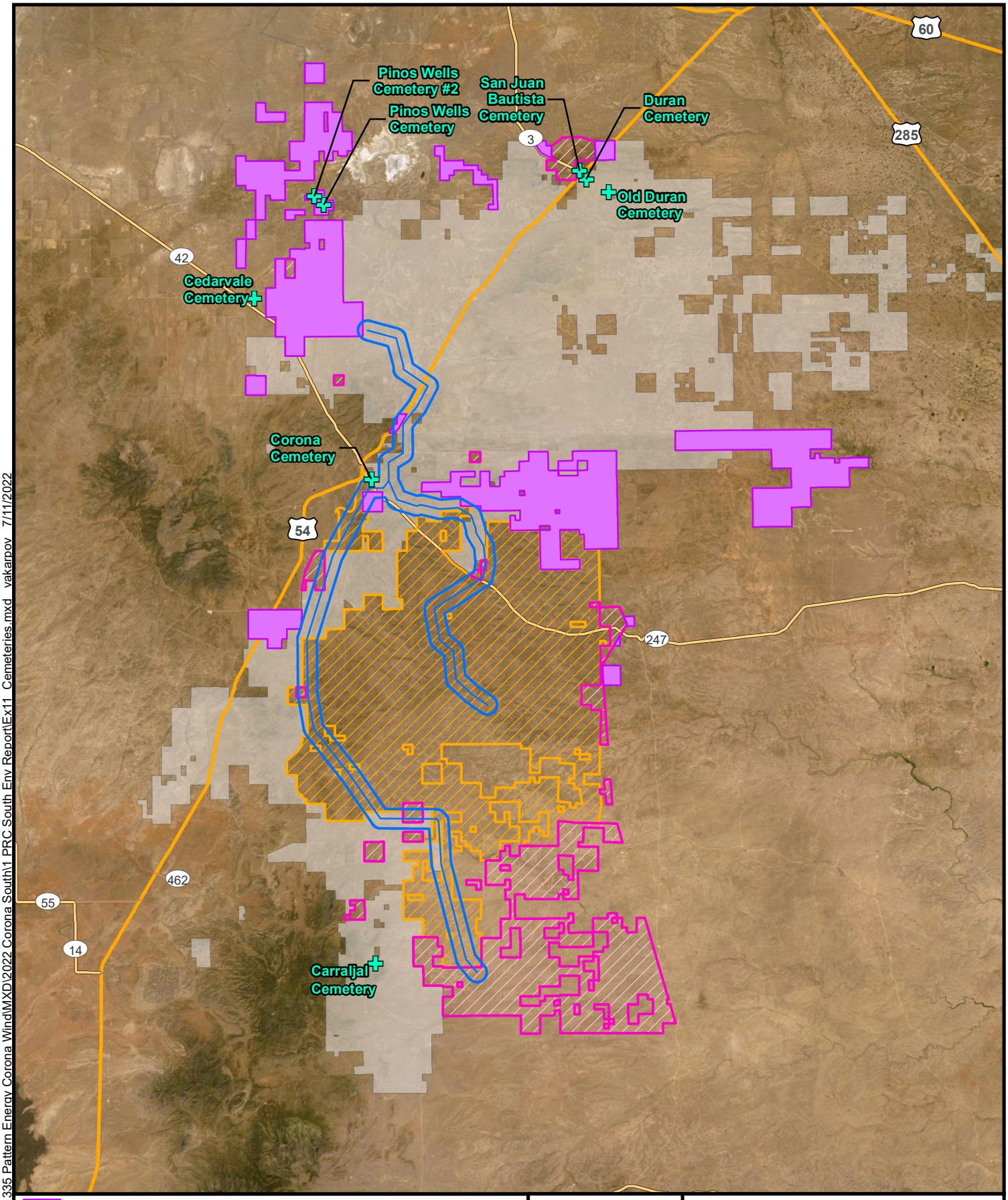
Exhibit 10
Sensitive Species Habitat
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Source: ESRI; SSURGO Soil Databases; Burns and McDonnell Engineering Company, Inc.

Issued: 7/11/2022



2022 Corona Generation Supplement
2021 Revised Corona Gen-Tie System and Corridor
2021 Corona Generation Expansion
Previously Approved Mesa Canyons Footprint
Previously Approved Corona Wind Footprint
Cemetery

NORTH

0 3 6
Miles

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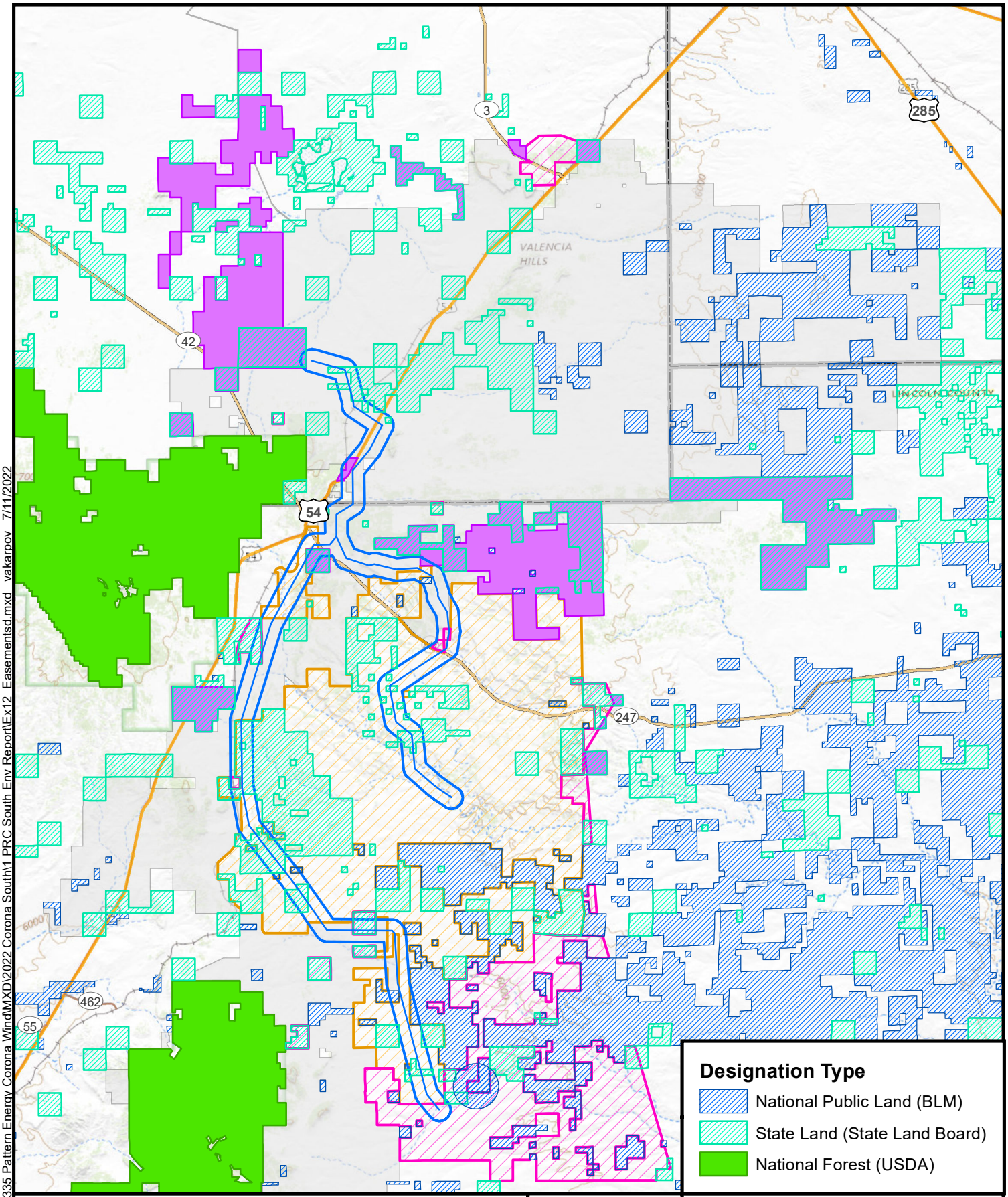
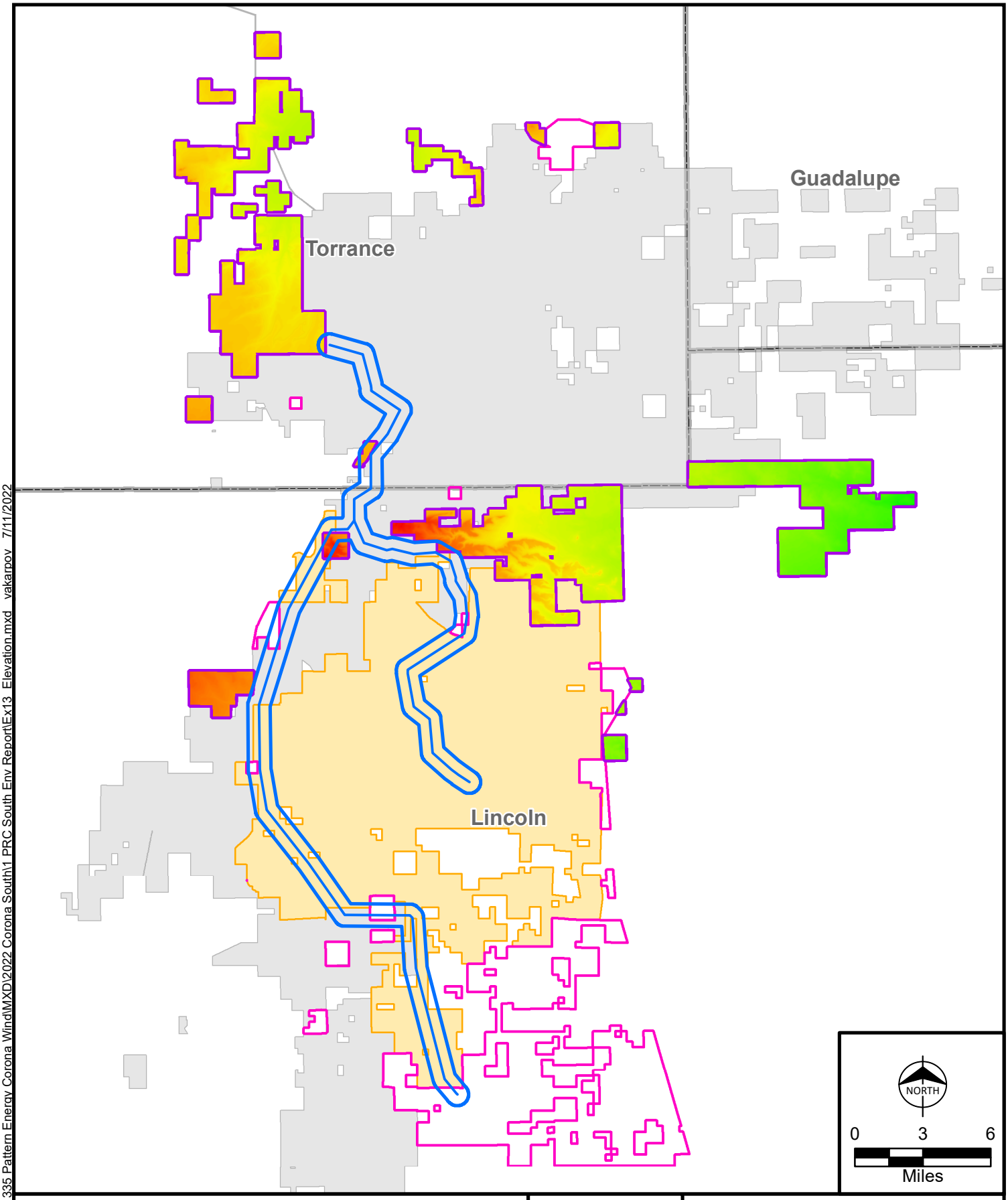
Exhibit 11
Cemeteries
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Path: C:\TEMP WORK\101335 Pattern Energy Corona Wind\MXD\2022 Corona South\1 PRC South Env Report\Ex11_Cemeteries.mxd vakarpov 7/11/2022

Source: ESRI; SSURGO Soil Databases; Burns and McDonnell Engineering Company, Inc.

Issued: 7/11/2022


3
285
42
54
247
462
55
VALENCIA HILLS
LINCOLN COUNTY
Designation Type
National Public Land (BLM)
State Land (State Land Board)
National Forest (USDA)
2022 Corona Generation Supplement
2021 Revised Corona Gen-Tie System and Corridor
2021 Corona Generation Expansion
Previously Approved Mesa Canyons Footprint
Previously Approved Corona Wind Footprint
NORTH
0 3 6
Miles
BURNS McDONNELL
Exhibit 12
Public Lands and Easements Map
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM
Path: C:\TEMP WORK\101335 Pattern Energy Corona Wind\MXD\2022 Corona South\1 PRC South Env Report\Ex12_Easementsd.mxd vakarpov 7/11/2022
Source: ESRI; PADUS;BLM; Burns and McDonnell Engineering Company, Inc.
Issued: 7/11/2022



2022 Corona Generation Expansion
2021 Revised Corona Gen-Tie System and Corridor
2021 Corona Generation Expansion
Previously Approved Mesa Canyons Footprint
Previously Approved Corona Wind Footprint

Elevation (Meters)
High : 2137.49
Low : 1682.51

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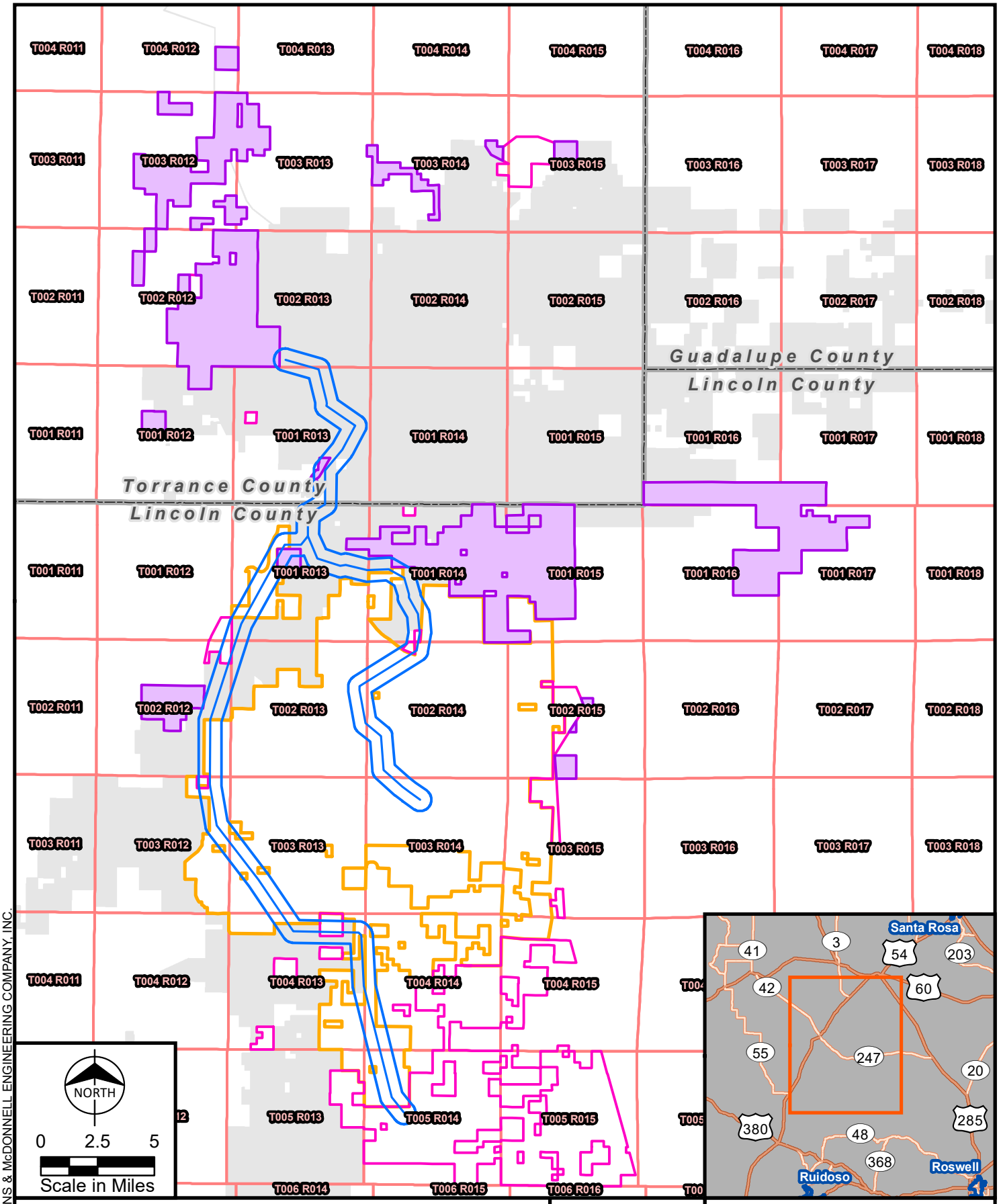
Exhibit 13
Elevation
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Path: C:\TEMP WORK\101335 Pattern Energy Corona Wind\MXD\2022 Corona South\1 PRC South Env Report\Ex13_Elevation.mxd vakarpov 7/11/2022

Source: ESRI; USGS; Burns and McDonnell Engineering Company, Inc.

Issued: 7/11/2022



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Source: Esri, Census, Pattern Development, Ventyx/Energy Velocity, and Burns & McDonnell Engineering Company, Inc.

Issued: 7/11/2022

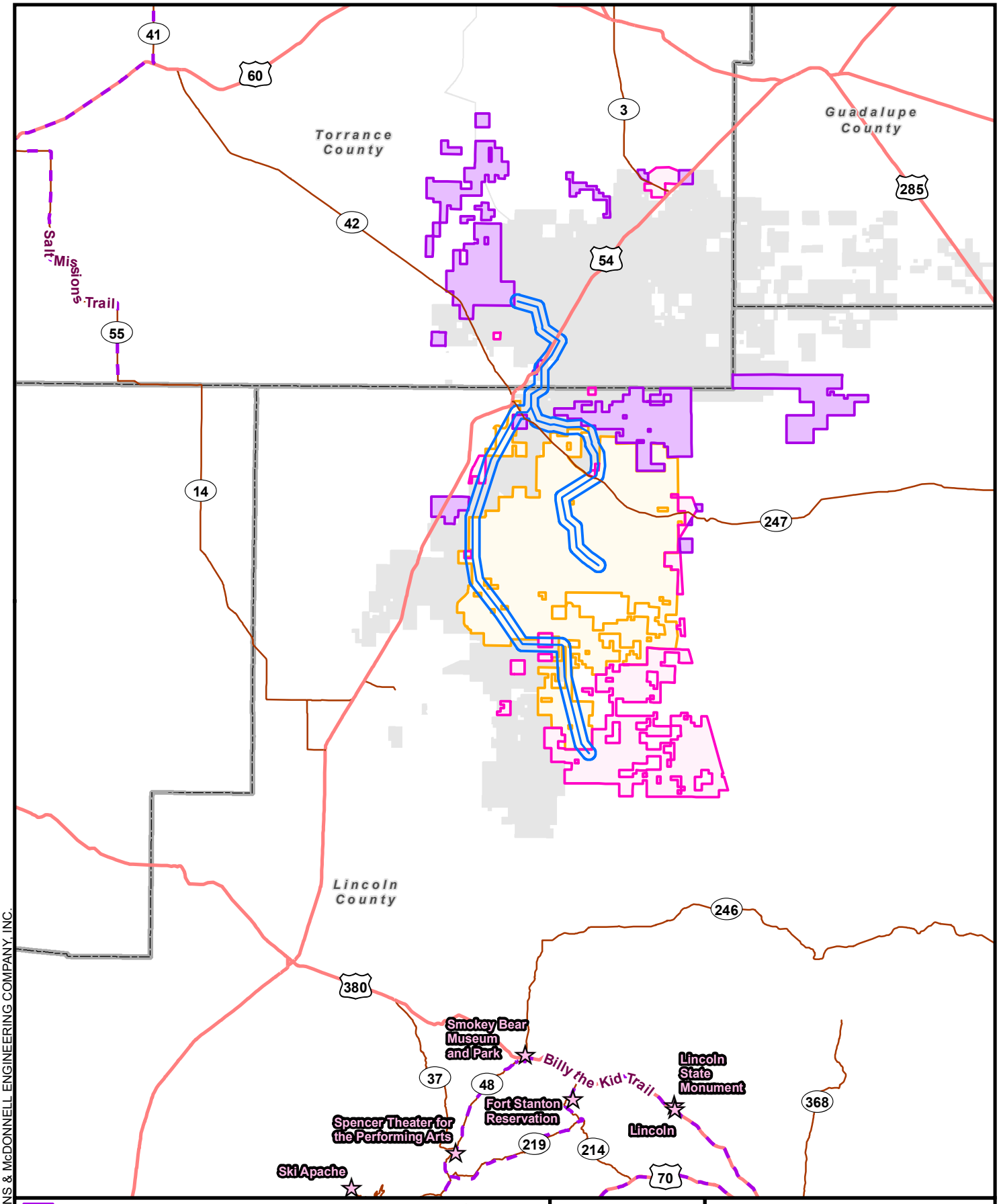

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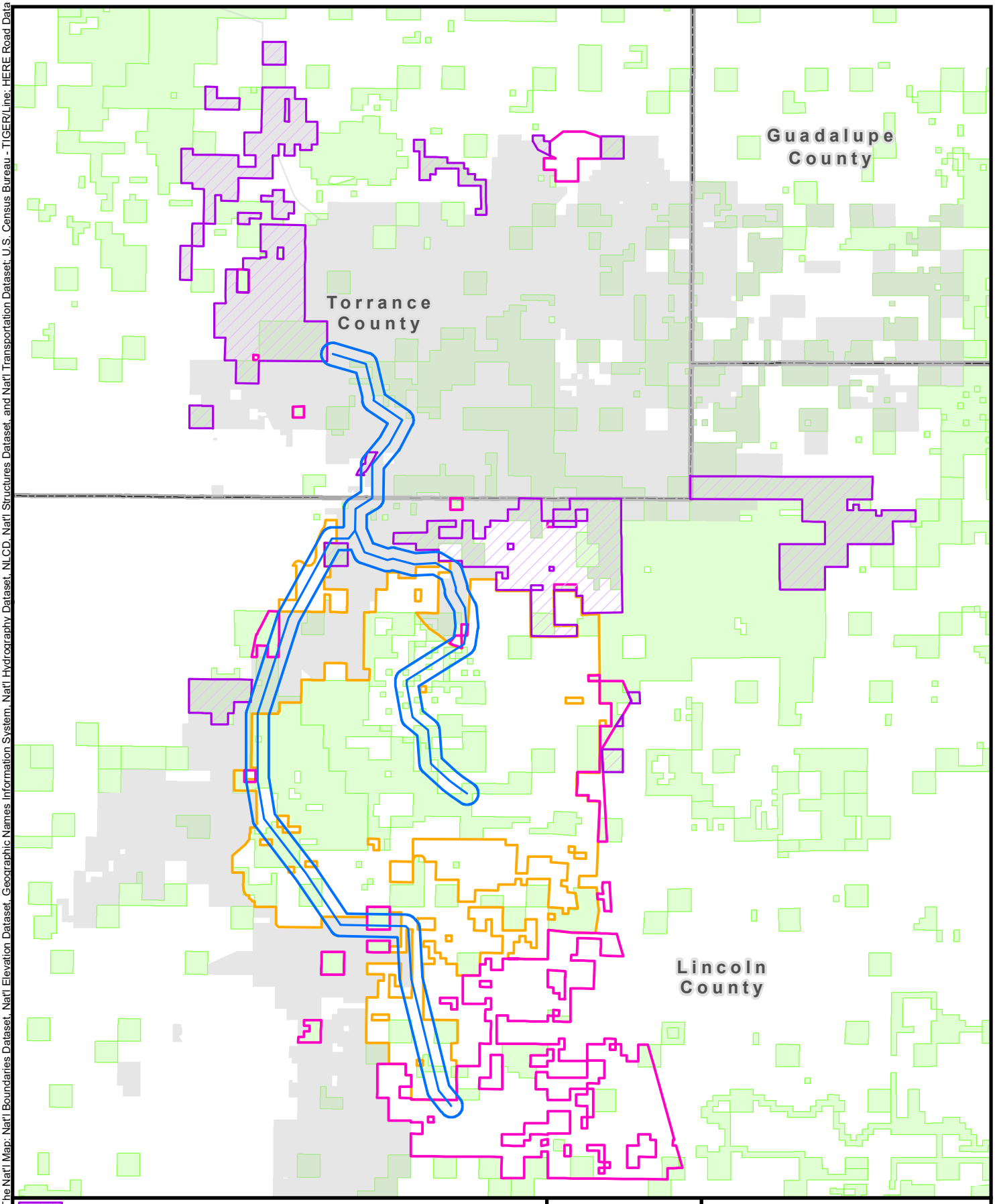
Exhibit 15
Byways & Trails
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln & Torrance Counties, NM

Source: Esri, Federal Highway Administration, Pattern Development, and Burns & McDonnell Engineering Company, Inc.

Issued: 7/11/2022



2022 Corona Generation Expansion
2021 Revised Corona Gen-Tie System and Corridor
2021 Corona Generation Expansion
Previously Approved Mesa Canyons Footprint
Previously Approved Corona Wind Footprint
State Land

NORTH

0 2.5 5
Scale in Miles

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Exhibit 16
State Lands
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln & Torrance Counties, NM

Source: Esri, Earth Data Analysis Center (EDAC), Playa Lakes Venture, State Land Office, Pattern Development, and Burns & McDonnell Engineering Company, Inc.

Issued: 7/11/2022

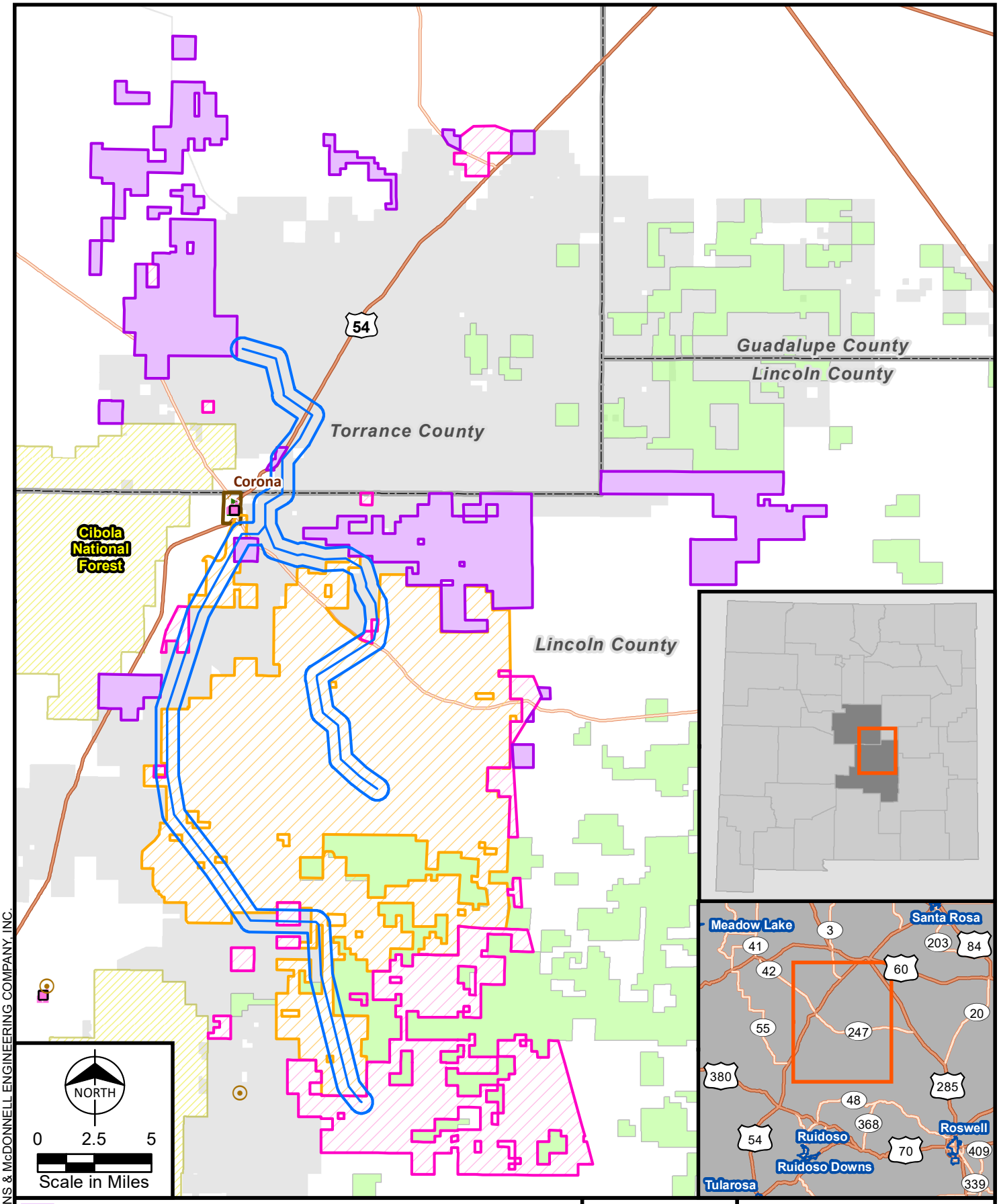

Exhibit 17
Project Vicinity
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Source: Esri, Census, Pattern Development, and Burns & McDonnell Engineering Company, Inc.

Issued: 7/11/2022

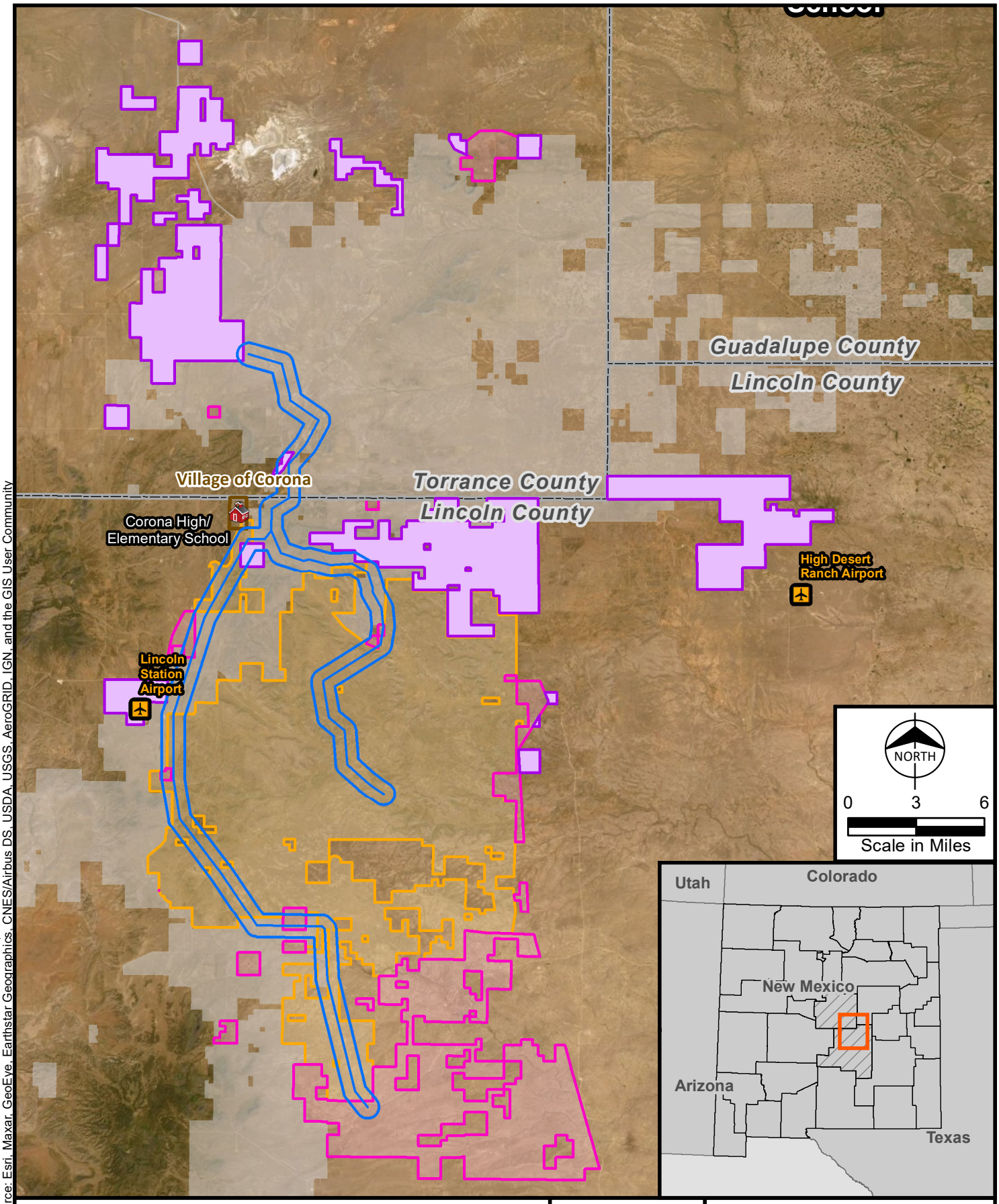

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Exhibit 18
General Vicinity Map
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln & Torrance Counties, NM

Source: Esri, Pattern Development, Ventyx/Energy Velocity, and Burns & McDonnell Engineering Company, Inc.

Issued: 7/11/2022

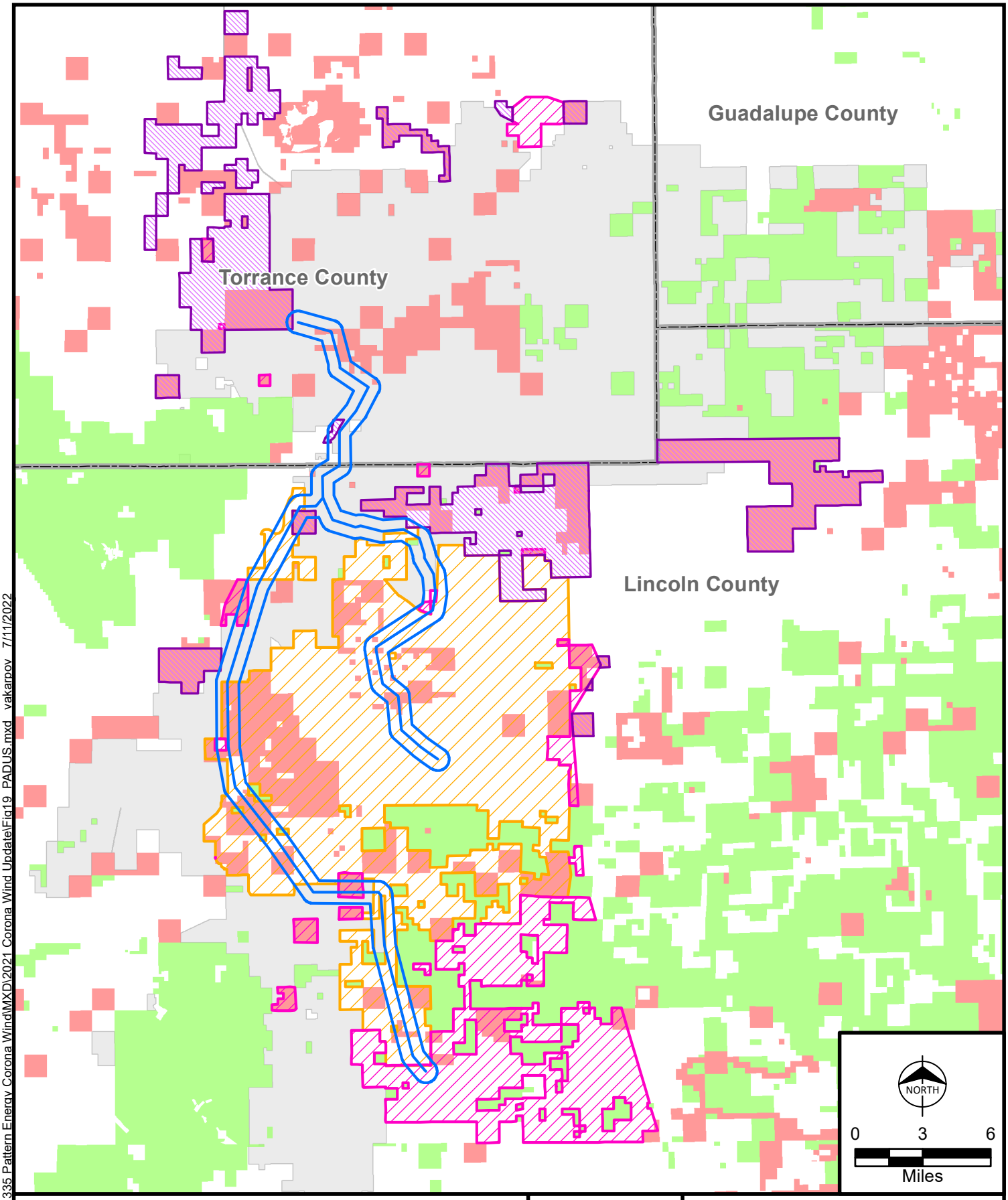

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Exhibit 19
GAP Analysis Program
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Source: ESRI; PADUS; Burns and McDonnell Engineering Company, Inc.

Issued: 7/11/2022

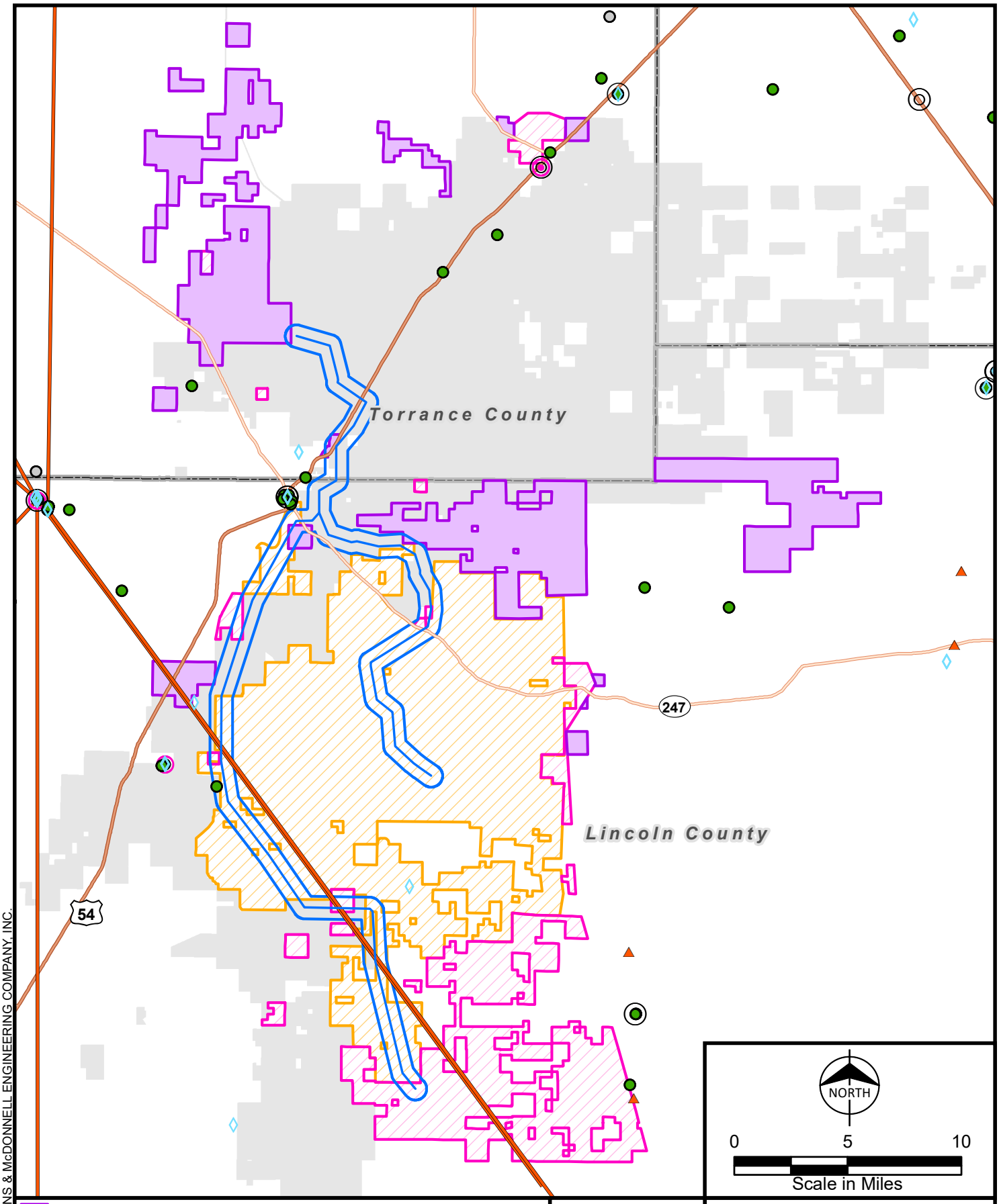

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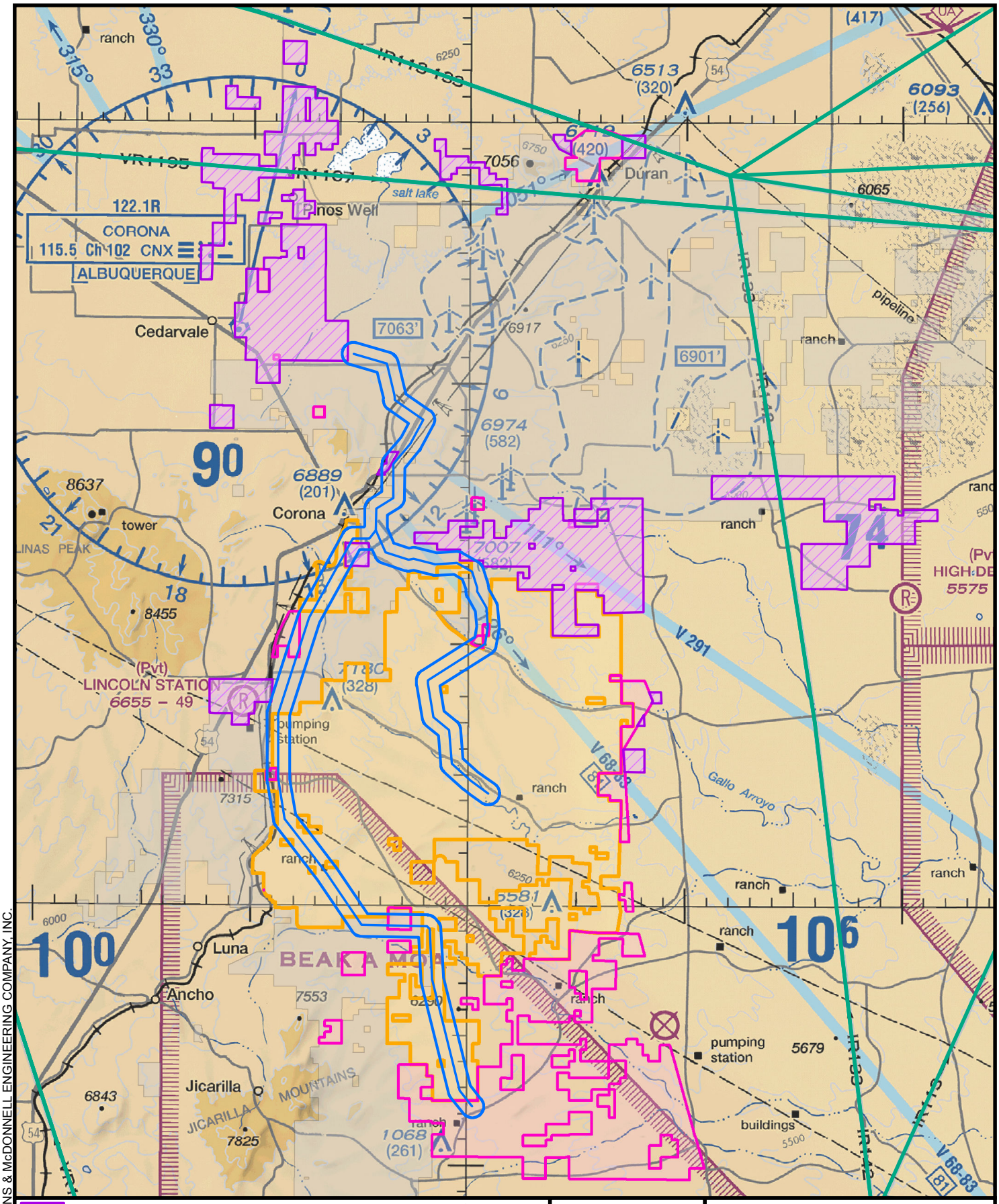
Exhibit 20
Communications Map
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM

Source: Esri, Census, Pattern Development, FCC, and Burns & McDonnell Engineering Company, Inc.

Issued: 7/11/2022


2022 Corona Generation Expansion
2021 Revised Corona Gen-Tie System and Corridor
2021 Corona Generation Expansion
Previously Approved Mesa Canyon Footprint
Previously Approved Corona Wind Footprint
Military Training Route
NORTH
0 2.5 5
Scale in Miles
BURNS McDONNELL
Exhibit 21
Visual Flight Rules Map
Corona Environmental Report
2022 Generation Supplement
Pattern Energy
Lincoln and Torrance Counties, NM
Source: Esri, Pattern Development, FAA, and Burns & McDonnell Engineering Company, Inc.
Issued: 7/11/2022
Path: Z:\Resources\Local\Clients\KCM\ENS\PatternSCHld\101335_CoronaWindENR\ArcGIS\Geospatial\DataFiles\ArcDocs\Updated Corona Figures 2021\New Generation Footprint August 2021\Fig21_VisualFlightRules.mxd vakarpov 7/11/2022
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Houston, TX 77027
O 713-622-0227
F 713-622-0224
www.burnsmcd.com

U.S. Fish & Wildlife Service

U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines

Cover Photo:

Wind Turbine. Photo by Stefanie Stavrakas, USFWS

OMB Control No, 1018-0148
Expiration Date: 11/30/2021

U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines

March 23, 2012

Acknowledgements

The U.S. Fish and Wildlife Service (Service) would like to recognize and thank the Wind Turbine Guidelines Advisory Committee for its dedication and preparation of its Recommendations. The Recommendations have served as the basis from which the Service's team worked to develop the Service's Land-Based Wind Energy Guidelines. The Service also recognizes the tireless efforts of the Headquarters, Regional and Field Office staff that helped to review and update these Guidelines.

Paperwork Reduction Act Statement: The Land-Based Wind Energy Guidelines contain reporting and recordkeeping requirements that require Office of Management and Budget approval in accordance with the Paperwork Reduction Act of 1995. Your response is voluntary. We collect this information in order to provide technical assistance related to addressing wildlife conservation concerns at all stages of land-based wind energy development. For each response, we estimate the time necessary to provide the information as follows:

Tier 1 – 83 hours
Tier 2 – 375 hours
Tier 3 – 2,880 hours
Tier 4 – 2,550 hours
Tier 5 – 2,400 hours

The above estimates include time for reviewing instructions, gathering and maintaining data, and preparing and transmitting reports. Send comments regarding these estimates or any other aspect of the requirements to the Service Information Collection Clearance Officer, U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, MS 2042-PDM, Arlington, VA 22203.

We may not conduct and you are not required to respond to a collection of information unless it displays a currently valid OMB control number.

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Executive Summary

As the Nation shifts to renewable energy production to supplant the need for carbon-based fuel, wind energy will be an important source of power. As wind energy production increases, both developers and wildlife agencies have recognized the need for a system to evaluate and address the potential negative impacts of wind energy projects on species of concern. These voluntary Guidelines provide a structured, scientific process for addressing wildlife conservation concerns at all stages of land-based wind energy development. They also promote effective communication among wind energy developers and federal, state, and local conservation agencies and tribes. When used in concert with appropriate regulatory tools, the Guidelines form the best practical approach for conserving species of concern. The Guidelines have been developed by the Interior Department's U.S. Fish and Wildlife Service (Service) working with the Wind Turbine Guidelines Advisory Committee. They replace interim voluntary guidance published by the Service in 2003.

The Guidelines discuss various risks to "species of concern" from wind energy projects, including collisions with wind turbines and associated infrastructure; loss and degradation of habitat from turbines and infrastructure; fragmentation of large habitat blocks into smaller segments that may not support sensitive species; displacement and behavioral changes; and indirect effects such as increased predator populations or introduction of invasive plants. The Guidelines assist developers in identifying species of concern that may potentially be affected by their proposed project, including migratory birds; bats; bald and golden eagles and other birds of prey; prairie and sage grouse; and listed, proposed, or candidate endangered and threatened species. Wind energy development in some areas may be precluded by federal law; other areas may be inappropriate for development because they have been recognized as having high wildlife value based on their ecological rarity and intactness.

The Guidelines use a "tiered approach" for assessing potential adverse effects to species of concern and their habitats. The tiered approach is an iterative decision-making process for collecting information in increasing detail; quantifying the possible risks of proposed wind energy projects to species of concern and their habitats; and evaluating those risks to make siting, construction, and operation decisions. During the pre-construction tiers (Tiers 1, 2, and 3), developers are working to identify, avoid and minimize risks to species of concern. During post-construction tiers (Tiers 4 and 5), developers are assessing whether actions taken in earlier tiers to avoid and minimize impacts are successfully achieving the goals and, when necessary, taking additional steps to compensate for impacts. Subsequent tiers refine and build upon issues raised and efforts undertaken in previous tiers. Each tier offers a set of questions to help the developer evaluate the potential risk associated with developing a project at the given location.

Briefly, the tiers address:

- Tier 1 – Preliminary site evaluation (landscape-scale screening of possible project sites)
- Tier 2 – Site characterization (broad characterization of one or more potential project sites)
- Tier 3 – Field studies to document site wildlife and habitat and predict project impacts
- Tier 4 – Post-construction studies to estimate impacts[1]
- Tier 5 – Other post-construction studies and research

The tiered approach provides the opportunity for evaluation and decision-making at each stage, enabling a developer to abandon or proceed with project development, or to collect additional information if required. This approach does not require that every tier, or every element within each tier, be implemented for every project. The Service anticipates that many distributed or community facilities will not need to follow the Guidelines beyond Tiers 1 and 2. Instead, the tiered approach allows efficient use of developer and wildlife agency resources with increasing levels of effort.

If sufficient data are available at a particular tier, the following outcomes are possible:

1. The project proceeds to the next tier in the development process without additional data collection.
2. The project proceeds to the next tier in the development process with additional data collection.
3. An action or combination of actions, such as project

[1] The Service anticipates these studies will include fatality monitoring as well as studies to evaluate habitat impacts.

modification, mitigation, or specific post-construction monitoring, is indicated.

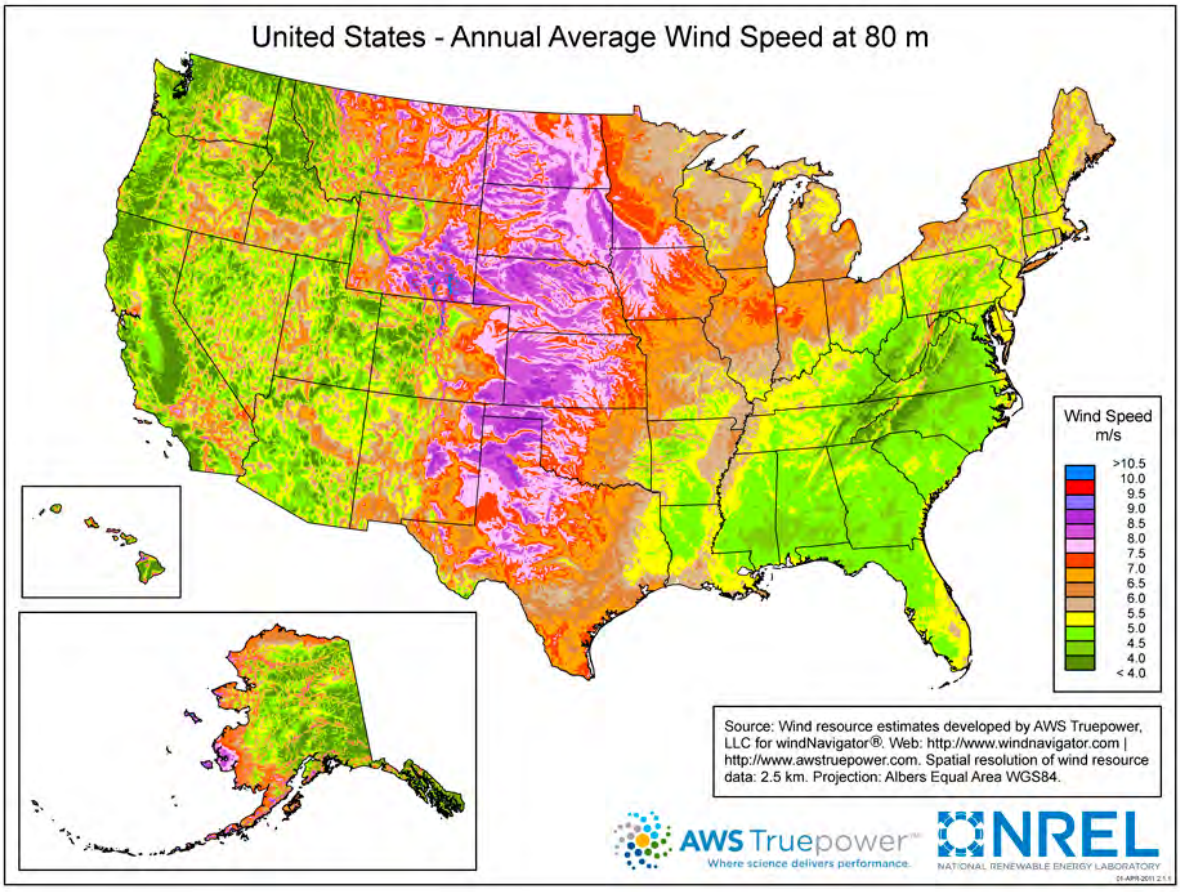
4. The project site is abandoned because the risk is considered unacceptable.

If data are deemed insufficient at a tier, more intensive study is conducted in the subsequent tier until sufficient data are available to make a decision to modify the project, proceed with the project, or abandon the project.

The most important thing a developer can do is to consult with the Service as early as possible in the development of a wind energy project. Early consultation offers the greatest opportunity for avoiding areas where development is precluded or where wildlife impacts are likely to be high and difficult or costly to remedy or mitigate at a later stage. By consulting early, project developers can also incorporate appropriate wildlife conservation measures and monitoring into their decisions about project siting, design, and operation.

Adherence to the Guidelines is voluntary and does not relieve any individual, company, or agency of the responsibility to comply with laws and regulations. However, if a violation occurs the Service will consider a developer's documented efforts to communicate with the Service and adhere to the Guidelines. The Guidelines include a Communications Protocol which provides guidance to both developers and Service personnel regarding appropriate communication and documentation.

The Guidelines also provide Best Management Practices for site development, construction, retrofitting, repowering, and decommissioning. For additional reference, a glossary of terms and list of literature cited are included in the appendices.



Wind Resource Map. Credit: NREL

Chapter 1 - General Overview

The mission of the U.S. Fish and Wildlife Service (Service) is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people. As part of this, the Service implements statutes including the Endangered Species Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act. These statutes prohibit taking of federally listed species, migratory birds, and eagles unless otherwise authorized.

Recent studies have documented that wind energy facilities can kill birds and bats. Mortality rates in fatalities per nameplate MW per year vary among facilities and regions. Studies have indicated that relatively low raptor (e.g., hawks, eagles) fatality rates exist at most modern wind energy developments with the exception of some facilities in California and Wyoming. Turbine-related bat deaths have been reported at each wind facility to date. Generally, studies in the West have reported lower rates of bat fatalities than facilities in the East. There is still much uncertainty regarding geographic distribution and causes of bat fatalities (NWCC 2010).

These Guidelines are intended to:

(1) Promote compliance with relevant wildlife laws and regulations;

(2) Encourage scientifically rigorous survey, monitoring, assessment, and research designs proportionate to the risk to species of concern;

(3) Produce potentially comparable data across the Nation;

(4) Mitigate, including avoid, minimize, and compensate for potential adverse effects on species of concern and their habitats; and,

(5) Improve the ability to predict and resolve effects locally, regionally, and nationally.

As the United States moves to expand wind energy production, it also must maintain and protect the Nation's wildlife and their habitats, which wind energy production can negatively affect. As with all responsible energy development, wind energy projects should adhere to high standards for environmental protection. With proper diligence paid to siting, operations, and management of projects, it is possible to mitigate for adverse effects to wildlife, and their habitats. This is best accomplished when the wind energy project developer communicates as early as possible with the Service and other stakeholders. Such early communication allows for the greatest range of development and mitigation options. The following website contains contact information for the Service Regional and Field offices as well as State wildlife agencies: http://www.fws.gov/offices/statelinks.html.

In response to increasing wind energy development in the United States, the Service released a set of voluntary, interim guidelines for reducing adverse effects to fish and wildlife resources from wind energy projects for public comment in July 2003. After the Service reviewed the public comments, the Secretary of the Interior (Secretary) established a Federal Advisory Committee[2] to provide recommendations to revise the guidelines related to land-based wind energy facilities. In March 2007, the U.S. Department of the Interior established the Wind Turbine Guidelines Advisory Committee (the Committee). The Committee submitted its final Recommended Guidelines (Recommendations) to the Secretary on March 4, 2010. The Service used the Recommendations to develop its Land-Based Wind Energy Guidelines.

The Service encourages project proponents to use the process described in these voluntary Land-based Wind Energy Guidelines (Guidelines) to address risks to species of concern. The Service intends that these Guidelines, when used in concert with the appropriate regulatory tools, will form the best practical approach for conservation of species of concern.

Statutory Authorities

These Guidelines are not intended nor shall they be construed to limit or preclude the Service from exercising its authority under any law, statute, or regulation, or from conducting enforcement action against any individual, company, or agency. They are not meant to relieve any individual, company, or agency of its obligations to comply with any applicable federal, state,

[2] Committee membership, from 2008 to 2011, has included: Taber Allison, Massachusetts Audubon; Dick Anderson, California Energy Commission; Ed Arnett, Bat Conservation International; Michael Azeka, AES Wind Generation; Thomas Bancroft, National Audubon; Kathy Boydston, Texas Parks and Wildlife Department; René Braud, EDP Renewables; Scott Darling, Vermont Fish and Wildlife Department; Michael Daulton, National Audubon; Aimee Delach, Defenders of Wildlife; Karen Douglas, California Energy Commission; Sam Enfield, MAP Royalty; Greg Hueckel, Washington Department of Fish and Wildlife; Jeri Lawrence, Blackfeet Nation; Steve Lindenberg, U.S. Department of Energy; Andy Linehan, Iberdrola Renewables; Rob Manes, The Nature Conservancy, Kansas; Winifred Perkins, NextEra Energy Resources; Steven Quarles, Crowell & Moring; Rich Rayhill, Ridgeline Energy; Robert Robel, Kansas State University; Keith Sexson, Association of Fish and Wildlife Agencies; Mark Sinclair, Clean Energy States Alliance; David Stout, U.S. Fish and Wildlife Service; Patrick Traylor, Hogan Lovells.

tribal, or local laws, statutes, or regulations. The Guidelines do not prevent the Service from referring violations of law for enforcement when a company has not followed the Guidelines.

Ultimately it is the responsibility of those involved with the planning, design, construction, operation, maintenance, and decommissioning of wind projects to conduct relevant wildlife and habitat evaluation and determine, which, if any, species may be affected. The results of these analyses will inform all efforts to achieve compliance with the appropriate jurisdictional statutes. Project proponents are responsible for complying with applicable state and local laws.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) is the cornerstone of migratory bird conservation and protection in the United States. The MBTA implements four treaties that provide for international protection of migratory birds. It is a strict liability statute, meaning that proof of intent, knowledge, or negligence is not an element of an MBTA violation. The statute's language is clear that actions resulting in a "taking" or possession (permanent or temporary) of a protected species, in the absence of a Service permit or regulatory authorization, are a violation of the MBTA.

The MBTA states, "Unless and except as permitted by regulations … it shall be unlawful at any time, by any means, or in any manner to pursue, hunt, take, capture, kill … possess, offer for sale, sell … purchase … ship, export, import … transport or cause to be transported … any migratory bird, any part, nest, or eggs of any such bird …. [The Act] prohibits the taking, killing, possession, transportation, import and export of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior." 16 U.S.C. 703. The word "take" is defined by regulation as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect." 50 CFR 10.12.

The MBTA provides criminal penalties for persons who commit any of the acts prohibited by the statute in section 703 on any of the species protected by the statute. See 16 U.S.C. 707. The Service maintains a list of all species protected by the MBTA at 50 CFR 10.13. This list includes over one thousand species of migratory birds, including eagles and other raptors, waterfowl, shorebirds, seabirds, wading birds, and passerines. The MBTA does not protect introduced species such as the house (English) sparrow, European starling, rock dove (pigeon), Eurasian collared-dove, and non-migratory upland game birds. The Service maintains a list of introduced species not protected by the Act. See 70 Fed. Reg. 12,710 (Mar. 15, 2005).

Bald and Golden Eagle Protection Act

Under authority of the Bald and Golden Eagle Protection Act (BGEPA), 16 U.S.C. 668–668d, bald eagles and golden eagles are afforded additional legal protection. BGEPA prohibits the take, sale, purchase, barter, offer of sale, purchase, or barter, transport, export or import, at any time or in any manner of any bald or golden eagle, alive or dead, or any part, nest, or egg thereof. 16 U.S.C. 668. BGEPA also defines take to include "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb," 16 U.S.C. 668c, and includes criminal and civil penalties for violating the statute. See 16 U.S.C. 668. The Service further defined the term "disturb" as agitating or bothering an eagle to a degree that causes, or is likely to cause, injury, or either a decrease in productivity or nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior. 50 CFR 22.3. BGEPA authorizes the Service to permit the take of eagles for certain purposes and under certain circumstances, including scientific or exhibition purposes, religious purposes of Indian tribes, and the protection of wildlife, agricultural, or other interests, so long as that take is compatible with the preservation of eagles. 16 U.S.C. 668a.

In 2009, the Service promulgated a final rule on two new permit regulations that, for the first time, specifically authorize the incidental take of eagles and eagle nests in certain situations under BGEPA. See 50 CFR 22.26 & 22.27. The permits authorize limited, non-purposeful (incidental) take of bald and golden eagles; authorizing individuals, companies, government agencies (including tribal governments), and other organizations to disturb or otherwise take eagles in the course of conducting lawful activities such as operating utilities and airports.

Bald Eagle, Credit: USFWS

Removal of active eagle nests would usually be allowed only when it is necessary to protect human safety or the eagles. Removal of inactive nests can be authorized when necessary to ensure public health and safety, when a nest is built on a human-engineered structure rendering it inoperable, and when removal is necessary to protect an interest in a particular locality, but only if the take or mitigation for the take will provide a clear and substantial benefit to eagles.

To facilitate issuance of permits under these new regulations, the Service has drafted Eagle Conservation Plan (ECP) Guidance. The ECP Guidance is compatible with these Land-Based Wind Energy Guidelines. The Guidelines guide developers through the process of project development and operation. If eagles are identified as a potential risk at a project site, developers are strongly encouraged to refer to the ECP Guidance. The ECP Guidance describes specific actions that are recommended to comply with the regulatory requirements in BGEPA for an eagle take permit, as described in 50 CFR 22.26 and 22.27. The ECP Guidance provides a national framework for assessing and mitigating risk specific to eagles through development of ECPs and issuance of programmatic incidental takes of eagles at wind turbine facilities. The Service will make its final ECP Guidance available to the public through its website.

Endangered Species Act

The Endangered Species Act (16 U.S.C. 1531–1544; ESA) was enacted by Congress in 1973 in recognition that many of our Nation's native plants and animals were in danger of becoming extinct. The ESA directs the Service to identify and protect these endangered and threatened species and their critical habitat, and to provide a means to conserve their ecosystems. To this end, federal agencies are directed to utilize their authorities to conserve listed species, and ensure that their actions

Indiana bat. Credit: USFWS

are not likely to jeopardize the continued existence of these species or destroy or adversely modify their critical habitat. Federal agencies are encouraged to do the same with respect to "candidate" species that may be listed in the near future. The law is administered by the Service and the Commerce Department's National Marine Fisheries Service (NMFS). For information regarding species protected under the ESA, see: http://www.fws.gov/endangered/.

The Service has primary responsibility for terrestrial and freshwater species, while NMFS generally has responsibility for marine species. These two agencies work with other agencies to plan or modify federal projects so that they will have minimal impact on listed species and their habitats. Protection of species is also achieved through partnerships with the states, through federal financial assistance and a system of incentives available to encourage state participation. The Service also works with private landowners, providing financial and technical assistance for management actions on their lands to benefit both listed and non-listed species.

Section 9 of the ESA makes it unlawful for a person to "take" a listed species. Take is defined as "... to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." 16 U.S.C. 1532(19). The terms harass and harm are further defined in our regulations. See 50 CFR 17.3. However, the Service may authorize "incidental take" (take that occurs as a result of an otherwise legal activity) in two ways.

Take of federally listed species incidental to a lawful activity may be authorized through formal consultation under section 7(a)(2) of the ESA, whenever a federal agency, federal funding, or a federal permit is involved. Otherwise, a person may seek an incidental take permit under section 10(a)(1)(B) of the ESA upon completion of a satisfactory habitat conservation plan (HCP) for listed species. Developers not receiving federal funding or authorization should contact the Service to obtain an incidental take permit if a wind

Utility-Scale Wind turbine with an anemometer tower in the background. Credit: University of Minnesota College of Science and Engineering

energy project is likely to result in take of listed threatened or endangered wildlife species. For more information regarding formal consultation and the requirements of obtaining HCPs, please see the Endangered Species Consultation Handbook at http://www.fws.gov/endangered/esa-library/index.html#consultations and the Service's HCP website, http://www.fws.gov/endangered/what-we-do/hcp-overview.html.

Implementation of the Guidelines

Because these Guidelines are voluntary, the Service encourages developers to use them as soon as possible after publication. To receive the considerations discussed on page 6 regarding enforcement priorities, a wind energy project would fall into one of three general categories relative to timing and implementation:

- For projects initiated after publication, the developer has applied the Guidelines, including the tiered approach, through site selection, design, construction, operation and post-operation phases of the project, and has communicated and shared information with the Service and considered its advice.

- For projects initiated prior to publication, the developer should consider where they are in the planning process relative to the appropriate tier and inform the Service of what actions they will take to apply the Guidelines.

- For projects operating at the time of publication, the developer should confer with the Service regarding the appropriate period of fatality monitoring consistent with Tier 4, communicate and share information with the Service on monitoring results, and consider Tier 5 studies and mitigation options where appropriate.

Projects that are already under development or are in operation are not expected to start over or return to the beginning of a specific tier. Instead, these projects should implement those portions of the Guidelines relevant to the current phases of the project per the bullets above.

The Service is aware that it will take time for Service staff and other personnel, including wind energy developers and their biologists, to develop expertise in the implementation of these Guidelines. Service staff and many staff associated with the wind energy industry have been involved with developing these Guidelines. Therefore, they have a working knowledge of the Guidelines. To further refine their training, the Service will make every effort to offer an in-depth course within 6 months of the final Guidelines being published.

The Communications Protocol on page 5 provides guidance to Service staff and developers in the exchange of information and recommendations at each tier in the process. Although the advice of the Service is not binding, a developer should review such advice, and either accept or reject it. If they reject it, they should contemporaneously document with reasoned justification why they did so. Although the Guidelines leave decisions up to the developer, the Service retains authority to evaluate whether developer efforts to mitigate impacts are sufficient, to determine significance, and to refer for prosecution any unlawful take that it believes to be reasonably related to lack of incorporation of Service recommendations or insufficient adherence with the Guidelines.

Table 1. Suggested Communications Protocol

This table provides examples of potential communication opportunities between a wind energy project developer and the Service. Not all projects will follow all steps indicated below.

TIER	*Project Developer/Operator Role*	*Service Role*
Tier 1: Preliminary site evaluation	• Landscape level assessment of habitat for species of concern • Request data sources for existing information and literature	• Provide lists of data sources and references, if requested
Tier 2: Site characterization	• Assess potential presence of species of concern, including species of habitat fragmentation concern, likely to be on site • Assess potential presence of plant communities present on site that may provide habitat for species of concern • Assess potential presence of critical congregation areas for species of concern • One or more reconnaissance level site visit by biologist • Communicate results of site visits and other assessments with the Service • Provide general information about the size and location of the project to the Service	• Provide species lists, for species of concern, including species of habitat fragmentation concern, for general area, if available • Provide information regarding plant communities of concern, if available • Respond to information provided about findings of biologist from site visit • Identify initial concerns about site(s) based on available information • Inform lead federal agencies of communications with wind project developers
Tier 3: Field studies and impact prediction	• Discuss extent and design of field studies to conduct with the Service • Conduct biological studies • Communicate results of all studies to Service field office in a timely manner • Evaluate risk to species of concern from project construction and operation • Identify ways to mitigate potential direct and indirect impacts of building and operating the project	• Respond to requests to discuss field studies • Advise project proponent about studies to conduct and methods for conducting them • Communicate with project proponent(s) about results of field studies and risk assessments • Communicate with project proponents(s) ways to mitigate potential impacts of building and operating the project • Inform lead federal agencies of communications with wind project developers
Tier 4: Post construction studies to estimate impacts	• Discuss extent and design of post-construction studies to conduct with the Service • Conduct post-construction studies to assess fatalities and habitat-related impacts • Communicate results of all studies to Service field office in a timely manner • If necessary, discuss potential mitigation strategies with Service • Maintain appropriate records of data collected from studies	• Advise project operator on study design, including duration of studies to collect adequate information • Communicate with project operator about results of studies • Advise project operator of potential mitigation strategies, when appropriate
Tier 5: Other post-construction studies and research	• Communicate with the Service about the need for and design of other studies and research to conduct with the Service, when appropriate, particularly when impacts exceed predicted levels • Communicate with the Service about ways to evaluate cumulative impacts on species of concern, particularly species of habitat fragmentation concern • Conduct appropriate studies as needed • Communicate results of studies with the Service • Identify potential mitigation strategies to reduce impacts and discuss them with the Service	• Advise project proponents as to need for Tier 5 studies to address specific topics, including cumulative impacts, based on information collected in Tiers 3 and 4 • Advise project proponents of methods and metrics to use in Tier 5 studies • Communicate with project operator and consultants about results of Tier 5 studies • Advise project operator of potential mitigation strategies, when appropriate, based on Tier 5 studies

Consideration of the Guidelines in MBTA and BGEPA Enforcement

The Service urges voluntary adherence to the Guidelines and communication with the Service when planning and operating a facility. While it is not possible to absolve individuals or companies from MBTA or BGEPA liability, the Office of Law Enforcement focuses its resources on investigating and prosecuting those who take migratory birds without identifying and implementing reasonable and effective measures to avoid the take. The Service will regard a developer's or operator's adherence to these Guidelines, including communication with the Service, as appropriate means of identifying and implementing reasonable and effective measures to avoid the take of species protected under the MBTA and BGEPA.[3] The Chief of Law Enforcement or more senior official of the Service will make any decision whether to refer for prosecution any alleged take of such species, and will take such adherence and communication fully into account when exercising discretion with respect to such potential referral. Each developer or operator will be responsible for maintaining internal records sufficient to demonstrate adherence to the Guidelines and response to communications from the Service. Examples of these records could include: studies performed in the implementation of the tiered approach; an internal or external review or audit process; a bird and bat conservation strategy; or a wildlife management plan.

If a developer and operator are not the same entity, the Service expects the operator to maintain sufficient records to demonstrate adherence to the Guidelines.

Scope and Project Scale of the Guidelines

The Guidelines are designed for "utility-scale" land-based wind energy projects to reduce potential impacts to species of concern, regardless of whether they are proposed for private or public lands. A developer of a distributed or community scale wind project may find it useful to consider the general principles of the tiered approach to assess and reduce potential impacts to species of concern, including answering Tier 1 questions using publicly available information. In the vast majority of situations, appropriately sited small wind projects are not likely to pose significant risks to species of concern. Answering Tier 1 questions will assist a developer of distributed or community wind projects, as well as landowners, in assessing the need to further communicate with the Service, and precluding, in many cases, the need for full detailed pre-construction assessments or monitoring surveys typically called for in Tiers 2 and 3. If landowners or community/distributed wind developers encounter problems locating information about specific sites they can contact the Service and/or state wildlife agencies to determine potential risks to species of concern for their particular project.

Communication with Christy Johnson-Hughes. Credit: Rachel London, USFWS

The tiered approach is designed to lead to the appropriate amount of evaluation in proportion to the anticipated level of risk that a project may pose to species of concern and their habitats. Study plans and the duration and intensity of study efforts should be tailored specifically to the unique characteristics of each site and the corresponding potential for significant adverse impacts on species of concern and their habitats as determined through the tiered approach. This is why the tiered approach begins with an examination of the potential location of the project, not the size of the project. In all cases, study plans and selection of appropriate study methods and techniques may be tailored to the relative scale, location, and potential for significant adverse impacts of the proposed site.

The Service considers a "project" to include all phases of wind energy development, including, but not limited to, prospecting, site assessment, construction, operation, and decommissioning, as well as all associated infrastructure and interconnecting electrical lines. A "project site" is the land and airspace where development occurs

[3] With regard to eagles, this paragraph will only apply when a project is not likely to result in take. If Tiers 1, 2, and/or 3 identify a potential to take eagles, developers should consider developing an ECP and, if necessary, apply for a take permit

or is proposed to occur, including the turbine pads, roads, power distribution and transmission lines on or immediately adjacent to the site; buildings and related infrastructure, ditches, grades, culverts; and any changes or modifications made to the original site before development occurs. Project evaluations should consider all potential effects to species of concern, which includes species 1) protected by the MBTA, BGEPA, or ESA (including candidate species), designated by law, regulation or other formal process for protection and/or management by the relevant agency or other authority, or that have been shown to be significantly adversely affected by wind energy development; and 2) determined to be possibly affected by the project.

These Guidelines are not designed to address power transmission beyond the point of interconnection to the transmission system.

Service Review Period

The Service is committed to providing timely responses. Service Field Offices should typically respond to requests by a wind energy developer for information and consultation on proposed site locations (Tiers 1 and 2), pre- and post-construction study designs (Tiers 3 and 4), and proposed mitigation (Tier 3) within 60 calendar days. The request should be in writing to the Field Office and copied to the Regional Office with information about the proposed project, location(s) under consideration, and point of contact. The request should contain a description of the information needed from the Service. The Service will provide a response, even if it is to notify a developer of additional review time, within the 60 calendar day review period. If the Service does not respond within 60 calendar days of receipt of the document, then the developer can proceed through Tier 3 without waiting for Service input. If the Service provides comments at a later time, the developer should incorporate the comments if feasible. It is particularly important that if data from Tier 1-3 studies predict that the project is likely to produce significant adverse impacts on species of concern, the developer inform the Service of the actions it intends to implement to mitigate those impacts. If the Service cannot respond within 60 calendar days, this does not relieve developers from their MBTA, BGEPA, and ESA responsibilities.

The tiered approach allows a developer in certain limited circumstances to move directly from Tier 2 to construction (e.g., adequate survey data for the site exists). The developer should notify the Service of this decision and give the Service 60 calendar days to comment on the proposed project prior to initiating construction activities.

Introduction to the Decision Framework Using a Tiered Approach

The tiered approach provides a decision framework for collecting information in increasing detail to evaluate risk and make siting and operational decisions. It provides the opportunity for evaluation and decision-making at each tier, enabling a developer to proceed with or abandon project development, or to collect additional information if necessary. This approach does not require that every tier, or every element within each tier, be implemented for every project. Instead, it allows efficient use of developer and wildlife agency resources with increasing levels of effort until sufficient information and the desired precision is acquired for the risk assessment.

Figure 1 ("General Framework of Tiered Approach") illustrates the tiered approach, which consists of up to five iterative stages, or tiers:

- Tier 1 – Preliminary site evaluation (landscape-scale screening of possible project sites)
- Tier 2 – Site characterization (broad characterization of one or more potential project sites)
- Tier 3 – Field studies to document site wildlife and habitat and predict project impacts
- Tier 4 – Post-construction studies to estimate impacts[4]
- Tier 5 – Other post-construction studies and research

At each tier, potential issues associated with developing or operating a project are identified and questions formulated to guide the decision process. Chapters Two through Six outline the questions to be posed at each tier, and describe recommended methods and metrics for gathering the data needed to answer those questions.

The first three tiers correspond to the pre-construction evaluation phase of wind energy development. At each of the three tiers, the Guidelines provide questions that developers should answer, followed by recommended methods and metrics to use in answering the questions. Some questions are repeated at each tier, with successive tiers requiring a greater investment in data collection to answer certain questions. For example, while Tier 2 investigations may discover some existing information on federal or state-listed species and their use of the proposed development site, it may be necessary to collect empirical data in Tier 3 studies to determine the presence of federal or state-listed species.

Developers decide whether to proceed to the next tier. Timely communication and sharing of information will allow opportunities for the Service to provide, and developers to consider, technical advice. A developer should base the decision on the information obtained from adequately answering the questions in this tier, whether the methods used were appropriate for the site selected, and the resulting

[4] The Service anticipates these studies will include fatality monitoring as well as studies to evaluate habitat impacts.

Wind turbines in California. Credit: Rachel London, USFWS

assessment of risk posed to species of concern and their habitats.

If sufficient data are available at a particular tier, the following outcomes are possible:

1. The project proceeds to the next tier in the development process without additional data collection.

2. The project proceeds to the next tier in the development process with additional data collection.

3. An action or combination of actions, such as project modification, mitigation, or specific post-construction monitoring, is indicated.

4. The project site is abandoned because the risk is considered unacceptable.

If data are deemed insufficient at a tier, more intensive study is conducted in the subsequent tier until sufficient data are available to make a decision to modify the project, proceed with the project, or abandon the project.

The tiered approach used in these Guidelines embodies adaptive management by collecting increasingly detailed information that is used to make decisions about project design, construction, and operation as the developer progresses through the tiers. Adaptive management is an iterative learning process producing improved understanding and improved management over time (Williams et al 2007). DOI has determined that its resource agencies, and the natural resources they oversee, could benefit from adaptive management. Use of adaptive management in DOI is guided by the DOI Policy on Adaptive Management. DOI has adopted the National Research Council's 2004 definition of adaptive management, which states:

"Adaptive management promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders."

This definition gives special emphasis to uncertainty about management effects, iterative learning to reduce uncertainty, and improved management as a result of learning. The DOI Adaptive Management Technical Guide is located on the web at: www.doi.gov/initiatives/AdaptiveManagement/index.html.

Figure 1. General Framework of Tiered Approach

TIER 1

A. Species of concern known to be present?
   1. No ……proceed to Tier 2
   2. Unknown - Insufficient or inconclusive data ……proceed to Tier 2
   3. Yes……abandon site or proceed to Tier 2

TIER 2

A. Probability of significant adverse impacts?
   1. Unknown - Insufficient or inconclusive data ……proceed to Tier 3
   2. Low……proceed to obtain state and local permit (if required), design, and construction following BMPs
   3. Moderate ……proceed to Tier 3 and mitigate
   4. High, and:
      a. can be adequately mitigated...modify project and proceed to Tier 3
      b. cannot be adequately mitigated……abandon project

TIER 3

A. Probability of significant adverse impacts?
   1. Low ……proceed to Tier 4
   2. Moderate to high, and:
      a. certainty regarding mitigation …… proceed to Tier 4
      b. uncertainty regarding mitigation ……proceed to Tier 4
   3. High, and:
      a. can be adequately mitigated……proceed to Tier 4
      b. cannot be adequately mitigated ……modify or abandon project

TIER 4a (See Table 2, pg 39)

A. Tier 3 studies indicate low probability of significant adverse impacts
   1. Documented fatalities are equal to or lower than predicted……no further studies or mitigation needed
   2. Documented fatalities are higher than predicted, but not significant, and:
      a. comparable data are available that support findings of not significant……no further studies needed
      b. comparable data not available to support findings of not significant……additional year(s) of monitoring recommended
   3. Documented fatalities are higher than predicted and are significant……communicate with Service

B. Tier 3 studies indicate moderate probability of significant adverse impacts
   1. Documented fatalities are lower than or no different predicted, and:
      a. are not significant and no ESA or BGEPA species are affected ……no further monitoring or mitigation needed
      b. are significant *OR* ESA or BGEPA species are affected ……communicate with Service
   2. Documented fatalities are greater than predicted and are likely to be significant *OR* ESA or BGEPA species are affected……communicate with Service

C. Tier 3 studies indicate high probability of significant adverse impacts
   1. Documented fatalities are less than predicted and are not significant, and no ESA or BGEPA species are affected……no further monitoring or mitigation needed
   2. Documented fatalities are less than predicted but are still significant, and no ESA or BGEPA species are affected……further monitoring or mitigation needed
   3. Fatalities are equal to or greater than predicted and are significant OR ESA or BGEPA species are affected……communicate with Service regarding additional mitigation

TIER 4b (See Table 3, pg. 42)

A. Species of habitat fragmentation concern potentially present?
   1. No……no further studies needed
   2. Yes, and:
      a. Tier 3 studies do not confirm presence…no further studies needed
      b. Tier 3 studies confirm presence, but no significant adverse impacts predicted, and:
         i. Tier 4b studies confirm Tier 3 predictions……no further studies or mitigation needed
         ii. Tier 4b studies indicate potentially significant adverse impacts ……Tier 5 studies and mitigation may be needed
      c. Tier 3 studies confirm presence, and significant adverse impacts predicted and mitigation plan is developed and implemented, and:
         i. Tier 4b studies determine mitigation is effective ……no further studies or mitigation needed
         ii. Tier 4b studies determine mitigation not effective……further mitigation and, where appropriate, Tier 5 studies needed

Considering Risk in the Tiered Approach

In the context of these Guidelines, risk refers to the likelihood that adverse impacts will occur to individuals or populations of species of concern as a result of wind energy development and operation. Estimates of fatality risk can be used in a relative sense, allowing comparisons among projects, alternative development designs, and in the evaluation of potential risk to populations. Because there are relatively few methods available for direct estimation of risk, a weight-of-evidence approach is often used (Anderson et al. 1999). Until such time that reliable risk predictive models are developed regarding avian and bat fatality and wind energy projects, estimates of risk would typically be qualitative, but should be based upon quantitative site information.

For the purposes of these Guidelines, risk can also be defined in the context of populations, but that calculation is more complicated as it could involve estimating the reduction in population viability as indicated by demographic metrics such as growth rate, size of the population, or survivorship, either for local populations, metapopulations, or entire species. For most populations, risk cannot easily be reduced to a strict metric, especially in the absence of population viability models for most species. Consequently, estimating the quantitative risk to populations is usually beyond the scope of project studies due to the difficulties in evaluating these metrics, and therefore risk assessment will be qualitative.

Risk to habitat is a component of the evaluation of population risk. In this context, the estimated loss of habitat is evaluated in terms of the potential for population level effects (e.g., reduced survival or reproduction).

The assessment of risk should synthesize sufficient data collected at a project to estimate exposure and predict impact for individuals and their habitats for the species of concern, with what is known about the population status of these species, and in communication with the relevant wildlife agency and industry wildlife experts. Predicted risk of these impacts could provide useful information for determining appropriate mitigation measures if determined to be necessary. In practice in the tiered approach, risk assessments conducted in Tiers 1 and 2 require less information to reach a risk-based decision than those conducted at higher tiers.

Cumulative Impacts of Project Development

Cumulative impacts are the comprehensive effect on the environment that results from the incremental impact of a project when added to other past, present, and reasonably foreseeable future actions. Developers are encouraged to work closely with federal and state agencies early in the project planning process to access any existing information on the cumulative impacts of individual projects on species and habitats at risk, and to incorporate it into project development and any necessary wildlife studies. To achieve that goal, it is important that agencies and organizations take the following actions to improve cumulative impacts analysis:

- review the range of development-related significant adverse impacts;
- determine which species of concern or their habitats within the landscape are most at risk of significant adverse impacts from wind development in conjunction with other reasonably foreseeable significant adverse impacts; and
- make that data available for regional or landscape level analysis.

The magnitude and extent of the impact on a resource depend on whether the cumulative impacts exceed the capacity for resource sustainability and productivity.

For projects that require a federal permit, funding, or other federal nexus, the lead federal agency is required to include a cumulative impacts analysis in their National Environmental Policy Act (NEPA) review. The federal action agency coordinates with the developer to obtain the necessary information for the NEPA review and cumulative impacts analysis. To avoid project delays, federal and state agencies are encouraged to use existing wildlife data for the cumulative impacts analysis until improved data are available.

Where there is no federal nexus, individual developers are not expected to conduct their own cumulative impacts analysis. However, a cumulative impacts analysis would help developers and other stakeholders better understand the significance of potential impacts on species of concern and their habitats.

Other Federal Agencies

Other federal agencies, such as the Bureau of Land Management, National Park Service, U.S. Department of Agriculture Forest Service and Rural Utility Service, Federal Energy Regulatory Commission and Department of Energy are often interested in and involved with wind project developments. These agencies have a variety of expertise and authorities they implement. Wind project developers on public lands will have to comply with applicable regulations and policies of those agencies. State and local agencies and Tribes also have additional interests and knowledge. The Service recommends that, where appropriate, wind project developers contact these agencies early in the tiered process and work closely with them throughout project planning and development to assure that projects address issues of concern to those agencies. The definition of "species of concern" in these Guidelines includes species which are trust resources of States and of federal agencies (See Glossary). In those instances where a project may significantly affect State trust

resources, wind energy developers should work closely with appropriate State agencies.

Relationship to Other Guidelines

These Guidelines replace the Service's 2003 interim voluntary guidelines. The Service intends that these Guidelines, when used in concert with the appropriate regulatory tools, will form the best practical approach for conservation of species of concern. For instance, when developers find that a project may affect an endangered or threatened species, they should comply with Section 7 or 10 of the ESA to obtain incidental take authorization. Other federal, state, tribal and local governments may use these Guidelines to complement their efforts to address wind energy development/wildlife interactions. They are not intended to supplant existing regional or local guidance, or landscape-scale tools for conservation planning, but were developed to provide a means of improving consistency with the goals of the wildlife statutes that the Service is responsible for implementing. The Service will continue to work with states, tribes, and other local stakeholders on map-based tools, decision-support systems, and other products to help guide future development and conservation. Additionally, project proponents should utilize any relevant guidance of the appropriate jurisdictional entity, which will depend on the species and resources potentially affected by proposed development.

Pronghorn Antelope. Credit: Steve Hillebrand, USFWS

Chapter 2: Tier 1 – Preliminary Site Evaluation

For developers taking a first look at a broad geographic area, a preliminary evaluation of the general ecological context of a potential site or sites can serve as useful preparation for working with the federal, state, tribal, and/or local agencies. The Service is available to assist wind energy project developers to identify potential wildlife and habitat issues and should be contacted as early as possible in the company's planning process. With this internal screening process, the developer can begin to identify broad geographic areas of high sensitivity due to the presence of: 1) large blocks of intact native landscapes; 2) intact ecological communities; 3) fragmentation-sensitive species' habitats; or 4) other important landscape-scale wildlife values.

Tier 1 may be used in any of the following three ways:

1. To identify regions where wind energy development poses significant risks to species of concern or their habitats, including the fragmentation of large-scale habitats and threats to regional populations of federal- or state-listed species.

2. To "screen" a landscape or set of multiple potential sites to avoid those with the highest habitat values.

3. To begin to determine if a single identified potential site poses serious risk to species of concern or their habitats.

Tier 1 can offer early guidance about the sensitivity of the site within a larger landscape context; it can help direct development away from sites that will be associated with additional study need, greater mitigation requirements, and uncertainty; or it can identify those sensitive resources that will need to be studied further to determine if the site can be developed without significant adverse impacts to the species of concern or local population(s). This may facilitate discussions with the federal, state, tribal, and/or local agencies in a region being considered for development. In some cases, Tier 1 studies could reveal serious concerns indicating that a site should not be developed.

Developers of distributed or community scale wind projects are typically considering limited geographic areas to install turbines. Therefore, they would not likely consider broad geographic areas. Nevertheless, they should consider the presence of habitats or species of concern before siting projects.

Development in some areas may be precluded by federal law. This designation is separate from a determination through the tiered approach that an area is not appropriate for development due to feasibility, ecological reasons, or other issues. Developers are encouraged to visit Service and other publicly available databases or other available information during Tier 1 or Tier 2 to see if a potential wind energy area is precluded from development by federal law. Some areas may be protected from development through state or local laws or ordinances, and the appropriate agency should be contacted accordingly. Service field offices are available to answer questions where they are knowledgeable, guide developers to databases, and refer developers to other agency contacts.

Some areas may be inappropriate for large scale development because they have been recognized according to scientifically credible information as having high wildlife value, based solely on their ecological rarity and intactness (e.g., Audubon Important Bird Areas, The Nature Conservancy portfolio sites, state wildlife action plan priority habitats). It is important to identify such areas through the tiered approach, as reflected in Tier 1, Question 2 below. Many of North America's native landscapes are greatly diminished, with some existing at less than 10 percent of their pre-settlement occurrence.

Attwater's prairie chicken. Credit: Gary Halvorsen, USFWS

Herbaceous scrub-shrub steppe in the Pacific Northwest and old growth forest in the Northeast represent such diminished native resources. Important remnants of these landscapes are identified and documented in various databases held by private conservation organizations, state wildlife agencies, and, in some cases, by the Service. Developers should collaborate with such entities specifically about such areas in the vicinity of a prospective project site.

Tier 1 Questions

Questions at each tier help determine potential environmental risks at the landscape scale for Tier 1 and project scale for Tiers 2 and 3. Suggested questions to be considered for Tier 1 include:

1. **Are there species of concern present on the potential site(s), or is habitat (including designated critical habitat) present for these species?**

2. **Does the landscape contain areas where development is precluded by law or areas designated as sensitive according to scientifically credible information? Examples of designated areas include, but are not limited to: federally-designated critical habitat; high-priority conservation areas for non-government organizations (NGOs); or other local, state, regional, federal, tribal, or international categorizations.**

3. **Are there known critical areas of wildlife congregation, including, but not limited to: maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, leks, or other areas of seasonal importance?**

4. **Are there large areas of intact habitat with the potential for fragmentation, with respect to species of habitat fragmentation concern needing large contiguous blocks of habitat?**

Tier 1 Methods and Metrics

Developers who choose to conduct Tier 1 investigations would generally be able to utilize existing public or other readily available landscape-level maps and databases from sources such as federal, state, or tribal wildlife or natural heritage programs, the academic community, conservation organizations, or the developers' or consultants' own information. The Service recommends that developers conduct a review of the publicly available data. The analysis of available sites in the region of interest will be based on a blend of the information available in published and unpublished reports, wildlife range distribution maps, and other such sources. The developer should check with the Service Field Office for data specific to wind energy development and wildlife at the landscape scale in Tier 1.

Tier 1 Decision Points

The objective of the Tier 1 process is to help the developer identify a site or sites to consider further for wind energy development. Possible outcomes of this internal screening process include the following:

1. One or more sites are found within the area of investigation where the answer to each of the above Tier 1 questions is "no," indicating a low probability of significant adverse impact to wildlife. The developer proceeds to Tier 2 investigations and characterization of the site or sites, answering the Tier 2 questions with site-specific data to confirm the validity of the preliminary indications of low potential for significant adverse impact.

2. If a developer answers "yes" to one or more of the Tier 1 questions, they should proceed to Tier 2 to further assess the probability of significant adverse impacts to wildlife. A developer may consider abandoning the area or identifying possible means by which the project can be modified to avoid or minimize potential significant adverse impacts.

3. The data available in the sources described above are insufficient to answer one or more of the Tier 1 questions. The developer proceeds to Tier 2, with a specific emphasis on collecting the data necessary to answer the Tier 2 questions, which are inclusive of those asked at Tier 1.

Chapter 3: Tier 2 – Site Characterization

At this stage, the developer has narrowed consideration down to specific sites, and additional data may be necessary to systematically and comprehensively characterize a potential site in terms of the risk wind energy development would pose to species of concern and their habitats. In the case where a site or sites have been selected without the Tier 1 preliminary evaluation of the general ecological context, Tier 2 becomes the first stage in the site selection process. The developer will address the questions asked in Tier 1; if addressing the Tier 1 questions here, the developer will evaluate the site within a landscape context. However, a distinguishing feature of Tier 2 studies is that they focus on site-specific information and should include at least one visit by a knowledgeable biologist to the prospective site(s). Because Tier 2 studies are preliminary, normally one reconnaissance level site visit will be adequate as a "ground-truth" of available information. Notwithstanding, if key issues are identified that relate to varying conditions and/or seasons, Tier 2 studies should include enough site visits during the appropriate times of the year to adequately assess these issues for the prospective site(s).

If the results of the site assessment indicate that one or more species of concern are present, a developer should consider applicable regulatory or other agency processes for addressing them. For instance, if migratory birds and bats are likely to experience significant adverse impacts by a wind project at the proposed site, a developer should identify and document possible actions that will avoid or compensate for those impacts. Such actions might include, but not be limited to, altering locations of turbines or turbine arrays, operational changes, or compensatory mitigation. As soon as a developer anticipates that a wind energy project is likely to result in a take of bald or golden eagles, a developer should prepare an ECP and, if necessary, apply for a programmatic take permit. As soon as a developer realizes endangered or threatened species are present and likely to be affected by a wind project located there, a federal agency should consult with the Service under Section 7(a)(2) of the ESA if the project has a federal nexus or the developer should apply for a section 10(a)(1)(B) incidental take permit if there is not a federal nexus, and incidental take of listed wildlife is anticipated. State, tribal, and local jurisdictions may have additional permitting requirements.

Developers of distributed or community scale wind projects are typically considering limited geographic areas to install turbines. Therefore, they would likely be familiar with conditions at the site where they are considering installing a turbine. Nevertheless, they should do preliminary site evaluations to determine the presence of habitats or species of concern before siting projects.

Tier 2 Questions

Questions suggested for Tier 2 can be answered using credible, publicly available information that includes published studies, technical reports, databases, and information from agencies, local conservation organizations, and/or local experts. Developers or consultants working on their behalf should contact the federal, state, tribal, and local agencies that have jurisdiction or management authority and responsibility over the potential project.

1. **Are known species of concern present on the proposed site, or is habitat (including designated critical habitat) present for these species?**

2. **Does the landscape contain areas where development is precluded by law or designated as sensitive according to scientifically credible information? Examples of designated areas include, but are not limited to: federally-designated critical habitat;**

Open landscape with wind turbines. Credit: NREL

high-priority conservation areas for NGOs; or other local, state, regional, federal, tribal, or international categorizations.

3. **Are there plant communities of concern present or likely to be present at the site(s)?**

4. **Are there known critical areas of congregation of species of concern, including, but not limited to: maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, leks, or other areas of seasonal importance?**

5. **Using best available scientific information has the developer or relevant federal, state, tribal, and/or local agency identified the potential presence of a population of a species of habitat fragmentation concern?**

6. **Which species of birds and bats, especially those known to be at risk by wind energy facilities, are likely to use the proposed site based on an assessment of site attributes?**

7. **Is there a potential for significant adverse impacts to species of concern based on the answers to the questions above, and considering the design of the proposed project?**

Tier 2 Methods and Metrics

Obtaining answers to Tier 2 questions will involve a more thorough review of the existing site-specific information than in Tier 1. Tier 2 site characterizations studies will generally contain three elements:

1. A review of existing information, including existing published or available literature and databases and maps of topography, land use and land cover, potential wetlands, wildlife, habitat, and sensitive plant distribution. If agencies have documented potential habitat for species of habitat fragmentation concern, this information can help with the analysis.

2. Contact with agencies and organizations that have relevant scientific information to further help identify if there are bird, bat or other wildlife issues. The Service recommends that the developer make contact with federal, state, tribal, and local agencies that have jurisdiction or management authority over the project or information about the potentially affected resources. In addition, because key NGOs and relevant local groups are often valuable sources of relevant local environmental information, the Service recommends that developers contact key NGOs, even if confidentiality concerns preclude the developer from identifying specific project location information at this stage. These contacts also provide an opportunity to identify other potential issues and data not already identified by the developer.

3. One or more reconnaissance level site visits by a wildlife biologist to evaluate current vegetation/habitat coverage and land management/use. Current habitat and land use practices will be noted to help in determining the baseline against which potential impacts from the project would be evaluated. The vegetation/habitat will be used for identifying potential bird and bat resources occurring at the site and the potential presence of, or suitable habitat for, species of concern. Vegetation types or habitats will be noted and evaluated against available information such as land use/land cover mapping. Any sensitive resources located during the site visit will be noted and mapped or digital location data recorded for future reference. Any individuals or signs of species of concern observed during the site visit will be noted. If land access agreements are not in place, access to the site will be limited to public roads.

Specific resources that can help answer each Tier 2 question include:

1. **Are known species of concern present on the proposed site, or is habitat (including designated critical habitat) present for these species?**

   Information review and agency contact: locations of state and federally listed, proposed and candidate species and species of concern are frequently documented in state and federal wildlife databases. Examples include published literature such as: Natural Heritage Databases, State Wildlife Action Plans, NGOs publications, and developer and consultant information, or can be obtained by contacting these entities.

   Site Visit: To the extent practicable, the site visit(s) should evaluate the suitability of habitat at the site for species identified and the likelihood of the project to adversely affect the species of concern that may be present.

2. **Does the landscape contain areas where development is precluded by law or designated as sensitive according to scientifically credible information?** Examples of designated areas include, but are not limited to: federally-designated critical habitat; high-priority conservation areas for NGOs; or other local, state, regional, federal, tribal, or international categorizations.

   Information review and agency contact such as: maps of political and administrative boundaries; National Wetland Inventory data files; USGS National Land Cover data maps; state, federal and tribal agency data on areas that have been designated to preclude development, including wind energy development; State Wildlife Action Plans; State Land and Water Resource Plans; Natural Heritage databases; scientifically credible information provided by NGO and local

Tall grass prairie. Credit: Amy Thornburg, USFWS

resources; and the additional resources listed in Appendix C: Sources of Information Pertaining to Methods to Assess Impacts to Wildlife of this document, or through contact of agencies and NGOs, to determine the presence of high priority habitats for species of concern or conservation areas.

Site Visit: To the extent practicable, the site visit(s) should characterize and evaluate the uniqueness of the site vegetation relative to surrounding areas.

3. **Are plant communities of concern present or likely to be present at the site(s)?**

Information review and agency contact such as: Natural Heritage Data of state rankings (S1, S2, S3) or globally (G1, G2, G3) ranked rare plant communities.

Site Visit: To the extent practicable, the site visit should evaluate the topography, physiographic features and uniqueness of the site vegetation in relation to the surrounding region. If plant communities of concern are present, developers should also assess in Tier 3 whether the proposed project poses risk of significant adverse impacts and opportunities for mitigation.

4. **Are there known critical areas of wildlife congregation, including, but not limited to, maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, leks, or other areas of seasonal importance?**

Information review and agency contact such as: existing databases, State Wildlife Action Plan, Natural Heritage Data, and NGO and agency information regarding the presence of Important Bird Areas, migration corridors or stopovers, leks, bat hibernacula or maternity roosts, or game winter ranges at the site and in the surrounding area.

Site Visit: To the extent practicable, the site visit should, during appropriate times to adequately assess these issues for prospective site(s), evaluate the topography, physiographic features and uniqueness of the site in relation to the surrounding region to assess the potential for the project area to concentrate resident or migratory birds and bats.

5. **Using best available scientific information, has the relevant federal, state, tribal, and/or local agency determined the potential presence of a population of a species of habitat fragmentation concern?**

If not, the developer need not assess impacts of the proposed project on habitat fragmentation.

Habitat fragmentation is defined as the separation of a block of habitat for a species into segments, such that the genetic or demographic viability of the populations surviving in the remaining habitat segments is reduced; and risk, in this case, is defined as the probability that this fragmentation will occur as a result of the project. Site clearing, access roads, transmission lines and turbine tower arrays remove habitat and displace some species

of wildlife, and may fragment continuous habitat areas into smaller, isolated tracts. Habitat fragmentation is of particular concern when species require large expanses of habitat for activities such as breeding and foraging.

Consequences of isolating local populations of some species include decreased reproductive success, reduced genetic diversity, and increased susceptibility to chance events (e.g. disease and natural disasters), which may lead to extirpation or local extinctions. In addition to displacement, development of wind energy infrastructure may result in additional loss of habitat for some species due to "edge effects" resulting from the break-up of continuous stands of similar vegetation resulting in an interface (edge) between two or more types of vegetation. The extent of edge effects will vary by species and may result in adverse impacts from such effects as a greater susceptibility to colonization by invasive species, increased risk of predation, and competing species favoring landscapes with a mosaic of vegetation.

Site Visit: If the answer to Tier 2 Question 5 is yes, developers should use the general framework for evaluating habitat fragmentation at a project site in Tier 2 outlined below. Developers and the Service may use this method to analyze the impacts of habitat fragmentation at wind development project sites on species of habitat fragmentation concern. Service field offices may be able to provide the available information on habitat types, quality and intactness. Developers may use this information in combination with site-specific information on the potential habitats to be impacted by a potential development and how they will be impacted.

<u>General Framework for Evaluating Habitat Fragmentation at a Project Site (Tier 2)</u>

A. The developer should define the study area. The study area should not only include the project site for the proposed project, but be based on the distribution of habitat for the local population of the species of habitat fragmentation concern.

B. The developer should analyze the current habitat quality and spatial configuration of the study area for the species of habitat fragmentation concern.

   i. Use recent aerial and remote imagery to determine distinct habitat patches, or boundaries, within the study area, and the extent of existing habitat fragmenting features (e.g., highways).

   ii. Assess the level of fragmentation of the existing habitat for the species of habitat fragmentation concern and categorize into three classes:

   - High quality: little or no apparent fragmentation of intact habitat
   - Medium quality: intact habitat exhibiting some recent disturbance activity
   - Low quality: Extensive fragmentation of habitat (e.g., row-cropped agricultural lands, active surface mining areas)

C. The developer should determine potential changes in quality and spatial configuration of the habitat in the study area if development were to proceed as proposed using existing site information.

D. The developer should provide the collective information from steps A-C for all potential developments to the Service for use in assessing whether the habitat impacts, including habitat fragmentation, are likely to affect population viability of the potentially affected species of habitat fragmentation concern.

6. **Which species of birds and bats, especially those known to be at risk by wind energy facilities, are likely to use the proposed site based on an assessment of site attributes?**

   Information review and agency contact: existing published information and databases from NGOs and federal and state resource agencies regarding the potential presence of:

   - Raptors: species potentially present by season
   - Prairie grouse and sage grouse: species potentially present by season and location of known leks
   - Other birds: species potentially present by season that may be at risk of collision or adverse impacts to habitat, including loss, displacement and fragmentation
   - Bats: species likely to be impacted by wind energy facilities and likely to occur on or migrate through the site

   Site Visit: To the extent practicable, the site visit(s) should identify landscape features or habitats that could be important to raptors, prairie grouse, and other birds that may be at risk of adverse impacts, and bats, including nesting and brood-rearing habitats, areas of high prey density, movement corridors and features such as ridges that may concentrate raptors. Raptors, prairie grouse, and other presence or sign of species of concern seen during the site visit should be noted, with species identification if possible.

7. **Is there a potential for significant adverse impacts to species of concern based on the answers to the questions above, and considering the design of the proposed project?**

The developer has assembled answers to the questions above and should make an initial evaluation of the probability of significant adverse impacts to species of concern and their habitats. The developer should make this evaluation based on assessments of the potential presence of species of concern and their habitats, potential presence of critical congregation areas for species of concern, and any site visits. The developer is encouraged to communicate the results of these assessments with the Service.

Tier 2 Decision Points

Possible outcomes of Tier 2 include the following:

1. The most likely outcome of Tier 2 is that the answer to one or more Tier 2 questions is inconclusive to address wildlife risk, either due to insufficient data to answer the question or because of uncertainty about what the answers indicate. The developer proceeds to Tier 3, formulating questions, methods, and assessment of potential mitigation measures based on issues raised in Tier 2 results.

2. Sufficient information is available to answer all Tier 2 questions, and the answer to each Tier 2 question indicates a low probability of significant adverse impact to wildlife (for example, infill or expansion of an existing facility where impacts have been low and Tier 2 results indicate that conditions are similar, therefore wildlife risk is low). The developer may then decide to proceed to obtain state and local permit (if required), design, and construction following best management practices (see Chapter 7: Best Management Practices).

3. Sufficient information is available to answer all Tier 2 questions, and the answer to each Tier 2 question indicates a moderate probability of significant adverse impacts to species of concern or their habitats. The developer should proceed to Tier 3 and identify measures to mitigate potential significant adverse impacts to species of concern.

4. The answers to one or more Tier 2 questions indicate a high probability of significant adverse impacts to species of concern or their habitats that:

   a) Cannot be adequately mitigated. The proposed site should be abandoned.

   b) Can be adequately mitigated. The developer should proceed to Tier 3 and identify measures to mitigate potential significant adverse impacts to species of concern or their habitats.

Greater sage grouse, Credit: Stephen Ting, USFWS

Chapter 4: Tier 3 – Field Studies to Document Site Wildlife and Habitat and Predict Project Impacts

Tier 3 is the first tier in which a developer would conduct quantitative and scientifically rigorous studies to assess the potential risk of the proposed project. Specifically, these studies provide pre-construction information to:

- Further evaluate a site for determining whether the wind energy project should be developed or abandoned
- Design and operate a site to avoid or minimize significant adverse impacts if a decision is made to develop
- Design compensatory mitigation measures if significant adverse habitat impacts cannot acceptably be avoided or minimized
- Determine duration and level of effort of post-construction monitoring. If warranted, provide the pre-construction component of post-construction studies necessary to estimate and evaluate impacts

At the beginning of Tier 3, a developer should communicate with the Service on the pre-construction studies. At the end of Tier 3, developers should communicate with the Service regarding the results of the Tier 3 studies and consider the Service's comments and recommendations prior to completing the Tier 3 decision process. The Service will provide written comments to a developer that identify concerns and recommendations to resolve the concerns based on study results and project development plans.

Not all Tier 3 studies will continue into Tiers 4 or 5. For example, surveys conducted in Tier 3 for species of concern may indicate one or more species are not present at the proposed project site, or siting decisions could be made in Tier 3 that remove identified concerns, thus removing the need for continued efforts in later tiers. Additional detail on the design issues for post-construction studies that begin in Tier 3 is provided in the discussion of methods and metrics in Tier 3.

Turkey vulture and wind turbine. Credit: Rachel London, USFWS

Tier 3 Questions

Tier 3 begins as the other tiers, with problem formulation: what additional studies are necessary to enable a decision as to whether the proposed project can proceed to construction or operation or should be abandoned? This step includes an evaluation of data gaps identified by Tier 2 studies as well as the gathering of data necessary to:

- Design a project to avoid or minimize predicted risk
- Evaluate predictions of impact and risk through post-construction comparisons of estimated impacts
- Identify compensatory mitigation measures, if appropriate, to offset significant adverse impacts that cannot be avoided or minimized

The problem formulation stage for Tier 3 also will include an assessment of which species identified in Tier 1 and/or Tier 2 will be studied further in the site risk assessment. This determination is based on analysis of existing data from Tier 1 and existing site-specific data and Project Site (see Glossary in Appendix A) visit(s) in Tier 2, and on the likelihood of presence and the degree of adverse impact to species or their habitat. If the habitat is suitable for a species needing further study and the site occurs within the historical range of the species, or is near the existing range of the species but presence has not been documented, additional field studies may be appropriate. Additional analyses should not be necessary if a species is unlikely to be present or is present but adverse impact is unlikely or of minor significance.

Tier 3 studies address many of the questions identified for Tiers 1 and 2, but Tier 3 studies differ because they attempt to quantify

the distribution, relative abundance, behavior, and site use of species of concern. Tier 3 data also attempt to estimate the extent that these factors expose these species to risk from the proposed wind energy facility. Therefore, in answering Tier 3 questions 1-3, developers should collect data sufficient to analyze and answer Tier 3 questions 4-6. High risk sites may warrant additional years of pre-construction studies. The duration and intensity of studies needed should be determined through communication with the Service.

If Tier 3 studies identify species of concern or important habitats, e.g., wetlands, which have specific regulatory processes and requirements, developers should work with appropriate state, tribal, or federal agencies to obtain required authorizations or permits.

Tier 3 studies should be designed to answer the following questions:

1. **Do field studies indicate that species of concern are present on or likely to use the proposed site?**

2. **Do field studies indicate the potential for significant adverse impacts on affected population of species of habitat fragmentation concern?**

3. **What is the distribution, relative abundance, behavior, and site use of species of concern identified in Tiers 1 or 2, and to what extent do these factors expose these species to risk from the proposed wind energy project?**

4. **What are the potential risks of adverse impacts of the proposed wind energy project to individuals and local populations of species of concern and their habitats? (In the case of rare or endangered species, what are the possible impacts to such species and their habitats?)**

5. **How can developers mitigate identified significant adverse impacts?**

6. **Are there studies that should be initiated at this stage that would be continued in post-construction?**

The Service encourages the use of common methods and metrics in Tier 3 assessments for measuring wildlife activity and habitat features. Common methods and metrics provide great benefit over the long-term, allowing for comparisons among projects and for greater certainty regarding what will be asked of the developer for a specific project. Deviation from commonly used methods should be carefully considered, scientifically justifiable and discussed with federal, tribal, or state natural resource agencies, or other credible experts, as appropriate. It may be useful to consult other scientifically credible information sources.

Tier 3 studies will be designed to accommodate local and regional characteristics. The specific protocols by which common methods and metrics are implemented in Tier 3 studies depend on the question being addressed, the species or ecological communities being studied and the characteristics of the study sites. Federally-listed threatened and endangered species, eagles, and some other species of concern and their habitats, may have specific protocols required by local, state or federal agencies. The need for special surveys and mapping that address these species and situations should be discussed with the appropriate stakeholders.

In some instances, a single method will not adequately assess potential collision risk or habitat impact. For example, when there is concern about moderate or high risk to nocturnally active species, such as migrating passerines and local and migrating bats, a combination of remote sensing tools such as radar, and acoustic monitoring for bats and indirect inference from diurnal bird surveys during the migration period may be necessary. Answering questions about habitat use by songbirds may be accomplished by relatively small-scale observational studies, while answering the same question related to wide-ranging species such as prairie grouse and sage grouse may require more time-consuming surveys, perhaps including telemetry.

Because of the points raised above and the need for flexibility in application, the Guidelines do not make specific recommendations on protocol elements for Tier 3 studies. The peer-reviewed scientific literature (such as the articles cited throughout this section) contains numerous recently published reviews of methods for assessing bird and bat activity, and tools for assessing habitat and landscape level risk. Details on specific methods and protocols for recommended studies are or will be widely available and should be consulted by industry and agency professionals.

Many methods for assessing risk are components of active research involving collaborative efforts of public-private research partnerships with federal, state and tribal agencies, wind energy developers and NGOs interested in wind energy-wildlife interactions (e.g., Bats and Wind Energy Cooperative and the Grassland Shrub Steppe Species Cooperative). It is important to recognize the need to integrate the results of research that improves existing methods or describes new methodological developments, while acknowledging the value of utilizing common methods that are currently available.

The methods and metrics that may be appropriate for gathering data to answer Tier 3 questions are compiled and outlined in the Technical Resources section, page 26. These are not meant to be all inclusive and other methods and metrics are available, such as the NWCC Methods & Metrics document (Strickland et al. 2011) and others listed in Appendix C:

Avian Radar

Sources of Information Pertaining to Methods to Assess Impacts to Wildlife.

Each question should be considered in turn, followed by a discussion of the methods and their applicability.

1. **Do field studies indicate that species of concern are present on or likely to use the proposed site?**

In many situations, this question can be answered based on information accumulated in Tier 2. Specific presence/absence studies may not be necessary, and protocol development should focus on answering the remaining Tier 3 questions. Nevertheless, it may be necessary to conduct field studies to determine the presence, or likelihood of presence, when little information is available for a particular site. The level of effort normally contemplated for Tier 3 studies should detect common species and species that are relatively rare, but which visit a site regularly (e.g., every year). In the event a species of concern is very rare and only occasionally visits a site, a determination of "likely to occur" would be inferred from the habitat at the site and historical records of occurrence on or near the site.

State, federal and tribal agencies often require specific protocols be followed when species of concern are potentially present on a site. The methods and protocols for determining presence of species of concern at a site are normally established for each species and required by federal, state and tribal resource agencies. Surveys should sample the wind turbine sites and applicable disturbance area during seasons when species are most likely present. Normally, the methods and protocols by which they are applied also will include an estimate of relative abundance. Most presence/absence surveys should be done following a probabilistic sampling protocol to allow statistical extrapolation to the area and time of interest.

Determining the presence of diurnally or nocturnally active mammals, reptiles, amphibians, and other species of concern will typically be accomplished by following agency-required protocols. Most listed species have required protocols for detection (e.g., the black-footed ferret). State, tribal and federal agencies should be contacted regarding survey protocols for those species of concern. See Corn and Bury 1990, Olson et al. 1997, Bailey et al. 2004, Graeter et al. 2008 for examples of reptile and amphibian protocols, survey and analytical methods. See Tier 3 Study Design Considerations on page 24 for further details.

2. **Do field studies indicate the potential for significant adverse impacts on affected populations of species of habitat fragmentation concern?**

If Tier 2 studies indicate the presence of species of habitat fragmentation concern, but existing information did not allow for a complete analysis of potential impacts and decision-making, then additional studies and analyses should take place in Tier 3.

As in Tier 2, the particulars of the analysis will depend on the species of habitat fragmentation concern and how habitat block size and fragmentation are defined for the life cycles of that species, the likelihood that the project will adversely affect a local population of the species and the significance of these impacts to the viability of that population.

To assess habitat fragmentation in the project vicinity, developers should evaluate landscape characteristics of the proposed site prior to construction and determine the degree to which habitat for species of habitat fragmentation concern will be significantly altered by the presence of a wind energy facility.

A general framework for evaluating habitat fragmentation at a project site, following that described in Tier 2, is outlined on page 27. This framework should be used in those circumstances when the developer, or a relevant federal, state, tribal and/or other local agency determines the potential presence of a population of a species of habitat fragmentation concern that may be adversely affected by the project. Otherwise, the developer need not assess the impacts of the proposed project on habitat fragmentation. This method for analysis of habitat fragmentation at project sites must be adapted to the local population of the species of habitat fragmentation concern potentially affected by the proposed development.

3. **What is the distribution, relative abundance, behavior, and site use of species of concern identified in Tiers 1 or 2, and to what extent do these factors expose these species to risk from the proposed wind energy project?**

For those species of concern that are considered at risk of collisions or habitat impacts, the questions to be answered in Tier 3 include: where are they likely to occur (i.e., where is their habitat) within a project site or vicinity, when might they occur, and in what abundance. The spatial distribution of species at risk of collision can influence how a site is developed. This distribution should include the airspace for flying species with respect to the rotor-

swept zone. The abundance of a species and the spatial distribution of its habitat can be used to determine the relative risk of impact to species using the sites, and the absolute risk when compared to existing projects where similar information exists. Species abundance and habitat distribution can also be used in modeling risk factors.

Surveys for spatial distribution and relative abundance require coverage of the wind turbine sites and applicable site disturbance area, or a sample of the area using observational methods for the species of concern during the seasons of interest. As with presence/absence (see Tier 3, question 1, above) the methods used to determine distribution, abundance, and behavior may vary with the species and its ecology. Spatial distribution is determined by applying presence/absence or using surveys in a probabilistic manner over the entire area of interest. Suggested survey protocols for birds, bats, and other wildlife are found in the Technical Resources section on page 26.

Whooping crane. Credit: Ryan Hagerty, USFWS

4. **What are the potential risks of adverse impacts of the proposed wind energy project to individuals and local populations of species of concern and their habitats? (In the case of rare or endangered species, what are the possible impacts to such species and their habitats?)**

Methods used for estimating risk will vary with the species of concern. For example, estimating potential bird fatalities in Tier 3 may be accomplished by comparing exposure estimates (described earlier in estimates of bird use) at the proposed site with exposure estimates and fatalities at existing projects with similar characteristics (e.g., similar technology, landscape, and weather conditions). If models are used, they may provide an additional tool for estimating fatalities, and have been used in Australia (Organ and Meredith 2004), Europe (Chamberlin et al. 2006), and the United States (Madders and Whitfield 2006). As with other prediction tools, model predictions should be evaluated and compared with post-construction fatality data to validate the models. Models should be used as a subcomponent of a risk assessment based on the best available empirical data. A statistical model based on the relationship of pre-construction estimates of raptor abundance and post-construction raptor fatalities is described in Strickland et al. (2011) and promises to be a useful tool for risk assessment.

Collision risk to individual birds and bats at a particular wind energy facility may be the result of complex interactions among species distribution, relative abundance, behavior, weather conditions (e.g., wind, temperature) and site characteristics. Collision risk for an individual may be low regardless of abundance if its behavior does not place it within the rotor-swept zone. If individuals frequently occupy the rotor-swept zone but effectively avoid collisions, they are also at low risk of collision with a turbine (e.g., ravens). Alternatively, if the behavior of individuals frequently places them in the rotor-swept zone, and they do not actively avoid turbine blade strikes, they are at higher risk of collisions with turbines regardless of abundance. For a given species (e.g., red-tailed hawk), increased abundance increases the likelihood that individuals will be killed by turbine strikes, although the risk to individuals will remain about the same. The risk to a population increases as the proportion of individuals in the population at risk to collision increases.

At some projects, bat fatalities are higher than bird fatalities, but the exposure risk of bats at these facilities is not fully understood (National Research Council (NRC) 2007). Horn et al. (2008) and Cryan (2008) hypothesize that bats are attracted to turbines, which, if true, would further complicate estimation

of exposure. Further research is required to determine if bats are attracted to turbines and if so, to evaluate 1) the influence on Tier 2 methods and predictions, and 2) if this increased individual risk translates into higher population-level impacts for bats.

The estimation of indirect impact risk requires an understanding of animal behavior in response to a project and its infrastructure, and a pre-construction estimate of presence/absence of species whose behavior would cause them to avoid areas in proximity to turbines, roads and other components of the project. The amount of habitat that is lost to indirect impacts will be a function of the sensitivity of individuals to the project and to the activity levels associated with the project's operations. The population-level significance of this indirect impact will depend on the amount of habitat available to the affected population. If the indirect impacts include habitat fragmentation, then the risk to the demographic and genetic viability of the isolated animals is increased. Quantifying cause and effect may be very difficult, however.

5. How can developers mitigate identified significant adverse impacts?

Results of Tier 3 studies should provide a basis for identifying measures to mitigate significant adverse impacts predicted for species of concern. Information on wildlife use of the proposed area is most useful when designing a project to avoid or minimize significant adverse impacts. In cases of uncertainty with regard to impacts to species of concern, additional studies may be necessary to quantify significant adverse impacts and determine the need for mitigation of those impacts.

Chapter 7, Best Management Practices, and Chapter 8, Mitigation, outline measures that can be taken to mitigate impacts throughout all phases of a project.

The following discussion of prairie grouse and sage grouse as species of concern illustrates the uncertainty mentioned above by describing the present state of scientific knowledge relative to these species, which should be considered when designing mitigation measures. The extent of the impact of wind energy development on prairie grouse and sage grouse lekking activity (e.g., social structure, mating success, persistence) and the associated impacts on productivity (e.g., nesting, nest success, chick survival) is poorly understood (Arnett et al. 2007, NRC 2007, Manville 2004). However, recent published research documents that anthropogenic features (e.g., tall structures, buildings, roads, transmission lines) can adversely impact vital rates (e.g., nesting, nest success, lekking behavior) of lesser prairie-chickens (Pruett et al. 2009, Pitman et al. 2005, Hagen et al. 2009, Hagen et al. 2011) and greater prairie-chickens over long distances. Pitman et al. (2005) found that transmission lines reduced nesting of lesser prairie chicken by 90 percent out to a distance of 0.25 miles, improved roads at a distance of 0.25 miles, a house at 0.3 miles, and a power plant at >0.6 miles. Reduced nesting activity of lesser prairie chickens may extend farther, but Pitman et al. (2005) did not analyze their data for lower impacts (less than 90 percent reduction in nesting) of those anthropogenic features on lesser prairie chicken nesting activities at greater distances. Hagen et al. (2011) suggested that development within 1 to 1 ½ miles of active leks of prairie grouse may have significant adverse impacts on the affected grouse population. It is not unreasonable to infer that impacts from wind energy facilities may be similar to those from these other anthropogenic structures. Kansas State University, as part of the National Wind Coordinating Collaborative's Grassland and Shrub Steppe Species Subgroup, is undertaking a multi-year telemetry study to evaluate the effects of a proposed wind-energy facility on displacement and demographic parameters (e.g., survival, nest success, brood success, fecundity) of greater prairie-chickens in Kansas.[5]

The distances over which anthropogenic activities impact sage grouse are greater than for prairie grouse. Based primarily on data documenting reduced fecundity (a combination of nesting, clutch size, nest success, juvenile survival, and other factors) in sage grouse populations near roads, transmissions lines, and areas of oil and gas development/production (Holloran 2005, Connelly et al. 2000), development within three to five miles (or more) of active sage grouse leks may have significant adverse impacts on the affected grouse population. Lyon and Anderson (2003) found that in habitats fragmented by natural gas development, only 26 percent of hens captured on disturbed leks nested within 1.8 miles of the lek of capture, whereas 91 percent of hens from undisturbed areas nested within the same area. Holloran (2005) found that active drilling within 3.1 miles of sage grouse lek reduced the number of breeding males by displacing adult males and reducing recruitment of juvenile males. The magnitudes and proximal causes (e.g., noise, height of structures, movement, human activity, etc.) of those impacts on vital rates in grouse populations are areas of much needed research (Becker et al. 2009). Data accumulated through such research may improve our understanding of the buffer distances necessary to avoid or minimize significant adverse impacts to prairie grouse and sage grouse populations.

When significant adverse impacts cannot be fully avoided or adequately minimized, some form of compensatory mitigation may be

[5] www.nationalwind.org

appropriate to address the loss of habitat value. For example, it may be possible to mitigate habitat loss or degradation for a species of concern by enhancing or restoring nearby habitat value comparable to that potentially influenced by the project.

6. Are there studies that should be initiated at this stage that would be continued in post-construction?

During Tier 3 problem formulation, it is necessary to identify the studies needed to address the Tier 3 questions. Consideration of how the resulting data may be used in conjunction with post-construction Tier 4 and 5 studies is also recommended. The design of post-construction impact or mitigation assessment studies will depend on the specific impact questions being addressed. Tier 3 predictions will be evaluated using data from Tier 4 studies designed to estimate fatalities for species of concern and impacts to their habitat, including species of habitat fragmentation concern. Tier 3 studies may demonstrate the need for mitigation of significant adverse impacts. Where Tier 3 studies indicate the potential for significant adverse direct and indirect impacts to habitat, Tier 4 studies will provide data that evaluate predictions of those impacts, and Tier 5 studies, if necessary, will provide data to evaluate the effect of those impacts on populations and the effectiveness of mitigation measures. Evaluations of the impacts of a project on demographic parameters of local populations, habitat use, or some other parameter(s) are considered Tier 5 studies, and typically will require data on these parameters prior to as well as after construction of the project.

Tier 3 Study Design Considerations

Specific study designs will vary from site to site and should be adjusted to the circumstances of individual projects. Study designs will depend on the types of questions, the specific project, and practical considerations. The most common considerations include the area being studied, the species of concern and potential risk to those species, potentially confounding variables, time available to conduct studies, project budget, and the magnitude of the anticipated impacts. Studies will be necessary in part to assess a) which species of concern are present within the project area; b) how these species are using the area (behavior); and c) what risks are posed to them by the proposed wind energy project.

Rows of wind turbines. Credit: Joshua Winchell, USFWS

Assessing Presence

A developer should assess whether species of concern are likely to be present in the project area during the life of the project. Assessing species use from databases and site characteristics is a potential first step. However, it can be difficult to assess potential use by certain species from site characteristics alone. Various species in different locations may require developers to use specific survey protocols or make certain assumptions regarding presence. Project developers should seek local wildlife expertise, such as Service Field Office staff, in using the proper procedures and making assumptions.

Some species will present particular challenges when trying to determine potential presence. For instance, species that a) are rare or cryptic; b) migrate, conduct other daily movements, or use areas for short periods; c) are small or nocturnal; or d) have become extirpated in parts of their historical range can be difficult to observe. One of these challenges is migration, broadly defined as the act of moving from one spatial unit to another (Baker 1978), or as a periodic movement of animals from one location to another. Migration is species-specific, and for birds and bats occurs throughout the year.

Assessing Site Use/Behavior

Developers should monitor potential sites to determine the types of migratory species present, what type of spatial and temporal use these species make of the site (e.g., chronology of migration or other use), and the ecological function the site may provide in terms of the migration cycle of these species. Wind developers should determine not only what species may migrate through a proposed development site and when, but also whether a site may function as a staging area or stopover habitat for wildlife on their migration pathway.

For some species, movements between foraging and breeding habitat, or between sheltering and feeding habitats, occur on a daily basis. Consideration of daily movements (morning and evening; coming and going) is a critical factor when considering project development.

Duration/Intensity of Studies

Where pre-construction assessments are warranted to help assess risk to wildlife, the studies should be of sufficient duration and intensity to ensure adequate data are collected to accurately characterize wildlife presence and use of the area. In ecological systems, resource quality and quantity can fluctuate rapidly. These fluctuations occur naturally, but human actions can significantly affect (i.e., increase or decrease) natural oscillations. Pre-construction monitoring and assessment of proposed wind energy sites are "snapshots in time," showing occurrence or no occurrence of a species or habitat at the specific time surveyed. Often due to prohibitive costs, assessments and surveys are conducted for very low percentages (e.g., less than 5 percent) of the available sample time in a given year, however, these data are used to support risk analyses over the projected life of a project (e.g., 30 years of operations).

To establish a trend in site use and conditions that incorporates annual and seasonal variation in meteorological conditions, biological factors, and other variables, pre-construction studies may need to occur over multiple years. However, the level of risk and the question of data requirements will be based on site sensitivity, affected species, and the availability of data from other sources. Accordingly, decisions regarding studies should consider information gathered during the previous tiers, variability within and between seasons, and years where variability is likely to substantially affect answers to the Tier 3 questions. These studies should also be designed to collect data during relevant breeding, feeding, sheltering, staging, or migration periods for each species being studied. Additionally, consideration for the frequency and intensity of pre-construction monitoring should be site-specific and determined through consultation with an expert authority based on their knowledge of the specific species, level of risk and other variables present at each individual site.

Assessing Risk to Species of Concern

Once likely presence and factors such as abundance, frequency of use, habitat use patterns, and behavior have been determined or assumed, the developer should consider and/or determine the consequences to the "populations" and species.

Below is a brief discussion of several types of risk factors that can be considered. This does not include all potential risk factors for all species, but addresses the most common ones.

Collision

Collision likelihood for individual birds and bats at a particular wind energy facility may be the result of complex interactions among species distribution, "relative abundance," behavior, visibility, weather conditions, and site characteristics. Collision likelihood for an individual may be low regardless of abundance if its behavior does not place it within the "rotor-swept zone." Individuals that frequently occupy the rotor-swept zone but effectively avoid collisions are also at low likelihood of collision with a turbine.

Alternatively, if the behavior of individuals frequently places them in the rotor-swept zone, and they do not actively avoid turbine blade strikes, they are at higher likelihood of collisions with turbines regardless of abundance. Some species, even at lower abundance, may have a higher collision rate than similar species due to subtle differences in their ecology and behavior.

At many projects, the numbers of bat fatalities are higher than the numbers of bird fatalities, but the exposure risk of bats at these facilities is not fully understood. Researchers (Horn et al. 2008 and Cryan 2008) hypothesize that some bats may be attracted to turbines, which, if true, would further complicate estimation of exposure. Further research is required to determine whether bats are attracted to turbines and if so, whether this increased individual risk translates into higher population-scale effects.

Habitat Loss and Degradation

Wind project development results in direct habitat loss and habitat modification, especially at sites previously undeveloped. Many of North America's native landscapes are greatly diminished or degraded from multiple causes unrelated to wind energy. Important remnants of these landscapes are identified and documented in various databases held by private conservation organizations, state wildlife agencies, and, in some cases, by the Service. Species that depend on these landscapes are susceptible to further loss of habitat, which will affect their ability to reproduce and survive. While habitat lost due to footprints of turbines, roads, and other infrastructure is obvious, less obvious is the potential reduction of habitat quality.

Habitat Fragmentation

Habitat fragmentation separates blocks of habitat for some species into segments, such that the individuals in the remaining habitat segments may suffer from effects such as decreased survival, reproduction, distribution, or use of the area. Site clearing, access roads, transmission lines, and arrays of turbine towers may displace some species or fragment continuous habitat areas into smaller, isolated tracts. Habitat fragmentation is of particular concern when species require large expanses of habitat for activities such as breeding, foraging, and sheltering.

Habitat fragmentation can result in increases in "edge" resulting in direct effects of barriers

and displacement as well as indirect effects of nest parasitism and predation. Sensitivity to fragmentation effects varies among species. Habitat fragmentation and site modification are important issues that should be assessed at the landscape scale early in the siting process. Identify areas of high sensitivity due to the presence of blocks of native habitats, paying particular attention to known or suspected "species sensitive to habitat fragmentation."

Displacement and Behavioral Changes

Estimating displacement risk requires an understanding of animal behavior in response to a project and its infrastructure and activities, and a pre-construction estimate of presence/absence of species whose behavior would cause them to avoid or seek areas in proximity to turbines, roads, and other components of the project. Displacement is a function of the sensitivity of individuals to the project and activity levels associated with operations.

Indirect Effects

Wind development can also have indirect effects to wildlife and habitats. Indirect effects include reduced nesting and breeding densities and the social ramifications of those reductions; loss or modification of foraging habitat; loss of population vigor and overall population density; increased isolation between habitat patches, loss of habitat refugia; attraction to modified habitats; effects on behavior, physiological disturbance, and habitat unsuitability. Indirect effects can result from introduction of invasive plants; increased predator populations or facilitated predation; alterations in the natural fire regime; or other effects, and can manifest themselves later in time than the causing action.

When collection of both pre- and post-construction data in the areas of interest and reference areas is possible, then the Before-After-Control-Impact (BACI) is the most statistically robust design. The BACI design is most like the classic manipulative experiment.[6] In the absence of a suitable reference area, the design is reduced to a Before-After (BA) analysis of effect where the differences between pre- and post-construction parameters of interest are assumed to be the result of the project, independent of other potential factors affecting the assessment area. With respect to BA studies, the key question is whether the observations taken immediately after the incident can reasonably be expected within the expected range for the system (Manly 2009). Reliable quantification of impact usually will include additional study components to limit variation and the confounding effects of natural factors that may change with time.

Virginia big-eared bat. Credit: USFWS

The developer's timeline for the development of a wind energy facility often does not allow for the collection of sufficient pre-construction data and/or identification of suitable reference areas to complete a BACI or BA study. Furthermore, alterations in land use or disturbance over the course of a multi-year BACI or BA study may complicate the analysis of study results. Additional discussion of these issues can be found in Tier 5 Study Design Considerations.

Tier 3 Technical Resources

The following methods and metrics are provided as suggested sources for developers to use in answering the Tier 3 questions.

Tier 3, Question 1

Acoustic monitoring can be a practical method for determining the presence of threatened, endangered or otherwise rare species of bats throughout a proposed project (Kunz et al. 2007). There are two general types of acoustic detectors used for collection of information on bat activity and species identification: the full-spectrum, time-expansion and the zero-crossing techniques for ultrasound bat detection (see Kunz et al. 2007 for detailed discussion). Full-spectrum time expansion detectors provide nearly complete species discrimination, while zero-crossing detectors provide reliable and cost-effective estimates of total bat use at a site and some species discrimination. Myotis species can be especially difficult to discriminate with zero-crossing detectors (Kunz et al. 2007). Kunz et al. (2007) describe the strengths and weaknesses of each technique for ultrasonic bat detection, and either type of detector may be useful in most situations except where species identification is especially important and zero-crossing methods are inadequate to provide the necessary data. Bat acoustics technology is evolving rapidly and study objectives are an important consideration when selecting detectors. When rare or endangered species of bats are suspected, sampling should occur during different seasons and at

[6] In this context, such designs are not true experiments in that the treatments (project development and control) are not randomly assigned to an experimental unit, and there is often no true replication. Such constraints are not fatal flaws, but do limit statistical inferences of the results.

multiple sampling stations to account for temporal and spatial variability.

Mist-netting for bats is required in some situations by state agencies, Tribes, and the Service to determine the presence of threatened, endangered or otherwise rare species. Mist-netting is best used in combination with acoustic monitoring to inventory the species of bats present at a site, especially to detect the presence of threatened or endangered species. Efforts should concentrate on potential commuting, foraging, drinking, and roosting sites (Kuenzi and Morrison 1998, O'Farrell et al. 1999). Mist-netting and other activities that involve capturing and handling threatened or endangered species of bats will require permits from state and/or federal agencies.

Tier 3, Question 2

The following protocol should be used to answer Tier 3, Question 2. This protocol for analysis of habitat fragmentation at project sites should be adapted to the species of habitat fragmentation concern as identified in response to Question 5 in Tier 2 and to the landscape in which development is contemplated. The developer should:

1. Define the study area. The study area for the site should include the "footprint" for the proposed facility plus an appropriate surrounding area. The extent of the study area should be based on the area where there is potential for significant adverse habitat impacts, including indirect impacts, within the distribution of habitat for the species of habitat fragmentation concern.

2. Determine the potential for occupancy of the study area based on the guidance provided for the species of habitat fragmentation concern described above in Question 1.

3. Analyze current habitat quality and spatial configuration of the study area for the species of habitat fragmentation concern.

   a. Use recent aerial or remote imagery to determine distinct habitat patches or boundaries within the study area, and the extent of existing habitat fragmenting features.

      i. Assess the level of fragmentation of the existing habitat for the species of habitat fragmentation concern and categorize into three classes:

         - High quality: little or no apparent fragmentation of intact habitat
         - Medium quality: intact habitat exhibiting some recent disturbance activity
         - Low quality: extensive fragmentation of habitat (e.g., row-cropped agricultural lands, active surface mining areas)

      ii. Determine edge and interior habitat metrics of the study area:

         - Identify habitat, non-habitat landscape features and existing fragmenting features relative to the species of habitat fragmentation concern, to estimate existing edge
         - Calculate area and acres of edge
         - Calculate area of intact patches of habitat and compare to needs of species of habitat fragmentation concern

   b. Determine potential changes in quality and spatial configuration of the habitat in the study area if development proceeds as proposed using existing site information and the best available spatial data regarding placement of wind turbines and ancillary infrastructure:

      i. Identify, delineate and classify all additional features added by the development that potentially fragment habitat for the species of habitat fragmentation concern (e.g., roads, transmission lines, maintenance structures, etc.)

      ii. Assess the expected future size and quality of habitat patches for the species of habitat fragmentation concern and the additional fragmenting features, and categorize into three classes as described above

      iii. Determine expected future acreages of edge and interior habitats

      iv. Calculate the area of the remaining patches of intact habitat

   c. Compare pre-construction and expected post-construction fragmentation metrics:

      i. Determine the area of intact habitat lost (to the displacement footprint or by alteration due to the edge effect)

      ii. Identify habitat patches that are expected to be moved to a lower habitat quality classification as a result of the development

4. Assess the likelihood of a significant reduction in the demographic and genetic viability of the local population of the species of habitat fragmentation concern using the habitat fragmentation information collected under item 3 above and any currently available demographic and genetic data. Based on this assessment, the developer makes the finding whether or not there is significant reduction. The developer should share the finding with the relevant agencies. If the developer finds the likelihood of a significant reduction, the developer should

consider items a, b or c below:

a. Consider alternative locations and development configurations to minimize fragmentation of habitat in communication with species experts, for all species of habitat fragmentation concern in the area of interest.

b. Identify high quality habitat parcels that may be protected as part of a plan to limit future loss of habitat for the impacted population of the species of habitat fragmentation concern in the area.

c. Identify areas of medium or low quality habitat within the range of the impacted population that may be restored or improved to compensate for losses of habitat that result from the project (e.g., management of unpaved roads and ORV trails).

Tier 3, Question 3

The following protocols are suggested for use in answering Tier 3, Question 3.

Bird distribution, abundance, behavior and site use

Diurnal Avian Activity Surveys

The commonly used data collection methods for estimating the spatial distribution and relative abundance of diurnal birds includes counts of birds seen or heard at specific survey points (point count), along transects (transect surveys), and observational studies. Both methods result in estimates of bird use, which are assumed to be indices of abundance in the area surveyed. Absolute abundance is difficult to determine for most species and is not necessary to evaluate species risk. Depending on the characteristics of the area of interest and the bird species potentially affected by the project, additional pre-construction study methods may be necessary. Point counts or line transects should collect vertical as well as horizontal data to identify levels of activity within the rotor-swept zone.

Avian point counts should follow the general methodology described by Reynolds et al. (1980) for point counts within a fixed area, or the line transect survey similar to Schaffer and Johnson (2008), where all birds seen within a fixed distance of a line are counted. These methods are most useful for pre- and post-construction studies to quantify avian use of the project site by habitat, determine the presence of species of concern, and to provide a baseline for assessing displacement effects and habitat loss. Point counts for large birds (e.g., raptors) follow the same point count method described by Reynolds et al. (1980), Ralph et al. (1993) and Ralph et al. 1995).

Point count plots, transects, and observational studies should allow for statistical extrapolation of data and be distributed throughout the area of interest using a probability sampling approach (e.g., systematic sample with a random start). For most projects, the area of interest is the area where wind turbines and permanent meteorological (met) towers are proposed or expected to be sited. Alternatively, the centers of the larger plots can be located at vantage points throughout the potential area being considered with the objective of covering most of the area of interest. Flight height should also be collected to focus estimates of use on activity occurring in the rotor-swept zone.

Sampling duration and frequency will be determined on a project-by-project basis and by the questions being addressed. The most important consideration for sampling frequency when estimating abundance is the amount of variation

Hoary bat. Credit: Paul Cryan, USGS

expected among survey dates and locations and the species of concern.

The use of comparable methods and metrics should allow data comparison from plot to plot within the area of interest and from site to site where similar data exist. The data should be collected so that avian activity can be estimated within the rotor-swept zone. Relating use to site characteristics requires that samples of use also measure site characteristics thought to influence use (i.e., covariates such as vegetation and topography) in relation to the location of use. The statistical relationship of use to these covariates can be used to predict occurrence in unsurveyed areas during the survey period and for the same areas in the future.

Surveys should be conducted at different intervals during the year to account for variation in expected bird activity with lower frequency during winter months if avian activity is low. Sampling frequency should also consider the episodic nature of activity during fall and spring migration. Standardized protocols for estimating avian abundance are well-established and should be consulted (e.g., Dettmers et al. 1999). If a more precise estimate of density is required for a particular species (e.g., when the goal is to determine densities of a special-status breeding bird species), the researcher will need more sophisticated sampling procedures, including estimates of detection probability.

Raptor Nest Searches

An estimate of raptor use of the project site is obtained through appropriate surveys, but if potential impacts to breeding raptors are a concern on a project, raptor nest searches are also recommended. These surveys provide information to predict risk to the local breeding population of raptors, for micro-siting decisions, and for developing an appropriate-sized non-disturbance buffer around nests. Surveys also provide baseline data for estimating impacts and determining mitigation

Red-tailed hawk. Credit: Dave Menke, USFWS

requirements. A good source of information for raptor surveys and monitoring is Bird and Bildstein (2007).

Searches for raptor nests or raptor breeding territories on projects with potential for impacts to raptors should be conducted in suitable habitat during the breeding season. While there is no consensus on the recommended buffer zones around nest sites to avoid disturbance of most species (Sutter and Jones 1981), a nest search within at least one mile of the wind turbines and transmission lines, and other infrastructure should be conducted. However, larger nest search areas are needed for eagles, as explained in the Service's ECP Guidance, when bald or golden eagles are likely to be present.

Methods for these surveys are fairly common and will vary with the species, terrain, and vegetation within the survey area. The Service recommends that protocols be discussed with biologists from the lead agency, Service, state wildlife agency, and Tribes where they have jurisdiction. It may be useful to consult other scientifically credible information sources. At minimum, the protocols should contain the list of target raptor species for nest surveys and the appropriate search protocol for each site, including timing and number of surveys needed, search area, and search techniques.

Prairie Grouse and Sage Grouse Population Assessments

Sage grouse and prairie grouse merit special attention in this context for three reasons:

1. The scale and biotic nature of their habitat requirements uniquely position them as reliable indicators of impacts on, and needs of, a suite of species that depend on sage and grassland habitats, which are among the nation's most diminished ecological communities (Vodehnal and Haufler 2007).

2. Their ranges and habitats are highly congruent with the nation's richest inland wind resources.

3. They are species for which some known impacts of anthropogenic features (e.g., tall structures, buildings, roads, transmission lines, wind energy facilities, etc.) have been documented.

Populations of prairie grouse and sage grouse generally are assessed by either lek counts (a count of the maximum number of males attending a lek) or lek surveys (classification of known leks as active or inactive) during the breeding season (e.g., Connelly et al. 2000). Methods for lek counts vary slightly by species but in general require repeated visits to known sites and a systematic search of all suitable habitat for leks, followed by repeated visits to active leks to estimate the number of grouse using them.

Recent research indicates that viable prairie grouse and sage grouse populations are dependent on suitable nesting and brood-rearing habitat (Connelly et al. 2000, Hagen et al. 2009). These habitats generally are associated with leks. Leks are the approximate centers of nesting and brood-rearing habitats (Connelly et al. 2000, but see Connelly et al. 1988 and Becker et al. 2009). High quality nesting and

brood rearing habitats surrounding leks are critical to sustaining viable prairie grouse and sage grouse populations (Giesen and Connelly 1993, Hagen et al. 2004, Connelly et al. 2000). A population assessment study area should include nesting and brood rearing habitats that may extend several miles from leks. For example, greater and lesser prairie-chickens generally nest in suitable habitats within one to two miles of active leks (Hagen et al. 2004), whereas the average distances from nests to active leks of non-migratory sage grouse range from 0.7 to four miles (Connelly et al. 2000), and potentially much more for migratory populations (Connelly et al. 1988).

While surveying leks during the spring breeding season is the most common and convenient tool for monitoring population trends of prairie grouse and sage grouse, documenting available nesting and brood rearing habitat within and adjacent to the potentially affected area is recommended. Suitable nesting and brood rearing habitats can be mapped based on habitat requirements of individual species. The distribution and abundance of nesting and brood rearing habitats can be used to help in the assessment of adverse impacts of the proposed project to prairie grouse and sage grouse.

Mist-Netting for Birds

Mist-netting is not recommended as a method for assessing risk of wind development for birds. Mist-netting cannot generally be used to develop indices of relative bird abundance, nor does it provide an estimate of collision risk as mist-netting is not feasible at the heights of the rotor-swept zone and captures below that zone may not adequately reflect risk. Operating mist-nets requires considerable experience, as well as state and federal permits.

Occasionally mist-netting can help confirm the presence of rare species at documented fallout or migrant stopover sites near a proposed project. If mist-netting is to be used, the Service recommends that procedures for operating nets and collecting data be followed in accordance with Ralph et al. (1993).

Nocturnal and Crepuscular Bird Survey Methods

Additional studies using different methods should be conducted if characteristics of the project site and surrounding areas potentially pose a high risk of collision to night migrating songbirds and other nocturnal or crepuscular species. For most of their flight, songbirds and other nocturnal migrants are above the reach of wind turbines, but they pass through the altitudinal range of wind turbines during ascents and descents and may also fly closer to the ground during inclement weather (Able, 1970; Richardson, 2000). Factors affecting flight path, behavior, and "fall-out" locations of nocturnal migrants are reviewed elsewhere (e.g., Williams et al., 2001; Gauthreaux and Belser, 2003; Richardson, 2000; Mabee et al., 2006).

In general, pre-construction nocturnal studies are not recommended unless the site has features that might strongly concentrate nocturnal birds, such as along coastlines that are known to be migratory songbird corridors. Biologists knowledgeable about nocturnal bird migration and familiar with patterns of migratory stopovers in the region should assess the potential risks to nocturnal migrants at a proposed project site. No single method can adequately assess the spatial and temporal variation in nocturnal bird populations or the potential collision risk. Following nocturnal study methods in Kunz et al. (2007) is recommended to determine relative abundance, flight direction and flight altitude for assessing risk to migrating birds, if warranted. If areas of interest are within the range of nocturnal species of concern (e.g., marbled murrelet, northern spotted owl, Hawaiian petrel, Newell's shearwater), surveyors should use species-specific protocols recommended by state wildlife agencies, Tribes or Service to assess the species' potential presence in the area of interest.

In contrast to the diurnal avian survey techniques previously described, considerable variation and uncertainty exist on the optimal protocols for using acoustic monitoring devices, radar, and other techniques to evaluate species composition, relative abundance, flight height, and trajectory of nocturnal migrating birds. While an active area of research, the use of radar for determining passage rates, flight heights and flight directions of nocturnal migrating animals has yet to be shown as a good indicator of collision risk. Pre- and post-construction studies comparing radar monitoring results to estimates of bird and bat fatalities will be necessary to evaluate radar as a tool for predicting collision risk. Additional studies are also needed before making recommendations on the number of nights per season or the number of hours per night that are appropriate for radar studies of nocturnal bird migration (Mabee et al., 2006).

Bat survey methods

The Service recommends that all techniques discussed below be conducted by biologists trained in bat identification, equipment use, and the analysis and interpretation of data resulting from the design and conduct of the studies. Activities that involve capturing and handling bats may require permits from state and/or federal agencies.

Acoustic Monitoring

Acoustic monitoring provides information about bat presence and activity, as well as seasonal changes in species occurrence and use, but does not measure the number of individual bats or population density. The goal of acoustic monitoring is to provide a prediction of the potential risk of bat fatalities resulting from the construction and operation of a project. Our current state of knowledge about bat-wind turbine interactions, however, does not allow a quantitative link between pre-construction acoustic assessments of bat activity and operations fatalities. Discussions with experts, state wildlife trustee agencies, Tribes, and

Tri-colored bat. Credit: USFWS

Service will be needed to determine whether acoustic monitoring is warranted at a proposed project site.

The predominance of bat fatalities detected to date are migratory species and acoustic monitoring should adequately cover periods of migration and periods of known high activity for other (i.e., non-migratory) species. Monitoring for a full year is recommended in areas where there is year round bat activity. Data on environmental variables such as temperature and wind speed should be collected concurrently with acoustic monitoring so these weather data can be used in the analysis of bat activity levels.

The number and distribution of sampling stations necessary to adequately estimate bat activity have not been well established but will depend, at least in part, on the size of the project area, variability within the project area, and a Tier 2 assessment of potential bat occurrence.

The number of detectors needed to achieve the desired level of precision will vary depending on the within-site variation (e.g., Arnett et al. 2006, Weller 2007, See also, Bat Conservation International website for up-to-date survey methodologies). One frequently used method is to place acoustic detectors on existing met towers, approximately every two kilometers across the site where turbines are expected to be sited. Acoustic detectors should be placed at high positions (as high as practicable, based on tower height) on each met tower included in the sample to record bat activity at or near the rotor swept zone, the area of presumed greatest risk for bats. Developers should evaluate whether it would be cost effective to install detectors when met towers are first established on a site. Doing so might reduce the cost of installation later and might alleviate time delays to conduct such studies.

If sampling at met towers does not adequately cover the study area or provide sufficient replication, additional sampling stations can be established at low positions (~1.5-2 meters) at a sample of existing met towers and one or more mobile units (i.e., units that are moved to different locations throughout the study period) to increase coverage of the proposed project area. When practical and based on information from Tier 2, it may be appropriate to conduct some acoustic monitoring of features identified as potentially high bat use areas within the study area (e.g., bat roosts and caves) to determine use of such features.

There is growing interest in determining whether "low" position samples (~1.5-2 meters) can provide equal or greater correlation with bat fatalities than "high" position samples (described above) because this would substantially lower cost of this work. Developers could then install a greater number of detectors at lower cost resulting in improved estimates of bat activity and, potentially, improved qualitative estimates of risk to bats. This is a research question that is not expected to be addressed at a project.

Other bat survey techniques

Occasionally, other techniques may be needed to answer Tier 3 questions and complement the information from acoustic surveys. Kunz et al. (2007), NAS (2007), Kunz and Parsons (2009) provide comprehensive descriptions of bat survey techniques, including those identified below that are relevant for Tier 3 studies at wind energy facilities.

Roost Searches and Exit Counts

Pre-construction survey efforts may be recommended to determine whether known or likely bat roosts in mines, caves, bridges, buildings, or other potential roost sites occur within the project vicinity, and to confirm whether known or likely bat roosts are present and occupied by bats. If active roosts are detected, it may be appropriate to address questions about colony size and species composition of roosts. Exit counts and roost searches are two approaches to answering these questions, and Rainey (1995), Kunz and Parsons (2009), and Sherwin et al. (2009) are resources that describe options and approaches for these techniques. Roost searches should be performed cautiously because roosting bats are sensitive to human disturbance (Kunz et al. 1996). Known maternity and hibernation roosts should not be entered or otherwise disturbed unless authorized by state and/or federal wildlife agencies. Internal searches of abandoned mines or caves can be dangerous and should only be conducted by trained researchers. For mine survey protocol and

guidelines for protection of bat roosts, see the appendices in Pierson et al. (1999). Exit surveys at known roosts generally should be limited to non-invasive observation using low-light binoculars and infrared video cameras.

Multiple surveys should be conducted to determine the presence or absence of bats in caves and mines, and the number of surveys needed will vary by species of bats, sex (maternity or bachelor colony) of bats, seasonality of use, and type of roost structure (e.g., caves or mines). For example, Sherwin et al. (2003) demonstrated that a minimum of three surveys are needed to determine the absence of large hibernating colonies of Townsend's big-eared bats in mines (90 percent probability), while a minimum of nine surveys (during a single warm season) are necessary before a mine could be eliminated as a bachelor roost for this species (90 percent probability). An average of three surveys was needed before surveyed caves could be eliminated as bachelor roosts (90 percent probability). The Service recommends that decisions on level of effort follow discussion with relevant agencies and bat experts.

Activity Patterns

If active roosts are detected, it may be necessary to answer questions about behavior, movement patterns, and patterns of roost use for bat species of concern, or to further investigate habitat features that might attract bats and pose fatality risk. For some bat species, typically threatened, endangered, or state-listed species, radio telemetry or radar may be recommended to assess both the direction of movement as bats leave roosts, and the bats' use of the area being considered for development. Kunz et al. (2007) describe the use of telemetry, radar and other tools to evaluate use of roosts, activity patterns, and flight direction from roosts.

Mist-Netting for Bats

While mist-netting for bats is required in some situations by state agencies, Tribes, and the Service to determine the presence of threatened, endangered or other bat species of concern, mist-netting is not generally recommended for determining levels of activity or assessing risk of wind energy development to bats for the following reasons: 1) not all proposed or operational wind energy facilities offer conditions conducive to capturing bats, and often the number of suitable sampling points is minimal or not closely associated with the project location; 2) capture efforts often occur at water sources offsite or at nearby roosts and the results may not reflect species presence or use on the site where turbines are to be erected; and 3) mist-netting isn't feasible at the height of the rotor-swept zone, and captures below that zone may not adequately reflect risk of fatality. If mist-netting is employed, it is best used in combination with acoustic monitoring to inventory the species of bats present at a site.

White-Nose Syndrome

White-nose syndrome is a disease affecting hibernating bats. Named for the white fungus that appears on the muzzle and other body parts of hibernating bats, WNS is associated with extensive mortality of bats in eastern North America. All contractors and consultants hired by developers should employ the most current version of survey and handling protocols to avoid transmitting white-nose syndrome between bats.

Mule deer. Credit: Tupper Ansel Blake, USFWS

Other wildlife

While the above guidance emphasizes the evaluation of potential impacts to birds and bats, Tier 1 and 2 evaluations may identify other species of concern. Developers are encouraged to assess adverse impacts potentially caused by development for those species most likely to be negatively affected by such development. Impacts to other species are primarily derived from potential habitat loss or displacement. The general guidance on the study design and methods for estimation of the distribution, relative abundance, and habitat use for birds is applicable to the study of other wildlife. References regarding monitoring for other wildlife are available in Appendix C:

Sources of Information Pertaining to Methods to Assess Impacts to Wildlife. Nevertheless, most methods and metrics will be species-specific and developers are advised to work with the state, tribal, or federal agencies, or other credible experts, as appropriate, during problem formulation for Tier 3.

Tier 3 Decision Points

Developers and the Service should communicate prior to completing the Tier 3 decision process. A developer should inform the Service of the results of its studies and plans. The Service will provide written comments to a developer on study and project development plans that identify concerns and recommendations to resolve the concerns. The developer and, when applicable, the permitting authority will make a decision regarding whether and how to develop the project. The decision point at the end of Tier 3 involves three potential outcomes:

1. Development of the site has a low probability of significant adverse impact based on existing and new information.

   There is little uncertainty regarding when and how development should proceed, and adequate information exists to satisfy any required permitting. The decision process proceeds to permitting, when required, and/or development, and Tier 4.

2. Development of the site has a moderate to high probability of significant adverse impacts without proper measures being taken to mitigate those impacts. This outcome may be subdivided into two possible scenarios:

   a. There is certainty regarding how to develop the site to adequately mitigate significant adverse impacts. The developer bases their decision to develop the site adopting proper mitigation measures and appropriate post-construction fatality and habitat studies (Tier 4).

Little brown bat with white nose syndrome. Credit: Marvin Moriarty, USFWS

   b. There is uncertainty regarding how to develop the site to adequately mitigate significant adverse impacts, or a permitting process requires additional information on potential significant adverse wildlife impacts before permitting future phases of the project. The developer bases their decision to develop the site adopting proper mitigation measures and appropriate post-construction fatality and habitat studies (Tier 4).

3. Development of the site has a high probability of significant impact that:

   a. Cannot be adequately mitigated.

   Site development should be delayed until plans can be developed that satisfactorily mitigate for the significant adverse impacts. Alternatively, the site should be abandoned in favor of known sites with less potential for environmental impact, or the developer begins an evaluation of other sites or landscapes for more acceptable sites to develop.

   b. Can be adequately mitigated.

   Developer should implement mitigation measures and proceed to Tier 4.

Chapter 5: Tier 4 – Post-construction Studies to Estimate Impacts

The outcome of studies in Tiers 1, 2, and 3 will determine the duration and level of effort of post-construction studies.

Tier 4 post-construction studies are designed to assess whether predictions of fatality risk and direct and indirect impacts to habitat of species of concern were correct. Fatality studies involve searching for bird and bat carcasses beneath turbines to estimate the number and species composition of fatalities (Tier 4a). Habitat studies involve application of GIS and use data collected in Tier 3 and Tier 4b and/or published information. Post-construction studies on direct and indirect impacts to habitat of species of concern, including species of habitat fragmentation concern need only be conducted if Tier 3 studies indicate the potential for significant adverse impacts.

Tier 4a – Fatality Studies

At this time, community- and utility-scale projects should conduct at least one year of fatality monitoring. The intensity of the studies should be related to risks of significant adverse impacts identified in pre-construction assessments. As data collected with consistent methods and metrics increases (see discussion below), it is possible that some future projects will not warrant fatality monitoring, but such a situation is rare with the present state of knowledge.

Fatality monitoring should occur over all seasons of occupancy for the species being monitored, based on information produced in previous tiers. The number of seasons and total length of the monitoring may be determined separately for bats and birds, depending on the pre-construction risk assessment, results of Tier 3 studies and Tier 4 monitoring from comparable sites (see Glossary in Appendix A) and the results of first year fatality monitoring. Guidance on the relationship between these variables and monitoring for fatalities is provided in Table 2.

A male Eastern red bat perches among green foliage. Credit: ©MerlinD.Tuttle,BatConservationInternational,www.batcon.org

It may be appropriate to conduct monitoring using different durations and intervals depending on the species of concern. For example, if raptors occupy an area year-round, it may be appropriate to monitor for raptors throughout the year (12 months). It may be warranted to monitor for bats when they are active (spring, summer and fall or

approximately eight months). It may be appropriate to increase the search frequency during the months bats are active and decrease the frequency during periods of inactivity. All fatality monitoring should include estimates of carcass removal and carcass detection bias likely to influence those rates.

Tier 4a Questions

Post-construction fatality monitoring should be designed to answer the following questions as appropriate for the individual project:

1. **What are the bird and bat fatality rates for the project?**
2. **What are the fatality rates of species of concern?**
3. **How do the estimated fatality rates compare to the predicted fatality rates?**
4. **Do bird and bat fatalities vary within the project site in relation to site characteristics?**
5. **How do the fatality rates compare to the fatality rates from existing projects in similar landscapes with similar species composition and use?**
6. **What is the composition of fatalities in relation to migrating and resident birds and bats at the site?**
7. **Do fatality data suggest the need for measures to reduce impacts?**

Tier 4a studies should be of sufficient statistical validity to address Tier 4a questions and enable determination of whether Tier 3 fatality predictions were correct. Fatality monitoring results also should allow comparisons with other sites, and provide a basis for determining if operational changes or other mitigation measures at the site are appropriate. The Service encourages project operators to discuss Tier 4 studies with local, state, federal, and tribal wildlife agencies. The number of years of monitoring is based on outcomes of Tier 3 and Tier 4 studies and analysis of comparable Tier 4 data from other projects as indicated in Table 2. The Service may recommend multiple years of monitoring for projects located near a listed species or bald or golden eagle, or other situations, as appropriate.

Tier 4a Protocol Design Considerations

The basic method of measuring fatality rates is the carcass search. Search protocols should be standardized to the greatest extent possible, especially for common objectives and species of concern, and they should include methods for adequately accounting for sampling biases (searcher efficiency and scavenger removal). However, some situations warrant exceptions to standardized protocol. The responsibility of demonstrating that an exception is appropriate and applicable should be on the project operator to justify increasing or decreasing the duration or intensity of operations monitoring.

Some general guidance is given below with regard to the following fatality monitoring protocol design issues:

- Duration and frequency of monitoring
- Number of turbines to monitor
- Delineation of carcass search plots, transects, and habitat mapping
- General search protocol
- Field bias and error assessment
- Estimators of fatality

More detailed descriptions and methods of fatality search protocols can be found in the California (California Energy Commission 2007) and Pennsylvania (Pennsylvania Game Commission 2007) state guidelines and in Kunz et al. (2007), Smallwood (2007), and Strickland et al. (2011).

Duration and frequency of monitoring

Frequency of carcass searches (search interval) may vary for birds and bats, and will vary depending on the questions to be answered, the species of concern, and their seasonal abundance at the project site. The carcass searching protocol should be adequate to answer applicable Tier 4 questions at an appropriate level of precision to make general conclusions about the project, and is not intended to provide highly precise measurements of fatalities. Except during low use times (e.g. winter months in northern states), the Service recommends that protocols be designed such that carcass searches occur at some turbines within the project area most days each week of the study.

The search interval is the interval between carcass searches at individual turbines, and this interval may be lengthened or shortened depending on the carcass removal rates. If the primary focus is on fatalities of large raptors, where carcass removal is typically low, then a longer interval between searches (e.g., 14-28 days) is sufficient. However, if the focus is on fatalities of bats and small birds and carcass removal is high, then a shorter search interval will be necessary.

There are situations in which studies of higher intensity (e.g., daily searches at individual turbines within the sample) may be appropriate. These would be considered only in Tier 5 studies or in research programs because the greater complexity and level of effort goes beyond that recommended for typical Tier 4 post construction monitoring. Tier 5 and research studies could include evaluation of specific measures that have been implemented to mitigate potential significant adverse impacts to species of concern identified during pre-construction studies.

Number of turbines to monitor

If available, data on variability among turbines from existing

Wind turbine. Credit: NREL

projects in similar conditions within the same region are recommended as a basis for determining needed sample size (see Morrison et al., 2008). If data are not available, the Service recommends that an operator select a sufficient number of turbines via a systematic sample with a random start point. Sampling plans can be varied (e.g., rotating panels [McDonald 2003, Fuller 1999, Breidt and Fuller 1999, and Urquhart et al. 1998]) to increase efficiency as long as a probability sampling approach is used. If the project contains fewer than 10 turbines, the Service recommends that all turbines in the area of interest be searched unless otherwise agreed to by the permitting or wildlife resource agencies. When selecting turbines, the Service recommends that a systematic sample with a random start be used when selecting search plots to ensure interspersion among turbines. Stratification among different habitat types also is recommended to account for differences in fatality rates among different habitats (e.g., grass versus cropland or forest); a sufficient number of turbines should be sampled in each strata.

Delineation of carcass search plots, transects, and habitat mapping

Evidence suggests that greater than 80 percent of bat fatalities fall within half the maximum distance of turbine height to ground (Erickson 2003 a, b), and a minimum plot width of 120 meters from the turbine should be established at sample turbines. Plots will need to be larger for birds, with a width twice the turbine height to ground. Decisions regarding search plot size should be made in discussions with the Service, state wildlife agency, permitting agency and Tribes. It may be useful to consult other scientifically credible information sources.

The Service recommends that each search plot should be divided into oblong subplots or belt transects and that each subplot be searched. The objective is to find as many carcasses as possible so the width of the belt will vary depending on the ground cover and its influence on carcass visibility. In most situations, a search width of 6 meters should be adequate, but this may vary from 3-10 meters depending on ground cover.

Searchable area within the theoretical maximum plot size varies, and heavily vegetated areas (e.g., eastern mountains) often do not allow surveys to consistently extend to the maximum plot width. In other cases it may be preferable to search a portion of the maximum plot instead of the entire plot. For example, in some landscapes it may be impractical to search the entire plot because of the time required to do an effective search, even if it is accessible (e.g., croplands), and data from a probability sample of subplots within the maximum plot size can provide a reasonable estimate of fatalities. It is important to accurately delineate and map the area searched for each turbine to adjust fatality estimates based on the actual area searched. It may be advisable to establish habitat visibility classes in each plot to account for differential detectability, and to develop visibility classes for different landscapes (e.g., rocks, vegetation) within each search plot. For example, the Pennsylvania Game Commission (2007) identified four classes based on the percentage of bare ground.

The use of visibility classes requires that detection and removal biases be estimated for each class. Fatality estimates should be made for each class and summed for the total area sampled. Global positioning systems (GPS) are useful for accurately mapping the actual total area searched and area searched in each habitat visibility class, which can be used to adjust fatality estimates. The width of the belt or subplot searched may vary depending on the habitat and species of concern; the key is to determine actual searched area and area searched in each visibility class regardless of transect width. An adjustment may also be needed to take into account the density of fatalities as a function of the width of the search plot.

General search protocol

Personnel trained in proper search techniques should look for bird and bat carcasses along transects or subplots within each plot and record and collect all carcasses located in the searchable areas. The Service will work with developers and operators to provide necessary permits for carcass possession. A complete search of the area should be accomplished and subplot size (e.g., transect width) should be adjusted to compensate for detectability differences in the search area. Subplots should be smaller when vegetation makes it difficult to detect carcasses; subplots can be wider in open terrain. Subplot width also can vary depending on the size of the species being looked for. For example, small species such as bats may require smaller subplots than larger species such as raptors.

Data to be recorded include date, start time, end time, observer, which turbine area was searched (including GPS coordinates) and weather data for each search. When a dead bat or bird is found, the searcher should place a flag near the carcass and continue the search. After searching the entire plot, the searcher returns to each carcass and records information

on a fatality data sheet, including date, species, sex and age (when possible), observer name, turbine number, distance from turbine, azimuth from turbine (including GPS coordinates), habitat surrounding carcass, condition of carcass (entire, partial, scavenged), and estimated time of death (e.g., <1 day, 2 days). The recorded data will ultimately be housed in the FWS Office of Law Enforcement Bird Mortality Reporting System. A digital photograph of the carcass should be taken. Rubber gloves should be used to handle all carcasses to eliminate possible transmission of rabies or other diseases and to reduce possible human scent bias for carcasses later used in scavenger removal trials. Carcasses should be placed in a plastic bag and labeled. Unless otherwise conditioned by the carcass possession permit, fresh carcasses (those determined to have been killed the night immediately before a search) should be redistributed at random points on the same day for scavenging trials.

Field bias and error assessment

During searches conducted at wind turbines, actual fatalities are likely incompletely observed. Therefore carcass counts must be adjusted by some factor that accounts for imperfect detectability (Huso 2011). Important sources of bias and error include: 1) fatalities that occur on a highly periodic basis; 2) carcass removal by scavengers; 3) differences in searcher efficiency; 4) failure to account for the influence of site (e.g. vegetation) conditions in relation to carcass removal and searcher efficiency; and 5) fatalities or injured birds and bats that may land or move outside search plots.

Some fatalities may occur on a highly periodic basis creating a potential sampling error (number 1 above). The Service recommends that sampling be scheduled so that some turbines are searched most days and episodic events are more likely detected, regardless of the search interval. To address bias sources 2-4 above, it is strongly recommended that all fatality studies conduct carcass removal and searcher efficiency trials using accepted methods (Anderson 1999, Kunz et al. 2007, Arnett et al. 2007, NRC 2007, Strickland et al. 2011). Bias trials should be conducted throughout the entire study period and searchers should be unaware of which turbines are to be used or the number of carcasses placed beneath those turbines during trials. Carcasses or injured individuals may land or move outside the search plots (number 5 above). With respect to Tier 4a fatality estimates, this potential sampling error is considered to be small and can be assumed insignificant (Strickland et al. 2011).

Prior to a study's inception, a list of random turbine numbers and random azimuths and distances (in meters) from turbines should be generated for placement of each bat or bird used in bias trials. Data recorded for each trial carcass prior to placement should include date of placement, species, turbine number, distance and direction from turbine, and visibility class surrounding the carcass. Trial carcasses should be distributed as equally as possible among the different visibility classes throughout the study period and study area. Studies should attempt to avoid "over-seeding" any one turbine with carcasses by placing no more than one or two carcasses at any one time at a given turbine. Before placement, each carcass must be uniquely marked in a manner that does not cause additional attraction, and its location should be recorded. There is no agreed upon sample size for bias trials, though some state guidelines recommend from 50 - 200 carcasses (e.g., PGC 2007).

Estimators of fatality

If there were a direct relationship between the number of carcasses observed and the number killed, there would be no need to develop a complex estimator that adjusts observed counts for detectability, and observed counts could be used as a simple index of fatality (Huso 2011). But the relationship is not direct and raw carcass counts recorded using different search intervals and under different carcass removal rates and searcher efficiency rates are not directly comparable. It is strongly recommended that only the most contemporary equations for estimating fatality be used, as some original versions are now known to be extremely biased under many commonly encountered field conditions (Erickson et al. 2000b, Erickson et al. 2004, Johnson et al. 2003, Kerns and Kerlinger 2004, Fiedler et al. 2007, Kronner et al. 2007, Smallwood 2007, Huso 2011, Strickland et al. 2011).

Tier 4a Study Objectives

In addition to the monitoring protocol design considerations described above, the metrics used to estimate fatality rates must be selected with the Tier 4a questions and objectives in mind. Metrics considerations for each of the Tier 4a questions are discussed briefly below. Not all questions will be relevant for each project, and which questions apply would depend on Tier 3 outcomes.

1. What are the bird and bat fatality rates for the project?

The primary objective of fatality searches is to determine the overall estimated fatality rates for birds and bats for the project. These rates serve as the fundamental basis for all comparisons of fatalities, and if studies are designed appropriately they allow researchers to relate fatalities to site characteristics and environmental variables, and to evaluate mitigation measures. Several metrics are available for expressing fatality rates. Early studies reported fatality rates per turbine. However, this metric is somewhat misleading as turbine sizes and their risks to birds vary significantly (NRC 2007). Fatalities are frequently reported per nameplate capacity (i.e. MW), a metric that is easily calculated and better for comparing fatality rates among different sized turbines. Even with turbines of the same name plate capacity, the size of the rotor swept area may vary among manufacturers, and turbines at various sites may operate for

different lengths of time and during different times of the day and seasons. With these considerations in mind, the Service recommends that fatality rates be expressed on a per-turbine and per-nameplate MW basis until a better metric becomes available.

2. What are the fatality rates of species of concern?

This analysis simply involves calculating fatalities per turbine of all species of concern at a site when sample sizes are sufficient to do so. These fatalities should be expressed on a per nameplate MW basis if comparing species fatality rates among projects.

3. How do the estimated fatality rates compare to the predicted fatality rates?

There are several ways that predictions can be evaluated with actual fatality data. During the planning stages in Tier 2, predicted fatalities may be based on existing data at similar facilities in similar landscapes used by similar species. In this case, the assumption is that use is similar, and therefore that fatalities may be similar at the proposed facility. Alternatively, metrics derived from pre-construction assessments for an individual species or group of species – usually an index of activity or abundance at a proposed project – could be used in conjunction with use and fatality estimates from existing projects to develop a model for predicting fatalities at the proposed project site. Finally, physical models can be used to predict the probability of a bird of a particular size striking a turbine, and this probability, in conjunction with estimates of use and avoidance behavior, can be used to predict fatalities.

The most current equations for estimating fatality should be used to evaluate fatality predictions. Several statistical methods can be found in the revised Strickland et al. 2011 and used to evaluate fatality predictions. Metrics derived from Tier 3 pre-construction assessments may be correlated with fatality rates, and (using the project as the experimental unit), in Tier 5 studies it should be possible to determine if different preconstruction metrics can in fact accurately predict fatalities and, thus, risk.

4. Do bird and bat fatalities vary within the project site in relation to site characteristics?

Data from pre-construction studies can demonstrate patterns of activity that may depend upon the site characteristics. Turbines placed near escarpments or cliffs may intrude upon airspace used by raptors soaring on thermals. Pre-construction and post construction studies and assessments can be used to avoid siting individual, specific turbines within an area used by species of concern. Turbine-specific fatality rates may be related to site characteristics such as proximity to water, forest edge, staging and roosting sites, known stop-over sites, or other key resources, and this relationship may be estimated using regression analysis. This information is particularly useful for evaluating micro-siting options when planning a future facility or, on a broader scale, in determining the location of the entire project.

5. How do the fatality rates compare to the fatality rates from existing facilities in similar landscapes with similar species composition and use?

Comparing fatality rates among facilities with similar characteristics can be useful to determine patterns and broader landscape relationships. Developers should communicate with the Service to ensure that such comparisons are appropriate to avoid false conclusions. Fatality rates should be expressed on a per nameplate MW or some other standardized metric basis for comparison with other projects,

Big brown bat. Credit: USFWS

and may be correlated with site characteristics – such as proximity to wetlands, riparian corridors, mountain-foothill interface, wind patterns, or other broader landscape features – using regression analysis. Comparing fatality rates from one project to fatality rates of other projects provides insight into whether a project has relatively high, moderate or low fatalities.

6. What is the composition of fatalities in relation to migrating and resident birds and bats at the site?

The simplest way to address this question is to separate fatalities per turbine of known resident species (e.g., big brown bat, prairie horned lark) and those known to migrate long distances (e.g. hoary bat, red-eyed vireo). These data are useful in determining patterns of species composition of fatalities and possible mitigation measures directed at residents, migrants, or perhaps both, and can be used in assessing potential population effects.

[7] In situations where a project operator was not the developer, the Service expects that obligations of the developer for adhering to the Guidelines transfer with the project.

Table 2. Decision Framework for Tier 4a Fatality Monitoring of Species of Concern.[8]

Probability of Significant Adverse Impacts in Tier 3	*Recommended Fatality Monitoring Duration and Effort*	*Possible Outcomes of Monitoring Results*
Tier 3 Studies indicate LOW probability of significant adverse impacts	Duration: At least one year of fatality monitoring to estimate fatalities of birds and bats. Field assessments should be sufficient to confirm that risk to birds and/or bats is indeed "low."	1. Documented fatalities are approximately equal to or lower than predicted risk. No further fatality monitoring or mitigation is needed. 2. Fatalities are greater than predicted, but are not likely to be significant (i.e., unlikely to affect the long-term status of the population). If comparable fatality data at similar sites also supports that impacts are not likely to be high enough to affect population status, no further monitoring or mitigation is needed. If no comparable fatality data are available or such data indicates high risk, one additional year of fatality monitoring is recommended. If two years of fatality monitoring indicate levels of impacts that are not significant, no further fatality monitoring or mitigation is recommended. 3. Fatalities are greater than predicted and are likely to be significant OR federally endangered or threatened species or BGEPA species are affected. Communication with the Service is recommended. Further efforts to address impacts to BGEPA or ESA species may be warranted, unless otherwise addressed in an ESA or BGEPA take permit.
Tier 3 studies indicate MODERATE probability of significant adverse impacts	Duration: Two or more years of fatality monitoring may be necessary. Field assessments should be sufficient to confirm that risk to birds and/or bats is indeed "moderate." Closely compare estimated effects to species to those determined from the risk assessment protocol(s).	1. Documented fatalities after the first two years are lower or not different than predicted and are not significant and no federally endangered species or BGEPA species are affected - no further fatality monitoring or mitigation is needed. 2. Fatalities are greater than predicted and are likely to be significant OR federally endangered or threatened species or BGEPA species are affected, communication with the Service is recommended. Further efforts to address impacts to BGEPA or ESA species may be warranted, unless otherwise addressed in an ESA or BGEPA take permit.
Tier 3 studies indicate HIGH probability of significant adverse impacts	Duration: Two or more years of fatality monitoring may be necessary to document fatality patterns. If fatality is high, developers should shift emphasis to exploring opportunities for mitigation rather than continuing to monitor fatalities. If fatalities are variable, additional years are likely warranted.	1. Documented fatalities during each year of fatality monitoring are less than predicted and are not likely to be significant, and no federally endangered or threatened species or BGEPA species are affected – no further fatality monitoring or mitigation is needed. 2. Fatalities are equal to or greater than predicted and are likely to be significant - further efforts to reduce impacts are necessary; communication with the Service are recommended. Further efforts, such as Tier 5 studies, to address impacts to BGEPA or ESA species may be warranted, unless otherwise addressed in an ESA or BGEPA take permit.

[8] Ensure that survey protocols, and searcher efficiency and scavenger removal bias correction factors are the most reliable, robust, and up to date (after Huso 2009).

7. Do fatality data suggest the need for measures to reduce impacts?

The Service recommends that the wind project operator[7] and the relevant agencies discuss the results from Tier 4 studies to determine whether these impacts are significant. If fatalities are considered significant, the wind project operator and the relevant agencies should develop a plan to mitigate the impacts.

Tier 4b – Assessing direct and indirect impacts of habitat loss, degradation, and fragmentation

The objective of Tier 4b studies is to evaluate Tier 3 predictions of direct and indirect impacts to habitat and the potential for significant adverse impacts on species of concern as a result of these impacts. Tier 4b studies should be conducted if Tier 3 studies indicate the presence of species of habitat fragmentation concern, or if Tier 3 studies indicate significant direct and indirect adverse impacts to species of concern (see discussion below). Tier 4b studies should also inform project operators and the Service as to whether additional mitigation is necessary.

Tier 4b studies should evaluate the following questions:

1. **How do post-construction habitat quality and spatial configuration of the study area compare to predictions for species of concern identified in Tier 3 studies?**

2. **Were any behavioral modifications or indirect impacts noted in regard to species of concern?**

3. **If significant adverse impacts were predicted for species of concern, and the project was altered to mitigate for adverse impacts, were those efforts successful?**

4. **If significant adverse impacts were predicted for species of concern, and the project was altered to mitigate for adverse impacts, were those efforts successful?**

The answers to these questions will be based on information estimating habitat loss, degradation, and fragmentation information collected in Tier 3, currently available demographic and genetic data, and studies initiated in Tier 3. As in the case of Tier 4a, the answers to these questions will determine the need to conduct Tier 5 studies. For example, in the case that significant adverse impacts to species of concern were predicted, but mitigation was not successful, then additional mitigation and Tier 5 studies may be necessary. See Table 3 for further guidance.

1. **How do post-construction habitat quality and spatial configuration of the study area compare to predictions for species of concern identified in Tier 3 studies?**

GIS and demographic data collected in Tier 3 and/or published information can be used to determine predictions of impacts to species of concern from habitat loss, degradation, and fragmentation. The developer can provide development assumptions based on Tier 3 information that can be compared to post-construction information. Additional post-construction studies on impacts to species of concern due to direct and indirect impacts to habitat should only be conducted if Tier 3 studies indicate the potential for significant adverse impacts.

2. **Were any behavioral modifications or indirect impacts noted in regard to affected species?**

Evaluation of this question is based on the analysis of observed use of the area by species of concern prior to construction in comparison with observed use during operation. Observations and demographic data collected during Tier 3, and assessment of published information about the potential for displacement and demographic responses to habit impacts could be the basis for this analysis. If this analysis suggests that direct and/or indirect loss of habitat for a species of concern leads to behavioral modifications or displacement that are significant, further studies of these impacts in Tier 5 may be appropriate.

3. **If significant adverse impacts were not predicted in Tier 3 because of loss, degradation, or fragmentation of habitat, but Tier 4b studies indicate such impacts have the potential to occur, can these impacts be mitigated?**

When Tier 4b studies indicate significant impacts may be occurring, the developer may need to conduct an assessment of these impacts and what opportunities exist for additional mitigation.

4. **If significant adverse impacts were predicted for species of concern, and the project was altered to mitigate for adverse impacts, were those efforts successful?**

When Tier 4b studies indicate significant impacts may be occurring, the developer may need to conduct an assessment of these impacts and what opportunities exist for additional mitigation. Evaluation of the effectiveness of mitigation is a Tier 4 study and should follow design considerations discussed in Tier 5 and from guidance in the scientific literature (e.g. Strickland et al. 2011).

When Tier 3 studies identified potential moderate or high risks to species of concern that caused a developer to incorporate mitigation measures into the project, Tier 4b studies should evaluate the effectiveness of those mitigation measures. Determining such effectiveness is important for the project being evaluated to ascertain whether additional mitigation measures are appropriate as well as informing future decisions about how to improve mitigation at wind

energy facilities being developed.

Tier 4b Protocol Design Considerations

Impacts to a species of concern resulting from the direct and indirect loss of habitat are important and must be considered when a wind project is being considered for development. Some species of concern are likely to occur at every proposed wind energy facility. This occurrence may range from a breeding population, to seasonal occupancy, such as a brief occurrence while migrating through the area. Consequently the level of concern regarding impacts due to direct and indirect loss of habitat will vary depending on the species and the impacts that occur.

If a breeding population of a species of habitat fragmentation concern occurs in the project area and Tier 3 studies indicate that fragmentation of their habitat is possible, these predictions should be evaluated following the guidance indicated in Table 3 using the protocols described in Tier 3. If the analysis of post-construction GIS data on direct and indirect habitat loss suggests that fragmentation is likely, then additional displacement studies and mitigation may be necessary. These studies would typically begin immediately and would be considered Tier 5 studies using design considerations illustrated by examples in Tier 5 below and from guidance in the scientific literature (e.g. Strickland et al. 2011).

Significant direct or indirect loss of habitat for a species of concern may occur without habitat fragmentation if project impacts result in the reduction of a habitat resource that potentially is limiting to the affected population. Impacts of this type include loss of use of breeding habitat or loss of a significant portion of the habitat of a federally or state protected species. This would be evaluated by determining the amount of the resource that is lost and determining if this loss would potentially result in significant impacts to the affected population. Evaluation of potential significant impacts would occur in Tier 5 studies that measure the demographic response of the affected population.

Black-capped Vireo. Credit: Greg W. Lasley

The intention of the Guidelines is to focus industry and agency resources on the direct and indirect loss of habitat and limiting resources that potentially reduce the viability of a species of concern. Not all direct and indirect loss of a species' habitat will affect limiting resources for that species, and when habitat losses are minor or non-existent no further study is necessary.

Tier 4b Decision Points

The developer should use the results of the Tier 4b studies to evaluate whether further studies and/or mitigation are needed. The developer should communicate the results of these studies, and decisions about further studies and mitigation, with the Service. Table 3 provides a framework for evaluating the need for further studies and mitigation. Level of effort for studies should be sufficient to answer all questions of interest. Refer to the relevant methods sections for Tier 2 Question 5 and Tier 3 Question 2 in the text for specific guidance on study protocols.

Table 3. Decision Framework to Guide Studies for Minimizing Impacts to Habitat and Species of Habitat Fragmentation (HF) Concern.

Outcomes of Tier 2	*Outcomes of Tier 3*	*Outcomes of Tier 4b*	*Suggested Study/Mitigation*
• No species of HF concern potentially present	• No further studies needed	• n/a	• n/a
• Species of HF concern potentially present	• No species of HF concern confirmed to be present	• No further studies needed	• n/a
	• Species of HF concern demonstrated to be present, but no significant adverse impacts predicted	• Tier 4b studies confirm Tier 3 predictions	• No further studies or mitigation needed
		• Tier 4b studies indicate potentially significant adverse impacts	• Tier 5 studies and mitigation may be needed
• Species of HF concern potentially present	• Species of HF concern demonstrated to be present; significant adverse impacts predicted	• Tier 4b studies determine mitigation plan is effective; no significant adverse impacts demonstrated	• No further studies or mitigation needed
	• Mitigation plan developed and implemented	• Tier 4b studies determine mitigation plan is NOT effective; potentially significant adverse impacts	• Further mitigation and, where appropriate, Tier 5 studies

Chapter 6: Tier 5 – Other Post-construction Studies

Tier 5 studies will not be necessary for most wind energy projects. Tier 5 studies can be complex and time consuming. The Service anticipates that the tiered approach will steer projects away from sites where Tier 5 studies would be necessary.

When Tier 5 studies are conducted, they should be site-specific and intended to: 1) analyze factors associated with impacts in those cases in which Tier 4 analyses indicate they are potentially significant; 2) identify why mitigation measures implemented for a project were not adequate; and 3) assess demographic effects on local populations of species of concern when demographic information is important, including species of habitat fragmentation concern.

Tier 5 Questions

Tier 5 studies are intended to answer questions that fall in three major categories; answering yes to any of these questions might indicate a Tier 5 study is needed:

1. **To the extent that the observed fatalities exceed anticipated fatalities, are those fatalities potentially having a significant adverse impact on local populations? Are observed direct and indirect impacts to habitat having a significant adverse impact on local populations?**

For example, in the Tier 3 risk assessment, predictions of collision fatalities and habitat impacts (direct and indirect) are developed. Post-construction studies in Tier 4 evaluate the accuracy of those predictions by estimating impacts. If post-construction studies demonstrate potentially significant adverse impacts, Tier 5 studies may also be warranted and should be designed to understand observed versus predicted impacts.

2. **Were mitigation measures implemented (other than fee in lieu) not effective? This includes habitat mitigation measures as well as measures undertaken to reduce collision fatalities.**

Tier 4a and b studies can assess the effectiveness of measures taken to reduce direct and indirect impacts as part of the project and to identify such alternative or additional measures as are necessary. If alternative or additional measures were unsuccessful, the reasons why would be evaluated using Tier 5 studies.

3. **Are the estimated impacts of the proposed project likely to lead to population declines in the species of concern (other than federally-listed species)?**

Impacts of a project will have population level effects if the project causes a population decline in the species of concern. For non-listed species, this assessment will apply only to the local population.

Wind turbines and habitat. Credit: NREL

Tier 5 studies may need to be conducted when:

- Realized fatality levels for individual species of concern reach a level at which they are considered significant adverse impacts by the relevant agencies.

  For example, if Tier 4a fatality studies document that a particular turbine or set of turbines exhibits bird or bat collision fatality higher than predicted, Tier 5 studies may be useful in evaluating alternative mitigation measures at that turbine/turbine string.

- There is the potential for significant fatality impacts or significant adverse impacts to habitat for species of concern, there is a need to assess the impacts more closely, and there is uncertainty over how these impacts will be mitigated.

- Fatality and/or significant adverse habitat impacts suggest the potential for a reduction in the viability of an affected population, in which case studies on the potential for population impacts may be warranted.

- A developer evaluates the effectiveness of a risk reduction measure before deciding to continue the measure permanently or whether to use the measure when implementing future phases of a project.

  In the event additional turbines are proposed as an expansion of an existing project, results from Tier 4 and Tier 5 studies and the decision-making framework contained in the tiered approach can be used to determine whether the project should be expanded and whether additional information should be collected. It may also be necessary to evaluate whether additional measures are warranted to reduce significant adverse impacts to species.

Tier 5 Study Design Considerations

As discussed in Chapter 4 Tier 3, Tier 5 studies will be highly variable and unique to the circumstances of the individual project, and therefore these Guidelines do not provide specific guidance on all potential approaches, but make some general statements about study design. Specific Tier 5 study designs will depend on the types of questions, the specific project, and practical considerations. The most common practical considerations include the area being studied, the time period of interest, the species of concern, potentially confounding variables, time available to conduct studies, project budget, and the magnitude of the anticipated impacts. When possible it is usually desirable to collect data before construction to address Tier 5 questions. Design considerations for these studies are including in Tier 3.

One study design is based on an experimental approach to evaluating mitigation measures, where the project proponent will generally select several alternative management approaches to design, implement, and test. The alternatives are generally incorporated into sound experimental designs. Monitoring and evaluation of each alternative helps the developer to decide which alternative is more effective in meeting objectives, and informs adjustments to the next round of management decisions. The need for this type of study design can be best determined by communication between the project operator, the Service field office, and the state wildlife agency, on a project-by-project basis. This study design requires developers and operators to identify strategies to adjust management and/or mitigation measures if monitoring indicates that anticipated impacts are being exceeded. Such strategies should include a timeline for periodic reviews and adjustments as well as a mechanism to consider and implement additional mitigation measures as necessary after the project is developed.

When pre-construction data are unavailable and/or a suitable reference area is lacking, the reference Control Impact Design (Morrison et al. 2008) is the recommended design. The lack of a suitable reference area also can be addressed using the Impact Gradient Design, when habitat and species use are homogenous in the assessment area prior to development. When applied both pre- and post-construction, the Impact Gradient Design is a suitable replacement for the classic BACI (Morrison et al. 2008).

In the study of habitat impacts, the resource selection function (RSF) study design (see Anderson et al 1999; Morrison et al. 2008; Manly et al. 2002) is a statistically robust design, either with or without pre-construction and reference data. Habitat selection is modeled as a function of characteristics measured on resource units and the use of those units by the animals of interest. The RSF allows the estimation of the probability of use as a function of the distance to various environmental features, including wind energy facilities, and thus provides a direct quantification of the magnitude of the displacement effect. RSF could be improved with pre-construction and reference area data. Nevertheless, it is a relatively powerful approach to documenting displacement or the effect of mitigation measures designed to reduce displacement even without those additional data.

Tier 5 Examples

As described earlier, Tier 5 studies will not be conducted at most projects, and the specific Tier 5 questions and methods for addressing these questions will depend on the individual project and the concerns raised during pre-construction studies and during operational phases. Rather than provide specific guidance on all potential approaches, these Guidelines offer the following case studies as examples of studies that have attempted to answer Tier 5 questions.

<u>Habitat impacts - displacement and demographic impact studies</u>

Rows of wind turbines. Credit: Joshua Winchell, USFWS

Studies to assess impacts may include quantifying species' habitat loss (e.g., acres of lost grassland habitat for grassland songbirds) and habitat modification. For example, an increase in edge may result in greater nest parasitism and nest predation. Assessing indirect impacts may include two important components: 1) indirect effects on wildlife resulting from displacement, due to disturbance, habitat fragmentation, loss, and alteration; and 2) demographic effects that may occur at the local, regional or population-wide levels due to reduced nesting and breeding densities, increased isolation between habitat patches, and effects on behavior (e.g., stress, interruption, and modification). These factors can individually or cumulatively affect wildlife, although some species may be able to habituate to some or perhaps all habitat changes. Indirect impacts may be difficult to quantify but their effects may be significant (e.g., Stewart et al. 2007, Pearce-Higgins et al. 2008, Bright et al. 2008, Drewitt and Langston 2006, Robel et al. 2004, Pruett et al. 2009).

Example: in southwestern Pennsylvania, development of a project is proceeding at a site located within the range of a state-listed terrestrial species. Surveys were performed at habitat locations appropriate for use by the animal, including at control sites. Post-construction studies are planned at all locations to demonstrate any displacement effects resulting from the construction and operation of the project.

The Service recognizes that indirect impact studies may not be appropriate for most individual projects. Consideration should be given to developing collaborative research efforts with industry, government agencies, and NGOs to conduct studies to address indirect impacts.

Indirect impacts are considered potentially significant adverse threats to species such as prairie grouse (prairie chickens, sharp-tailed grouse), and sage grouse, and demographic studies may be necessary to determine the extent of these impacts and the need for mitigation.

Displacement studies may use any of the study designs describe earlier. The most scientifically robust study designs to estimate displacement effects are BACI, RSF, and impact gradient. RSF and impact gradient designs may not require specialized data gathering during Tier 3.

Telemetry studies that measure impacts of the project development on displacement, nesting, nest success, and survival of prairie grouse and sage grouse in different environments (e.g., tall grass, mixed grass, sandsage, sagebrush) will require spatial and temporal replication, undisturbed reference sites, and large sample sizes covering large areas. Examples of study designs and analyses used in the studies of other forms of energy development are presented in Holloran et al. (2005), Pitman et al. (2005), Robel et al. (2004), and Hagen et al. (2011). Anderson et al. (1999) provides a thorough discussion of the design, implementation, and analysis of these kinds of field studies and should be consulted when designing the BACI study.

Studies are being initiated to evaluate effects of wind energy development on greater sage grouse in Wyoming. In addition to measuring demographic patterns, these studies will use the RSF study design (see Sawyer et al. 2006) to estimate the probability of sage grouse use as a function of the distance to environmental features, including an existing and a proposed project.

In certain situations, such as for a proposed project site that is relatively small and in a more or less homogeneous landscape, an impact gradient design may be an appropriate means to assess avoidance of the wind energy facility by resident populations (Strickland et al., 2002). For example, Leddy et al. 1999 used the impact gradient design to evaluate grassland bird density as a function of the distance from wind turbines. Data were collected at various distances from turbines along transects.

This approach provides information on whether there is an effect, and may allow quantification of the gradient of the effect and the distance at which the displacement

effect no longer exists – the assumption being that the data collected at distances beyond the influence of turbines are the reference data (Erickson et al., 2007). An impact gradient analysis could also involve measuring the number of breeding grassland birds counted at point count plots as a function of distance from the wind turbines (Johnson et al. 2000).

Sound and Wildlife

Turbine blades at normal operating speeds can generate levels of sound beyond ambient background levels. Construction and maintenance activities can also contribute to sound levels by affecting communication distance, an animal's ability to detect calls or danger, or to forage. Sound associated with developments can also cause behavioral and/or physiological effects, damage to hearing from acoustic over-exposure, and masking of communication signals and other biologically relevant sounds (Dooling and Popper 2007). Some birds are able to shift their vocalizations to reduce the masking effects of noise. However, when shifts don't occur or are insignificant, masking may prove detrimental to the health and survival of wildlife (Barber et al. 2010). Data suggest noise increases of 3 dB to 10 dB correspond to 30 percent to 90 percent reductions in alerting distances for wildlife, respectively (Barber et al. 2010).

The National Park Service has been investigating potential impacts to wildlife due to alterations in sound level and type. However, further research is needed to better understand this potential impact. Research may include: how wind facilities affect background sound levels; whether masking, disturbance, and acoustical fragmentation occur; and how turbine, construction, and maintenance sound levels can vary by topographic area.

Levels of fatality beyond those predicted

More intensive post-construction fatality studies may be used to determine relationships between fatalities and weather, wind speed or other covariates, which usually require daily carcass searches. Fatalities determined to have occurred the previous night can be correlated with that night's weather or turbine characteristics to establish important relationships that can then be used to evaluate the most effective times and conditions to implement measures to reduce collision fatality at the project.

Measures to address fatalities

The efficacy of operational changes (e.g. changing turbine cut-in speed) of a project to reduce collision fatalities has only recently been evaluated (Arnett et al. 2009, Baerwald et al 2009). Operational changes to address fatalities should be applied only at sites where collision fatalities are predicted or demonstrated to have significant adverse impacts.

Tier 5 Studies and Research

The Service makes a distinction between Tier 5 studies focused on project-specific impacts and research (which is discussed earlier in the Guidelines). For example, developers may be encouraged to participate in collaborative studies (see earlier discussion of Research) or asked to conduct a study on an experimental mitigation technique, such as differences in turbine cut-in speed to reduce bat fatalities. Such techniques may show promise in mitigating the impacts of wind energy development to wildlife, but their broad applicability for mitigation purposes has not been demonstrated. Such techniques should not be routinely applied to projects, but application at appropriate sites will contribute to the breadth of knowledge regarding the efficacy of such measures in addressing collision fatalities. In addition, studies involving multiple sites and academic researchers can provide more robust research results, and such studies take more time and resources than are appropriately carried out by one developer at a single site. Examples below demonstrate collaborative research efforts to address displacement, operational changes, and population level impacts.

Studies of Indirect Effects

The Service provides two examples below of ongoing studies to assess the effects of indirect impacts related to wind energy facilities.

Kansas State University, as part of the NWCC Grassland Shrub-steppe Species Collaborative, is undertaking a multi-year research project to assess the effects of wind energy facilities on populations of greater prairie-chickens (GPCH) in Kansas. Initially the research was based on a Before/After Control/Impact (BACI) experimental design involving three replicated study sites in the Flint Hills and Smoky Hills of eastern Kansas. Each study site consisted of an impact area where a wind energy facility was proposed to be developed and a nearby reference area with similar rangeland characteristics where no development was planned. The research project is a coordinated field/laboratory effort, i.e., collecting telemetry and observational data from adult and juvenile GPCH in the field, and determining population genetic attributes of GPCH in the laboratory from blood samples of birds and the impact and reference areas. Detailed data on GPCH movements, demography, and population genetics were gathered from all three sites from 2007 to 2010. By late 2008, only one of the proposed wind energy facilities was developed (the Meridian Way Wind Farm in the Smoky Hills of Cloud County), and on-going research efforts are focused on that site. The revised BACI study design now will produce two years of pre-construction data (2007 and 2008), and three years of post-construction data (2009, 2010, and 2011) from a single wind energy facility site (impact area) and its reference area. Several hypotheses were formulated for testing to determine if wind energy facilities impacted GPCH populations, including but not limited to addressing issues relating to: lek attendance, avoidance of turbines and associated features,

nest success and chick survival, habitat usage, adult mortality and survival, breeding behavior, and natal dispersal. A myriad of additional significant avenues are being pursued as a result of the rich database that has been developed for the GPCH during this research effort. GPCH reproductive data will be collected through the summer of 2011 whereas collection of data from transmitter-equipped GPCH will extend through the lekking season of 2012 to allow estimates of survival of GPCH over the 2011-2012 winter. At the conclusion of the study, the two years of pre-construction data and three years of post-construction data will be analyzed and submitted to peer-reviewed journals for publication.

Erickson et al. (2004) evaluated the displacement effect of a large wind energy facility in the Pacific Northwest. The study was conducted in a relatively homogeneous grassland landscape. Erickson et al. (2004) conducted surveys of breeding grassland birds along 300 meter transects perpendicular to strings of wind turbines. Surveys were conducted prior to construction and after commercial operation. The basic study design follows the Impact Gradient Design (Morrison et al. 2008) and in this application, conformed to a special case of BACI where areas at the distal end of each transect were considered controls (i.e., beyond the influence of the turbines). In this study, there is no attempt to census birds in the area, and observations per survey are used as an index of abundance. Additionally, the impact-gradient study design resulted in less effort than a BACI design with offsite control areas. Erickson et al. (2004) found that grassland passerines as a group, as well as grasshopper sparrows and western meadowlarks, showed reduced use in the first 50 meter segment nearest the turbine string. About half of the area within that segment, however, had disturbed vegetation and separation of behavior avoidance from physical loss of habitat in this portion of the area was impossible. Horned larks and savannah sparrows appeared unaffected. The impact gradient design is best used when the study area is relatively small and homogeneous.

Operational Changes to Reduce Collision Fatality

Arnett et al. (2009) conducted studies on the effectiveness of changing turbine cut-in speed on reducing bat fatality at wind turbines at the Casselman Wind Project in Somerset County, Pennsylvania. Their objectives were to: 1) determine the difference in bat fatalities at turbines with different cut-in-speeds relative to fully operational turbines; and 2) determine the economic costs of the experiment and estimated costs for the entire area of interest under different curtailment prescriptions and timeframes. Arnett et al. (2009) reported substantial reductions in bat fatalities with relatively modest power losses.

In Kenedy County, Texas, investigators are refining and testing a real-time curtailment protocol. The projects use an avian profiling radar system to detect approaching "flying vertebrates" (birds and bats), primarily during spring and fall bird and bat migrations. The blades automatically idle when risk reaches a certain level and weather conditions are particularly risky. Based on estimates of the number and timing of migrating raptors, feathering (real-time curtailment) experiments are underway in Tehuantepec, Mexico, where raptor migration through a mountain pass is extensive.

Other tools, such as thermal imaging (Horn et al. 2008) or acoustic detectors (Kunz et al. 2007), have been used to quantify post-construction bat activity in relation to weather and turbine characteristics for improving operational change efforts. For example, at the Mountaineer project in 2003, Tier 4 studies (weekly searches at every turbine) demonstrated unanticipated and high levels of bat fatalities (Kerns and Kerlinger 2004). Daily searches were instituted in 2004 and revealed that fatalities were strongly associated with low-average-wind-speed nights, thus providing a basis for testing operational changes (Arnett 2005, Arnett et al. 2008). The program also included behavioral observations using thermal imaging that demonstrated higher bat activity at lower wind speeds (Horn et al. 2008).

Studies are currently underway to design and test the efficacy of an acoustic deterrent device to reduce bat fatalities at wind facilities (E.B. Arnett, Bat Conservation International, under the auspices of BWEC). Prototypes of the device have been tested in the laboratory and in the field with some success. Spanjer (2006) tested the response of big brown bats to a prototype eight speaker deterrent emitting broadband white noise at frequencies from 12.5–112.5 kHz and found that during non-feeding trials, bats landed in the quadrant containing the device significantly less when it was broadcasting broadband noise. Spanjer (2006) also reported that during feeding trials, bats never successfully took a tethered mealworm when the device broadcast sound, but captured mealworms near the device in about 1/3 of trials when it was silent. Szewczak and Arnett (2006, 2007) tested the same acoustic deterrent in the field and found that when placed by the edge of a small pond where nightly bat activity was consistent, activity dropped significantly on nights when the deterrent was activated. Horn et al. (2007) tested the effectiveness of a larger, more powerful version of this deterrent device on reducing nightly bat activity and found mixed results. In 2009, a new prototype device was developed and tested at a project in Pennsylvania. Ten turbines were fitted with deterrent devices, daily fatality searches were conducted, and fatality estimates were compared with those from 15 turbines without deterrents (i.e., controls) to determine if bat fatalities were reduced. This experiment found that estimated bat fatalities per turbine were 20 to 53 percent lower at treatment turbines compared to controls.

More experimentation is required. At the present time, there is not an operational deterrent available that has demonstrated effective reductions in bat kills (E. B. Arnett, Bat Conservation International, unpublished data).

Assessment of Population-level Impacts

The Altamont Pass Wind Resource Area (APWRA) has been the subject of intensive scrutiny because of avian fatalities, especially for raptors, in an area encompassing more than 5,000 wind turbines (e.g., Orloff and Flannery 1992; Smallwood and Thelander 2004, 2005). Field studies on golden eagles, a long-lived raptor species, have been completed using radio telemetry at APWRA to understand population demographics, assess impacts from wind turbines, and explore measures to effectively reduce the incidence of golden eagle mortality for this area. (Hunt et al. 1999, and Hunt 2002). Results from nesting surveys (Hunt 2002) indicated that there was no decline in eagle territory occupancy. However Hunt (2002) also found that subadult and floater components of golden eagle populations at APWRA are highly vulnerable to wind turbine mortality and results from this study indicate that turbine mortality prevented the maintenance of substantial reserves of nonbreeding adults characteristic of healthy populations elsewhere, suggesting the possibility of an eventual decline in the breeding population (Hunt and Hunt 2006). Hunt conducted follow-up surveys in 2005 (Hunt and Hunt 2006) and determined that all 58 territories occupied by eagle pairs in 2000 were occupied in 2005. It should be noted however that golden eagle studies at APWRA (Hunt et al. 1999, Hunt 2002, and Hunt and Hunt 2006) were all conducted after the APWRA was constructed and the species does not nest within the footprint of the APWRA itself (Figure 4; Hunt and Hunt 2006). The APWRA is an area of about 160 sq. km (Hunt 2002) and presumably golden eagles formerly nested within this area. The loss of breeding eagle pairs from the APWRA suggests these birds have all been displaced by the project, or lost due to various types of mortality including collisions with turbine blades.

Golden eagle. Credit: George Gentry, USFWS

Chapter 7: Best Management Practices

Site Construction and Operation

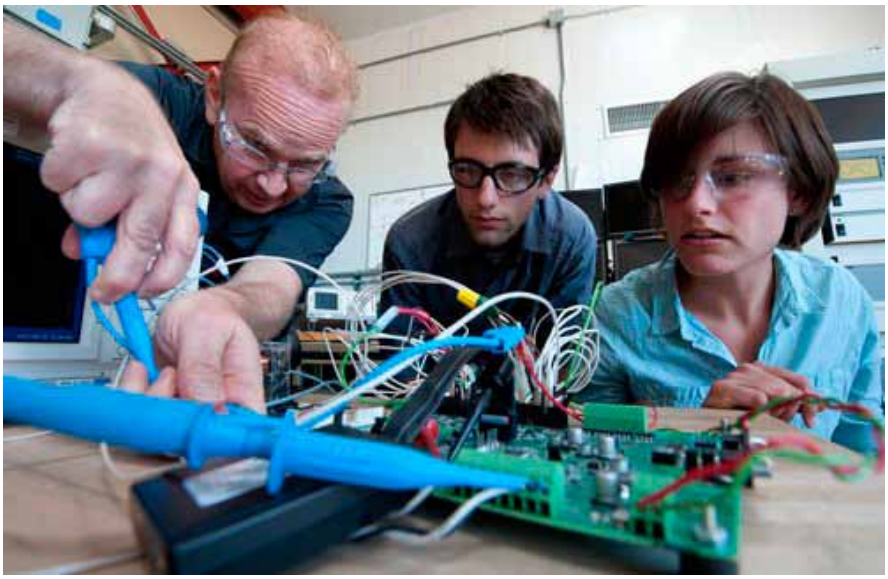
During site planning and development, careful attention to reducing risk of adverse impacts to species of concern from wind energy projects, through careful site selection and facility design, is recommended. The following BMPs can assist a developer in the planning process to reduce potential impacts to species of concern. Use of these BMPs should ensure that the potentially adverse impacts to most species of concern and their habitats present at many project sites would be reduced, although compensatory mitigation may be appropriate at a project level to address significant site-specific concerns and pre-construction study results.

These BMPs will evolve over time as additional experience, learning, monitoring and research becomes available on how to best minimize wildlife and habitat impacts from wind energy projects. Service should work with the industry, stakeholders and states to evaluate, revise and update these BMPs on a periodic basis, and the Service should maintain a readily available publication of recommended, generally accepted best practices.

1. Minimize, to the extent practicable, the area disturbed by pre-construction site monitoring and testing activities and installations.

2. Avoid locating wind energy facilities in areas identified as having a demonstrated and unmitigatable high risk to birds and bats.

3. Use available data from state and federal agencies, and other sources (which could include maps or databases), that show the location of sensitive resources and the results of Tier 2 and/or 3 studies to establish the layout of roads, power lines, fences, and other infrastructure.



Wind electronic developers. Credit: NREL

4. Minimize, to the maximum extent practicable, roads, power lines, fences, and other infrastructure associated with a wind development project. When fencing is necessary, construction should use wildlife compatible design standards.

5. Use native species when seeding or planting during restoration. Consult with appropriate state and federal agencies regarding native species to use for restoration.

6. To reduce avian collisions, place low and medium voltage connecting power lines associated with the wind energy development underground to the extent possible, unless burial of the lines is prohibitively expensive (e.g., where shallow bedrock exists) or where greater adverse impacts to biological resources would result:

   a. Overhead lines may be acceptable if sited away from high bird crossing locations, to the extent practicable, such as between roosting and feeding areas or between lakes, rivers, prairie grouse and sage grouse leks, and nesting habitats. To the extent practicable, the lines should be marked in accordance with Avian Power Line Interaction Committee (APLIC) collision guidelines.

   b. Overhead lines may be used when the lines parallel tree lines, employ bird flight diverters, or are otherwise screened so that collision risk is reduced.

   c. Above-ground low and medium voltage lines, transformers and conductors should follow the 2006 or most recent APLIC "Suggested Practices for Avian Protection on Power Lines."

7. Avoid guyed communication towers and permanent met towers at wind energy project sites. If guy wires are necessary,

bird flight diverters or high visibility marking devices should be used.

8. Where permanent meteorological towers must be maintained on a project site, use the minimum number necessary.

9. Use construction and management practices to minimize activities that may attract prey and predators to the wind energy facility.

10. Employ only red, or dual red and white strobe, strobe-like, or flashing lights, not steady burning lights, to meet Federal Aviation Administration (FAA) requirements for visibility lighting of wind turbines, permanent met towers, and communication towers. Only a portion of the turbines within the wind project should be lighted, and all pilot warning lights should fire synchronously.

11. Keep lighting at both operation and maintenance facilities and substations located within half a mile of the turbines to the minimum required:

    a. Use lights with motion or heat sensors and switches to keep lights off when not required.

    b. Lights should be hooded downward and directed to minimize horizontal and skyward illumination.

    c. Minimize use of high-intensity lighting, steady-burning, or bright lights such as sodium vapor, quartz, halogen, or other bright spotlights.

    d. All internal turbine nacelle and tower lighting should be extinguished when unoccupied.

12. Establish non-disturbance buffer zones to protect sensitive habitats or areas of high risk for species of concern identified in pre-construction studies. Determine the extent of the buffer zone in consultation with the Service and state, local and tribal wildlife biologists, and land management agencies (e.g., U.S. Bureau of Land Management (BLM) and U.S. Forest Service (USFS)), or other credible experts as appropriate.

13. Locate turbines to avoid separating bird and bat species of concern from their daily roosting, feeding, or nesting sites if documented that the turbines' presence poses a risk to species.

14. Avoid impacts to hydrology and stream morphology, especially where federal or state-listed aquatic or riparian species may be involved. Use appropriate erosion control measures in construction and operation to eliminate or minimize runoff into water bodies.

15. When practical use tubular towers or best available technology to reduce ability of birds to perch and to reduce risk of collision.

16. After project construction, close roads not needed for site operations and restore these roadbeds to native vegetation, consistent with landowner agreements.

17. Minimize the number and length of access roads; use existing roads when feasible.

18. Minimize impacts to wetlands and water resources by following all applicable provisions of the Clean Water Act (33 USC 1251-1387) and the Rivers and Harbors Act (33 USC 301 et seq.); for instance, by developing and implementing a storm water management plan and taking measures to reduce erosion and avoid delivery of road-generated sediment into streams and waters.

19. Reduce vehicle collision risk to wildlife by instructing project personnel to drive at appropriate speeds, be alert for wildlife, and use additional caution in low visibility conditions.

20. Instruct employees, contractors, and site visitors to avoid harassing or disturbing wildlife, particularly during reproductive seasons.

21. Reduce fire hazard from vehicles and human activities (instruct employees to use spark arrestors on power equipment, ensure that no metal parts are dragging from vehicles, use caution with open flame, cigarettes, etc.). Site development and operation plans should specifically address the risk of wildfire and provide appropriate cautions and measures to be taken in the event of a wildfire.

22. Follow federal and state measures for handling toxic substances to minimize danger to water and wildlife resources from spills. Facility operators should maintain Hazardous Materials Spill Kits on site and train personnel in the use of these.

23. Reduce the introduction and spread of invasive species by following applicable local policies for invasive species prevention, containment, and control, such as cleaning vehicles and equipment arriving from areas with known invasive species issues, using locally sourced topsoil, and monitoring for and rapidly removing invasive species at least annually.

24. Use invasive species prevention and control measures as specified by county or state requirements, or by applicable federal agency requirements (such as Integrated Pest Management) when federal policies apply.

25. Properly manage garbage and waste disposal on project sites to avoid creating attractive nuisances for wildlife by providing them with supplemental food.

26. Promptly remove large animal carcasses (e.g., big game,

domestic livestock, or feral animal).

27. Wildlife habitat enhancements or improvements such as ponds, guzzlers, rock or brush piles for small mammals, bird nest boxes, nesting platforms, wildlife food plots, etc. should not be created or added to wind energy facilities. These wildlife habitat enhancements are often desirable but when added to a wind energy facility result in increased wildlife use of the facility which may result in increased levels of injury or mortality to them.

Retrofitting, Repowering, and Decommissioning

As with project construction, these Guidelines offer BMPs for the retrofitting, repowering, and decommissioning phases of wind energy projects.

Retrofitting

Retrofitting is defined as replacing portions of existing wind turbines or project facilities so that at least part of the original turbine, tower, electrical infrastructure or foundation is being utilized. Retrofitting BMPs include:

1. Retrofitting of turbines should use installation techniques that minimize new site disturbance, soil erosion, and removal of vegetation of habitat value.

2. Retrofits should employ shielded, separated or insulated electrical conductors that minimize electrocution risk to avian wildlife per APLIC (2006).

3. Retrofit designs should prevent nests or bird perches from being established in or on the wind turbine or tower.

4. FAA visibility lighting of wind turbines should employ only red, or dual red and white strobe, strobe-like, or flashing lights, not steady burning lights.

5. Lighting at both operation and maintenance facilities and substations located within half a mile of the turbines should be kept to the minimum required:

   a. Use lights with motion or heat sensors and switches to keep lights off when not required.

   b. Lights should be hooded downward and directed to minimize horizontal and skyward illumination.

   c. Minimize use of high intensity lighting, steady-burning, or bright lights such as sodium vapor, quartz, halogen, or other bright spotlights.

6. Remove wind turbines when they are no longer cost effective to retrofit.

Repowering

Repowering may include removal and replacement of turbines and associated infrastructure. BMPs include:

1. To the greatest extent practicable, existing roads, disturbed areas and turbine strings should be re-used in repower layouts.

2. Roads and facilities that are no longer needed should be demolished, removed, and their footprint stabilized and re-seeded with native plants appropriate for the soil conditions and adjacent habitat and of local seed sources where feasible, per landowner requirements and commitments.

3. Existing substations and ancillary facilities should be re-used in repowering projects to the extent practicable.

4. Existing overhead lines may be acceptable if located away from high bird crossing locations, such as between roosting and feeding areas, or between lakes, rivers and nesting areas. Overhead lines may be used when they parallel tree lines, employ bird flight diverters, or are otherwise screened so that collision risk is reduced.

5. Above-ground low and medium voltage lines, transformers and conductors should follow the 2006 or most recent APLIC "Suggested Practices for Avian Protection on Power Lines."

6. Guyed structures should be avoided. If use of guy wires is absolutely necessary, they should be treated with bird flight diverters or high visibility marking devices, or are located where known low bird use will occur.

7. FAA visibility lighting of wind turbines should employ only red, or dual red and white strobe, strobe-like, or flashing lights, not steady burning lights.

8. Lighting at both operation and maintenance facilities and substations located within ½ mile of the turbines should be kept to the minimum required.

   a. Use lights with motion or heat sensors and switches to keep lights off when not required.

   b. Lights should be hooded downward and directed to minimize horizontal and skyward illumination.

Towers are being lifted as work continues on the 2 MW Gamesa wind turbine that is being installed at the NWTC. Credit: NREL

c. Minimize use of high intensity lighting, steady-burning, or bright lights such as sodium vapor, quartz, halogen, or other bright spotlights.

Decommissioning

Decommissioning is the cessation of wind energy operations and removal of all associated equipment, roads, and other infrastructure. The land is then used for another activity. During decommissioning, contractors and facility operators should apply BMPs for road grading and native plant re-establishment to ensure that erosion and overland flows are managed to restore pre-construction landscape conditions. The facility operator, in conjunction with the landowner and state and federal wildlife agencies, should restore the natural hydrology and plant community to the greatest extent practical.

1. Decommissioning methods should minimize new site disturbance and removal of native vegetation, to the greatest extent practicable.

2. Foundations should be removed to a minimum of three feet below surrounding grade, and covered with soil to allow adequate root penetration for native plants, and so that subsurface structures do not substantially disrupt ground water movements. Three feet is typically adequate for agricultural lands.

3. If topsoils are removed during decommissioning, they should be stockpiled and used as topsoil when restoring plant communities. Once decommissioning activity is complete, topsoils should be restored to assist in establishing and maintaining pre-construction native plant communities to the extent possible, consistent with landowner objectives.

4. Soil should be stabilized and re-vegetated with native plants appropriate for the soil conditions and adjacent habitat, and of local seed sources where feasible, consistent with landowner objectives.

5. Surface water flows should be restored to pre-disturbance conditions, including removal of stream crossings, roads, and pads, consistent with storm water management objectives and requirements.

6. Surveys should be conducted by qualified experts to detect populations of invasive species, and comprehensive approaches to preventing and controlling invasive species should be implemented and maintained as long as necessary.

7. Overhead pole lines that are no longer needed should be removed.

8. After decommissioning, erosion control measures should be installed in all disturbance areas where potential for erosion exists, consistent with storm water management objectives and requirements.

9. Fencing should be removed unless the landowner will be utilizing the fence.

10. Petroleum product leaks and chemical releases should be remediated prior to completion of decommissioning.

Chapter 8: Mitigation

Mitigation is defined in this document as avoiding or minimizing significant adverse impacts, and when appropriate, compensating for unavoidable significant adverse impacts, as determined through the tiered approach described in the recommended Guidelines. The Service places emphasis in project planning on first avoiding, then minimizing, potential adverse impacts to wildlife and their habitats. Several tools are available to determine appropriate mitigation, including the Service Mitigation Policy (USFWS Mitigation Policy, 46 FR 7656 (1981)). The Service policy provides a common basis for determining how and when to use different mitigation strategies, and facilitates earlier consideration of wildlife values in wind energy project planning.

Under the Service Mitigation Policy, the highest priority is for mitigation to occur on-site within the project planning area. The secondary priority is for the mitigation to occur off-site. Off-site mitigation should first occur in proximity to the planning area within the same ecological region and secondarily elsewhere within the same ecological region. Generally, the Service prefers on-site mitigation over off-site mitigation because this approach most directly addresses project impacts at the location where they actually occur. However, there may be individual cases where off-site mitigation could result in greater net benefits to affected species and habitats. Developers should work with the Service in comparing benefits among multiple alternatives.

In some cases, a project's effects cannot be forecast with precision. The developer and the agencies may be unable to make some mitigation decisions until post-construction data have been collected. If significant adverse effects have not been adequately addressed, additional mitigation for those adverse effects from operations may need to be implemented.

Mitigation measures implemented post-construction, whether in addition to those implemented pre-construction or whether they are new, are appropriate elements of the tiered approach. The general terms and funding commitments for future mitigation and the triggers or thresholds for implementing such compensation should be developed at the earliest possible stage in project development. Any mitigation implemented after a project is operational should be well defined, bounded, technically feasible, and commensurate with the project effects.

NEPA Guidance on Mitigation

CEQ issued guidance in February 2011 on compliance with the National Environmental Policy Act (NEPA) entitled, "Appropriate Use of Mitigation and Monitoring and Clarifying the Appropriate Use of Mitigated Findings of No Significant Impact." This new guidance clarifies that when agencies premise their Finding of No Significant Impact on a commitment to mitigate the environmental impacts of a proposed action, they should adhere to those commitments, publicly report on those efforts, monitor how they are implemented, and monitor the effectiveness of the mitigation.

To the extent that a federal nexus with a wind project exists, for example, developing a project on federal lands or obtaining a federal permit, the lead federal action agency should make its decision based in part on a developer's commitment to mitigate adverse environmental impacts. The federal action agency should ensure that the developer adheres to those commitments, monitors how they are implemented, and monitors the effectiveness of the mitigation. Additionally, the lead federal action agency should make information on mitigation monitoring available to the public through its web site;

Greater prairie chicken. Credit: Amy Thornburg, USFWS

and should ensure that mitigation successfully achieves its goals.

Compensatory Mitigation

Compensatory mitigation as defined in this document refers to replacement of project-induced losses to fish and wildlife resources. Substitution or offsetting of fish and wildlife resource losses with resources considered to be of equivalent biological value.

- **In-kind** – Providing or managing substitute resources to replace the value of the resources lost, where such substitute resources are physically and biologically the same or closely approximate to those lost.

- **Out-of-kind** – Providing or managing substitute resources to replace the value of the resources lost, where such substitute resources are physically or biologically different from those lost. This may include conservation or mitigation banking, research or other options.

The amount of compensation, if necessary, will depend on the effectiveness of any avoidance and minimization measures undertaken. If a proposed wind development is poorly sited with regard to wildlife effects, the most important mitigation opportunity is largely lost and the remaining options can be expensive, with substantially greater environmental effects.

Compensation is most often appropriate for habitat loss under limited circumstances or for direct take of wildlife (e.g., Habitat Conservation Plans). Compensatory mitigation may involve contributing to a fund to protect habitat or otherwise support efforts to reduce existing impacts to species affected by a wind project. Developers should communicate with the Service and state agency prior to initiating such an approach.

Ideally, project impact assessment is a cooperative effort involving the developer, the Service, tribes, local authorities, and state resource agencies. The Service does not expect developers to provide compensation for the same habitat loss more than once. But the Service, state resource agencies, tribes, local authorities, state and federal land management agencies may have different species or habitats of concern, according to their responsibilities and statutory authorities. Hence, one entity may seek mitigation for a different group of species or habitat than does another.

Migratory Birds and Eagles

Some industries, such as the electric utilities, have developed operational and deterrent measures that when properly used can avoid or minimize "take" of migratory birds. Many of these measures to avoid collision and electrocution have been scientifically tested with publication in peer-reviewed, scientific journals. The Service encourages the wind industry to use these measures in siting, placing, and operating all power lines, including their distribution and grid-connecting transmission lines.

E.O. 13186, which addresses responsibilities of federal agencies to protect migratory birds, includes a directive to federal agencies to restore and enhance the habitat of migratory birds as practicable. E.O. 13186 provides a basis and a rationale for compensating for the loss of migratory bird habitat that results from developing wind energy projects that have a federal nexus.

Regulations concerning eagle take permits in 50 CFR 22.26 and 50 CFR 22.27 may allow for compensation as part of permit issuance. Compensation may be a condition of permit issuance in cases of nest removal, disturbance or take resulting in mortality that will likely occur over several seasons, result in permanent abandonment of one or more breeding territories, have large scale impacts, occur at multiple locations, or otherwise contribute to cumulative negative effects. The draft ECP Guidance has additional information on the use of compensation for programmatic permits.

Endangered Species

The ESA has provisions that allow for compensation through the issuance of an Incidental Take Permit (ITP). Under the ESA, mitigation measures are determined on a case by case basis, and are based on the needs of the species and the types of effects anticipated. If a federal nexus exists, or if a developer chooses to seek an ITP under the ESA, then effects to listed species need to be evaluated through the Section 7 and/or Section 10 processes. If an ITP is requested, it and the associated HCP must provide for minimization and mitigation to the maximum extent practicable, in addition to meeting other necessary criteria for permit issuance. For further information about compensation under federal laws administered by the Service, see the Service's Habitat and Resource Conservation website http://www.fws.gov/habitatconservation.

Bald eagle. Credit: USFWS

Chapter 9: Advancing Use, Cooperation and Effective Implementation

This chapter discusses a variety of policies and procedures that may affect the way wind project developers and the Service work with each other as well as with state and tribal governments and non-governmental organizations. The Service recommends that wind project developers work closely with field office staff for further elaboration of these policies and procedures.

Conflict Resolution

The Service and developers should attempt to resolve any issues arising from use of the Guidelines at the Field Office level. Deliberations should be in the context of the intent of the Guidelines and be based on the site-specific conditions and the best available data. However, if there is an issue that cannot be resolved within a timely manner at the field level, the developer and Service staff will coordinate to bring the matter up the chain of command in a stepwise manner.

Bird and Bat Conservation Strategies (BBCS)

The Service has recommended that developers prepare written records of their actions to avoid, minimize and compensate for potential adverse impacts. In the past, the Service has referred to these as Avian and Bat Protection Plans (ABPP). However, ABPPs have more recently been used for transmission projects and less for other types of development. For this reason the Service is introducing a distinct concept for wind energy projects and calling them Bird and Bat Conservation Strategies (BBCS).

Typically, a project-specific BBCS will explain the analyses, studies, and reasoning that support progressing from one tier to the next in the tiered approach. A wind energy project-specific BBCS is an example of a document or compilation of documents that describes the steps a developer could or has taken to apply these Guidelines to mitigate for adverse impacts and address the post-construction monitoring efforts the developer intends to undertake. A developer may prepare a BBCS in stages, over time, as analysis and studies are undertaken for each tier. It will also address the post-construction monitoring efforts for mortality and habitat effects, and may use many of the components suggested in the Suggested Practices for Avian Protection on Power Lines (APLIC 2006). Any Service review of, or discussion with a developer, concerning its BBCS is advisory only, does not result in approval or disapproval of the BBCS by the Service, and does not constitute a federal agency action subject to the National Environmental Policy Act or other federal law applicable to such an action.

Electricity towers and wind turbines. Credit: NREL

Project Interconnection Lines

The Guidelines are designed to address all elements of a wind energy facility, including the turbine string or array, access roads, ancillary buildings, and the above- and below-ground electrical lines which connect a project to the transmission system. The Service recommends that the project evaluation include consideration of the wildlife- and habitat-related impacts of these electrical lines, and that the developer include measures to reduce impacts of these lines, such

as those outlined in the Suggested Practices for Avian Protection on Power Lines (APLIC 2006). The Guidelines are not designed to address transmission beyond the point of interconnection to the transmission system. The national grid and proposed smart grid system are beyond the scope of these Guidelines.

Confidentiality of Site Evaluation Process as Appropriate

Some aspects of the initial pre-construction risk assessment, including preliminary screening and site characterization, occur early in the development process, when land or other competitive issues limit developers' willingness to share information on projects with the public and competitors. Any consultation or coordination with agencies at this stage may include confidentiality agreements.

Collaborative Research

Much uncertainty remains about predicting risk and estimating impacts of wind energy development on wildlife. Thus there is a need for additional research to improve scientifically based decision-making when siting wind energy facilities, evaluating impacts on wildlife and habitats, and testing the efficacy of mitigation measures. More extensive studies are needed to further elucidate patterns and test hypotheses regarding possible solutions to wildlife and wind energy impacts.

It is in the interests of wind developers and wildlife agencies to improve these assessments to better mitigate the impacts of wind energy development on wildlife and their habitats. Research can provide data on operational factors (e.g. wind speed, weather conditions) that are likely to result in fatalities. It could also include studies of cumulative impacts of multiple wind energy projects, or comparisons of different methods for assessing avian and bat activity relevant to predicting risk. Monitoring and research should be designed and conducted to ensure unbiased data collection that meets technical standards such as those used in peer review. Research projects may occur at the same time as project-specific Tier 4 and Tier 5 studies.

Research would usually result from collaborative efforts involving appropriate stakeholders, and is not the sole or primary responsibility of any developer. Research partnerships (e.g., Bats and Wind Energy Cooperative (BWEC[9], Grassland and Shrub Steppe Species Collaborative (GS3C)[10]) involving diverse players will be helpful for generating common goals and objectives and adequate funding to conduct studies (Arnett and Haufler 2003). The National Wind Coordinating Collaborative (NWCC)[11] , the American Wind Wildlife Institute (AWWI)[12] , and the California Energy Commission (CEC)'s Public Interest Energy Research Program[13] all support research in this area.

Study sites and access will be necessary to design and implement research, and developers are encouraged to participate in these research efforts when possible. Subject to appropriations, the Service also should fund priority research and promote collaboration and information sharing among research efforts to advance science on wind energy-wildlife interactions, and to improve these Guidelines.

Service - State Coordination and Cooperation

The Service encourages states to increase compatibility between state guidelines and these voluntary Guidelines, protocols, data collection methods, and recommendations relating to wildlife and wind energy. States that desire to adopt, or those that have formally adopted, wind energy siting, permitting, or environmental review regulations or guidelines are encouraged to cooperate with the Service to develop consistent state level guidelines. The Service may be available to confer, coordinate and share its expertise with interested states when a state lacks its own guidance or program to address wind energy-wildlife interactions. The Service will also use states' technical resources as much as possible and as appropriate.

The Service will explore establishing a voluntary state/federal program to advance cooperation and compatibility between the Service and interested state and local governments for coordinated review of projects under both federal and state wildlife laws. The Service, and interested states, will consider using the following tools to reach agreements to foster consistency in review of projects:

- Cooperation agreements with interested state governments.
- Joint agency reviews to reduce duplication and increase coordination in project review.
- A communication mechanism:
  - To share information about prospective projects
  - To coordinate project review
  - To ensure that state and federal regulatory processes, and/or mitigation requirements are being adequately addressed

[9] www.batsandwind.org
[10] www.nationalwind.org
[11] www.nationalwind.org
[12] http://www.awwi.org
[13] http://www.energy.ca.gov/research

  - To ensure that species of concern and their habitats are fully addressed

- Establishing consistent and predictable joint protocols, data collection methodologies, and study requirements to satisfy project review and permitting.

- Designating a Service management contact within each Regional Office to assist Field Offices working with states and local agencies to resolve significant wildlife-related issues that cannot be resolved at the field level.

- Cooperative state/federal/industry research agreements relating to wind energy -wildlife interactions.

The Service will explore opportunities to:

- Provide training to states.

- Foster development of a national geographic data base that identifies development-sensitive ecosystems and habitats.

- Support a national database for reporting of mortality data on a consistent basis.

- Establish national BMPs for wind energy development projects.

- Develop recommended guidance on study protocols, study techniques, and measures and metrics for use by all jurisdictions.

- Assist in identifying and obtaining funding for national research priorities.

Service - Tribal Consultation and Coordination

Federally-recognized Indian Tribes enjoy a unique government-to-government relationship with the United States. The United States Fish and Wildlife Service (Service) recognizes Indian tribal governments as the authoritative voice regarding the management of tribal lands and resources within the framework of applicable laws. It is important to recall that many tribal traditional lands and tribal rights extend beyond reservation lands.

Wind turbine in California.. Credit: NREL

The Service consults with Indian tribal governments under the authorities of Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments" and supporting DOI and Service policies. To this end, when it is determined that federal actions and activities may affect a Tribe's resources (including cultural resources), lands, rights, or ability to provide services to its members, the Service must, to the extent practicable, seek to engage the affected Tribe(s) in consultation and coordination.

Tribal Wind Energy Development on Reservation Lands

Indian tribal governments have the authority to develop wind energy projects, permit their development, and establish relevant regulatory guidance within the framework of applicable laws.

The Service will provide technical assistance upon the request of Tribes that aim to establish regulatory guidance for wind energy development for lands under the Tribe's jurisdiction. Tribal governments are encouraged to strive for compatibility between their guidelines and these Guidelines.

Tribal Wind Energy Development on Lands that are not held in Trust

Indian tribal governments may wish to develop wind energy projects on lands that are not held in trust status. In such cases, the Tribes should coordinate with agencies other than the Service. At the request of a Tribe, the Service may facilitate discussions with other regulatory organizations. The Service may also lend its expertise in these collaborative efforts to help determine the extent to which tribal resource management plans and priorities can be incorporated into established regulatory protocols.

Non-Tribal Wind Energy Development – Consultation with Indian Tribal Governments

When a non-Tribal wind energy project is proposed that may affect a Tribe's resources (including cultural resources), lands, rights, or ability to govern or provide services to its members, the Service should seek to engage the affected Tribe(s) in consultation and coordination as

early as possible in the process. In siting a proposed project that has a federal nexus, it is incumbent upon the regulatory agency to notify potentially affected Tribes of the proposed activity. If the Service or other federal agency determines that a project may affect a Tribe(s), they should notify the Tribe(s) of the action at the earliest opportunity. At the request of a Tribe, the Service may facilitate and lend its expertise in collaborating with other organizations to help determine the extent to which tribal resource management plans and priorities can be incorporated into established regulatory protocols or project implementation. This process ideally should be agreed to by all involved parties.

In the consultative process, Tribes should be engaged as soon as possible when a decision may affect a Tribe(s). Decisions made that affect Indian Tribal governments without adequate federal effort to engage Tribe(s) in consultation have been overturned by the courts. See, e.g., Quechan Tribe v. U.S. Dep't of the Interior, No. 10cv2241 LAB (CAB), 2010 WL 5113197 (S.D. Cal. Dec. 15, 2010). When a tribal government is consulted, it is neither required, nor expected that all of the Tribe's issues can be resolved in its favor. However, the Service must listen and may not arbitrarily dismiss concerns of the tribal government. Rather, the Service must seriously consider and respond to all tribal concerns. Regional Native American Liaisons are able to provide in-house guidance as to government-to-government consultation processes. (See Service - State Coordination and Cooperation, above).

Non-Governmental Organization Actions

If a specific project involves actions at the local, state, or federal level that provide opportunities for public participation, non-governmental organizations (NGOs) can provide meaningful contributions to the discussion of biological issues associated with that project, through the normal processes such as scoping, testimony at public meetings, and comment processes. In the absence of formal public process, there are many NGOs that have substantial scientific capabilities and may have resources that could contribute productively to the siting of wind energy projects. Several NGOs have made significant contributions to the understanding of the importance of particular geographic areas to wildlife in the United States. This work has benefited and continues to benefit from extensive research efforts and from associations with highly qualified biologists. NGO expertise can – as can scientific expertise in the academic or private consulting sectors – serve highly constructive purposes. These can include:

- Providing information to help identify environmentally sensitive areas, during the screening phases of site selection (Tiers 1 and 2, as described in this document)
- Providing feedback to developers and agencies with respect to specific sites and site and impact assessment efforts
- Helping developers and agencies design and implement mitigation or offset strategies
- Participating in the defining, assessing, funding, and implementation of research efforts in support of improved predictors of risk, impact assessments and effective responses
- Articulating challenges, concerns, and successes to diverse audiences

Non-Governmental Organization Conservation Lands

Implementation of these Guidelines by Service and other state agencies will recognize that lands owned and managed by non-government conservation organizations represent a significant investment that generally supports the mission of state and federal wildlife agencies. Many of these lands represent an investment of federal conservation funds, through partnerships between agencies and NGOs. These considerations merit extra care in the avoidance of wind energy development impacts to these lands. In order to exercise this care, the Service and allied agencies can coordinate and consult with NGOs that own lands or easements which might reasonably be impacted by a project under review.

Appendix A: Glossary

Accuracy – The agreement between a measurement and the true or correct value.

Adaptive management – An iterative decision process that promotes flexible decision-making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Comprehensively applying the tiered approach embodies the adaptive management process.

Anthropogenic – Resulting from the influence of human beings on nature.

Area of interest – For most projects, the area where wind turbines and meteorological (met) towers are proposed or expected to be sited, and the area of potential impact.

Avian – Pertaining to or characteristic of birds.

Avoid – To not take an action or parts of an action to avert the potential effects of the action or parts thereof. First of three components of "mitigation," as defined in Service Mitigation Policy. (See mitigation.)

Before-after/control-impact (BACI) – A study design that involves comparisons of observational data, such as bird counts, before and after an environmental disturbance in a disturbed and undisturbed site. This study design allows a researcher to assess the effects of constructing and operating a wind turbine by comparing data from the "control" sites (before and undisturbed) with the "treatment" sites (after and disturbed).

Best management practices (BMPs) – Methods that have been determined by the stakeholders to be the most effective, practicable means of avoiding or minimizing significant adverse impacts to individual species, their habitats or an ecosystem, based on the best available information.

Buffer zone – A zone surrounding a resource designed to protect the resource from adverse impact, and/or a zone surrounding an existing or proposed wind energy project for the purposes of data collection and/or impact estimation.

Community-scale – Wind energy projects greater than 1 MW, but generally less than 20 MW, in name-plate capacity, that produce electricity for off-site use, often partially or totally owned by members of a local community or that have other demonstrated local benefits in terms of retail power costs, economic development, or grid issues.

Comparable site – A site similar to the project site with respect to topography, vegetation, and the species under consideration.

Compensatory mitigation – Replacement of project-induced losses to fish and wildlife resources. Substitution or offsetting of fish and wildlife resource losses with resources considered to be of equivalent biological value.

- **In-kind** – Providing or managing substitute resources to replace the value of the resources lost, where such substitute resources are physically and biologically the same or closely approximate to those lost.

- **Out-of-kind** – Providing or managing substitute resources to replace the value of the resources lost, where such substitute resources are physically or biologically different from those lost. This may include conservation or mitigation banking, research or other options.

Cost effective – Economical in terms of tangible benefits produced by money spent.

Covariate – Uncontrolled random variables that influence a response to a treatment or impact, but do not interact with any of the treatments or impacts being tested.

Critical habitat – For listed species, consists of the specific areas designated by rule making pursuant to Section 4 of the Endangered Species Act and displayed in 50 CFR § 17.11 and 17.12.

Cumulative impacts – See impact.

Curtailment – The act of limiting the supply of electricity to the grid during conditions when it would normally be supplied. This is usually accomplished by cutting-out the generator from the grid and/or feathering the turbine blades.

Cut-in Speed – The wind speed at which the generator is connected to the grid and producing electricity. It is important to note that turbine blades may rotate at full RPM in wind speeds below cut-in speed.

Displacement – The loss of habitat as result of an animal's behavioral avoidance of otherwise suitable habitat. Displacement may be short-term, during the construction phase of a project, temporary as a result of habituation, or long-term, for the life of the project.

Distributed wind – Small and mid-sized turbines between 1 kilowatt and 1 megawatt that are installed and produce electricity at the point of use to off-set all or a portion of on-site energy consumption.

Ecosystem – A system formed by the interaction of a community of organisms with their physical and chemical environment. All of the biotic elements (i.e., species, populations, and communities) and abiotic elements (i.e., land, air, water, energy) interacting in a given geographic area so that a flow of energy leads to a clearly defined trophic structure, biotic diversity, and material cycles. Service Mitigation Policy adopted definition from E. P. Odum 1971 Fundamentals of Ecology.

Edge effect – The effect of the juxtaposition of contrasting environments on an ecosystem.

Endangered species – See listed species.

Extirpation – The species ceases to exist in a given location; the species still exists elsewhere.

Fatality – An individual instance of death.

Fatality rate – The ratio of the number of individual deaths to some parameter of interest such as megawatts of energy produced, the number of turbines in a wind project, the number of individuals exposed, etc., within a specified unit of time.

Feathering – Adjusting the angle of the rotor blade parallel to the wind, or turning the whole unit out of the wind, to slow or stop blade rotation.

Federal action agency – A department, bureau, agency or instrumentality of the United States which plans, constructs, operates or maintains a project, or which reviews, plans for or approves a permit, lease or license for projects, or manages federal lands.

Federally listed species – See listed species.

Footprint – The geographic area occupied by the actual infrastructure of a project such as wind turbines, access roads, substation, overhead and underground electrical lines, and buildings, and land cleared to construct the project.

G1 (Global Conservation Status Ranking) Critically Imperiled – At very high risk of extinction due to extreme rarity (often five or fewer populations), very steep declines, or other factors.

G2 (Global Conservation Status Ranking) Imperiled – At high risk of extinction or elimination due to very restricted range, very few populations, steep declines, or other factors.

G3 (Global Conservation Status Ranking) Vulnerable – At moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factors.

Guy wire – Wires used to secure wind turbines or meteorological towers that are not self-supporting.

Habitat – The area which provides direct support for a given species, including adequate food, water, space, and cover necessary for survival.

Habitat fragmentation – Habitat fragmentation separates blocks of habitat for some species into segments, such that the individuals in the remaining habitat segments may suffer from effects such as decreased survival, reproduction, distribution, or use of the area.

Impact – An effect or effects on natural resources and on the components, structures, and functioning of affected ecosystems.

- **Cumulative** – Changes in the environment caused by the aggregate of past, present and reasonably foreseeable future actions on a given resource or ecosystem.
- **Direct** – Effects on individual species and their habitats caused by the action, and occur at the same time and place.
- **Indirect impact** – Effects caused by the action that are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect impacts include displacement and changes in the demographics of bird and bat populations.

Infill – Add an additional phase to the existing project, or build a new project adjacent to existing projects.

In-kind compensatory mitigation – See compensatory mitigation.

Intact habitat – An expanse of habitat for a species or landscape scale feature, unbroken with respect to its value for the species or for society.

Intact landscape – Relatively undisturbed areas characterized by maintenance of most original ecological processes and by communities with most of their original native species still present.

Lattice design – A wind turbine support structure design characterized by horizontal or diagonal lattice of bars forming a tower rather than a single tubular support for the nacelle and rotor.

Lead agency – Agency that is responsible for federal or non-federal regulatory or environmental assessment actions.

Lek – A traditional site commonly used year after year by males of certain species of birds (e.g., greater and lesser prairie-chickens, sage and sharp-tailed grouse, and buff-breasted sandpiper), within which the males display communally to attract and compete for female mates, and where breeding occurs.

Listed species – Any species of fish, wildlife or plant that has been determined to be endangered or threatened under section 4 of the Endangered Species Act (50 CFR §402.02), or similarly designated by state law or rule.

Local population – A subdivision of a population of animals or plants of a particular species that is in relative proximity to a project.

Loss – As used in this document, a change in wildlife habitat due to human activities that is considered adverse and: 1) reduces the biological value of that habitat for species of concern; 2) reduces population numbers of species of concern; 3) increases population numbers of invasive or exotic species; or 4) reduces the human use of those species of concern.

Megawatt (MW) – A measurement of electricity-generating capacity equivalent to 1,000 kilowatts (kW), or 1,000,000 watts.

Migration – Regular movements of wildlife between their seasonal ranges necessary for completion of the species lifecycle.

Migration corridor – Migration routes and/or corridors are the relatively predictable pathways that a migratory species travel between seasonal ranges, usually breeding and wintering grounds.

Migration stopovers – Areas where congregations of wildlife assemble during migration. Such areas supply high densities of food or shelter.

Minimize – To reduce to the smallest practicable amount or degree.

Mitigation – (Specific to these Guidelines) Avoiding or minimizing significant adverse impacts, and when appropriate, compensating for unavoidable significant adverse impacts.

Monitoring – 1) A process of project oversight such as checking to see if activities were conducted as agreed or required; 2) making measurements of uncontrolled events at one or more points in space or time with space and time being the only experimental variable or treatment; 3) making measurements and evaluations through time that are done for a specific purpose, such as to check status and/or trends or the progress towards a management objective.

Mortality rate – Population death rate, typically expressed as the ratio of deaths per 100,000 individuals in the population per year (or some other time period).

Operational changes – Deliberate changes to wind energy project operating protocols, such as the wind speed at which turbines "cut in" or begin generating power, undertaken with the object of reducing collision fatalities. Considered separately from standard mitigation measures due to the fact that operational changes are considered as a last resort and will rarely be implemented if a project is properly sited.

Passerine – Describes birds that are members of the Order Passeriformes, typically called "songbirds."

Plant communities of concern –Plant communities of concern are unique habitats that are critical for the persistence of highly specialized or unique species and communities of organisms. Often restricted in distribution or represented by a small number of examples, these communities are biological hotspots that significantly contribute to the biological richness and productivity of the entire region. Plant communities of concern often support rare or uncommon species assemblages, provide critical foraging, roosting, nesting, or hibernating habitat, or perform vital ecosystem functions. These communities often play an integral role in the conservation of biological integrity and diversity across the landscape. (Fournier et al. 2007) Also, any plant community with a Natural Heritage Database ranking of S1, S2, S3, G1, G2, or G3.

Population – A demographically and genetically self-sustaining group of animals and/or plants of a particular species.

Practicable – Capable of being done or accomplished; feasible.

Prairie grouse – A group of gallinaceous birds, includes the greater prairie-chicken, the lesser prairie-chicken, and the sharp-tailed grouse.

Project area – The area that includes the project site as well as contiguous land that shares relevant characteristics.

Project commencement – The point in time when a developer begins its preliminary evaluation of a broad geographic area to assess the general ecological context of a potential site or sites for wind energy project(s). For example, this may include the time at which an option is acquired to secure real estate interests, an application for federal land use has been filed, or land has been purchased.

Project Site – The land that is included in the project where development occurs or is proposed to occur.

Project transmission lines – Electrical lines built and owned by a project developer.

Raptor – As defined by the American Ornithological Union, a group of predatory birds including hawks, eagles, falcons, osprey, kites, owls, vultures and the California condor.

Relative abundance – The number of organisms of a particular kind in comparison to the total number of organisms within a given area or community.

Risk – The likelihood that adverse effects may occur to individual animals or populations of species of concern, as a result of development and operation of a wind energy project. For detailed discussion of risk and risk assessment as used in this document see Chapter One - General Overview.

Rotor – The part of a wind turbine that interacts with wind to produce energy. Consists of the turbine's blades and the hub to which the blades attach.

Rotor-swept area – The area of the circle or volume of the sphere swept by the turbine blades.

Rotor-swept zone – The altitude within a wind energy project which is bounded by the upper and lower limits of the rotor-swept area and the spatial extent of the project.

S1 (Subnational Conservation Status Ranking) Critically Imperiled – Critically imperiled in the jurisdiction because of extreme rarity or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the jurisdiction.

S2 (Subnational Conservation Status Ranking) Imperiled – Imperiled in the jurisdiction because of rarity due to very restricted range, very few populations, steep declines, or other factors making it very vulnerable to extirpation from jurisdiction.

S3 (Subnational Conservation Status Ranking) Vulnerable – Vulnerable in the jurisdiction due to a restricted range, relatively few populations, recent and widespread declines, or other factors making it vulnerable to extirpation.

Sage grouse – A large gallinaceous bird living in the sage steppe areas of the intermountain west, includes the greater sage grouse and Gunnison's sage grouse.

Significant – For purposes of characterizing impacts to species of concern and their habitats, "significance" takes into account the duration, scope, and intensity of an impact. Impacts that are very brief or highly transitory, do not extend beyond the immediate small area where they occur, and are minor in their intensity are not likely to be significant. Conversely, those that persist for a relatively long time, encompass a large area or extend well beyond the immediate area where they occur, or have substantial consequences are almost certainly significant. A determination of significance may include cumulative impacts of other actions. There is probably some unavoidable overlap among these three characteristics, as well as some inherent ambiguity in these terms, requiring the exercise of judgment and the development of a consistent approach over time.

Species of concern – For a particular wind energy project, any species which 1) is either a) listed as an endangered, threatened or candidate species under the Endangered Species Act, subject to the Migratory Bird Treaty Act or Bald and Golden Eagle Protection Act; b) is designated by law, regulation, or other formal process for protection and/or management by the relevant agency or other authority; or c) has been shown to be significantly adversely affected by wind energy development, and 2) is determined to be possibly affected by the project.

Species of habitat fragmentation concern—Species of concern for which a relevant federal, state, tribal, and/or local agency has found that separation of their habitats into smaller blocks reduces connectivity such that the individuals in the remaining habitat segments may suffer from effects such as decreased survival, reproduction, distribution, or use of the area. Habitat fragmentation from a wind energy project may create significant barriers for such species.

String – A number of wind turbines oriented in close proximity to one another that are usually sited in a line, such as along a ridgeline.

Strobe – Light consisting of pulses that are high in intensity and short in duration.

Threatened species – See listed species.

Tubular design – A type of wind turbine support structure for the nacelle and rotor that is cylindrical rather than lattice.

Turbine height – The distance from the ground to the highest point reached by the tip of the blades of a wind turbine.

Utility-scale – Wind projects generally larger than 20 MW in nameplate generating capacity that sell electricity directly to utilities or into power markets on a wholesale basis.

Voltage (low and medium) – Low voltages are generally below 600 volts, medium voltages are commonly on distribution electrical lines, typically between 600 volts and 110 kV, and voltages above 110 kV are considered high voltages.

Wildlife – Birds, fishes, mammals, and all other classes of wild animals and all types of aquatic and land vegetation upon which wildlife is dependent.

Wildlife management plan – A document describing actions taken to identify resources that may be impacted by proposed development; measures to mitigate for any significant adverse impacts; any post-construction monitoring; and any other studies that may be carried out by the developer.

Wind turbine – A machine for converting the kinetic energy in wind into mechanical energy, which is then converted to electricity..

Appendix B: Literature Cited

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U.S. Fish & Wildlife Service
http://www.fws.gov

March 2012

Statement of Safety and Health Commitments

Pattern Energy is committed to the safety and health of our employees, contractors, and people in the communities where we work. There is nothing more important than having our people return home safely at the end of each workday. We incorporate safety and wellness into our decision making in everything we do. We believe in having an injury-free workplace, and we aspire to create an environment where this is possible. To this end, Pattern Energy strives to:

- Follow all applicable health and safety laws and regulations as our minimum standard.
- Engage our employees to identify potential hazards and develop proper mitigations.
- Provide training to all employees so they may recognize and mitigate risks.
- Empower our workforce to use their “stop work” authority to halt activity if they perceive a hazard that may endanger themselves or others.
- Identify root causes and learn from any accidents that may occur.
- Construct our projects and operate our facilities using best practices to prevent injury to employees, contractors, and the public.
- Contract with companies that share our values and commit to supporting our vision of an injury-free workplace.
- Work to monitor, report, and continually improve our overall safety performance.

Statement of Environmental Commitments

Pattern Energy is committed to protecting the environment. We believe climate change is the world's biggest environmental challenge, and producing energy from clean, renewable sources is essential to reducing the global carbon footprint. We consider it our responsibility to produce and transport renewable energy to consumers in a way that respects the integrity of our environment. To this end, Pattern Energy strives to:

- Develop, construct, and operate responsibly by complying with all environmental laws and regulations as our minimum standard and implementing best practices where local regulations are not as stringent.
- Assess potential positive and negative ecological impacts and incorporate them into our decision-making, applying our creative spirit and energy to explore sustainable mitigation solutions to minimize adverse effects.
- Listen to people in communities where we work, including community representatives and natural resource agencies, during the planning of our projects.
- Site and design our projects in a manner that respects wildlife and their habitats.
- Construct our projects using best practices to prevent pollution and conserve our natural resources.
- Work to monitor, report, and continually improve our overall environmental performance.

Statement of Community and Cultural Commitments

Pattern Energy considers our company to be a part of the local communities where we have a presence. We believe acting as a good neighbor benefits both the areas where we operate and our company's long-term success. We are committed to listening to and respecting the communities that host our projects and being involved in engagement and giving activities for the long term. To this end, Pattern Energy strives to:

- Share information and solicit input to build local relationships while respecting and considering all points of view.
- Explore ways to support the growth of healthy and vibrant communities where we work through sponsorships and donations.
- Identify and assess potential positive and negative community and cultural impacts to inform our planning and decision-making.
- Design and construct our projects and operate our facilities in a manner that complies with all siting regulations.
- Work to monitor, report, and continually improve our overall performance, incorporating feedback into our outreach and giving programs.

Statement of Diversity, Equity, and Inclusion Commitments

Pattern Energy is committed to a diverse, equitable, and inclusive workplace where all employees belong, regardless of gender, gender identity, race, ethnicity, national origin, age, sexual orientation, religion, or ability. We believe having diversity in our teams and our leadership, while providing an environment where employees from underrepresented groups are encouraged and empowered, leads to a more engaged workforce and better business outcomes. We recognize diversity, equity, and inclusion are multifaceted and changing behaviors and systems takes work and time. We pledge to take actions that result in lasting change at Pattern Energy by committing to the following:

- Develop and act on strategic action plans to ensure our Diversity, Equity, and Inclusion (DE&I) commitments achieve concrete results and prioritize and drive accountability.
- Identify, track, and report on DE&I performance metrics and progress on DE&I initiatives.
- Determine and address DE&I barriers that impact talent acquisition and development, retention, recognition, and advancement.
- Create a community where employees are comfortable bringing their authentic selves to work and are open to participating in difficult conversations, allowing employees to gain greater awareness of each other's experiences and perspectives.
- Encourage, support, and resource our employee-led Affinity Networks.
- Support the Pattern Energy DE&I Council to provide input into our DE&I initiatives.
- Enhance our culture by demonstrating these commitments throughout all levels of the organization.

Building Wildlife-Friendly Wind

As a renewable energy company, Pattern Energy is committed to protecting the environment. We consider it our responsibility to provide renewable energy with the least amount of impact to the environment, especially when it comes to wildlife.

Pattern Energy follows in-depth wildlife protection protocols at all of our wind farms. In fact, we are one of the industry leaders in promoting environmentally-friendly wind energy, while conserving and protecting wildlife. Take a look at some of what we do to ensure that we build wildlife-friendly wind energy:

1. Identify Potential Impacts From the Start

With every new wind farm, we study and identify the wildlife that could potentially be affected by our activities before we move forward with any project.

2. Build Wisely

Once we've selected a specific location to build a wind farm, our team begins conducting studies, consulting with regulatory agencies and other stakeholders, and working with other departments at key stages of development to ensure that we:

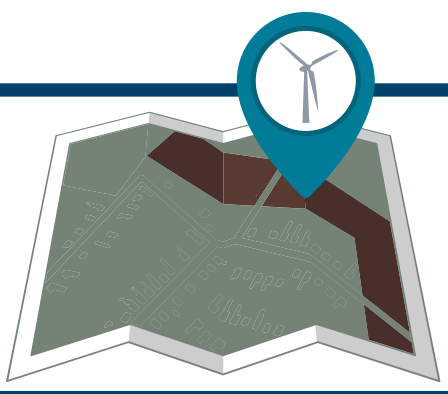
A. Avoid Impact

If there are certain areas of a site that could significantly affect wildlife, we will try to avoid that area and build around it.

Example: *If there's an eagle nest nearby, Pattern Energy will try to site project turbines away from that nest.*

B. Minimize Impact

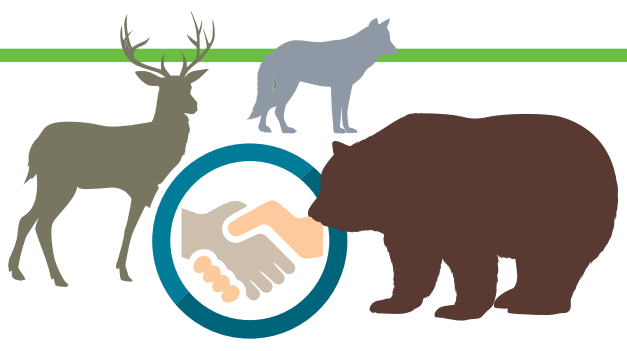
When avoidance isn't feasible, we try to minimize impacts.



Example: *If project areas contain native prairie grassland, we will try to microsite turbines in already disturbed areas such as cropland. This helps to preserve the intact habitat that could be utilized by grouse species like prairie chickens, which are species of habitat fragmentation concern.*

C. Mitigate Impact

When avoidance and minimization isn't enough to reduce significant adverse impacts, we provide compensatory mitigation.



Example: *If impacts are unavoidable, Pattern may provide compensatory mitigation such as the purchase and management of prime habitat for at risk wildlife in the area.*

Example: *If we're in an area where there are endangered bats, we will employ various mitigation measures such as cave gating and operate our turbines in a manner that reduces impacts to bats during crucial migration periods.*

3. Monitor the Area

Our work of protecting wildlife doesn't stop once the site is up and running. We make sure that all on-site employees are mindful of local wildlife and train them in the proper protocol to avoid, minimize and mitigate impacts.

Monitoring is different and specialized for each location. Whether it's sending a biomonitor out to make sure we aren't affecting nearby endangered lizards or physically relocating species so they aren't impacted by the turbines, we employ a diverse set of tools to address specific issues of each project.

At Pattern Energy, we believe that it is fundamental to produce energy in a way that respects the integrity of our natural environment. Through our protocols, we work to continually improve our overall environmental performance so we can protect the environment, especially wildlife, at all of our wind farms.

To learn more about our environmental protocol, contact Rene Braud at rene.braud@patternenergy.com today.

Category	No.	Final BMP Language
Design	1	New surface disturbance will be minimized within 200 feet of the boundary of riparian areas, wetlands, playas or other water bodies (e.g., the ordinary high water mark) to the extent practicable. Where avoidance is not practicable, impacts will be minimized and comply with the U.S. Army Corps of Engineers Nationwide Permit under Section 404 of the Clean Water Act. Boring under these water features may be utilized where practicable and designs are approved. To minimize new surface disturbance within 200 feet of the boundary of any riparian area, wetland, playa or other water body means: only temporary use will be allowed; no blading, grading, or digging; no permanent structures; no permanent roads (with the exception of the permanent maintenance road where no other route is possible, but never across playas); no introduction of outside material, (ie gravel, caliche, base course), no mechanical compaction, and full reclamation requirements for any temporary use: flipping or ripping compacted temporary use areas if necessary; reseeding, weed control, re-contouring to previous condition. For any permanent maintenance road crossing a riparian area, to minimize new surface disturbance means the minimium width that is absolutely necessary, and the road must be designed to allow the natural hydrology of the basin to continue functioning as if the road was not there: built to allow water to move under, through or across the road, without catchments or pooling or channeling, with erosion control structures and flow dispersal structures as necessary, and plantings as necessary to manage hydrologic functioning condition.
	2	All efforts should be made to minimize new surface disturbance: new roads and rights-of-way should make use of pre-existing disturbed areas, including existing roadbeds, pipeline or utility line rights-of-way, or in pre-existing or dedicated corridors when practicable.
	3	No new surface disturbance will be permitted within 200' feet of the centerline of ephemeral drainages, floodways, arroyos or other short duration flow channels, except when crossing these channels and drainages. Where avoidance is not practicable, impacts will be minimized and comply with the U.S. Army Corps of Engineers Nationwide Permit under Section 404 of the Clean Water Act. Drainage crossings will be perpendicular to flow, and will be built to accommodate 25-year flood events and to control erosion. Boring under these water features may be utilized where practicable and designs are approved.
	4	Establish property boundaries.
	5	Minimize new surface disturbance and design for minimum necessary width/area of impact according to expected purpose and use.
	6	Avoid wetlands, known critical habitat and protected areas;
	7	Avoid steep slopes (>12%) where practicable; grades from 4-10% are preferred for managing drainage; roads and rights-of-way are best placed at the toe of slopes where cross slope is between 5% and 40%
	8	Preserve as much natural vegetation and living root structure as possible. If the material is less than three inches in diameter, lopping and scattering is permitted. If greater than three inches, the material can be chipped or masticated then spread to no thicker than four and a half inches.
	9	Provide adequate surface drainage; as grade steepens drainage features, such as water bars, must be closer together; drainage features on fine grained soils should be closer together;

		10	Account for cultural resources at least in accordance with minimum standards as set forth in NMSLO policy ADM-0106	
		11	Account for biological resources at least in accordance with minimum standards as set forth in NMSLO Policy ADM-0105	
		12	Include a spill containment and prevention plan where hazardous materials are involved	
		13	Include a reclamation plan detailing soil stabilization and revegetation process;	
		14	Include an access control plan	
		15	All reclamation success criteria shall follow federal NPDES guidelines whereas a minimum of 70% density (of pre-existing conditions) of native flora shall be successfully reestablished prior to release from permit requirements for ongoing inspections and maintenance of temporary ESC BMPs.	
		16	Use only native weed-free certified seed for reclamation	
		17	Include a noxious weed prevention plan	ADDED
		18	Include a dust abatement plan	ADDED

Land Office Required Practices for Surface Users		19	Address crown, inslope, outslope and shoulder design (roads)
		20	Address trenching and boring design, including depth, casing, core sampling, valve location and access management (pipelines)
		21	Define use, location and size of temporary work space, temporary storage and turnouts;
		22	Address logistics of construction;
		1	Address all pertinent state and federal regulations.
		2	Control access to the construction site;
		3	Control unauthorized use of space adjacent to permitted rights-of-way and use areas
		4	Maintain temporary erosion control structures, such as silt fencing to prevent sediment flow during construction
		5	All water utilized for dust abatement shall be suitable for meeting federal NPDES guidelines for revegetation, whereby a minimum of 70% density (of pre-existing conditions) of native flora shall be successfully reestablished prior to release from permit requirements for ongoing inspections and maintenance of temporary ESC BMPs
		6	When requested by the Commissioner, engage a compliance inspection officer to monitor quality control and compliance with NMSLO best management practices
		7	Sample, test and monitor to ensure construction materials meet design specifications;
		1	Dispose of unsuitable or excess excavation material in approved locations to minimize adverse impacts to water quality or other resources.
		2	Grade and shape roadway surfaces to maintain distinct inslope, outslope or crown shape to move water effectively off the road surface

New Mexico State		3	Compact graded roadway surfaces to preserve hard driving surface; replace surface material when needed; implement dust abatement plans
		4	Fill ruts and potholes with gravel or compacted fill or remove ruts through rolling dips and water bars; reshape structures to maintain proper function
		5	Clean ditches and reshape when necessary to allow adequate flow capacity;
		6	Remove debris from the entrance of culverts to prevent plugging and overtopping; check for signs of damage
		7	Replace or repair rock armor, erosion control structures, or vegetation used for slope protection, scour protection or energy dissipation
		8	Inspect and repair fencing, gates, cattle-guards and other access control structures;
		1	Inspect reclamation, revegetation and noxious weed treatments and retreat as necessary to maintain proper functioning of erosion control and establishment of native vegetation
		2	Seek a remediation right-of-entry for any reclamation of state trust land outside the bounds of the permitted right-of-way
		3	Verify compliance with NMSLO biological and cultural resource policies (ADM-0105 and ADM-0106) for the area to be reclaimed;
		4	Sample, remove and properly dispose of any contaminated soils
		5	Remove and properly dispose of any caliche or other surface base course
		6	Contaminated soils and caliche should be disposed of only in state permitted disposal locations, such as land farms or hazardous disposal sites

	Reclamation	**7**	Replace caliche, base course or contaminated soils with certified clean top soil comparable to undisturbed clean soils in the near vicinity
		8	Contour the ground surface to blend in with the surrounding topography and to allow the natural hydrology of the basin to function without impediment or impact;
		9	Install erosion control structures as necessary to repair and control gullies, head-cuts, rills, and other forms of sediment movement
		10	Erosion control structures should be designed to restore natural hydrologic function and to the extent possible should use local rock or bio-degradable materials and low-energy, minimum necessary designs;
		11	Structures may include, but are not limited to, one rock dams, rock mulch rundowns, zuni bowls, media lunas, swales, berms, terraces, wattles, rock or log mats, hay mulch, gabions, bales or other stabilizing enhancements to control erosion
		12	Prepare the seedbed to maximize potential for success. This may include, but is not limited to, a combination of watering, mechanical packing to consolidate loose soils, disking to loosen compacted soils, or crimping hay mulch into the soil, (2 tons/acre), adding soil amendments, contouring and/or importing top soil

13	Install water bars, or other NMSLO approved flow control, at an angle of 30% to the grade along the contour of the road or right-of-way, up to two feet high and six feet wide; water bars should be placed on any slope greater than level, every ten feet in elevation change or every 300 feet, whichever is less	
14	Seed the prepared seedbed with a drill seeder or hydraulic seeder. Hydroseeding will be used on 3:1 slopes or greater. The seed mix will be based on NMSLO revegetation guidelines and will be provided or approved by the NMSLO;	
15	In the event of a spill or hazardous materials release, the project SPCC Plan guidelines must be followed and reporting requirements set forth by NMED shall be followed. Provide draft copy of SPCC Plan to SLO for approval.	
16	A noxious weed plan will be developed and noxious weeds will be monitored and treated on an annual basis, or as needed, for three years post construction.	ADDED
Category		
Objective	To reduce and prevent erosion, remove contaminants and contaminated materials, restore clean soils, restore native plant diversity and abundance, restore and maintain hydrological regime, and restore and maintain productive habitat for livestock and wildlife;	

Applicability		These Minimum Requirements are applicable to all reclamation activities on state trust lands including: hazardous materials spills/releases, site closure for oil and gas, mineral and business leases, plug and abandon site reclamation, mine site reclamation, pit, pad, or pond reclamation, illegal dump reclamation, road and pipeline reclamation, dairy farm or other agricultural impact reclamation, and any other clean up or reclamation activity on state trust land;
Access	**1**	If the spill/release or reclamation project extends beyond the lease boundary or permitted right of way, contact the NMSLO Rights Of Way Division and obtain a remediation right-of-entry;
Compliance	**2**	Before commencing any new ground disturbing activity:
	3	(a). Conduct an archaeological survey of the impacted area, or verify that the area has already been surveyed and that no cultural properties will be impacted by ground disturbing activities;
	4	(b). If cultural properties have been impacted by a spill/release or reclamation project, immediately stop all ground disturbing activities and contact NMSLO for further direction;
	5	(c). Verify compliance with NMSLO biological and cultural resource policies (ADM-0105 and ADM-0106) for the area to be reclaimed; conduct surveys where necessary;
	6	(d). Verify compliance with all state and federal regulations, including but not limited to storm water pollution and prevention, air quality control, and hazardous materials disposal;
	7	Other Spills/Releases: (i). Upon discovery of any non-oil and gas related hazardous material release, including mine waste, either current or historic, immediately notify NMED and NMSLO;

Delineation	**8**	Upon discovery of contaminated soils, delineate the horizontal and vertical extent of the contamination;
	9	For any spill on State Trust Lands: Written Report for all spills. For spills greater than 25 gallons, immediate notification (email address to be defined) to SLO within 24 hours
	10	For non-oil and gas related contamination, the NMED may require delineation and monitoring related to surface and ground water impacts
	11	The NMSLO may require any necessary sampling or reclamation related to the restoration of surface conditions within 60 days post-notification.
Reclamation Plan	**12**	A project revegetation plan will be designed to meet NPDES requirements and submitted to NMSLO for review and approval.
Removal/Containment	**13**	Remove and replace, or stabilize and contain any contaminated soils, including contaminated caliche or base course; remove and replace all caliche or base course; contaminated soils and caliche should be disposed of only in state permitted disposal locations, such as land farms or hazardous disposal sites, and in accordance with state and federal regulations
Soil Replacement	**14**	Replace contaminated soils, caliche or base course, and uncontaminated caliche or base course, with certified clean top soil; soils should have comparable structure and chemistry to healthy, native undisturbed soils in the vicinity;
Trash and Debris	**15**	Unless equipment is to be re-used onsite, any trash, debris, garbage, rubbish, junk, scrap, or broken or contaminated equipment, such as pipelines, plastic lining, surface flowlines, tanks, scrap materials of any kind, or other equipment must be removed and disposed of in accordance with state and federal regulations within 30 days of final use or completion of construction;
	16	No hazardous substances, trash or litter will be buried or placed in pits
Surface Preparation	**17**	Contour the ground surface to blend in with the surrounding topography to allow the natural hydrology of the basin to function without impediment or impact;

emens for Surface Reclamation

New Mexico State Land Office Minimum Requir

	18	No major depressions or pits will be left that will trap water or cause ponding except where the project involves a mining pit where there is no possible outlet, such as a caliche pit;		
Erosion Control	19	Where active transportation of sediment through gullying, headcutting, slumping or deep or excessive rills (greater than 3 inches deep) occurs within the lease area or within the adjacent area of impact, install erosion control structures to repair and control gullies, head-cuts, rills, and other forms of sediment movement		
	20	(a). Erosion control structures should be designed to restore natural hydrological function and flood regime, and to the extent possible should use local rock or biodegradable materials and low-energy, minimum-necessary designs		
	21	(b). Erosion control structures may include, but are not limited to, one rock dams, rock mulch rundowns, zuni bowls, media lunas, swales, berms, terraces, wattles, rock or log mats, hay mulch, gabions, bales or other stabilizing enhancements to control erosion		
Drainage Control	22	Drainage control structures should be designed to mimic natural hydrological function and flood regime as much as possible so as not to increase the erosional impact of hydrologic flows to the structure or to the upstream or downstream landscape; drainage control designs should be engineered and stamped by a PE.		
	23	(b). Drainage control structures may include but are not limited to road bars, culverts, water bars, parallel and lateral ditches, drains, and low water crossings;		
Seedbed Preparation	24	Revegetation to meet or exceed 70% density of surrounding cover. If straw/hay mulching is used, straw/hay must be certified weed free.		
Revegetation	25	On 3:1 slopes or greater additional revegetation BMPs shall be deployed (such as: hydromulching, crimp mulching, or erosion control blanket)		
Noxious Weeds	26	A noxious weed plan will be developed and approved by the NMSLO and noxious weeds will be monitored and treated on a semi-annual basis for three years post-construction.		

Access Control * applicable to SLO properties	**27**	a. Gate and Fencing Specifications: Unless otherwise directed by the NMSLO, a locked metal gate with 4-inch H-braces and a permanent fence extending at least 100 feet from either side of the gate, or to the next adjacent gate, will be installed to block public access to all closed reclamation sites; fence will be constructed with steel T-posts on 16-foot spacing, with stays every 8 feet and 4 strands ofbarbed wire; the top wire should be set at 42 inches above the ground surface; inline braces will be used at intervals not to exceed 660 feet; corners will be braced and set in concrete; fence wire will be attached on the outside of the T-posts with wire ties;
	28	b. Permanent Closure Specifications: Dirt berms, permanent hard barriers or rock barricades will be installed to block unauthorized access points to reclamation sites; berms and barriers will be at least 3 feet high and will extend the width of the access point; berms will be hard packed; barriers and barricades may be constructed of metal pipe rail, concrete, or rock and may be used in combination with berm work to ensure closure of an access point; Keep these areas from being general access routes for the public. Require fencing with requests for other options on a case-by- case basis.
Monitoring	**29**	The responsible party will monitor the reclamation site annually until relinquished by the NMSLO during restoration sign-off process and completion of action item list.

		30	Prior to relinquishment, the NMSLO will retain the right to inspect and to provide sign-off prior to release and may require supplemental clean up, maintenance of erosion control structures, additional reseeding efforts, or noxious weed treatments to ensure success of reclamation.
		31	The NMSLO may request detailed annual monitoring reports depending on the severity of the situation
	Reporting	32	The NMSLO may require monthly updates during the course of the initial reclamation work; monthly updates will include a brief narrative statement of work completed with photo documentation; upon completion of the initial reclamation work, the responsible party will notify the NMSLO that the site is ready for inspection; rights of way lessees will provide an affidavit of completion (NMAC 19.2.10.21); annual monitoring reports may be required depending on the severity of the situation.
	Relinquishment	33	The NMSLO will inspect the initial reclamation work upon completion and will provide the responsible party with a statement indicating that the initial work has been completed as required and detailing any follow up work that may be necessary prior to relinquishment; notice of relinquishment will be provided upon complete satisfaction of all NMSLO reclamation requirements;
W	**Watershed**	1	Minimize the number of roads constructed in a watershed through comprehensive road planning, recognizing intermingled ownership, and foreseeable future uses.
		2	All personnel appointed as fire watch under hot work permitting will have immediate access to shovel, fire extinguisher, and backpack water sprayer. In addition, all project work will follow guidelines detailed in the site fire protection and prevention plan.
	Riparian/Wetland Edge	3	No constructed features of the project should be located in a wetland. Linear features which must cross a riparian area will be required to follow U.S. Army Corps of Engineers regulations.
		4	Wetlands and other environmentally sensitive areas will be marked in the field for easy identification by crews. Sensitive features will be defined in Waters of the U.S. Report.
	Streamside Management Areas	5	200' minimum for Streamside Management Area (SMA) boundaries
		6	Leave trees on the bank that will eventually fall across the stream, helping to create a stair step of pools in the stream channel, providing a fish habitat component. Larger trees increase the benefits for the habitat. Hazard trees may be felled and left in place at contractor's discretion.
		7	Do not service vehicles where chemicals, oil, or other toxic substances might contaminate soils, waterways, or waterbodies.
		8	Properly design roads and drainage facilities to prevent potential water quality problems before construction starts.
		9	Minimize the number of roads constructed in a watershed through comprehensive planning, recognizing intermingled ownership, and future uses.
		10	Road design specifications should be included in a contract between the landowner and the road builder. The contract should include exact road locations, dimensions, erosion control and drainage features, stream crossing and structure specifications, season(s) of construction and use, and maintenance schedule, road closure and re-vegetation procedures, and penalties for non-compliance. The more specific the road contract, the more protection there is for the resources and landowner.

	Roads	11	Fit the road to the landscape. This entails altering natural drainage patterns as little as possible by following contours and minimizing cuts, fill, and stream crossings. Utilize natural road building locations away from streams.
		12	Avoid problem areas such as flood zones, narrow canyon bottoms, wet areas and highly erodible or unstable soils. Do not locate roads on slopes more than 60 percent.
		13	Keep the road grade to a minimum, usually less than 10 percent. This can be exceeded for short distances where necessary. An easy grade prevents runoff from building up erosive force and also provides for safer and more efficient travel.
		14	Prevent the concentration of water on the road by designing adequate drainage features. Some suggested drainage methods are insloping and outsloping the road surface, and installation of grade dips and cross drains. Installation of these features is explained in the civil details.
		15	When a stream crossing is necessary, locate the site on a stable, straight portion of the stream. The approach to the crossing should be at a minimal grade and a right angle to the stream.
		16	Leave 200' buffer of undisturbed soil and vegetation on either side of a stream being impacted.
		17	Schedule construction activities to avoid heavy seasonal rains. Excavation operations may expose mineral soil which is highly susceptible to erosion. Soil stabilization and erosion control measures should be completed before the monsoon (thunderstorm) season of July, August, and September. Clear only that part of the route that can be completed in the current season.
		18	Minimize disturbance during construction activities by restricting machinery to the designated road. Clear vegetation to the width required for cut and fill slopes. Excessive removal of vegetation further increases erosion and is more costly. Keep machinery out of streams except when absolutely necessary for culvert installation and bridge construction. Round the top of cut slopes only when this will provide more stability than a vertical cut.

	Culverts	**19**	During clearing operations, do not mix organic debris with fill materials. Trees and brush will eventually decay in the fill material causing the road surface to become unstable. Dispose of organic debris properly by utilization, piling and burning, chipping, or lopping and scattering. A good use for slash is to place it along fill slopes to slow runoff and trap sediment.
		20	Remove debris from stream channels that was added during construction. It is a good practice to remove all debris from channels for at least 100 feet upstream from culverts to reduce the chance of the culvert becoming plugged. However, never remove well established logs from a stream, as this will likely cause accelerated channel erosion.
		21	Deposit surplus soil and rock in designated areas where sediment from this material will not threaten streams. Do not simply cast surplus material downslope from the road. This material is highly susceptible to erosion and may have future value as fill.
		22	Compact all fill material. This can be done simply by running a bulldozer up and down the fill slope where it is safe to do so. Large fills should be constructed and compacted in layers of approximately 18 inches. The slots made perpendicular to the slope in the soil by the bulldozer's tracks retard runoff and moisture, thus inhibiting erosion and encouraging re-vegetation. In addition, the chance of fill slumping and requiring expensive repair will be reduced.
		23	Servicing and refueling machinery must be conducted well away from wetlands, lakes or watercourses. Fluids such as oil, diesel fuel, and antifreeze are easily washed or leached into streams and present a significant threat to water quality and aquatic life.
		24	Make certain the road surface is adequately drained. This can be accomplished in a number of ways depending on the site factors, the type and level of use, and the standard to which the road is built.
	Culverts	**25**	A shallow gravel fill on either side of the culvert will lessen maintenance requirements. As with any cross drain, rocks and slash should be placed at the outlet to slow runoff and spread sediment. Size of the culverts, of any type, should follow recommendations in Table 3 (page 63). Care must be taken to disperse the discharge from these cross drains through vegetation.
		26	The culvert must be long enough to extend at least one foot beyond the fill.
		27	Align the culvert exactly with the stream, on the existing grade, and at the depth of the streambed.
		28	Culverts on fish-bearing streams must be installed to allow fish passage so as not to isolate populations.

	Claunch-Pinto specific recommendations	**29**	Fill should be well compacted to half the diameter of the culvert, and fill over the culvert should be to a depth of half the diameter but not less than one foot. Compaction will prevent water from seeping around the culvert and washing away the fill material. Fill over the culvert must be deep enough to prevent damage from heavy vehicles. If more than one culvert must be installed side by side, they should spread half their diameter so that the fill may be compacted between them
		30	Protect the fill material around the culvert inlets and outlets with riprap. Deep fills or culverts on large streams may require more elaborate protection such as wingwalls constructed of concrete or gabions
		31	Inspect newly constructed roads after the first good rain to insure all drainage structures and erosion control features are functioning properly. Gullies forming on cut and fill slopes should be filled in and the drainage formed.
		32	Grade the road surface as needed to correct washboarding and rutting. Maintain the proper inslope, outslope, or crown, and reshape grade dips. Ditches should be disturbed only if they are becoming clogged with sediment. Apply gravel to spots on the road that are persistently wet
		33	Inspect drainage structures frequently. Culverts and ditches should be cleared of sediment and debris.
		34	Application of chemicals to roads to reduce dust should be limited to those road sections where dust will cause major discomfort. Applications should be avoided where road runoff discharges into or near a stream.
		35	Inspect all tracked equipment for excessive soil prior to entering the site.